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Developing Quiz Content for a Mobile Health App for Diabetes Self-Management Education and Support

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Abstract

Developing Quiz Content for a Mobile Health App for Diabetes Self-Management Education and Support

By: Sheritha Rayford

Background: In the United States, diabetes is considered an epidemic, and minority populations, i.e., African Americans, Hispanic/ Latino Americans, Asian Americans, and Indigenous people, are at higher risk for developing diabetes than their White counterparts. Since there is no cure for diabetes, effective self-management with a particular focus on healthy eating, being active, and medication is an essential aspect of living a healthy life with diabetes. Self-management requires navigating challenges, such as accessing healthy foods, supplies, and safe places to exercise. Although there have been many improvements with diabetes self-management tools, lifestyle modifications are still challenging to initiate and maintain, and diabetes self-management is particularly difficult for under-resourced populations.

Purpose: This project aimed to develop educational content for a mobile application to support self-management amongst those living with diabetes who attend the Diabetes Center of Grady Memorial Hospital, Atlanta's inner-city safety-net hospital. The goal was to identify priority topics across different diabetes self-management education and support (DSMES) curricula and develop sample educational quiz questions for two of the seven key behaviors: healthy eating and being active.

Methods: The educational content was developed based on six diabetes self-management curricula. The six selected curricula allowed us to understand the priority topics across healthy eating and being active, defined as those which all curricula included. In addition, sample quiz questions were developed for the learning objectives common to the six DSMES curricula reviewed.

Results: The creation of the sample quiz questions targeted learning objectives common across the six curricula, along with supplementary ones, included due to their importance despite not appearing in all reviewed curricula. In addition, sample feedback was developed for all quiz answer options to encourage information retention and skills-building.

Conclusion: This special studies project identified topics that were most commonly addressed across six different DSMES curricula for two key behaviors. The sample quiz questions can serve as a foundation for developing a more comprehensive DSMES quiz on all seven critical behaviors for a mobile application to educate, motivate, and empower individuals to understand and self-manage diabetes and improve their quality of life.

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Chapter 1: Introduction and Background

Introduction and Rationale

In the United States, diabetes is considered an epidemic, affecting approximately 34.2 million Americans (10.5% of the U.S population) (National Institute of Diabetes and Digestive and Kidney Diseases, 2020). Diabetes is a chronic health problem with severe, though preventable, consequences. Minority populations (i.e., African Americans, Hispanic/Latino Americans, Asian Americans, and American Indians) are at higher risk of developing diabetes than White Americans (Spanakis & Golden, 2013). Diabetes can have a devastating impact on lives nationwide, including for the residents of Georgia. Approximately 949,000 adults in Georgia have been diagnosed with diabetes, representing 12.1% of its population (American Diabetes Association, 2020a).

Although there is no cure for diabetes, those living with the disease can decrease their risk of developing other health issues such as heart disease, vision loss, and kidney disease by practicing self-care behaviors (Centers for Disease Control and Prevention, 2021e). Diabetes Self-Management Education and Support (DSMES) is a critical component of care for people with diabetes. DSMES provides a foundation that assists those living with diabetes in navigating their treatment goals and decisions to help improve their health outcomes. It does this by helping them collaborate with their healthcare team, make informed decisions, solve problems, develop personal goals and action plans, and cope with emotions and life stresses (Powers et al., 2016).

Although DSMES is an effective tool to help individuals manage their diabetes, it is underutilized, especially among under-resourced patients. In response to the underuse of DSMES, Horigan and colleagues (2017) conducted a systematic review to understand why patients referred

to diabetes education programs choose not to attend. The results from this review identified two critical themes for why individuals were not attending: 1) logistical, medical or financial reasons (e.g., timing, costs, or existing comorbidities), and 2) their perception that the programs offered no benefit and that they had sufficient knowledge (Horigan, Davies, Findlay-White, Chaney, & Coates, 2017). In addition, this review concluded that the use of technology could increase access and delivery of diabetes education, which is a crucial component for effective diabetes self-management in this population. Another systematic review evaluated technology-enabled diabetes self-management education support and its impact on health outcomes. This study concluded that technology-enabled diabetes self-management solutions improved HbA1c (glycated hemoglobin, a simple blood test that measures the average blood sugar levels over the past three months, typically used as an indicator of diabetes management success) (Greenwood, Gee, Fatkin, & Peeples, 2017).

Moreover, the most effective interventions incorporated multiple components such as two-way communication with the healthcare team, tailored education, and individualized feedback. In addition, the study concluded that, with the expected advancements in technology devices, future DSMES digital devices should incorporate evidence-based, behaviorally designed interventions to assist with improving the reach of and access to diabetes self-management education (Greenwood et al., 2017). A well-designed mobile application (app) could be beneficial for individuals with diabetes by supporting the development of problem-solving skills and providing ongoing decision-making support necessary to self-manage diabetes (Beck et al., 2017).

During this special studies project, Grady Diabetes Center was the focal location. Grady Memorial Hospital is one of the primary hospitals that maintains its commitment to providing care to under-resourced communities in Fulton and DeKalb Counties in Atlanta, GA. Most Grady

patients have Medicare or Medicaid, which covers some but not all medical expenses (Grady Hospital, 2019). As an inner-city safety-net hospital with close proximity to majority-minority neighborhoods, lower-income individuals and minorities with diabetes in Fulton and DeKalb counties are more likely to visit the Grady Diabetes Center than other local hospital systems to receive care and seek information about different approaches to manage their diabetes. Due to self-management being a crucial component of diabetes management for this population, a DSMES curriculum is essential to learn how to navigate effective diabetes self-management. A DSMES curriculum incorporates content that patients can quickly adapt to their life no matter their socioeconomic status, age, health literacy, type of diabetes, and other pre-existing comorbidities (Powers et al., 2016). Mobile applications have the potential to incorporate educational content that can make self-management more understandable, more effective, and more straightforward for individuals who are living with diabetes. Mobile diabetes applications could be a promising supplement to the current DSMES approaches.

Problem Statement

The goal of diabetes self-management is to provide information and skills for people to manage their diabetes effectively, maintain their blood glucose levels within a healthy range, improve their quality of life, and prevent or reduce diabetes complications (Centers for Disease Control and Prevention, 2018). The assistance of a mobile application can lessen the burden of managing diabetes (Y. Wu et al., 2017). DSMES can be very effective when delivered correctly and at the right time. However, most mobile health (mHealth) apps may not currently incorporate content needed for effective self-management, particularly for underserved populations. Therefore, this study serves as a basis for developing informational content for a self-management mobile app that will help individuals living with diabetes who access care at Grady Diabetes

Center. The goal of the proposed diabetes app would be to allow people living with diabetes to have timely, accurate, helpful, and applicable educational resources to manage their diabetes and live a healthy lifestyle.

Purpose Statement and Project Objectives

This project aims to develop sample quiz content for a mobile application to support self-management among individuals living with diabetes who attend the Grady Diabetes Center. The aims are to identify priority topics that would be beneficial to support patients in improved self-management of their diabetes by educating, motivating, and empowering them to understand their condition and improve their quality of life.

The objectives for developing the sample content are to:

I. Identify priority topics that should be addressed in the mobile app
II. Review existing and relevant DSMES curricula to identify key learning objectives
III. Design a sample quiz question and feedback for each learning objective drawing on best practices for the use of quizzes in education

Significance Statement

One of the key roles of public health practitioners is to inform and increase the knowledge within populations through innovative public health tools. Using technology to inform and increase self-management knowledge among those with diabetes who attend Grady Diabetes Center can make self-management more straightforward and comprehensive by supporting low-literacy populations to live a healthier lifestyle. In addition, after the development of additional content and integration into a mobile app for those at Grady Diabetes Center, the educational materials

developed in this study may be used more broadly to improve diabetes self-management and health outcomes for underserved populations around the U.S.

Abbreviations

ACDES: Association of Diabetes Care and Education Specialists

ACDES7: Association of Diabetes Care & Education Specialists 7 Key Self-Care Behaviors

CGM: Continuous Glucose Monitoring

CHC: Community Health Center

DSMES: Diabetes Self-Management Education and Support

GCH: Georgia Department of Community Health

HbA1c: Glycated hemoglobin A1c

mHealth: Mobile Health

SMS: Short Message Services

TES: Technology-enabled self-management

Chapter 2: Review of Literature

Overview of Diabetes

Diabetes is a chronic health condition that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces (World Health Organization, 2021). The three types of diabetes are type 1, type 2, and gestational. Key differences in the etiology and characteristics of the types of diabetes are outlined below in *Table 1*. According to the 2020 National Diabetes Statistics Report, 34.2 million people have diabetes, accounting for 10.5% of the U.S. population (Centers for Disease Control and Prevention, 2020).

In addition, due to the various complications of diabetes, it is considered the seventh leading cause of death in the United States (Georgia Department of Community Health, 2021).

Within the state of Georgia, approximately 1,013,358 adults were living with a diabetes diagnosis in 2018 (American Diabetes Association, 2021). In addition, an estimated 234,000 people in Georgia have diabetes but are unaware of their condition, which increases their risk of other health complications (American Diabetes Association, 2021). According to the Georgia Department of Community Health (GCH), diabetes is twice as common among African Americans in Georgia as among Whites, but compared with non-Hispanic Whites, diabetes rates are about 60% higher in African Americans. Additionally, studies show that death rates from diabetes for African American women in Georgia are three times higher than for their White counterparts.

Types of Diabetes			
Type	**Definition**	**Age of Onset**	**Cause**
Type1	When the pancreas does not make insulin or makes very little insulin. Type 1 diabetes was also called "insulin-dependent or juvenile diabetes."	It usually develops in children, teens, and young adults but can happen at any age.	Caused by an autoimmune reaction, the body attacks itself by mistake. Some people have specific genes that make them more likely to develop type 1 diabetes.
Type 2	When the body either does not make enough insulin or the body's cells do generally not respond to insulin. Type 2 diabetes was also called "insulin resistance."	Usually, it occurs in middle-aged and older people, but children, teens, and young adults can also develop it.	It can be caused by lifestyle factors (overweight, obesity, and physical activity) and genes.
Gestational Diabetes	Develops during pregnancy in women who do not already have diabetes.	Any pregnant woman can develop gestational diabetes.	When the body cannot make enough insulin during pregnancy. It usually goes away after pregnancy.

Table 1- Description of Diabetes Types (Centers for Disease Control and Prevention, 2021e)

Diabetes Treatment

Currently, there is no cure for diabetes. However, effective diabetes management with the guidance of a healthcare provider and self-management by the patient between clinic visits, including medication adherence, can reduce the adverse impacts of diabetes (Centers for Disease Control and Prevention, 2021e). Treatment options may vary depending on the type of diabetes a person is diagnosed with. Treatment for type 1 diabetes usually involves insulin injections or automatic insulin administration via an insulin pump, regular blood sugar checks, and carbohydrate counting (Mayo Clinic, 2020). Management strategies for type 2 diabetes primarily involve lifestyle changes, monitoring blood sugar levels, and diabetes medications (Mayo Clinic, 2020). Gestational diabetes treatment includes maintaining a healthy diet, exercising, and sometimes using insulin. In addition, gestational diabetes treatment involves pregnant women carefully controlling their blood sugar levels because it is essential to keep the unborn child healthy and avoid complications during delivery (Mayo Clinic, 2020). Although diabetes treatment plans differ depending on the diagnosis type, without effective management, over time, diabetes can lead to other serious health problems, such as chronic kidney disease, eye problems, foot problems, heart disease (cardiovascular disease (CVD)), and nerve problems (Centers for Disease Control and Prevention, 2021e).

Diabetes Self-Management Education and Support

Diabetes Self-Management Education and Support (DSMES) is a crucial component of care for people living with diabetes; it facilitates the knowledge, skills, and abilities necessary for diabetes self-management (Powers et al., 2016). The DSMES curricula can be tailored to fit a specific individual's needs, goals, and life experiences (Centers for Disease Control and Prevention, 2018). DSMES is designed to address the health beliefs, cultural needs, current

knowledge, physical limitations, emotional concerns, medical history, health literacy, and other factors that influence each person's ability to meet self-management challenges (Powers et al., 2016). DSMES focuses on seven key self-care behaviors: healthy eating, healthy coping, being active, taking medication, monitoring, reducing risk, and problem-solving. Depending on the needs of the individual with diabetes, the DSMES curriculum can be tailored to be administered one-on-one or in a group-based setting.

DSMES is associated with numerous benefits for people with diabetes, such as being cost-effective by reducing hospital admissions and readmission, improving quality of life, and supporting lifestyle behavior change (Powers et al., 2016). A systematic review studied the impact of DSMES on all-causes mortality risk in type 2 diabetic patients. Researchers discovered significant effects of these programs for participants receiving DSMES with more than ten contact hours and those receiving repeated DSMES. At the end of the study, the researchers concluded that for individuals with diabetes to achieve better self-management, they need to receive DSMES support (He et al., 2017).

Furthermore, in 2020 a Consensus Report was published on how to improve clinical and educational services to improve the health of individuals with diabetes and reduce the costs associated with this condition and its treatment (Powers et al., 2020b). The report discusses recommendations for providers, health policymakers, health systems, and healthcare teams. Some recommendations include: providers discussing with all persons with diabetes the benefits and value of initial and ongoing DSMES; identifying and addressing barriers affecting participation in DSMES services following referral; expanding awareness, access, and utilization of innovative and nontraditional DSMES services; and facilitating reimbursement processes and other means of

financial support in consideration of cost-savings related to the benefits of DSMES services. The report concluded that these recommendations could benefit people with diabetes by lowering their HbA1c, reducing diabetes-related distress, and reducing emergency department visits, hospital admissions, and hospital readmissions (Powers et al., 2020a).

Although there are various benefits to DSMES, other factors still influence effective self-management, including the person's ability to manage and cope with diabetes complications, medication, physical limitations, emotional needs, basic living needs, and other health conditions (Greenwood Deborah et al., 2017). The 2020 Consensus Report discussed numerous barriers starting with the health system or programmatic barriers, which include limited numbers of diabetes care and education specialists, geographic location of services and their distance from individuals needing to access them, referral to DSMES services not being effectively embedded in the health system service structure, limited resources for marketing of DSMES, and limited or low reimbursement rates. Another type of barrier related to uptake of DSMES is participant-related, including "underutilization of services because of a lack of understanding or knowledge of the benefits, cultural factors, a desire to keep diabetes private due to perceived stigma and shame, and lack of family support" (Powers et al., 2020a). Understanding the potential barriers to participation in DSMES services can be helpful to this special studies project because we can address and tailor specific questions to the needs of the target population.

Diabetes Self-Management Challenges

Diabetes self-management can come with a variety of challenges. People living with diabetes may experience issues due to medication cost, health literacy, and incorporating a

healthier lifestyle, amongst other things. According to a systematic review conducted in 2016, low health literacy is defined as a lack of capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions (Kim & Lee, 2016). This study discovered that low health literacy is associated with poor health outcomes and poor use of healthcare services. More specifically, it affects tasks such as decision-making and problem-solving skills for effective diabetes management. As a result, various interventions have been proposed to reduce the health disparities associated with low health literacy. Recommendations address written communication (easy-to-read materials), spoken communication (clear communication, follow-up with patients to make sure they understand), empowerment (encouragement of questions, behavioral activation, action plans, and motivational interviewing), and language or cultural consideration (Kim & Lee, 2016). Another study, performed a few years later, "demonstrated that health literacy affected diabetes self-management via one direct and three specific-indirect pathways through social isolation only, self-efficacy only, and both social isolation and self-efficacy serially." (Lee et al., 2021).The study showed that individuals with low health literacy could feel ashamed or hide their lack of understanding of diabetes. Due to this, these individuals may be unable to seek resources to help them. The findings from this study suggested that health literacy was directly related to self-management and that clinical practices can be improved through more comprehensive diabetes self-management interventions that promote all the components of health literacy, social contacts/networks, and self-efficacy (Lee et al., 2021).

