Implementing Heikes Screening Tool for Prediabetes and Type 2 Diabetes for Adult Patients in a Rural Primary Care Clinic

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Abstract

The problem identified showed inconsistencies in screening for prediabetes and type 2 diabetes by primary care providers at a primary care office in rural Maryland. After a complete literature review, a standardized screening process for identifying those at risk for prediabetes and type 2 diabetes was the solution to this problem.

The purpose of this project was to standardize a screening process for prediabetes and type 2 diabetes. A standardized screening process was created to assure all patients meeting criteria for the American Diabetes Association (ADA) screening guidelines were screened properly for risk while delivering the standard of care to all patients. The goal was to increase screening by practitioners. This will aid in early diagnosis of the disease, thus leading to a decrease in diabetic related complications.

Heikes screening tool was implemented using a standardized process involving an inclusion and exclusion checklist created by the ADA to identify those needing further screening. If a patient met inclusion criteria, a Heikes screening tool was completed. The patient's risk was then identified from the screening tool and discussed in real time with the patient. Heikes screening tool was evaluated and measured by how many additional patients could be captured for being at risk with the use of a standardized screening process.

The Heikes screening tool and process created a more standardized approach to identifying patients at risk for prediabetes and type 2 diabetes. Descriptive and inferential statistics were used to analyze this screening process. There was a final sample of 40 participants using convenience sampling. The screening process was able to identify and

screen 22.5% of participants that had not been previously screened as evidenced by a chart review or patient reporting. The data also revealed participants who had a waist circumference of 38.4in or more had a 6.65% higher risk of being in the high-risk category for diabetes development through the Heikes screening tool ($p < 0.001$).

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Project Overview

Introduction

Prediabetes and type 2 diabetes is a rising problem in America. According to the Centers for Disease and Control (2019), 88 million adults in America have prediabetes and 80% of them are unaware they have the diagnosis. Often times, lifestyle modification can positively impact a prediabetes diagnosis and can prevent medication treatment. However, if a patient was unaware of their prediabetes diagnosis, they will not be educated on the importance of how lifestyle change can improve their health and decrease their risk of developing diabetes. Screening for prediabetes and type 2 diabetes is important in a primary care setting because it provides an opportunity to identify risk and provide knowledge of the disease, resulting in better patient outcomes from prompt intervention.

Problem Statement

The problem identified with the diagnosis of prediabetes and type 2 diabetes were the inconsistencies in screening by primary care providers at a primary care office in rural Maryland. There was not a consistent process followed by all of the providers in this primary care office. Each provider has a different method for how to capture which patients are at risk for the development of prediabetes and type 2 diabetes mellitus which typically does not involve use of screening tools. The current process for providers is recall of memory for risk inclusion criteria set by the American Diabetes Association and

then ordering hemoglobin A1Cs for patients at risk based off of that criteria. This lack of consistent screening and identification by providers can lead to complications related to uncontrolled diabetes such as Diabetic Ketoacidosis. Mochan & Ebell (2009) explains "early intervention with lifestyle modifications or pharmacotherapy has been shown to effectively delay or prevent type 2 diabetes in adults" (p. 1). Standard screening according to the The ADA is to begin at age 45 unless there are other circumstances or risks suggesting earlier screening. The American Diabetes Association (2019) states, "Type 2 diabetes testing should be done in all asymptomatic adults who are overweight or obese (BMI ≥ 25 or ≥ 23 in Asian Americans) and who have one or more diabetes risk factors." These risk factors include physical inactivity, a first degree relative with diabetes, high risk racial or ethnic groups, history of gestational diabetes, women who delivered a baby weighing more than 9lbs, HDL cholesterol <35, Triglycerides >250, hypertension, previous A1C >5.7%, conditions associated with insulin resistance and history of cardiovascular disease (LabCE). By using the information set forth by the American Diabetes Association, a standardized screening process for prediabetes and diabetes will improve provider awareness of the patient's individual risk for developing diabetes, allowing an opportunity to discuss disease prevention and deter related complications with prompt intervention for the disease.