In addition, a 2016 systematic review identified why individuals offered a place in diabetes education programs declined the opportunity to participate. The main reasons were identified: first, individuals experienced a range of logistical, medical, or financial reasons; second, they already considered themselves to have sufficient knowledge; and third, cultural norms and emotional

rejection of their diabetes diagnosis resulted in ineffective self-management of diabetes (Horigan et al., 2017).This study concluded that new and innovative methods of delivering diabetes education are required that address the needs of people with diabetes to help maintain and improve overall health. Finally, the Association of Diabetes Care and Education Specialists (ADCES) reviewed some underlying barriers within the revised ADCES7, a framework for diabetes self-management. The framework is designed to be person-centered, guide the collaboration between the diabetes healthcare team and individuals with diabetes, and set goals to achieve health-related outcomes to improve their quality of life. The ADCES7 includes possible barriers influencing self-management for all seven key behaviors: healthy coping, healthy eating, being active, taking medication, monitoring, reducing risks, and problem-solving. Barriers can contribute to an individual's inability to achieve better health outcomes. Some barriers included in the ADCES7 are financial burdens, competing priorities, health literacy, environmental factors, and the person's current health beliefs (Kolb et al., 2021). Awareness of some diabetes self-management challenges individuals face may help this special studies project develop questions and feedback to assist individuals with diabetes with self-management decision-making and problem-solving to address some pre-existing challenges.

Current Diabetes Self-Management Resources

There are currently diabetes self-management education resources available to assist individuals with diabetes in navigating and making decisions to live a healthier lifestyle effectively. The most commonly used diabetes self-management strategy is working with diabetes healthcare professionals to begin effectively navigating and implementing self-management activities. Another valuable tool to support diabetes self-management is continuous glucose monitoring (CGM) systems, which automatically track blood glucose levels throughout the day.

CGM allows individuals to see their glucose levels and review trends of their glucose level changes over time. In addition, this tool can allow people to make daily decisions regarding balancing their medications, foods, and physical activity (NIH, 2017). Knowing current diabetes self-management resources is beneficial to the development of educational content for the sample questions for the mHealth app because questions can be developed which include current resources, which will give the user more information surrounding such resources.

Digital Applications

Mobile phone technology applications have demonstrated acceptance across various ages and socioeconomic groups. Due to technological advancements, especially in mobile technology, smartphones have many digital applications, and many more are currently being developed. The use of mobile digital applications (apps) to assist with effective diabetes self-management can influence healthy-lifestyle modifications. Greenwood and colleagues(2017) conducted a systematic review on how other studies have evaluated how technology impacted health outcomes for people living with diabetes (Greenwood et al., 2017). The different forms of technology used in the various studies included mobile phone apps that allowed direct communication with healthcare providers and assimilated education into patients' self-management plans. The researchers reported that, overall, mobile app use led to a decrease in HbA1c among participants. The improvement in HbA1c was demonstrated by the most effective studies that included all elements of the feedback loop: communication, patient-generated health data, tailored education and individualized response feedback to and from the diabetes healthcare team (Greenwood et al., 2017).

Another systematic review was conducted to summarize and synthesize the clinical evidence of the efficacy of mobile phone apps for lifestyle modification in diverse types of diabetes

(X. Wu, Guo, & Zhang, 2019). This study shows that apps incorporating different modules, such as health education, medication or insulin adjustment, and health management feedback, can positively affect those living with diabetes. However, researchers concluded that while there is strong evidence for the efficacy of mobile apps for lifestyle modifications in type 2 diabetes, the evidence for the efficacy of those tools for individuals with other diabetes subtypes was inconclusive. Therefore, this study suggested that different considerations should be made when designing and developing future apps for lifestyle modifications for people with each subtype of diabetes (X. Wu et al., 2019). A few years later, a review was conducted by Greenwood and colleagues (2017) based on their previous study to understand how technology-enabled self-management (TES) feedback loops can decrease HbA1c. During this review, researchers found that TES feedback loops, which included communication between the care team and participants with diabetes, were beneficial in decreasing participants' HbA1c (Greenwood et al., 2017).

Although both studies contributed to our understanding of the role technology can play in improving diabetes management, there are still gaps that need to be addressed. For example, neither study provided information about how CGM devices could be integrated with mobile health apps and how this could impact effective diabetes self-management, tailored education, and interactive activities (Greenwood et al., 2021). During the same year, the revised ADCES7 self-management document included a section about the role of technology in diabetes self-management, which discussed medical devices developed to support self-care such as glucose meters, insulin pumps, continuous glucose monitors, and digital therapeutics such as mobile apps, text messaging, electronic communications, and video conference platforms. Later, this section of the ADCES7 discussed how technology gave opportunities to synthesize information into a simplified format for interpretation by the user. ADCES7 suggested that when designing

educational content, materials developers should keep the user in mind and highlighted that there is a need for long-term studies to evaluate the sustainability of these types of interventions (Kolb et al., 2021). However, the ADCES7 suggest that new challenges may arise with the development of technology usage, such as the healthcare team staying current with the fast growth of technology, overcoming their technology phobias, and teaching their patients about the new technology. Although there will be challenges and new developments within the digital space and technology, it is important for this special studies project to be aware of the limitations, achievements, and recommendations of prior diabetes self-management apps. Knowing these three things will guide the design of the educational content and inform how the app should be delivered.

Benefits of mHealth Interventions

The benefits of mHealth interventions (apps and other digital interventions) can range from giving patients faster access to healthcare providers to influencing healthier lifestyle changes. In 2013, many mHealth pilot projects were being undertaken to understand better how mHealth innovations can act as health systems strengthening tools. The term "health systems" refers to all activities whose initial purpose is to promote, restore, or maintain health. During this study, researchers gathered data from twelve mHealth applications. This study found that short message services (SMS), video clips, images, digital forms, and data collection and reporting influenced education and behavior change in individuals who used the applications (Labrique, Vasudevan, Kochi, Fabricant, & Mehl, 2013). This helped researchers develop a framework to assist future projects in identifying gaps within their innovations when developing mHealth applications.

According to recent studies, technology can enhance diabetes self-management by providing educational and motivational support. An integrative review was conducted to evaluate

the various types of technology that were being used to assist with diabetes self-management and to understand the effects that technology has on self-management when it comes to diabetes outcomes for individuals living with type 2 (Hunt, 2015). Educational components included within mHealth interventions allowed patients to learn new skills and daily routines related to diabetes self-management. Some benefits included daily diabetes self-management activities such as blood glucose monitoring, exercising, healthy eating, taking medication, monitoring for complications, and problem-solving. During the review of various studies, researchers discovered that participants felt that the glucose tracking graphs with the apps were beneficial by displaying how their exercise and eating patterns affected their blood glucose levels. Participating in intervention programs also promoted a general health awareness among participants, which they reported as beneficial. However, this review recommended that the studies lacked educational content and decision support features (Hunt, 2015). In 2021, Whelan and colleagues (2021) conducted a trial of a digital lifestyle behavior change intervention for the prevention of type 2 diabetes. This study explored intuitive engagement with real-time glucose and physical activity feedback. The findings from this study showed that behavioral and physiological feedback could increase self-awareness of how lifestyle impacts short-term health. Therefore, this study recommended supplementing technologies with training and educational support to optimize feedback on physiology and behavior to promote effective diabetes self-management (Whelan et al., 2021). Understanding the benefits and recommendations of prior mHealth is important to this special studies project because we can supplement some of the existing materials and accommodate the recommendations from prior studies.

Educational Quiz Design

Including practical educational quiz questions in skills and knowledge-building apps is essential to self-management because quizzes will reinforce important diabetes self-management information to help improve participants' quality of life. Research studies have discovered the best way to design education quiz questions. A recent study reviewed how multiple-choice quiz questions were used in medical school assessments for a decade and identified many drawbacks, such as being hard to construct, allowing guessing, and providing no opportunity for those answering the questions to express ideas. After conducting the study, researchers concluded that written and directly answered short quiz questions like concise answers are considered a better alternative with several advantages such as answering without guessing or using the process of elimination, revealing participants' competence, and participants expressing their ideas (Puthiaparampil & Rahman, 2020). This study lacked an explanation of the other advantages of direct and short-answer questions in detail. However, the article summarized the literature on multiple-choice questions and provided guidance on writing good questions. After conducting this study, the researchers emphasized that some downsides of multiple-choice questions included promoting guessing, and not fully assessing the recall of subject details, or a deep understanding of applied knowledge (Boland, Lester, & Williams, 2010). To create effective quiz content, individuals developing the content should evaluate each question and ensure that it tests the essential information the respondents should know. Later Boland and colleagues (2010) discussed the qualities of an excellent multiple-choice quiz question. Some qualities include being focused and clear, leading to only one possible answer, and using similar content, length, and grammar for all answer options, including incorrect answers (known as "distractors") (***Error! Reference source not found.***) .

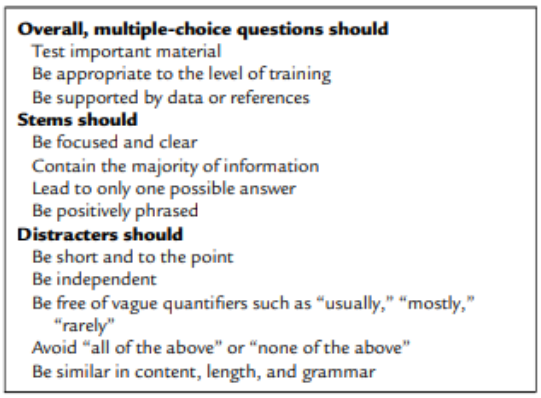


Figure 1: Qualities of a good multiple choice quiz question (Boland et al., 2010)

Knowing how to write quiz questions effectively is as important as developing feedback after selecting an answer. According to Greving and colleagues (2022), the effect of the feedback from multiple-choice quizzes on long-term information retention is significant. This study discussed the benefits of incorporating feedback into quiz material, such as confirming information, improving comprehension, and promoting self-regulated learning (Greving et al., 2022). To understand the conditions that enable effective feedback, Henderson and colleagues (2019) conducted a study to understand the experiences of feedback that influenced both learners and educators (Henderson et al., 2019). At the end of the study, it was concluded that feedback is successful when the twelve conditions (***Error! Reference source not found.***) that enable effective feedback are met. Overall, this study emphasized the importance of understanding feedback for both the users and developers, effective design of feedback, and remembering the target population during the process (Henderson et al., 2019). Knowing how to design quiz questions and develop feedback effectively is essential for this special studies project because drawing from the best practices from prior studies can optimize reinforcement of educational material.

Capacity for feedback	1. Learners and educators understand and value feedback 2. Learners are active in the feedback process 3. Educators seek and use evidence to plan and judge the effectiveness 4. Learners and educators have access to appropriate space and technology
Designs for feedback	5. Information provided is usable and learners know how to use it 6. It is tailored to meet the different needs of learners 7. A variety of sources and modes are used as appropriate 8. Learning outcomes of multiple tasks are aligned
Culture for feedback	9. It is a valued and visible enterprise at all levels 10. There are processes in place to ensure consistency and quality 11. Leaders and educators ensure continuity of vision and commitment 12. Educators have flexibility to deploy resources to the best effect

Table 2: The 12 conditions that enable effective feedback (Henderson et al., 2019)

Grady DSMES Curriculum

The Grady's DSMES curriculum(Grady Diabetes Center n.d.) was developed for residents in Atlanta, GA, or surrounding areas that attend the Grady Diabetes Center. The Grady DSMES curriculum provides a brief overview of the seven fundamental behaviors for effective diabetes self-management: healthy eating, being active, monitoring, taking medication, problem-solving, healthy coping, and reducing risk. The content area for each critical behavior section includes the purpose of the behavior, learning objectives, methods of instruction, content that should be covered, and evaluation methods.

Chapter 3: Methods

To understand how DSMES curriculum educational content is delivered, an in-depth web search was done within different diabetes centers and programs to identify DSMES curricula that could expand and supplement the Grady curriculum. This search used keywords such as "diabetes

education programs", "diabetes program curriculum," "DSMES program manual," "diabetes self-management education curriculum," and "Diabetes Self-Management Education and Support (DSMES) Curriculum" to search for various curricula. While searching, five curricula were found that could be analyzed to compare and contrast with the Grady Diabetes Center's current curriculum(Grady Diabetes Center n.d.). The five curricula included the Association of Diabetes Care & Education (ADCES7) (ADCES, 2021), Maine DSMES Program Manual (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019), North Carolina (NC) DSMES Curriculum (North Carolina Diabetes Advisory Council, 2001), Power to Prevent Curriculum (National Institutes of Health, Centers for Disease Control and Prevention, & National Diabetes Education Program, 2012), and the Six-Session Diabetes Self-Management Curriculum(Community Health Center, 2003).

Curriculum Selection

The *Association of Diabetes Care & Education (ADCES7) Curriculum* (ADCES, 2021) was chosen because it was produced by the ADCES, the premier organization focused on improving diabetes care. The ADCES7 teaches people living with diabetes to self-manage this chronic condition to help patients take control and improve their quality of life. This curriculum goes in depth on the seven key behaviors, giving background information, learning objectives, questions to consider when designing an instructional plan, and skills participants should gain.

The *Maine DSMES program manual* (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019) was chosen because it is very patient-focused. This curriculum also provides recommended learning objectives for each content area and divides them into survival and intermediate/advanced levels, which was unique among the other curricula

reviewed. In addition to learning objectives, the Maine DSMES manual has behavioral objectives to influence decision-making and problem-solving.

The *North Carolina (NC) DSMES* (North Carolina Diabetes Advisory Council, 2001) is a curriculum designed for people with type 2 diabetes and their families. Although the NC DSMES curriculum was developed solely for individuals with type 2 diabetes, the learning objectives within this curriculum have many commonalities with the other curricula and in-depth information on conducting activities surrounding each fundamental behavior.

The *Power to Prevent* (National Institutes of Health et al., 2012) curriculum was chosen because of its focus on African Americans, one of the populations Grady serves. Although this curriculum focuses mainly on diabetes prevention, the content is valuable because we can compare what educational content is used within curricula designed for African American populations, the terminology used, and the activities used for this population.

Lastly, the *Six-Session Diabetes Self-Management Curriculum* (Community Health Center, 2003) was chosen because the curriculum was developed by The Community Health Center, Inc. (CHC), which was a part of the Diabetes Initiative. The Diabetes Initiative is a national program focused on improving self-management support for adults living with diabetes. The CHC is based in Connecticut and serves underserved, uninsured, or underinsured populations from ethnically diverse backgrounds, similar to the populations Grady Diabetes Center serves. The content of this curriculum's key behaviors' learning objectives is detailed, providing an overview, teaching objectives, and critical teaching points.

The six chosen curricula allowed us to identify the main topics used across each key behavior area: healthy eating, being active, monitoring, taking medication, problem-solving,

healthy coping, and reducing risks. In addition, this provided a better understanding of how they were delivered and the commonalities and differences within the educational content to assist in developing educational content for a mobile application to support diabetes patients at Grady Diabetes Center to achieve effective diabetes self-management.

For this special studies project, we focused only on two out of seven key behaviors: healthy eating and being active. However, these are the two most important lifestyle behaviors for diabetes self-management, and they were present in all six curricula.

Sample Quiz Questions Development

A table was created to assist with understanding the similarities and differences between the six curricula, which listed all learning objectives within each curriculum for the two selected critical behaviors for this project. In addition, the ***Error! Reference source not found.***, located in Appendix A, allowed a more visual, side-by-side understanding of the most common learning objectives discussed. After analyzing the educational learning objectives of the six DSMES curricula, common learning objectives for healthy eating and being active were examined. Learning objectives were chosen based on whether they were present in at least four out of the six DSMES curricula. In addition, we supplemented these with additional learning objectives based on their importance and prominence across the curricula. For these supplementary learning objectives to be included, they needed to be present in at least two of the curricula.

The quiz questions were developed to provide example assessments for selected learning objectives. During the quiz question development, multiple-choice questions were influenced by the curricula, various databases of existing diabetes education and skill-building resources, and research articles explaining the most effective ways to design educational quiz multiple-choice questions. The most practical ways to structure questions and answers, write feedback for selected

responses, and develop questions for behavior change were analyzed to frame each question and appropriately address the learning objectives. In addition, reviewing previous research studies on quiz design assisted with understanding the best practices for developing quiz questions to reinforce the learning objectives effectively.

Ethical Considerations

Due to this special studies project not involving human subjects or clinical investigation and therefore not qualifying as human subjects research, Institutional Review Board approval was not sought.

Chapter 4: Results

With effective educational content, DSMES can help people with diabetes improve their health outcomes and quality of life. ADCES identifies seven key self-care behaviors to assist people living with diabetes with effective self-management. The key behaviors are: being active, healthy eating, healthy coping, taking medication, monitoring, problem-solving, and reducing risks, as shown in *Figure 2*.

Figure 2: ACES7 Self-Care Behaviors (Kolb et al., 2021)

The two key behaviors selected for this project were healthy eating and being active. These two behaviors were selected because they are the most essential lifestyle behaviors for diabetes self-management and often serve as the basis for care plans. Following the web review of curricula, as indicated, six DSMES curricula that displayed many similarities and unique differences stood out amongst the others and were selected for inclusion. Therefore, the six DSMES curricula chosen for further analysis included Grady DSMES (Grady Diabetes Center n.d.), Maine DSMES Program Manual (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019), North Carolina (NC) DSMES Curriculum (North Carolina Diabetes Advisory Council, 2001), Six-Session Diabetes Self-Management Curriculum (Community Health Center, 2003), Association of Diabetes Care & Education (ADCES7) (ADCES, 2021), and Power to Prevent Curriculum (U.S. Department of Health and Human Services, 2012).

Background on the Six DSMES curricula

Behaviors Targeted by Each Curriculum							
	Healthy Coping	Healthy Eating	Being Active	Taking Medication	Monitoring	Reducing Rick	Problem Solving
Grady DSMES							
Maine DSMES Program Manual							
North Carolina (NC) DSMES Curriculum							
Six-Session Diabetes Self-Management Curriculum							
Association of Diabetes Care & Education (ADCES7)							
Power to Prevent Curriculum							

Table 3: Key Behaviors Within DSMES Curricula -The shaded blocks display the key behaviors covered in each curriculum.

Grady Diabetes Self-Management Education (DSMES) Program Curriculum

Grady Diabetes Center's DSMES curriculum displayed a brief overview of six of the seven fundamental behaviors (it did not explicitly include a section on problem-solving). The content area for each critical behavior section included the purpose of the behavior, learning objectives, methods of instruction, content that would be covered, and evaluation methods. The strengths of the Grady DSMES curriculum are that at the beginning of each section, there is an explanation for why the content area being discussed is essential (Grady Diabetes Center n.d.). Although the Grady DSMES curriculum is designed to be discussion-based, there was no clear indication of whether these discussions should be held individually or in group sessions. Throughout the Grady DSMES

curriculum, the learning objectives were not specific to type 1 or type 2 diabetes, which could influence how content is delivered. In addition, the curriculum did not display much detail on what was explicitly covered during each session (Grady Diabetes Center n.d.). The five other curricula included educational learning objectives that can supplement what Grady's DSMES curriculum lacks.

Maine DSMES Program Manual

Maine DSMES Program Manual (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019) was an in-depth manual covering several topics. This curriculum discussed behavior change and how self-management behavior is the desired outcome of DSMES. The Maine DSMES Program Manual curriculum provided suggested learning objectives for each of the seven fundamental behavior and divided them into survival and intermediate/advanced levels. The difference between the two levels was that survival-level objectives focused on the basic knowledge needed when an individual is diagnosed with diabetes. In contrast, the intermediate/advanced levels covered topics more in depth, such as describing how physical activity affects blood glucose and identifying healthy eating behaviors. Another area of interest is the inclusion of behavioral objectives, which are actions to improve and support informed discussion-making, problem-solving, and collaboration with the diabetes healthcare team (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019).

Before the curriculum section of the manual, there was a section for instructors called *Principles of Teaching and Learning*. This section explained the steps in counseling for behavior change and how to incorporate various learning activities and teaching techniques for participants with different learning styles. Educators knowing how to deliver material in multiple ways can be beneficial because everyone has different learning styles. In addition, instructors' understanding

of how to identify individuals' learning styles can help relay adequate self-management information in ways that participants can understand and better remember (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019).

Before the start of each content section, there was an introduction, behavioral objectives, and learning objectives (divided into diverse competence levels: survival level, intermediate/advanced level). For each key behavior, there were tables with learning objectives, content, and potential tools that might be needed during each session. The Maine DSMES Program Manual curriculum was mainly designed to be implemented in person due to the inclusion of discussion-based activities, handouts, videos, and computer presentations. There was no clear indicator within the curriculum whether sessions were one-on-one or in group settings. The curriculum stated that periodic individualized reassessments should be done to evaluate the attainment of learning objectives and the need for more educational sessions. Lastly, the end of each session had a helpful material list for participants that included videos, handouts/visuals, web-based educational content, models, and books geared toward promoting effective self-management (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019).

North Carolina (NC) DSMES Curriculum - Curriculum For Persons With Type 2 Diabetes and Their Families

The North Carolina (NC) DSMES Curriculum (North Carolina Diabetes Advisory Council, 2001) was geared toward persons with type 2 diabetes and their families. This curriculum was incredibly detailed and informative. It started with adult teaching tips for providers and then included lesson plans for each of the seven ACDES7 diabetes self-management behaviors: nutrition, physical activity, taking medication, monitoring, problem-solving, healthy coping, and reducing risks. The NC DSMES curriculum was developed to facilitate diabetes self-management

training in a group setting and can be adapted or modified to fit the needs of specific programs across the state of North Carolina. The teaching tips for adults were designed to allow the instructor to understand how to plan the lesson and how adult participants prefer to learn (North Carolina Diabetes Advisory Council, 2001).

Each key behavior session explained why the session was being conducted. The educational objectives stated what the participant would be able to do after each session, a pre-teaching guide for instructors that helped plan an overview of topics, supplies, and materials needed for teaching, and handouts and resources for participants to use after each session, which was designed to be informative and easy to comprehend. The tables displayed within the NC DSMES curriculum outlined the entire lesson plan conducted by the instructor and listed learning objectives, the presentation/ content, detailed and comprehensive activities, materials needed, and estimated time for each objective learning section. This curriculum focused on interactive activities such as drawing, discussions, handouts, group activities, and individual exercises. The curriculum emphasized that sessions should be interactive because people learned at different rates and were ready to take on their diabetes management at various times. Although this curriculum was geared toward persons living with type 2 diabetes, the learning objectives and content can benefit those with other types of diabetes (North Carolina Diabetes Advisory Council, 2001).

Six-Session Diabetes Self-Management Curriculum

The Six-Session DSMES Curriculum (Community Health Center, 2003) was developed by the Community Health Center (CHC) in Middletown, CT. The CHC sites primarily serve populations that are uninsured or underinsured patients from ethnically diverse backgrounds. The Six-Session DSMES curriculum was developed because CHC found that traditional diabetes education and self-management programs often fail to consider the unique needs of people from

different ethnic and socioeconomic backgrounds (Community Health Center, 2003). Due to this, CHC designed a culturally sensitive diabetes education program that can be provided in both group and individual settings. The curriculum also has a Spanish version to assist patients that speak only Spanish.

Only six of the seven ADCES7 self-care behaviors were discussed in this curriculum: nutrition, physical activity, taking medication, monitoring, problem-solving, and reducing risks. This curriculum also had an additional section for shopping at the grocery store and supermarket. Each session gave an overview of what was learned from the previous session and introduced the new learning objectives. In addition, there were teaching objectives, teaching points (which go more in-depth about the overall teaching objectives), and critical teaching points for each teaching objective (Community Health Center, 2003). However, one issue was that it is unclear if this curriculum was designed for all types of diabetes or only type 2.

Association of Diabetes Care & Education (ADCES7) Curriculum

The ADCES7's primary purpose was to create a practical framework to assist with behavior change, leading to effective self-management amongst people living with diabetes (Kolb et al., 2021). The curriculum included content on all the critical behaviors: healthy coping, healthy eating, being active, taking medication, monitoring, reducing risk, and problem-solving. The tables in the curriculum in which the learning objectives were displayed provided a clear understanding of the knowledge and skills participants would have learned. The ADCES7 curriculum provided an informative overview of what knowledge aspects were covered, potential skills, and possible barriers influencing effective outcomes. Additionally, the ADCES7 explained how each behavior and learning objective could be applied to a real-life scenario on how to drive decision-making by identifying barriers and proposing barrier resolution strategies that could be used. However, the

ADCES7 curriculum did not explicitly state if it was dedicated to a specific type of diabetes or how it would be delivered (in-person, virtually, individual, or group sessions) (Kolb, 2021).

Power to Prevent Curriculum

The Power to Prevent curriculum (National Institutes of Health et al., 2012) was considered "A Family Lifestyle Approach to Diabetes Prevention". This curriculum was developed to help bring diabetes prevention and control to African American communities (National Institutes of Health et al., 2012). The Power to Prevent curriculum was comprised of multiple sessions designed to inform organizations to promote, start, conduct and evaluate activities that help individuals and families make good nutrition and physical activity part of their daily lives. This curriculum was delivered both within group discussion sessions and one-on-one counseling sessions. Each session in this curriculum included health tips, resources, and other educational activities to assist with effective diabetes self-management. Power to Prevent emphasized making sessions interactive and assisting participants in thinking about different problem-solving methods to overcome barriers such as how to eat at a restaurant (National Institutes of Health et al., 2012).

The overarching goal of Power to Prevent was to encourage African Americans at risk of diabetes or with diabetes to become physically active and eat healthier foods to prevent diabetes (for those who have not yet developed the condition), control blood glucose, and delay further health complications. However, the Power to Prevent curriculum only addressed two of the seven ADCES7 self-care behaviors: healthy eating and being active. Although this curriculum focused heavily on preventing diabetes, the curriculum was selected for inclusion in this project because the emphasis and learning objectives for healthy eating and being active overlapped with the other curricula. In addition, this curriculum was developed to serve African Americans, the population

that Grady Diabetes Center primarily provides services to and the terminology used was specifically designed for people within that demographic.

Educational Content Development for Healthy Eating Learning Objectives

All six curricula identified effectively and correctly interpreting food labels as a main learning objective. Nutrition label comprehension was reinforced throughout the curricula; this could be because understanding food labels is important when helping individuals make better decisions about what they eat and how to manage their diabetes. All six curricula also emphasized the significance of carbohydrates, protein, and fat sources. The curricula educated individuals with diabetes to further their understanding of carb counting and identifying foods that are significant contributors to each of the three macronutrients to maintain an appropriate blood glucose level. Additionally, the strategies used for meal planning, such as the importance of portion sizing, using the plate method, and watching for ingredients on food labels, were emphasized throughout all six curricula. MyPlate (FDA, 2022b) has surfaced as a practical learning tool for healthy eating throughout each curriculum. The curricula engaged with MyPlate by showing examples of healthy, balanced meals and asking participants to demonstrate how they would meal plan or prepare a meal. However, none of the six curricula specifically mentioned the diabetes plate method (American Diabetes Association, 2020b) designed for people living with diabetes, although the diabetes plate method is considered an effective way to create healthy meals while managing blood sugar levels. Some benefits of using the diabetes plate method include helping avoid peaks in blood sugar levels, easy learning, and providing a balanced diet, simply and effortlessly (Richard Johnson, 2022).

Although the six curricula strongly emphasized healthy eating, some differences set them apart. For example, the Maine DSMES curriculum (Maine Center for Disease Control and

Prevention Division of Disease Prevention, 2019) incorporated participants' feelings into their learning objectives, such as asking participants to describe their feelings regarding meal planning. In addition, the Maine DSMES (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019) curriculum asked participants to describe the relationship between nutrition, physical activity, and medication within one of their learning objectives. Understanding how these three key behaviors are connected can help people with diabetes understand better how to manage glucose levels. In addition, the Maine (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019), Power to Prevent (National Institutes of Health et al., 2012), and ADCES7 (Kolb et al., 2021) curricula displayed the importance of understanding and navigating how to make healthier food choices at fast food and casual dining restaurants as an essential factor to eating healthier. The ADCES7 learning objectives matched all the others, with only one key difference: this curriculum was the only one that listed possible barriers that might affect healthy eating, such as food and beliefs, health literacy, food security, and environmental factors. Another curriculum that displayed unique differences was the NC DSMES curriculum (North Carolina Diabetes Advisory Council, 2001), which only focused on people with type 2 diabetes and their families. The difference within the NC curriculum was that it focused more on strategies to incorporate and consider while eating, such as reducing fat intake, increasing fiber intake, reducing the use of salt, reducing sugar, and topics surrounding cholesterol.

In contrast, the Six-Session DSMES curriculum dedicated a section to protein intake specifically, how it impacts blood glucose levels, and how to identify healthier proteins. The other five curricula did not focus intensely on protein but did mention it within the curriculum. Lastly, the healthy eating learning objectives in the Grady DSMES (Grady Diabetes Center n.d.) and

Power to Prevent curricula (National Institutes of Health et al., 2012) did not differ critically from the other four discussed.

Table 4 provides information on the key learning objectives and main points common for Healthy Eating across the six reviewed curricula, along with a sample quiz question and feedback.