Purpose of Project

The purpose of this DNP project was to standardize a screening process allowing for early identification of a patient's risk for prediabetes and type 2 diabetes at a primary care office in rural Maryland. Again, the providers at this primary care office did not use a standardized screening tool for prediabetes and type 2 diabetes, each provider used their

knowledge recall of current treatment guidelines to determine a patient's risk. For many years there were no screening tools to assess risk solely for prediabetes or developing type 2 diabetes (Mochan & Ebell, 2009). Then the diabetes risk calculator was developed from Heikes screening tool in 2008 (Mochan & Ebell, 2009). According to Mochan & Ebell (2009), once the screening tool is completed, the patient will have a determined risk of developing prediabetes or type 2 diabetes (p. 3). The goal was to increase screening by practitioners, which will aid in early diagnosis. Early identification of diagnosis allows for prompt interventions such as educating patients about their disease and encouraging changing pertinent modifiable lifestyle factors which is in line with the current standard of care. The only way to achieve this goal was to assure all practitioners are following the same clinical practice guidelines and properly identifying those patients at risk.

Clinical Question

In order to create a clinical question for this DNP project, a review of literature was completed, to examine what screening process would be most valid and reliable for early diagnosis and increasing practitioner awareness about this disease. The ADA website was used to find what methods for diabetic screening have been tested and approved. The ADA website utilizes the Heikes diabetic screening tool. This screening tool uses an algorithm technique to input a patient's information for certain categories and create results with a risk percentage of developing prediabetes and diabetes from set criteria. After this screening tool was discovered, a search engine, specifically CINAHL (EBSCO) was used to find research using key words of "screening for diabetes," "primary care practice," "diabetes and screening," and "diagnosis." Duplicates articles were removed. Inclusion criteria for articles included those articles discussing the

screening process more in detail for strictly adult patients. Exclusion criteria included articles focusing on screening already diagnosed diabetic patients for other complications. There was a final total of 16 articles that pertained to capturing patients at risk for prediabetes and type 2 diabetes with the use of screening tools. After collecting articles and reviewing research, a final clinical question was developed. In adult patients in a rural care setting, will the implementation of Heikes screening tool improve primary care adherence to clinical guidelines for screening for prediabetics and undiagnosed type 2 diabetics?

After researching the problem at hand on how to increase providers' awareness of a patient's risk for prediabetes and diabetes, part of the solution was to implement a standardized screening process that will calculate a patient's risk for developing prediabetes and type 2 diabetes. By implementing a standardized screening tool at a primary care practice in rural Maryland, it will streamline prompt identification of pre-diabetes and type 2 diabetes and allow for interventions in primary care.

Synthesis of Literature

Screening for prediabetes and type 2 diabetes with a standardized and structured method is not the standard for all primary care providers (PCPs). Many PCPs screen for prediabetes and type 2 diabetes in various ways. From a synthesis of the literature, there were common themes drawn from all of the research articles that can be applied to clinical practice and using the Heikes screening tool. Themes routinely found in the literature include identifying gaps in knowledge on how to appropriately screen for prediabetes and type 2 diabetes, room for primary care providers to create standardized screening processes for the disease and the fact of Heikes screening tool being able to appropriately capture a patient's risk for developing pre-diabetes and type 2 diabetes.

One common theme that was present among most of the articles is a gap in knowledge on how to appropriately screen patients for prediabetes and type 2 diabetes. Ugwu (2020) reportedly only 7.8% of PCPs in the study could correctly identify all of the three glycemic cut-offs for diabetes and nearly half of the PCPs did not know a single glycemic value for diagnosis of diabetes mellitus (DM). It is clear if only 7.8% of PCPs are able to appropriately identify how to diagnose diabetes mellitus based off of glycemic markers then there is a knowledge gap and a need for improvement in assisting providers with who needs to be further screened for diabetes.