Healthy Eating	
Learning Objectives	Main Points
Participants will be able to understand and interpret nutritional fact labels and identify major carbohydrate, protein, and fat sources	a. Learn how to read nutrition fact labels b. Use the nutrition fact labels to identify how foods that are high/low in fat, sugar, and sodium impact their diets c. Define which foods are significant contributors to each macronutrient, i.e., carbohydrate, protein, fat
Participants will be able to demonstrate an understanding of healthy eating patterns and make healthy food choices	a. Understand what healthy eating habits are b. Understand the benefits of healthy eating c. Increase ability to make healthy food choices d. Choose to incorporate healthier eating into daily routines
Participants will be able to identify strategies related to eating in moderation and portion control	a. Understand the importance of portion sizes b. Identify the difference between "portion" and "serving"
Participants will learn how meal prepping can be beneficial	a. Describe the benefits of healthy eating/meal planning b. Understand that meals each day should include vegetables, fruits, whole grains, dairy, and lean protein sources c. Understanding how many food groups exist d. Describe meal planning and problem-solving for special occasions
Participants will be able to understand the effects of beverages on blood glucose (blood sugar)	a. Understand how drinks affect blood sugar levels b. Define and understand what a "Glucose Tolerance Test" is c. Identify substitutions for beverages that raise blood sugar levels

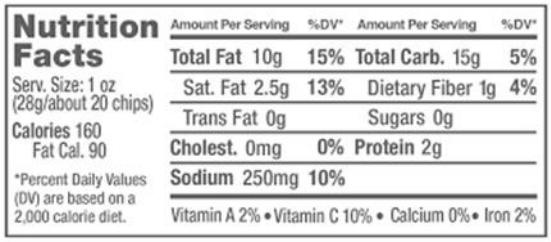
	d. Effects of Alcohol on Diabetes

Table 4: Healthy Eating Learning Objectives

Learning Objectives:

- Participants will be able to understand and interpret nutritional fact labels and identify major carbohydrate, protein, and fat sources.
    - Main points:
        a. Learn how to read nutrition fact labels

        Quiz example: Based on the photo below, **what is the total number of carbs in grams in one serving of chips**?



        a. 28g
        b. 15g
        c. 10g

        Feedback (A-wrong answer): 28g is the total number of grams of chips in each serving size (about 20 chips). It does not tell you anything about the number of carbs in one serving.

        Feedback (B-correct answer): The total number of carbs tells you how many grams of carbs are in one serving. If you eat more than one serving, you will need to multiply the grams accordingly. Example: If you eat two servings, the new total number of carbs would be 30g (15g x 2= 30g).

        Feedback (C-wrong answer): 10g is the total number of fats per serving size. This does not tell you anything about the number of carbs.

    b. Use the nutrition fact labels to identify how foods that are high/low in fat, sugar, and sodium impact their diets

        Quiz example: Sarah noticed her blood pressure has been high lately. **She wants to reduce her sodium intake. Which of the foods on these nutritional facts labels would be the best choice?**

Nutrition Facts

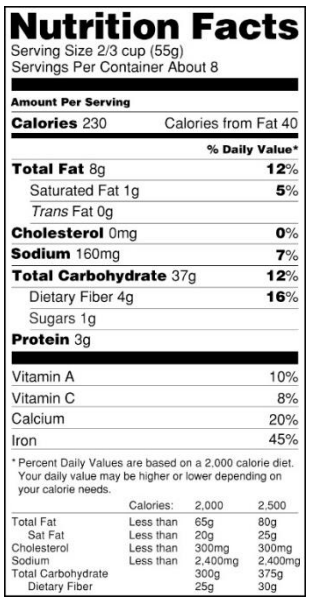
4 servings per container
Serving size 1 1/2 cup (208g)

Amount per serving
Calories **240**

	% Daily Value*
Total Fat 4g	**5%**
Saturated Fat 1.5g	**8%**
Trans Fat 0g	
Cholesterol 5mg	**2%**
Sodium 430mg	**19%**
Total Carbohydrate 46g	**17%**
Dietary Fiber 7g	**25%**
Total Sugars 4g	
Includes 2g Added Sugars	**4%**
Protein 11g	
Vitamin D 2mcg	10%
Calcium 260mg	20%
Iron 6mg	35%
Potassium 240mg	6%

* The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Figure 1



Nutrition Facts

Serving Size 2/3 cup (55g)
Servings Per Container About 8

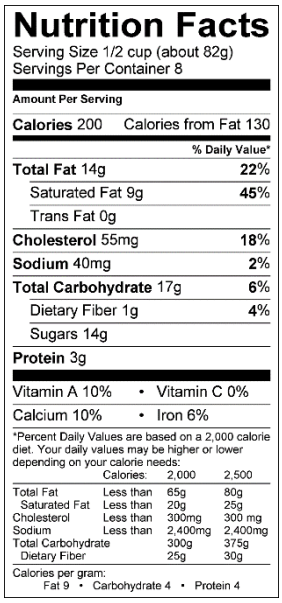
Amount Per Serving
Calories 230 Calories from Fat 40

	% Daily Value*
Total Fat 8g	**12%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 160mg	**7%**
Total Carbohydrate 37g	**12%**
Dietary Fiber 4g	**16%**
Sugars 1g	
Protein 3g	
Vitamin A	10%
Vitamin C	8%
Calcium	20%
Iron	45%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily value may be higher or lower depending on your calorie needs.

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Figure 2



Nutrition Facts

Serving Size 1/2 cup (about 82g)
Servings Per Container 8

Amount Per Serving
Calories 200 Calories from Fat 130

	% Daily Value*
Total Fat 14g	**22%**
Saturated Fat 9g	**45%**
Trans Fat 0g	
Cholesterol 55mg	**18%**
Sodium 40mg	**2%**
Total Carbohydrate 17g	**6%**
Dietary Fiber 1g	**4%**
Sugars 14g	
Protein 3g	

Vitamin A 10% • Vitamin C 0%
Calcium 10% • Iron 6%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Saturated Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300 mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Figure 3

a. Figure 1
b. Figure 2
c. Figure 3

Feedback (A- wrong answer): The recommendation for sodium intake is 2,300mg per day. In figure 1, the sodium in one serving is 430mg, which is 19% of the recommended sodium per day. This is the food with the highest amount of sodium. Controlling sodium intake is essential because too much sodium can increase high blood pressure and the risk of heart disease and stroke.

Feedback (B- wrong answer): The recommendation for sodium intake is 2,300mg per day. In figure 2, one serving size includes 160mg of sodium. This is 7% of the recommended daily amount of sodium (2300mg), but in figure 3, one serving size includes 40mg, which is less sodium than in figures 1 and 2. Controlling sodium intake is essential because too much sodium can increase high blood pressure and the risk of heart disease and stroke.

Feedback (C-correct answer): The recommendation for sodium intake is 2,300mg per day. Figure 3 is the best option for someone with high blood pressure because it contains the lowest sodium per serving (40mg or 2% of the recommended daily amount). Controlling sodium intake is essential because too much sodium can increase high blood pressure and the risk of heart disease and stroke.

Question & Feedback inspired by: (Centers for Disease Control and Prevention, 2021d)

c. Define which foods are significant contributors to each macronutrient, i.e., carbohydrate, protein, fat.
Quiz example: Which group of three foods contains the most protein sources?

a. fish, fries, bread
b. chicken, lima beans, cheese
c. beef, carrot, crackers

Feedback (A- wrong answer): This food group only contains one source of protein (fish). The two other foods (fries and bread) are carbohydrates, making this group high in carbs.

Feedback (B-correct answer): Chicken, lima beans, and cheese are full of protein. Chicken is one of the most common sources of protein. Lima beans are considered a superfood because they are packed with protein, fiber, and other nutrients. Cheese can also provide calcium, vitamin B12, and vitamin A; although cheese is nutrient-dense, it is still ideal to be mindful of your portion size because some cheese can be high in sodium and fats. Too much sodium can raise your blood sugar levels, and a high intake of saturated fats can increase LDL cholesterol levels.

Feedback (C-wrong answer): In this food group, the only source of protein is beef. Carrots are from the non-starchy vegetable food group. Lastly, crackers are high in carbs. This group of three food sources is high in carbs.

Question & Feedback inspired by: (Harvard T.H. Chan, 2022); (Adda Bjarnadottir, 2019)

- Participants will be able to demonstrate an understanding of healthy eating patterns and make healthy food choices
    - Main points:
        a. Understand what healthy eating habits are
        Quiz example: While at work, Jordan realizes she skipped breakfast. **How can Jordan improve her morning eating habits?** *Choose the Best Option*

a. Prepping breakfast the night before
b. Grabbing breakfast from a fast-food restaurant on her way to work
c. Keeping granola bars in her desk at work

Feedback (A-correct): Meal prepping breakfast the night before improves healthy eating habits by helping you eat a more balanced breakfast such as overnight oats, egg muffins, and homemade burritos. Another benefit is reducing the stress of missing meals; it is important to eat regularly to keep your blood sugar levels steady.

Feedback (B-wrong answer): Grabbing breakfast on the way to work is not the best option. Although there may be some healthier options at fast-food places, the food is often still highly processed. Although processed foods can be very convenient, they are not the best option for people with diabetes because they are high in fat, salt, sugars, and calories, affecting blood sugar levels. Also, stopping on the way to work takes time, and you can easily miss breakfast if you are running late.

Feedback (C-wrong answer): Although granola bars are very convenient and portable, some are not as healthy as you might expect. They tend to contain large amounts of sugars, calories, and carbs. If you like granola bars as an easy snack, preparing homemade granola bars at home is ideal so you can control what goes into them.

Questions & Feedback Inspired by: (Rachael Link, 2019);(ADCES, 2021); (North Carolina Diabetes Advisory Council, 2001); (Bayshore HealthCare, 2018)

b. Understand the benefits of healthy eating

Quiz example: True or False: Lizzie recently learned she is underweight. Lizzie increasing the amount of fried food she consumes is the ideal way to gain weight.

a. True
b. False

Feedback (A-wrong answer): Fried food can influence weight gain, but it is not the best option if her goal is to gain healthy weight. Fried foods are loaded with carbohydrates, which can quickly spike blood sugar levels and increase the risk of other health complications.

Feedback (B-correct answer): If her goal is to reach a healthy weight, she should not increase the amount of fried food she eats. Fried foods are loaded with carbohydrates, which can spike blood sugar levels. Lizzie can use alternative cooking methods, such as baking, boiling, or cooking oils, reducing her risk of consuming extra carbohydrates.

Question & Feedback Inspired by: (Harvard T.H. Chan School of Public Health, 2014) ;(Klinio, n.d.)

c. Increase ability to make healthy food choices

Quiz example: When Joe has a stressful day at work today, he craves ice cream. Which of the following is **NOT** a good substitute for ice cream?

a. Home- made protein smoothie
b. Small dark chocolate bar
c. Frozen yogurt

Feedback (A-wrong answer): Home-made protein smoothies can be a good substitute for eating ice cream because Joe can add nutritious ingredients such as green veggies and fruits while satisfying his sweet tooth. By the way, Joe does not have to stop eating ice cream. However, he needs to be mindful of the kinds and amount of ice cream he eats. Reading nutritional labels carefully will help him figure out what ice cream (and how much) he can eat.

Feedback (B-wrong answer): A small amount of dark chocolate can be a healthier alternative than ice cream to help Joe with his sweet tooth. Dark chocolate is not only a tasty treat, but it contains nutrients such as iron, magnesium, zinc, copper, phosphorus, and flavanol; like all sweets, it should be consumed in moderation. However, Joe does not have to give up ice cream completely; he may just need to be thoughtful about the type of ice cream he eats. He must consider many factors such as the number of carbs, fat content, and sugar content; it is always important to read the nutritional labels before eating foods.

Feedback (C-correct): Although frozen yogurt is often considered a healthy substitute for ice cream, it is the worst substitute within the choices. Although frozen yogurt typically contains less fat than ice cream, it can contain as much sugar and spike blood sugar levels. Check the nutritional labels to see how much sugar is in a serving before selecting a flavor.

Question & Feedback Inspired by: (Rachael Link & Lisa Hodgson, 2021); (Nizam Khan & Miho Hatanaka, 2020); (Ely Foronoville, 2022); (Harvard T.H. Chan school of Public Health, n.d.)

d. Choose to incorporate healthier eating into daily routines

Quiz example: True or False: The healthiest way to cook a white potato is by baking.

a. True
b. False

Feedback (A-wrong answer): Although baking white potatoes is better than some other cooking methods, like frying, it is not the best cooking method. This is because a baked potato still contains lots of carbs and can increase your blood sugar levels because it is quickly digested.

Feedback (B-correct answer): The healthiest way to cook a white potato is to boil it because it has a lower effect on your blood sugar levels when boiled compared to other cooking methods. The skin on the potatoes is also beneficial because it contains vitamins, minerals, and fiber, so it is a good idea to avoid peeling potatoes before cooking them. Although boiling potatoes is a great alternative to baking, it is essential to eat potatoes in moderation because they are high in carbs and can increase your blood sugar quickly.

Question & Feedback Inspired by: (Diabetes Care Community, 2020)

- Participants will be able to identify strategies related to eating in moderation and portion control

    - Main points:
        a. Understand the importance of portion sizes
        Quiz example: Controlling the portions on your plate can___:

            a. Encourage overeating
            b. Improve blood sugar
            c. Increase intake of unhealthy foods

        Feedback (A-wrong answer): Controlling the portions on your plate can decrease overeating and help you avoid eating too much of any one food. For someone with diabetes, this particularly helps you not to eat too many carbs and also helps with weight management since you are limiting the amount of food you eat.

        Feedback (B-correct answer): Controlling portion size is a great strategy to track how many carbs you eat and how much you eat of other types of foods. Portion sizes can allow for a more balanced meal which is needed to help keep your blood sugar within normal range.

        Feedback (C-wrong answer): If you are not effectively portioning out the food on your plate, you risk increasing the intake of extra carbs and consuming unhealthy foods. Portion control can help reduce the intake of extra carbs and unhealthy foods by limiting the amount of food consumed at a given time.

        Question & Feedback Inspired by: (Donna Sykes, 2021); (Centers for Disease Control and Prevention, 2021a)

        b. Identify the difference between "portion" and "serving"
        Quiz example: Serving size is _____?

            a. The amount of food you choose to eat at one time
            b. The amount of a nutrient that is in a particular food
            c. The amount of food that the nutrition facts label recommends you eat at one time

        Feedback (A-wrong answer): Portion size is the amount of food you choose to eat at one time, and serving size is the standard amount of food people typically eat. On a nutrition label, serving size is the amount of food for which percentage daily values are shown.

        Feedback (B-wrong answer): The % daily value is the percentage of the recommended daily amount of a nutrient that is present in one serving of a particular food.

Feedback (C-correct answer): Serving size is an essential factor in eating healthy. Consuming more than one serving of a particular food at a time can lead to weight gain and high blood sugar levels. Therefore, if eating more than one serving, it is essential to remember to multiply the grams accordingly.

Question & Feedback Inspired by: (eatright, 2020); (FDA, 2022a)

- Participants will learn how meal prepping can be beneficial
    - Main point:
        a. Describe the benefits of healthy eating/meal planning
        Quiz example: What is not a benefit of meal planning?

            a. Maintaining consistency of eating habits
            b. Increasing carb consumption
            c. Avoiding unhealthy options

        Feedback(A-wrong answer): Meal planning can help you maintain consistency of eating habits by making sure you consider each food group when prepping, eating the same amount of food during each meal, and allowing you to see how much you are planning to consume which can help maintain normal blood sugar levels.

        Feedback (B-correct answer): Meal planning can help you reduce the number of carbs you consume throughout the day to help keep your blood sugar within your target range. By planning ahead and preparing appropriate portion sizes for each meal, you can more easily track how many carbs are within each meal.

        Feedback (C-wrong answer): By planning what you will eat ahead of time, rather than waiting until you are ready to eat, meal planning can help you make healthier food choices. For example, meal planning helps ensure you are eating from all five food groups and avoiding unhealthy food choices that may raise your blood sugar levels quickly. It also help you avoid making unwise food choices when you are hungry.

        Question and Feedback Inspired by:(Centers for Disease Control and Prevention, 2021a)

        b. Understand that daily meals should include vegetables, fruits, whole grains, dairy, and lean protein sources.

        Quiz example: Zoey is meal prepping for work tomorrow. She has packed green beans, one apple, and brown rice. What else should she include?

            a. Corn
            b. A banana
            c. **Salmon**

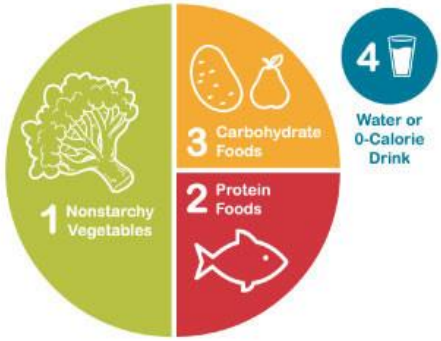
Feedback (A-wrong answer): Corn is considered a starchy vegetable. Zoey has already included green beans, a vegetable. For a balanced meal, she needs to add protein to the food she has already packed.

Feedback (B-wrong answer): Bananas are in the fruit food group. Bananas are known for being rich in potassium and containing various nutrients. However, Zoey has a fruit (apple) already packed within her meal, so there is no need to add another fruit.

Feedback (C-correct answer): Salmon is the best option because it would help balance Zoey's meal. She has already packed a vegetable, fruit, and whole grain. Zoey should include salmon because she does not yet have a protein. Also, salmon contains healthy fats called Omega-3 fatty acids that can improve her overall health.

Question and Feedback Inspired by:(Franziska Spritzler & Sade Meeks, 2022); (Joan Raymond & Hansa D. Bhargav, 2020)

c. Understanding how to use the plate method
Quiz example: According to the diabetes plate method, which of the following vegetables should you choose to fill half your plate?



a. Yams
b. Green peas
c. **Green beans**

Feedback (A-wrong answer): Yams are rich in vitamins, minerals, and fiber. However, yam is a starchy vegetable with high amounts of carbohydrates, which can cause a rise in blood sugar levels. Therefore, it is recommended that starchy vegetables should be a quarter of your plate because this group is high in carbs.

Feedback (B-wrong answer): Within the diabetes plate method, half the plate should be non-starchy vegetables. Although green peas are a good source of vitamins and

antioxidants, they are considered a starchy vegetable that is not recommended to be half of your plate.

Feedback (C-correct answer): Green beans fall within the non-starchy vegetable group. For the diabetes plate method, non-starchy vegetables should fill half your plate. In addition, non-starchy vegetables are lower in carbohydrates, reducing blood sugar levels.

Question & Feedback inspired by: (American Diabetes Association, 2020b);(Cheri Bantilan, 2019; Dan Brennan, 2021)

d. Describe meal planning and problem-solving for special occasions.

Quiz example: Jaime is celebrating her friend's birthday at a restaurant. When her food arrives, she realizes it is a large serving size. What should she do?

a. Order another smaller meal instead
b. Skip her next meal to compensate
c. Take some of her meal home for lunch the next day

Feedback (A-wrong answer): Ordering another meal is not the correct answer because her food is already served. An effective option would be only to eat half of the meal she ordered and take the remaining home in a to-go bag for lunch the next day.

Feedback (B-wrong answer): Skipping her next meal to compensate for overeating is not ideal. Going without her next meal could cause her blood sugar levels to drop and cause her to feel tired and dizzy.

Feedback (C-right answer): Sometimes, restaurants serve large portions. She can manage her portion size at the restaurant and for the next day by taking some of her meal home. She will also save time and reduce the possibility of missing a meal the next day by eating the leftovers.

Question & Feedback Inspired by: (Kasey Dunifer, 2021);(Peconic Bay Medical Center, 2018)

- Participants will be able to understand the effects of beverages on blood glucose (blood sugar)
  - Main points :

a. Understand how drinks affect blood sugar levels

Quiz example: After Monica hiked with her friends, they went to grab lunch. She checked her blood sugar which was 65. What kind of drink can she order to increase her blood sugar quickly?

a. Orange Juice

b. Unsweetened tea
c. Seltzer water

Feedback (A-correct answer): Orange juice is the best option because it contains more sugar, quickly raising Monica's blood sugar levels. However, it's important to remember that consuming sugary foods/beverages is only recommended if your blood sugar levels are low.

Feedback (B-wrong answer): Unsweetened tea is a low-calorie beverage that does not impact blood sugar levels. If you need to raise your blood sugar levels quickly, drinks containing sugary drinks, such as orange juice, sweet tea, and soda, are good options.

Feedback (C-wrong answer): Seltzer water has no calories or carbs and will not affect blood sugar levels, so it is not a good choice if Monica's sugars are low. Seltzer water is simply carbonated water and is a great way to stay hydrated and support healthy blood sugar levels at other times.

Question & Feedback Inspired by:(Lisa Hodgson & Daniela Ginta, 2021)

b. Define and understand what a "Glucose Tolerance Test" is
Quiz example: Which of the following does a glucose tolerance test do?

a. See how your body processes sugar
b. Check your fasting blood sugar levels
c. Measure your average blood sugar for the past three months

Feedback (A-correct answer): A glucose tolerance test measures how your body responds to sugars and can be used to screen for type 2 diabetes. It involves comparing the glucose levels in your blood before and after a sugary drink.

Feedback (B-wrong answer): A glucose tolerance test does not check your fasting blood sugar levels. It is used to measure how your body responds to sugars and can be used to test for type 2 diabetes. A fasting glucose test measures blood sugar after you have not eaten overnight.

Feedback (C-wrong answer): A glucose tolerance test does not measure your average blood sugar over the past three months. An A1c test does this.

Question & Feedback Inspired by: (American Diabetes Association, n.d.-e);(Centers for Disease Control and Prevention, 2021b)

c. Identify substitutions for beverages that raise blood sugar levels

Quiz example: Mary is out at a restaurant with her friends. While at the restaurant, she orders an orange soda. Which of the following beverages would be best for her to drink instead?

a. Green smoothie
b. Energy drink
c. Sweetened Juice

Feedback (A-correct answer): A *green smoothie* would be the best replacement for orange soda among the three options because these can be a good way to include more leafy greens, fiber, and other nutrients into your diet. Green smoothies can be an excellent way to help boost immunity, improve digestion, and lower the risk of chronic disease. Remember that fruits used when making green smoothies have carbs, so if there are fruits in the smoothie, count them towards your daily carb intake. Additionally, when ordering drinks from restaurants, read the nutritional labels on the menus to know how many carbs are in each drink before ordering.

Feedback (B-wrong answer): Energy drinks are high in sugars and calories. Energy drinks can be beneficial when your blood sugar levels are low and you need to make them rise quickly, but Mary does not need her to raise her blood sugar levels. Instead, she needs an alternative drink to keep her levels in a normal range.

Feedback (C-wrong answer): Sweetened juice such as fruit punch often contains high sugar levels, like sodas. Because these beverages contain large amounts of sugar, they can cause a spike in blood sugar levels.

Question and Feedback Inspired by:(Lisa Hodgson & Daniela Ginta, 2021); (Dan Brennan, 2020)

d. Effects of Alcohol on Diabetes

Quiz example: Mike goes to the bar with his coworkers after work. He decides to have an alcoholic beverage. Which is the ***best option*** to prevent low blood sugar?

a. He should drink in moderation
b. He should only drink beverages that have a low alcohol content
c. He should not drink on an empty stomach

Feedback (A-wrong answer): Alcoholic beverages are not forbidden for most people with diabetes, but, like for everyone, drinking in moderation is important. If adults with diabetes choose to consume an alcoholic beverage, they should still include the number of carbs in their daily total carb count calculation. Additionally, having a meal or snack while drinking can reduce the risk of hypoglycemia.

Feedback (B-wrong answer): Although alcoholic beverages are not forbidden for most people with diabetes, only drinking beverages that have low alcohol content is not the best option here. Mike still has to be mindful of the amount of carbs he consumes with each drink and count them towards his daily carbs total.

Additionally, having a meal or snack when you are drinking can reduce the risk of hypoglycemia.

Feedback (C-correct answer): Alcohol is not forbidden for most persons with diabetes. However, if someone who has diabetes is planning on consuming alcohol, they should drink with a meal or snack. Eating food helps slows the absorption of alcohol in the body, so it is essential always to have something to eat if you choose to drink alcohol.

Question & Feedback Inspired by: (ADCES, 2021); (Diabetes Teaching Center at the University of California, n.d.-a),(American Diabetes Association, n.d.-a)

Educational Content Development for Being Active Learning Objectives

The *Being Active* sessions of all six curricula displayed similar learning objectives. The focus was on the importance of daily physical activity, how physical activities impact blood glucose levels, the benefits of being active, and how to incorporate physical activity into daily routines. Some recurrent learning objectives included the significance of why blood glucose levels should be checked before and after physical activity and hypoglycemia's signs and symptoms. Studies have shown that fear of hypoglycemia is one of the main barriers to physical activity for individuals with type 1 diabetes (Yardley & Sigal, 2015). Therefore, individuals living with type 1 diabetes should be aware of the signs and symptoms of hypoglycemia and, most importantly, check their blood sugar levels before, during, and after any physical activity (Yardley & Sigal, 2015).

In contrast to the other curricula, which focused primarily on factual information about the importance of physical activity, the Maine DSMES curriculum (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019) focused on the perceptions and feelings of the participants towards physical activity. The Maine DSMES (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019) and Grady curriculum (Grady Diabetes Center n.d.) were the only ones to list learning objectives related to educating participants on the

differences between aerobic and anaerobic activity and the importance of knowing the differences between the two. In addition, the Maine DSMES (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019) and ADCES7 (Kolb et al., 2021)curricula were the only ones to focus on educating participants on identifying strategies to handle barriers to physical activity. Another critical learning objective within the ADCES7 curriculum (Kolb et al., 2021) was an emphasis on possible external obstacles that may inhibit exercise, such as pre-existing health conditions/ injuries, environmental factors, fear (of hypoglycemia), and lack of social support. Finally, the ADCES7 (Kolb et al., 2021) and Power to Prevent (National Institutes of Health et al., 2012) curricula emphasized the importance of special considerations, such as proper footwear when exercising which is not mentioned in the other curricula. Wearing the right shoes will help support arches, ankles, and heels during exercise.

Table 5 below provides information on the key learning objectives and main points common for Being Active across the six reviewed curricula, along with a sample quiz question and feedback for each sub-objective.

Being Active	
Learning Objectives	Main Points
Participants will be able to understand and increase their knowledge of the importance of being physically active	a. Be able to define what physical activity means b. Understanding how physical activity is beneficial c. Understand the positive aspects of physical activity and its impact on blood glucose levels. d. Understand the importance of checking blood sugar before and after doing any physical activity
Participants will be able to understand the importance of consulting with the healthcare team before beginning an exercise program and always carrying a diabetes identification card	a. Never begin an exercise program without checking with your primary care provider. b. Always carry a medical diabetes identification card and bracelet

Participants will be able to understand the importance of increasing the opportunity for physical activity in daily activities	a. Learning that all minutes of physical activity add up to the recommended amount of daily physical activity b. Identify several types of physical activities c. Learn about other ways to include physical activities in daily activities d. Ways to stay motivated

Table 5: Being Active Learning Objectives

Learning Objectives:

- Participants will be able to discuss the importance of physical activity and its impact on blood glucose levels

    - Main points:
        a. Be able to define what physical activity means
        Quiz example: Doing household chores is a form of physical activity. True/ False
            a. True
            b. False

        Feedback (A-correct answer): Doing household chores is considered an unstructured physical activity that allows you to burn calories. Physical activity includes all types of movement, such as gardening, walking, dancing, and sports.

        Feedback (B-wrong answer): Physical activity includes all types of movement, including leisure activities, dance, yoga, mowing the lawn, and more. Doing household chores is considered an unstructured physical activity that still allows you to burn calories.

        Question & Feedback Inspired by:(ADCES, 2021); (World Health Organization, n.d.)

        b. Understanding how physical activity is beneficial

        Quiz example: Which of the following does physical activity **not** do? *Choose one of the following.*

            a. Help control blood sugar levels
            b. Decrease insulin sensitivity
            c. Lower the risk of heart disease

        Feedback (A-wrong answer): Physical activity has many benefits, such as maintaining a healthy weight, reducing stress, lowering the risk of heart disease, and, most importantly, helping with controlling blood sugar levels. Physical activity makes the body more sensitive to insulin, which helps control blood sugar levels.

Feedback (B-correct answer): Physical activity does not decrease insulin sensitivity. It actually makes your body more sensitive to insulin by making your body use blood sugar for energy, which helps you to manage your diabetes. Some exercises that can increase insulin sensitivity are swimming, biking, and taking a brisk walk.

Feedback (C-wrong answer): Physical activity can lower the risk of heart disease by lowering blood pressure levels, which is a major cause of heart disease.

Question & Feedback Inspired by: (Diabetes Teaching Center at the University of California, n.d.-b); (Sheri Colberg, 2015);(Johns Hopkins Medicine, 2022);(Centers for Disease Control and Prevention, 2021c)

c. Understand the positive aspects of physical activity and its impact on blood glucose levels

Quiz example: Scenario: Tasha wants to be more active in order to control her blood sugar. Her daily schedule is busy, and she does not think she can make time to go to the gym every week. What is **NOT** a good way for her to be more physically active? *Choose Best Answer*

a. Walk 20 mins during her lunch break
b. Go to the gym every other week
c. Park further away from the office and walk

Feedback (A-wrong answer): Incorporating walking into your lunch break or any part of your day can be beneficial because it helps with lowering glucose levels.

Feedback (B-correct answer): Tasha going to the gym every other week increases her risk of injury. Going to the gym would have been beneficial if she had been able to go to the gym more regularly. In this case, finding other ways to be active will be more beneficial for Tasha.

Feedback (C-wrong answer): Parking further away from the office and walking would be an ideal way for Tasha to increase her physical activity gradually. Parking further away allows Tasha to add steps to her daily walks.

d. Understand the importance of checking blood sugar before and after doing any physical activity

Quiz example: Wendy started her first day of Zumba class today. After class, she fainted as she was leaving. Which of the following should she have done?

a. Checked blood sugar before Zumba class
b. Drunk fruit juice before Zumba class
c. Checked blood sugar after Zumba class

Feedback (A-right answer): Wendy should have checked her blood sugar levels before Zumba class. If she had checked before, she would have been aware of her blood sugar level and known if it was in danger of going low. It is important to monitor your blood sugar levels before, during, and after physical activity. This can show how your body responds to various physical activities and reduce the risk of hyperglycemia or hypoglycemia. Finally, remember to keep a small snack when doing physical activity if your blood sugar levels are typically low before or after a workout.

Feedback (B-wrong answer): Wendy drinking fruit juice before Zumba class would have been beneficial if she knew her blood sugar levels were low before class. Eating a small snack such as fruit, crackers, or half of a sandwich can help prevent hypoglycemia during exercise. Monitoring blood sugar levels before, during, and after will show how your body responds to various physical activities and reduce the risk of hyperglycemia or hypoglycemia. Also, remember to keep a small snack when doing physical activity if your blood sugar levels are typically low before or after a workout.