A second theme found among the literature is the room for growth in PCPs implementing a structured screening process. One research study explained, screening tools consistent with prior research identified fewer patients that needed screening for prediabetes compared to screening tools now consistent with latest research (Nhim, 2018, p.42). Through various studies, many primary care providers did not routinely use a

screening tool or process to evaluate their patient's risk of prediabetes or type 2 diabetes. The standard of care is to properly assess all patients at risk for the disease of diabetes. Providers should be educated on implementing screening processes and knowing when patients present at risk.

One article of importance was from Cristo Rodrıguez-Perez, et al (2017) discussing the DIABSCORE screening. This screening tool screens for the same risk factors as the Heikes screening tool. The screening was found to be just as effective as assessing the patient's risk as blood draws for hemoglobin A1C.

The article by Heikes (2008) about the screening tool developed explains that the Heikes screening tool is also commonly referred to as the diabetes risk calculator. During the process for developing the screening tool, this tool was targeted for the US population. Other screening tools were not designed for the US population. Heikes (2008) reports, "the positive predictive values of the DRC were 14 and 49% for diabetes and elevated plasma glucose, respectively, and the negative predictive values were 99.3 and 85% respectively," (p. 1043).

Finally, many of the research articles, showed that the Heikes diabetic screening tool, also known as the diabetes risk calculator, were effective in screening for disease of diabetes. Some of the other pertinent articles evaluated how similar screening tools used in other countries were also proven through research to be effective. These screening tools were compared with Heikes, showing all of the screening tools compared had similar data with risk factors for diabetes. In general, there is a large need for increased diabetes screening and education to the large majority of the public, including healthcare

professionals. This is a gap identified in healthcare with evidence-based practice supported solutions to be implemented.

Theoretical Framework and EBP Model

Theoretical Framework

The theoretical framework I chose for my DNP project to improve screening for prediabetes and type 2 diabetes is the Donabedian model of quality. This model has three main focuses. Those focuses are structure, process, and outcome. The structure of my project is known to occur at a primary care practice in rural Maryland with the help of the staff. The providers will be involved in the screening process. The process is screening patients meeting set criteria by the American Diabetes Association and creating a standardized screening process for the location. Lastly, the outcome is how this screening tool is measured. The measurement for this will be if a patient's risk is successfully captured for prediabetes and type 2 diabetes using the Heikes diabetic screening tool. The measurement will compare how many patients met screening criteria are screened appropriately using the new process implemented at a rural primary care facility in Maryland.

EBP/ QI Model

The quality improvement model that I have identified to use for my project is Six Sigma. Six Sigma uses the Define, Measure, Analyze, Improve and Control (DMAIC) strategy. This process works well for quality improvement projects because it helps to eliminate defects in the process. Step 1 is to define the problem. Step 2 is measure which refers to what needs to be improved and is it measurable. Step 3 is to analyze the process. Step 4 is to implement improvements for the process and then finally, step 5 is to control and sustain the process (The Lean Six Sigma Company, 2022).

This model focuses on standardizing processes, fixing processes and improving outcomes. This DNP project focuses on implementing a screening tool in order to standardize care and improve patient outcomes, this model fits those needs perfectly. The Six Sigma model also allows the project to continuously grow as it is in the control phase. The control phase focuses on having a monitoring plan to assure that the project evolves as healthcare evolves. This assures as new guidelines and new data emerge the project can adapt to those new guidelines. For example, if in the future research changes on new risk factors or additional information on who would need to be screened. The implementation process would be able to easily adapt to change and continue to capture those patients at risk. Altogether, this will improve quality of patient care for diabetes screening now and in the future.

Project Design

Methodology

In order to implement this project, buy in from the staff and education was required. Providers at this primary care setting were included in the screening of patients. A PowerPoint presentation with step-by-step instructions was used to educate all staff members involved in this project. The DNP student investigator educated the staff personally and assured everyone was competent in the procedures before the go live date for implementation with patients. In order to assure competence, several case studies were given to staff and they had to appropriately identify which patients require further screening utilizing Heike's screening tool.