Feedback (C-wrong answer): Wendy should have first checked her blood sugar levels before Zumba class because she fainted after class. However, it is still essential if you are doing physical activity also to check your blood sugar levels after to understand how your body reacted to the activity, and if it is low, you should eat a snack to bring your blood sugar levels back up. Additionally, monitoring blood sugar levels before, during, and after physical activity is important. Tracking your blood sugar levels will show how your body responds to various physical activities and reduce the risk of hyperglycemia or hypoglycemia. Lastly, remember to keep a small snack when doing physical activity if your blood sugar levels are typically low before or after a workout.

Question and Feedback Inspired by : (ADCES, 2021);(American Diabetes Association, n.d.-b);(American Diabetes Association, n.d.-c);(Mayo Clinic Staff, 2022a)

- Participants will be able to understand the importance of consulting with the healthcare team before beginning an exercise program and always carrying a diabetes identification card
    - Main points:
        a. Never begin an exercise program without checking with your primary care provider.
        Quiz example: Susan is interested in joining a workout class at her community fitness center. What is the **most important** thing for Susan to do before attending the fitness class? *Choose Best Answer*

            a. Buy appropriate footwear
            b. Ask her friends if they want to join her

c. See her doctor

Feedback (A-wrong answer): It is important to wear the proper footwear during physical activity to prevent possible injuries. However, to avoid potential health risks, it is even more important to speak with your diabetes care team before starting a new physical activity. This will help to ensure this exercise is right for you and avoid potential risks like hypoglycemia.

Feedback (B-wrong answer): It is always fun to have a supportive friend group when starting a fitness journey, and it can help you to stay motivated to keep exercising. However, before being in any new fitness class, it is essential to speak with your healthcare team to make sure it is an appropriate form of exercise for you and avoid potential risks, like hypoglycemia.

Feedback (C-correct answer): Speaking with your diabetes care team is essential before starting a new exercise program because providers can help you ensure it is an appropriate form of exercise for you. They can also assist by providing you with information to manage your blood sugar levels and avoid hypoglycemia

Question & Feedback Inspired by:(ADCES, 2021)

b. Always carry a medical diabetes identification card and bracelet
Quiz example: Taylor went for a morning jog. She started to feel dizzy and passed out. **What would help the first responders to give her the right treatment?**

a. **If she had worn a diabetes ID bracelet**
b. If she had checked her blood sugar before leaving
c. If she had carried a snack with her

Feedback (A-correct answer): It is ideal to wear your diabetes ID bracelet to ensure you quickly get the care you need. Without your diabetes ID bracelet, first responders do not know the cause of the problem and might try other medical protocols, taking longer to provide the care you need.

Feedback (B-wrong answer): It is always good to check your blood sugar before exercising to help avoid hypoglycemia, but this will not help the first responders give you the right treatment if you pass out. Wearing your diabetes ID bracelet will help first responders quickly give you the necessary care.

Feedback (C-wrong answer): It would be good for Taylor to have a snack with her in case her blood sugar went low. However, she would need to take it before she passed out. In addition, this will not help the first responders give you the right treatment if you pass out. Wearing your diabetes ID bracelet will help first responders give you the care you need quickly

Question and Feedback Inspired by: (Hope Cristol & Michael Dansinger, 2022)

- Participants will be able to understand the importance of increasing the opportunity for physical activity in daily activities
    - Main points:
        a. Learning that all minutes of physical activity add up to the recommended amount of daily physical activity

        Quiz example: Jada, Tom, and Sadie all enjoy doing physical activity. Jada walks 15 minutes, four days a week, and jogs for 30 minutes, two days a week. Tom jogs for 25 minutes three days a week and swims 20 minutes two days a week. Lastly, Sadie bike rides for 25 minutes, five days a week, and does Zumba for 15 minutes, two days a week. Which of them is getting the recommended amount of physical activity?

            a. Jada
            b. Tom
            c. Sadie

        Feedback (A-wrong answer): The recommended amount of physical activity for adults per week is 150 minutes of moderate-intensity physical activity. Jada walks 15 minutes four days a week (15 x 4= 60) and jogs for 30 minutes two days a week (30 x 2=60) which makes her total amount of exercise for the week 120 minutes. This is below the recommended time for adults. It is important to remember that you can always spread your activity out throughout the week and break it up into smaller chunks to meet your desired goal; any physical activity is better than none.

        Feedback (B-wrong answer): The recommended amount of physical activity for adults per week is 150 minutes of moderate-intensity physical activity. Tom jogs for 25 minutes three days a week (25 x 3= 75) and swims 20 minutes two days a week (20 x 2=40) which makes his total amount 115 minutes. This is below the recommended time for adults. It is important to remember that you can always spread your activity out throughout the week and break it up into smaller chunks to meet your desired goal; any physical activity is better than none.

        Feedback (C-correct answer): The recommended amount of physical activity for adults per week is 150 minutes of moderate-intensity physical activity. 150 minutes of physical activity each week sounds like a lot, but you do not have to do it all at once. For example, Sadie rides her bike for 25 mins five days a week (25 x 5=125) and does Zumba 15 mins twice a week (15 x 2=30), making her total for the week 155 minutes. Like Sadie, you can spread your activity out during the week and break it up into smaller chunks of time.

        Question & Feedback Inspired by: (Centers for Disease Control and Prevention, 2022)

        b. Identify several types of physical activities

Quiz example: Jasmine does not like going to the gym because she becomes bored quickly. Hula-hooping would be a good alternative to reduce boredom while still getting exercise.

a. True
b. False

Feedback (A-correct answer): Physical activity does not have to be boring or intense. Many non-traditional physical activities, such as hula-hooping, swimming, hopscotch, and dancing, can be fun.

Feedback (B-wrong answer): Jasmine can do non-traditional physical activities that allow her to play, move, and have fun at the same time. For example, doing a fun activity such as hula-hooping will still allow her to use her lower body muscles and improve her core muscles.

Question & Feedback Inspired by: (Anne Poirier, 2016);(Sara Lindberg & Daniel Bubnis, 2019)

c. Learn about other ways to include physical activities in daily activities
Quiz example: Joe typically goes on short walks during the evening. He wants to become more active. **Which activity should <u>not be included in his goal</u>?**

a. Playing catch with his dog
b. Taking the stairs instead of the elevator at work
c. Looking for fitness classes

Feedback (A-wrong answer): Joe actively playing fetch with his dog would be great for increasing the time he does physical activity. Playing fetch with his dog allows him to run, jump, and do other movements.

Feedback (B-wrong answer): Joe taking the stairs instead of the elevator at work would not only contribute to the recommended daily amount of time he does physical activity but does not require special equipment. Taking the stairs can help build and maintain healthy bones, muscles, and joints.

Feedback (C-correct answer): Joe looking for fitness classes does not incorporate physical activity into his daily routine. If Joe joined a fitness class, he would be physically active and increase the amount of physical activity he does daily.

Question/ Feedback Inspired by: (ADCES, 2021);(Duke Human Resources, n.d.)

d. Ways to stay motivated
Quiz example: What is **not** the best way to stay motivated when exercising?

a. Depending on your friends

b. Beginning new exercises slowly
c. Choosing a fun activity

Feedback (A-correct answer): Depending on others to exercise with is not the best way to stay motivated because it may delay your exercise journey. However, it would be motivating if you invited your friends to exercise with you instead of waiting on them.

Feedback (B-wrong answer): Beginning a new exercise program slowly can help your body build up strength and endurance; this is important, especially if you do not exercise regularly. Gradually approaching exercises can help reduce the risks of aches, pains, and injury**.**

Feedback (C-wrong answer): Making exercising fun can be motivating. If you struggle with motivation to exercise, try activities you can enjoy without thinking of them as exercising, such as volleyball, ballroom dancing, and yoga. Finding a physical activity you enjoy can make exercising more exciting and increase your chances of continuing to be active.

Question & Feedback Inspired by: (Mayo Clinic Staff, 2021b)

Educational Content Development for Additional Learning Objectives

Supplemented Learning Objectives (topics that were not included in four of the six DSMES curricula)

Healthy Eating	
Learning Objectives	Main Points
Participants will be able to understand the relationship between how much is eaten (portion size) and how much energy is used (physical activity)	a. Describe the relationship between nutrition and physical activity

Table 6: Supplemented Learning Material- Healthy Eating

- Participants will be able to understand the relationship between how much is eaten (portion size) and how much energy is used (physical activity)
    - Main points:
        a. Describe the relationship between nutrition and physical activity.
        Quiz example: During Johnny's last doctor's visit, he was told he was overweight. He decides to join a fitness class. What would **NOT** be the healthiest way to help himself lose weight*? Choose Best Answer*

            a. Prepping his meals

b. Purchasing frozen low-calorie meals

c. Talking to a health care professional

Feedback (A-wrong answer): Johnny joining a fitness class to help him lose weight is already part of his weight loss journey. However, he still needs to incorporate healthy eating into his daily routine, which he can do by preparing balanced meals. For example, if he prepares meals at the beginning of the week, he can manage the carbs he eats daily, reduce overeating, and give himself the proper nutrients.

Feedback (B-right answer): Purchasing frozen low-calorie meals may be convenient because they are quick to prepare and already portioned. However, this is not the best answer because most frozen meals are high in sodium and carbohydrates. Therefore, if Johnny decides to purchase frozen meals, he should be mindful of the amount of sodium and the total number of carbohydrates.

Feedback (C-wrong answer): Johnny talking to a healthcare professional can be beneficial because he can learn how to lose weight while managing his blood sugar levels effectively. Specifically, talking to a dietitian to develop a healthy eating plan that fits his needs and controls his blood sugar while reaching his weight loss goals.

Question & Feedback Inspired by:(Mayo Clinic Staff, 2021a);(Healthy People 2020, 2022);(Amy Campbell, 2014)

Be Active	
Learning Objectives	Main Points
Participants will be able to understand the signs and symptoms of hypoglycemia during physical activity	a. Define hypoglycemia b. Understanding the signs and symptoms of hypoglycemia can result from exercise

Table 7: Table 6: Supplemented Learning Material- Be Active

- Participants will be able to understand the signs and symptoms of hypoglycemia during physical activity
    - Main points:

a. Define hypoglycemia
Quiz example: Hypoglycemia is when your blood sugar is very ____.
    a. High
    b. **Low**
    c. Changeable

Feedback (A-wrong answer): Hyperglycemia is when your blood sugar levels are high; some symptoms include frequently needing to urinate and being more thirsty

than usual. However, low blood sugar is called hypoglycemia. This happens when blood sugar levels are below the normal range. Some signs of hypoglycemia include feeling easily annoyed, being excessively tired, sweating, and confusion.

Feedback (B-correct answer): Hypoglycemia is when blood sugar is very low. When you notice your blood sugar levels are below the normal range, you can consume high sugar foods such as orange juice to bring them into the normal range. Some signs of low blood sugar levels are irritability, fatigue, sweating, and confusion.

Feedback (C-wrong answer): Hypoglycemia is when your blood sugar levels are below the normal range. If you notice your blood sugar levels are changing between high and low levels frequently, this is a sign that your body is having trouble managing your blood sugar with your current strategies. You should speak with your doctor to find alternative ways to manage your blood sugar levels.

Question & Feedback Inspired: (American Diabetes Association, n.d.-d); (Mayo Clinic Staff, 2022b)

b. Understanding the signs and symptoms of hypoglycemia can result from exercise. ***Quiz example***: What signs and symptoms are triggered by hypoglycemia (low blood glucose levels)?

    a. Frequent urination
    b. Dizziness
    c. Increased thirst

Feedback (A-wrong answer): Low blood sugar can cause fatigue, making the person feel dizzy and weak. Frequent urination is a sign that your blood sugar levels are too high.

Feedback (B-correct answer): Dizziness and weakness are two signs of low blood sugar levels. When you notice these symptoms, you can take the proper steps to manage your blood sugar, such as taking medication or a high-sugar snack or drink.

Feedback (C-wrong answer): Low blood sugar levels can cause fatigue which can cause make the person feel dizzy and weak. Increased thirst is a sign that your blood sugar levels are high.

Question & Feedback Inspired:(Mayo Clinic Staff, 2022b); (American Diabetes Association, n.d.-d)

Chapter 5: Discussion

To identify and prioritize the most essential educational content to support patients' diabetes self-management, the learning objectives from six DSMES curricula were analyzed. These curricula were: Grady Diabetes Center's current curriculum (Grady Diabetes Center n.d.) , Association of Diabetes Care & Education (ADCES7) (Kolb et al., 2021), Maine DSMES Program Manual (Maine Center for Disease Control and Prevention Division of Disease Prevention, 2019), North Carolina (NC) DSMES Curriculum (North Carolina Diabetes Advisory Council, 2001), Power to Prevent Curriculum (U.S. Department of Health and Human Services, 2012), and the Six-Session Diabetes Self-Management Curriculum (Community Health Center, 2003). This project focused on two key behaviors: healthy eating and being active. Comparison of the curricula's healthy eating and being active sections revealed commonalities around the following learning objectives:

For Healthy Eating, the curricula aligned on the importance of understanding:

- Nutritional fact labels and macronutrients
- The benefits of healthy eating and healthy eating patterns
- Meal planning, portion sizing, and plate method
- How beverages (including alcoholic drinks) can affect blood sugar levels

For Being Active, the curricula all highlighted the importance of understanding:

- The benefits of physical activity
- The relationship between physically active and glucose levels
- The value of speaking with the healthcare team before beginning a workout plan
- How to incorporate physical activity into daily routines

Drawing on similarities across the six curricula, the learning objectives related to healthy eating and being active were selected for inclusion based on whether they were shared across at least four of the six curricula. In addition, while some learning objectives within the curricula were not uniformly present across at least four DSMES curricula, they were deemed essential and therefore included to supplement the core learning objectives. These supplemented learning objectives were chosen only if there were present in at least two of the six curricula.

The learning objectives were identified as a foundation for developing sample quiz questions and related feedback to provide educational content for a digital app that would support diabetes self-management amongst this population. While designing the sample quiz questions, we kept in mind some common challenges mentioned throughout the literature surrounding diabetes self-management, such as the health literacy of our target population. According to Kim and Lee (2016), low health literacy is one reason for poor health outcomes and poor use of healthcare services. Therefore, keeping health literacy in mind is important during the educational content development to ensure quiz questions, answers, and feedback are simple and informational; we reviewed the recommendations from Kim and Lee's (2016) study, which allowed us to understand how to create effective learning materials. The recommendations from the Kim and Lee (2016) study were that learning materials must be easy to read, that clear communication strategies should be used, and that language and culture need to be considered. We incorporated these recommendations into our sample quiz questions and feedback. Each sample quiz question included feedback. According to Grieving and colleagues (2022) providing feedback for multiple-choice quizzes is essential for long-term information retention and self-regulated learning. Quiz questions with feedback allow users to understand how they are learning the material throughout the process and to check whether they have retained it (Greving et al., 2022).

Lastly, another study by Henderson and colleagues (2019) emphasized that it was important for both the developer and users to understand the significance of the feedback and for the developer to keep the target population in mind throughout the process. These recommendations guided the development of quiz questions and feedback in this special studies project.

Limitations

Despite the positive aspects of this special studies project, it is also essential to note the limitations of this project. A significant limitation of this project is that it only analyzed six of the many existing curricula to identify key learning objectives for diabetes self-management. This could lead to potential bias when creating sample quiz questions because some curricula did not specifically cover every diabetes subtype: type 1, type 2, and gestational. By acknowledging this limitation, future researchers should revise the specific method of gathering and analyzing curricula by ensuring that more than six curricula are reviewed and that learning objectives are categorized by and address diabetes subtype. This would ensure that the sample quiz questions being developed include the needs of people living with each diabetes subtype.

Another limitation to this project is that mostly multiple-choice sample quiz questions were developed. This has the potential of the wrong answer options exposing users to misinformation, hence the importance of providing feedback for each answer option. Alternative ways that future researchers could work around this is to involve various types of questions such as fill-in-the-blank, short answer questions, and matching that encourage users to memorize terms and details, which would may allow users to better understand and retain the information that they are learning.

Lastly, the sample quiz questions and feedback developed have not been tested or used in previous studies, which limits our ability to know how effective the questions and feedback are for

the users' learning. However, each sample quiz question was extensively studied. Therefore, future researchers should include a study group to test the sample quiz question to assess whether users can understand the content or if adjustments to the questions need to be made.

Conclusion

This study aimed to identify and develop educational content to improve the knowledge and skills related to healthy eating and increasing physical activity, two of the seven critical behaviors for diabetes self-management among people living with diabetes. The anticipated goals of this special studies project were to (1) identify priority topics that should be addressed in a potential mobile app for people living with diabetes, (2) review DSMES curricula to identify key learning objectives, and (3) design a sample quiz question and feedback for each learning objective drawing on best practices for the use of quizzes in education. The findings of this project provide insights into how two key behaviors, healthy eating and being active, can be used to educate users on diabetes self-management practices. Throughout the development of the educational sample quiz questions and feedback, we identified various factors that go into creating educational learning content, such as finding similarities across the different curricula, effective ways to develop questions and feedback, and, most importantly, considering the target population's level of literacy throughout the process. The insight gained from this special studies project may be of assistance to future research by allowing them to expand on the development of the sample quiz questions and feedback for the remaining critical behaviors in the ADCES7: monitoring, taking medication, problem-solving, healthy coping, and reducing risks while addressing each diabetes subtype, especially during the development of future quiz questions.

Recommendations

The following recommendations are aimed at improving the effectiveness of the content delivery for an interactive diabetes self-management mobile application. First, future research studies should use the sample quiz questions from this special studies project as a foundation for developing a more comprehensive DSMES quiz on all seven critical behaviors. The second recommendation is to identify how the content (e.g., quiz questions) should be sequenced to adapt to the diabetes literacy of the individual user. Third, next steps should identify and understand the best way to deliver content based on user preference (quizzes, facts, short videos, etc.). Fourth, learning objectives from more pre-existing DSMES curricula should be incorporated into future learning material to create effective informational content. Lastly, reaching out to diabetes patients is crucial to gather information to understand their perspectives on how best to tailor educational content and to integrate these findings into future iterations of quiz questions for a potential future mobile app for this audience.

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Appendices:

Appendix A: Comparison Table for Eating Healthy Learning Objectives

Color Meanings:

- Green Similarities across the curriculum
- Gray what should be added or supplemented (learning objectives that was only found in three or less)

Eating Healthy					
Grady DSMES	**Association of Diabetes Care & Education (ADCES7)**	**Six-Session Diabetes Self-Management Curriculum**	**Maine DSMES Program Manual**	**North Carolina (NC) DSMES Curriculum**	**Power to Prevent Curriculum**
Learning Objectives: • List nutritional goals for diabetes mgt. • Report the dietary recommendation of CHO grams per meal • List guidelines for the use of alcohol • List nutritional guidelines for exercise. Illness, and hypoglycemia • Explain in Plate method of meal planning **Content:** 1.Benefits of CHO counting 2.Food adjustment for exercise 3.Tips for controlling food craving	**Learning Objectives:** • Effect of foods/beverages on metabolic parameters (including blood glucose, lipids, blood pressure, weight, etc.) • Sources and distribution of nutrients (nutrient-dense carbohydrates, lean proteins, healthy fats) • Eating patterns (frequency of meals, timing, portions, etc.) • Resources to assist in food choices • Macronutrient composition (quality, quantity, combination, substitutions) **Skills:** • Meal planning • Portion awareness and management	**Learning Objectives:** Participants will be able to define the role of nutrition in the therapy of diabetes. *Teaching Points:* • Good and healthy nutrition is the first step in managing your diabetes. This helps to better control blood glucose levels, decreases your risk of complications and helps us to achieve or maintain a healthy body weight. • Medication alone is not enough to control diabetes. • Stress the positives of good nutrition and help participants realize that favorite foods do not have to be omitted from their intake Help participants realize there are no good foods or bad foods; rather there are "sometimes" foods. Ask participants to share what foods they think can"t be included in their diet because of diabetes. Discuss how the	**Learning Objectives:** *Survival Level:* • Describe the relationship between nutrition, physical activity, and medication. • Describe benefits of healthy eating/meal planning. • Recognize eating and activity behaviors. • State the need for eating meals and snacks at consistent times in relatively consistent amounts. • Identify tools for healthy eating/meal planning. • Identify strategies to support healthy eating & meal planning while still maintaining the pleasure of eating. *Intermediate/Advanced Level:* • Describe feelings regarding following a meal plan. • State the importance of healthy eating/meal planning for control of blood glucose, blood pressure and blood lipids. • Describe the nutrition goals for individuals with diabetes.	**Learning Objectives:** • The participant will be able to describe the role of meal planning and carbohydrate counting in managing diabetes. • The participant will be describing briefly the relationship of food and insulin in diabetes. • The participant demonstrates, using the meal assessment, that his/her daily meals include items from each basic food group (meat or meat substitute, bread, vegetable and/or fruit, milk) – according to plan. • The participant can name strategies by which to reduce fat intake. • The participant can name strategies by which to increase intake of fiber. • The participant can name strategies by which to reduce use of salt • The participants can name strategies by which to reduce use of sugar.	**Learning Objectives:** *Strategies for healthy eating* • Describe the importance of choosing more healthful foods • Identify more healthful foods by reading food labels • Choose to incorporate healthier eating into daily routines *Make healthy food choices one day at a time* • Incorporate healthy eating into daily routines • Substitute more healthful foods for less healthful foods *Portion Size* • Identify the difference between "portion" and "serving" • Describe the Plate Method for controlling portion size • Discuss the relationship between how much you eat (portion size) and how much energy you use (physical activity)

4.Choosing appropriate portions of CHO, Protein, and Vegetables 5.Benefits of water	• Planning strategies (carb counting, exchanges, plate method, mindful eating) • Nutrition facts label comprehension • Special situations and problem-solving (planning, shopping, meal delivery/kits, eating away from home at work/school/restaurants) **Barriers:** • Environmental factors • Cultural and family influences • Food and health beliefs • Financial (food security) • Cognitive • Health literacy and numeracy • Emotional • Meal pattern sustainability the	food may be included or try to offer a similar healthier alternative for a favorite food, i.e. Canadian bacon instead of regular bacon. Both are high in sodium, but the Canadian bacon is much leaner. Participants will be able to define the major sources of carbohydrate, protein and fat. Teaching Points: • Beginning with carbohydrates have participants define which foods are major contributors of each of the macronutrients, i.e. carbohydrate, protein, fat. • Stress the importance of including each of these nutrients at a meal. • Emphasize that variety is key to enjoying food, and that meals each day should include vegetables, fruits, whole grains, dairy and lean sources of protein. • Discuss portion size and emphasize that healthy blood glucose is achieved by moderate portion sizes. Use food models to help participants understand the concept portion size Participants will be able to plan a basic menu which incorporates the inclusion of each of the macronutrients. *Teaching Points:* • Explain the concept that woman will usually have three and men four choices of carbohydrates at a meal. Using food models, discuss that participants may choose three to four different choices of a carbohydrate at a meal, or more of just one choice. Illustrate using pasta as an example. • Explain the concept that a portion of protein must be included at lunch and supper. Generally for woman, this may be 2-3 ounces of cooked protein and for men, 3-6 ounces of cooked protein. • Using food models have participants attempt to assemble a sample meal. Participants will be able to discuss the impact of carbohydrate on blood glucose levels	• Explain the dietary concepts of macronutrients (carbohydrate, protein, and fat) and food groups. • Explain the appropriate use of dietetic foods. • List guidelines for use of alcohol. • Describe guidelines for dining out. • Describe meal planning and problem-solving for special occasions. • Describe how recipes can be calculated into the meal plan. • Identify diabetes meal planning resources. *Behavioral Objectives* • Make a plan for one thing s/he will do to eat for health. • Demonstrate the use of two or more tools for healthy eating/meal planning. • Record a day's meals and snacks on a food record. • Select the types and amounts of foods to be included in meals and snacks in his/her individualized meal plan.	• The participant demonstrates, using the meal plan assessment, that the amount of food from each food group is consistent according to his/her recommended meal plan. • The participant can recall that weight reduction will help manage blood sugar and may decrease the need for insulin or oral hypoglycemic agents. • The participant will understand he/she needs an individualized, prescribed meal plan. • The participant understands the exchange ability of common food items. • The participant can recall that food should be cooked with a limited amount of fat because fats may add calories. • Choosing his/her own meal plan, the participant can recall or write a daily menu, specifying the foods and the amounts. • The participant will be able to recall that dietetic foods are not necessary for person with diabete • The participant will understand how to use the information about ingredients on food labels to make food choices. • Participant will define cholesterol and its basic function in the body. • Participant is able to state the danger of elevated blood cholesterol. • Participant can name at least five of the eight risk factors for coronary heart disease. • Participant will state the recommended level of cholesterol. • Participant can explain the importance of meal planning in treating hypercholesterolemia • Participant will be able to state where saturated fats are found and three ways to reduce intake. • Participant will be able to briefly explain the major food changes needed to reduce cholesterol. • The participant can identify at least 3 points to remember when eating out in a restaurant.	*Navigating eating out* • Identify the four keys to healthy eating out • Apply the four keys to healthy eating out • Describe methods to control overeating at buffets or receptions

		Teaching Points: • Carbohydrates are necessary for important body functions. Participants don″t have to avoid carbohydrates; rather they should moderate their intake. • Carbohydrate foods have the greatest effect and quickest effect on blood glucose levels. • Carbohydrate foods raise blood glucose regardless of the source. Participants need to realize that milk, fruit and bread raise blood glucose just as a cookie does. Participants will be able to discuss the impact of protein on blood glucose levels and identify healthier proteins to include in their intake. Teaching Points: • Proteins are also necessary for important body functions. We need proteins but we don″t need an excessive amount. Using food models show participants examples of 3 ounce portions of cooked protein. • Proteins affect blood glucose levels but to a much lesser extent that carbohydrates. • A source of protein should be included at each meal. • Try to choose very lean and lean protein choices if possible. Examples include: white meat chicken or turkey (no skin), fish such as cod, salmon or trout, shellfish like lobster, crabs, clams and low fat cottage cheese. • Some red meats are also lean. These include flank steak, roasts such as a pot roast, pork tenderloin. Make sure that you trim the fat! Participants will be able to discuss the impact of fat on blood glucose levels and identify healthier fats to include in their intake and why less healthy fats should be avoided. Teaching Points: • Fats have very little direct effect on blood glucose levels. Fats make us fatter! Because excess weight makes it harder for our body to use the insulin we are		• The participant can state how to include alcohol in her/his meal plan (what and when) if she/he chooses to drink alcoholic beverages • The participant states the need to carry a source of concentrated sugar when traveling and names one type of sugar she/he carries.	

		making, we should avoid an excessive fat intake. • A high fat diet, especially a diet high in unhealthy fats can clog our arteries and this may lead to a heart attack or stroke. • Try to avoid fried foods or foods with extras sauces or gravies on them. When in restaurants, order gravies/sauces on the side. At fast food restaurants, order items plain, no cheese, no sauce. Lettuce, tomato and small amounts of ketchup are fine. • When using fat, choose healthy alternatives such as olive and canola oils. Nuts in small amounts may also be included. • Use margarines that are trans fat free. Provide examples of these margarines. • Try to use high fat foods less frequently or substitute lower fat alternatives. Provide examples such as low fat milk or skim milk for whole milk, reduced fat cheeses. Participants will understand the impact of delaying or omitting meals, and the importance of appropriate portion size will be reviewed. Teaching Points: • Emphasize the fact that the body needs food to provide fuel for the activities we perform each day. • Food/fuel is also needed for the medicine or insulin we take each day. If we do not provide enough food, than our blood glucose levels may fall too low. Review hypoglycemia. • If a meal is going to be delayed for more than ½ to one hour, then a snack should be eaten at the usual mean time. • An adequate amount of food should be eaten at each meal. Food cannot be saved from one meal to the next meal. For example, if you do not eat any carbohydrate at lunch, you cannot have double your usual intake of carbohydrate at supper. Remember, balance is important!			

		Participants will understand how to make healthier choices at fast food restaurants. Teaching Points: • Encourage participants to ask for foods without extra sauces and to omit cheeses • Discourage the practice of "supersizing" selections. Illustrate the difference in calories, fats and carbohydrates between a regular portion and a "supersized" portion. • Encourage participants to choose items that are grilled, baked or roasted rather than fried. • Remind participants of the principles of good meal planning; i.e., a carbohydrate, a protein and a fat at each meal. Only a side salad or a frozen yogurt is not enough.			

Appendix B: Comparison Table for Be Active Learning Objectives

Be Active					
Grady DSMES	**Association of Diabetes Care & Education (ADCES7)**	**Six-Session Diabetes Self-Management Curriculum**	**Maine DSMES Program Manual**	**North Carolina (NC) DSMES Curriculum**	**Power to Prevent Curriculum**
Learning Objectives: • List three benefits of exercise • Describes the effects of exercise on blood glucose • States the signs and symptoms of hypoglycemia • Describe how to adjust food intake or insulin dose to account for exercise • Develop a personal exercise plan **Content:** 1. Benefits of regular exercise 2. Effects on blood glucose 3. Choosing or creating an exercise program 4. Aerobic vs, anaerobic exercise 5. Hypoglycemia and exercise 6. Food and insulin adjustments 7. Tips for staying with your program	**Learning Objectives:** • Planned exercise (type, duration, intensity, frequency, progression) • Daily movement • Breaking up sedentary time • Safety precautions, such as obtaining preparticipation medical clearance and/or exercise stress testing prior to unaccustomed vigorous activity • Special considerations, such as appropriate footwear **Skills** 1. Appropriate daily movement and physical activity plan 2. Adjustment of activity with food and medication to maintain glycemic balance 3. Monitoring of cardiometabolic parameters, data stream, and feedback **Barriers** • Physical (health conditions, injuries) • Perceived lack of time • Environment, facilities • Fear (hypoglycemia) • Self-efficacy • Lack of enjoyment • Lack of social support	**Learning Objectives:** Participants will be able to discuss the importance of physical activity and its impact on blood glucose levels. Teaching Points: Never begin an exercise program without checking with your primary care provider. • Emphasize the many positive aspects of physical activity. Include: ○ Lowers blood glucose levels ○ Helps maintain and achieve a healthy body weight ○ Helps to keep heart and lungs healthy ○ May improve blood pressure • Discuss reasonable goals for beginning an exercise program. Ideally, strive for 30-45 minutes per day. May accumulate minutes of exercise; i.e., exercise 10 minutes three times per day. • Begin slowly and gradually increase activity level. • Any amount of exercise is better than none. Always carry identification and a quick acting carbohydrate. • Provide examples of quick acting carbohydrate. • Stress the importance of comfortable shoes, and visually checking the inside of the shoe before it is worn. • Discuss comfortable socks; cotton socks without seams are ideal	**Learning Objectives:** *Survival Level:* • List benefits of physical activity. • Describe strategies to follow his/her physical activity plan. • Describe ways she/he can stay safe when physically active. • List signs indicating the need to stop activity and consult a health care provider. *Intermediate/Advanced Level:* • Describe his/her perceptions of physical activity. • Describe his/her feelings about participating in regular physical activity. • Describe the differences between aerobic and anaerobic activity. • Define exercise intensity in his/her own words. • Describe how physical activity affects blood glucose. • List the physical activity guidelines for adult Americans. • Identify strategies to handle barriers to physical activity. • Describe signs and symptoms of hypoglycemia during and after physical activity. • Identify guidelines for making food adjustments for physical activity. • List types of physical activity. • Identify community resources to support his/her physical activity plan *Behavioral Objectives* • Make a plan for one way she/he will be physically active. • Make a plan for one way she/he will handle barriers to physical activity	**Learning Objectives:** *Educational Objectives:* • State that regular physical activity helps to control blood glucose, achieve desirable body weight, and minimize the risk factors (e.g., hypertension, hyperlipidemia) for diabetes complications. • Determine simple ways to incorporate physical activity into daily activities. • State that exercise can affect blood glucose levels (i.e., usually lowers). • Understand the need to consult with the healthcare team before beginning an exercise program. • State that hypoglycemia can result from exercise (if hypoglycemic medication is used). • State that blood glucose level should be checked before, during, and after moderate or strenuous exercise, (if hypoglycemic medication is used). • Discuss the rationale for snacks before extra activity. • Describe the type and amount of food that can be consumed to prevent hypoglycemia during exercise. • State the need to wear diabetes identification while exercising. *Learning Objectives: From Table* • Participants can cite the benefits of regular physical activity. • Participants understand the need to consult with the health-care team before beginning an exercise program. • Participants know that blood sugar should be checked before moderate or strenuous exercise. • Participants can state that hypoglycemia may result from exercise if hypoglycemic medication is used. • Participants will recognize the symptoms of HYPOGLYCEMIA (low blood sugar) and identify the possible cause, treatment, and prevention.	**Learning Objectives:** *Physical Activity- Get moving today* • Explain why physical activity is important for helping people with diabetes control their blood glucose levels, for preventing or delaying diabetes in those at high risk for the disease, and for helping everyone maintain a healthy weight • Describe easy ways to add physical activity to your daily routine • OPTIONAL: Identify correct footwear and proper foot care for people with diabetes *Physical Activity for families* • Identify ways to stay physically active • Identify ways to partner with family and friends for physical activity

				• Patent will wear or carry diabetes ID, especially while exercising.	

Appendix C: Table of Summary of External Sources from Results

Healthy Eating		
Learning Objectives	**Summary of Sources**	**Sources URL**
Participants will be able to understand and interpret nutritional fact labels and identify major carbohydrate, protein, and fat sources	a. Informs the readers about the recommended sodium intake per day and why controlling sodium intake is essential. b. Informs readers about cheese's nutritional benefits, such as providing protein, fats, and minerals, and explains how some cheese can contain high amounts of sodium. c. Informs readers about the nutrition facts and health benefits of carrots, such as how carrots provide a good source of various vitamins and minerals.	a. https://www.cdc.gov/salt/index.htm b. https://www.hsph.harvard.edu/nutritionsource/cheese/ c. https://www.healthline.com/nutrition/foods/carrots
Participants will be able to demonstrate an understanding of healthy eating patterns and make healthy food choices	a. Informs readers about the benefits and downsides of consuming granola bars. The article explains how some granola bars contain carbs, calories, and as much sugar as candy bars. However, some benefits discuses within the article were that if granola bars are made with healthy ingredients, it could help improve health and blood sugar control. b. Informs readers about the benefits of meal prepping. c. The National Carolina Advisory Council designed a curriculum for persons with type 2 diabetes and their family. Within this curriculum are lesson plans that as activities to enhance their participant's levels of learning. d. Informs readers about a research study that concluded how eating fried foods is tied to an increased risk of diabetes and heart disease. e. Informs readers about the relationship between fried foods and diabetes. In addition, this source gives information about why people with diabetes should avoid fried foods and that there are healthy alternatives. f. Informs readers of 12 sweet and diabetes-friendly snacks low in carbs and added sugars that can be a part of their diet. g. Informs readers about 11 foods and drinks to avoid when having diabetes. In addition, this source gives detailed information about how different foods and drinks affect blood sugar levels.	a. https://www.healthline.com/nutrition/are-granola-bars-healthy b. https://journals.sagepub.com/doi/full/10.1177/0145721720978154 c. file:///C:/Users/laptop/Downloads/NCDiabetesEdCurriculum%20(10).pdf d. https://www.hsph.harvard.edu/news/hsph-in-the-news/eating-fried-foods-tied-to-increased-risk-of-diabetes-and-heart-disease/ e. https://klinio.com/hub/article/fried-food-and-diabetes f. https://www.healthline.com/nutrition/sweet-snacks-for-diabetics g. https://www.healthline.com/nutrition/foods-to-avoid-with-diabetes h. https://diabeticme.org/diabetes-products/diet/the-best-ice-cream-for-diabetics/ i. https://www.hsph.harvard.edu/nutritionsource/food-features/dark-chocolate/ j. https://www.diabetescarecommunity.ca/diet-and-fitness-articles/diabetes-and-potatoes-what-are-the-best-types-of-potatoes-for-people-with-diabetes/ k. https://www.bayshore.ca/resources/diabetes-and-processed-

	h. Informs readers that people with diabetes can consume ice cream and various ice-creams that can also be consumed, that it is essential to remember that they must read the nutrition fact labels to avoid those brands that could increase blood sugar levels and have a high carb count. i. Informs readers about the origin, benefits, and nutritional sources. j. Inform readers about the relationship between diabetes and potatoes and both benefits and downsides of different types of potatoes. k. Informs readers about the relationship of diabetes and processed food.	foods/#:~:text=Other%20studies%20have%20shown%20that,can%20affect%20blood%20glucose%20control
Participants will be able to identify strategies related to eating in moderation and portion control	a. This source is a quiz website about serving size and portion control. This website inspired the questions about controlling portion sizes when eating. b. Informs readers about the relationship between diabetes and meal planning. It explains how to count carbs, the plate methods, and how to portion size. c. Informs the readers about the difference between serving and portion size. d. Informs readers about how to understand and use nutrition fact labels.	a. https://quizizz.com/admin/quiz/6022b4a9505edc00204ecdbf/serving-sizes-and-portion-control?queryId=624da5e9a30b42001e649e94-1649275143390 b. https://www.cdc.gov/diabetes/managing/eat-well/meal-plan-method.html c. https://www.eatright.org/food/nutrition/nutrition-facts-and-food-labels/serving-size-vs-portion-size-is-there-a-difference d. https://www.fda.gov/food/new-nutrition-facts-label/how-understand-and-use-nutrition-facts-label#top
Participants will learn how meal prepping can be beneficial	a. Informs readers about the benefits of diabetes meal planning. b. Informs readers about the nutrition and health benefits of salmon. c. Informs readers about the health benefits of bananas. d. Informs readers about the diabetes plate methods and how this method can help portion meals with a healthy balance of vegetables, protein, and carbohydrates. e. Informs readers of ten ways to eat healthier at a restaurant to reduce intake of extra carbs.	a. https://www.cdc.gov/diabetes/managing/eat-well/meal-plan-method.html b. https://www.healthline.com/nutrition/salmon-nutrition-and-health-benefits#1 c. https://www.webmd.com/food-recipes/health-benefits-bananas d. https://www.diabetesfoodhub.org/articles/what-is-the-diabetes-plate-method.html e. *(Kasey Dunifer, 2021)*https://www.iowadiabetes.com/2021/08/03/10-

		ways-to-eat-healthier-at-restaurants/
Participants will be able to understand the effects of beverages on blood glucose (blood sugar)	a. Informs readers about the drinks that people living with diabetes should be aware of and drinks they can consume in moderation. b. Informs readers of the difference between A1C, fasting plasma glucose (FPG), random blood sugar test, and Oral glucose tolerance test (OFTT). c. Informs readers of various prediabetes, type 1, type 2, and gestational diabetes tests. This source goes into detail about each test and how it is conducted. d. Informs readers that although alcohol is not forbidden for most adults living with diabetes that they should still consume alcohol products in moderation. In addition, this source gives background information about different alcoholic beverages and how to manage blood sugar levels to reduce the risk of low blood sugar levels. e. This source is a diabetes education quiz website that provides information and quizzes surrounding diabetes and alcohol. This website inspired the sample quiz question about the effects of alcohol on diabetes. f. Informs readers about the relationship between alcohol and diabetes, detailing consumption's pros and cons. g. Informs readers about the benefits of green smoothies.	a. https://www.healthline.com/health/diabetes/drinks-for-diabetics b. https://www.diabetes.org/diabetes/a1c/diagnosis c. https://www.cdc.gov/diabetes/basics/getting-tested.html#:~:text=Fasting%20Blood%20Sugar%20Test,higher%20indicates%20you%20have%20diabetes d. https://journals.sagepub.com/doi/full/10.1177/0145721720978154 e. https://dtc.ucsf.edu/learning-library/quizzes/alcohol/ f. https://www.diabetes.org/healthy-living/medication-treatments/alcohol-diabetes#:~:text=A%20daily%20cocktail%20or%20two,t%20mean%20you%20should%20start. g. https://www.webmd.com/diet/green-smoothies-are-they-good-for-you

Being Active		
Learning Objectives	**Summary of Sources**	**Sources URL**
Participants will be able to understand and increase their knowledge of the importance of being physically active	a. Informs readers of what physical activity means and different kinds of physical activity that people can do to become more active. b. Informs readers of what physical activity means, the benefits of physical activity, and gives examples of popular ways to be active. c. This source is a diabetes education quiz website that provides information and quizzes surrounding diabetes and exercise. This website inspired the sample quiz question about the benefits of exercise. d. Informs readers about how being physically active can increase insulin sensitivity.	a. https://journals.sagepub.com/doi/full/10.1177/0145721720978154 b. https://www.who.int/health-topics/physical-activity#tab=tab_1 c. https://dtc.ucsf.edu/learning-library/quizzes/exercise/ d. https://www.diabetesselfmanagement.com/managing-diabetes/treatment-approaches/increasing-insulin-sensitivity/#:~:text=Any%20type%20of%20physical%20activity,to%20have%20the%20greatest%20effect

	e. Informs readers about seven benefits of physical activity and how physical activity can lower blood pressure. f. Informs readers about ways to stay safe when doing physical activities, such as preventing hypoglycemia or hyperglycemia, medical clearance, medical identification, and more. g. Informs readers about the relationship between blood sugar and physical activity. In addition, this source gives information about how to reduce the risks of hypoglycemia, such as checking blood sugar levels (before, during, and after). h. Informs readers of eating tips before and after physical activities, including foods, different activities, and taking medication. i. Informs readers about the importance of developing a healthy-eating plan and gives detailed information about what foods could be included in the benefits of those foods.	e. https://www.hopkinsmedicine.org/health/wellness-and-prevention/7-heart-benefits-of-exercise f. https://journals.sagepub.com/doi/full/10.1177/0145721720978154 g. https://www.diabetes.org/healthy-living/fitness/getting-started-safely/blood-glucose-and-exercise#:~:text=Hypoglycemia%20and%20Physical%20Activity&text=Checking%20your%20blood%20sugar%20before,hypoglycemia%20(low%20blood%20sugar h. https://www.diabetes.org/healthy-living/weight-loss/eating-tips-before-after-exercise i. https://www.mayoclinic.org/diseases-conditions/diabetes/in-depth/diabetes-diet/art-20044295#:~:text=If%20you%20have%20diabetes%20or,pressure%20and%20high%20blood%20fats
Participants will be able to understand the importance of consulting with the healthcare team before beginning an exercise program and always carrying a diabetes identification card	a. Informs readers of the importance of wearing a diabetes medical identification (ID). b. Informs readers of why medical ID bracelets are essential and could be a life-saving device.	a. https://journals.sagepub.com/doi/full/10.1177/0145721720978154 b. https://www.webmd.com/diabetes/medical-id-bracelets-for-diabetes
Participants will be able to understand the importance of increasing the opportunity for physical activity in daily activities	a. Informs readers about the recommended amount of time each week adults needs for physical activity and examples of how to break up activities throughout the week to reach the recommended time for adults. b. Informs readers of 23 ideas for making physical activity more enjoyable. c. Informs readers about the benefits of hula hooping. d. Informs readers of different physical activities to do to become more active. e. Informs readers about the benefits of taking the stair, such as weight loss, no special equipment needed, and more.	a. https://www.cdc.gov/physicalactivity/basics/adults/index.htm b. https://www.fitwoman.com/blog/make-exercise-feel-like-play/ c. https://www.healthline.com/health/exercise-fitness/hula-hoop-benefits#1 d. https://journals.sagepub.com/doi/full/10.1177/0145721720978154 e. https://hr.duke.edu/wellness/exercise-fitness/take-stairs/benefits-taking-stairs

	f. Informs readers of tips for staying motivated when doing physical activities.	f. https://www.mayoclinic.org/healthy-lifestyle/fitness/in-depth/fitness/art-20047624

Supplemented Learning Objectives		
Learning Objectives	**Summary of Sources**	**Sources URL**
Participants will be able to understand the relationship between how much is eaten (portion size) and how much energy is used (physical activity)	a. Informs readers about the importance of developing a healthy-eating plan and gives detailed information about what foods could be included in the benefits of those foods b. Informs readers about the relationship between nutrition, physical activity, and obesity. This source discusses the health impacts and ways to reduce health risks.	a. https://www.mayoclinic.org/diseases-conditions/diabetes/in-depth/diabetes-diet/art-20044295#:~:text=If%20you%20have%20diabetes%20or,pressure%20and%20high%20blood%20fats b. https://www.healthypeople.gov/2020/leading-health-indicators/2020-lhi-topics/Nutrition-Physical-Activity-and-Obesity#:~:text=Good%20nutrition%2C%20physical%20activity%2C%20and,disease%2C%20stroke%2C%20and%20cancer
Participants will be able to understand the signs and symptoms of hypoglycemia during physical activity	a. Informs readers about hyperglycemia (high blood sugar). This source explains the causes, symptoms, and how to treat and prevent hyperglycemia. b. Informs readers about hypoglycemia (low blood sugar). This source explains the causes, symptoms, and how to treat and prevent hyperglycemia.	a. https://www.diabetes.org/healthy-living/medication-treatments/blood-glucose-testing-and-control/hyperglycemia#:~:text=Hyperglycemia%20is%20the%20technical%20term,can't%20use%20insulin%20properly b. https://www.mayoclinic.org/diseases-conditions/hypoglycemia/symptoms-causes/syc-20373685#:~:text=Hypoglycemia%20is%20a%20condition%20in,who%20don't%20t%20have%20diabetes