Utilizing Heikes screening tool, a percentage for the patient's risk to develop prediabetes or type 2 diabetes is provided of set criteria. This set criteria includes age, waist circumference, weight, height, race, hypertension history, family history of diabetes, history of gestational diabetes and exercise habits. Everyone 45 years and older were screened. It also includes those who are under the age of 45 if they have a BMI greater than or equal to 25 with one or more risk factors. Those risk factors include physical inactivity, a first degree relative with diabetes, high risk racial or ethnic group, gestational diabetes, a woman who delivered a baby weighing more than 9lbs, HDL cholesterol less than 35, triglycerides more than 250, history of hypertension, an A1C higher than 5.7% in the past, conditions associated with insulin resistance or history of cardiovascular disease (LabCE).

During this phase of implementation, the data collection process consisted of an inclusion criteria paper form being completed by the DNP student with the patient's

assistance in answering questions. The inclusion criteria will be analyzed by the provider or DNP student to evaluate if the patient meets further criteria for the Heikes screening tool based on risk factors. The provider or DNP student then completes Heikes screening tool during the visit and evaluates the results. Based on each risk category the patient will have a different protocol for additional screening, testing or follow-up established by the primary care practice and guided by the standard of care for all patients.

Organizational System Analysis (SWOT)

The strengths of the organization are many providers at the primary care practice (PCP) are already aware of the current treatment guidelines for patients who are diagnosed for prediabetes and type 2 diabetes. Along with being knowledgeable about providing the standard of care to all patients. The care system at this PCP office is also easily able to adapt to any new processes implemented within the system.

Weaknesses noted within the organization are the differences and inconsistencies in screening for prediabetes and type 2 diabetes among the multiple providers. Not all of the providers at this PCP office can identify the risk factors that increase a patient's risk for prediabetes and type 2 diabetes as listed by the American Diabetes Association. Additionally, not all of the providers within the office are familiar with Heikes screening tool or the benefit it can provide to improving quality of care for the patients.

The opportunities found within this area are the patients at this PCP office are considered underserved. They are at higher risk for diabetes and higher risk for going longer with undiagnosed diabetes. There is an opportunity to standardize the prediabetes and diabetes screening process so that all patients are equally receiving the same screening throughout.

A threat identified was the lack of standardization for screening and how it allowed delay in early diagnosis for prediabetes and type 2 diabetes

Implementation Timeline

The timeline for this DNP project is to educate providers on use of screening tool and how to implement the tool in the clinical setting during October 2021. In October of 2021 protocols will be finalized for the screening tool and diabetic testing with facility operators, as well as implementing the screening tool into the clinical areas of the rural primary care facility in Maryland. Predata will be collected for a comparison population use the charts from August 2021 and September 2021. Starting October 11, 2021 through December 2021 the implementation process data will be collected with the screening tool. In January 2022 all final data for the project will be completed and used to complete statistical analyses from project implementation. Finally, in April of 2022 the findings will be disseminated through presentation.

IRB and Agency Approval

An IRB application was completed and submitted. for this DNP project in the Spring of 2021. In early Summer of 2021, the suggestions for the application were received from the IRB committee. In the late summer of 2021, the final IRB application was submitted. A few weeks later additional questions from the IRB committee were sent to the DNP student investigator who finalized details for those questions. Final approval of the DNP project was received on October 5, 2021 by Salisbury University IRB committee. Once Salisbury University's IRB approved the project, the rural primary care facility approved the project via their chief clinical officer's approval.

Project Implementation

The implementation process began with the initial screening of the patient during their visit to the clinic. This screening tool was used during physical exam visits, new patient appointments and chronic disease follow-up appointments. During the visit, the medical provider or DNP student investigator completed the consent form with the patient after explaining the purpose of the project. Once this form was reviewed, the inclusion and exclusion criteria screening form was completed by the provider or DNP student investigator to again determine if the patient meets inclusion criteria for Heikes screening tool. The inclusion and exclusion criteria was set by the American Diabetes Association to describe patients that should have proper diabetes risk screenings completed. The provider or DNP student then followed the algorithm style screening by Heikes with an end result of the patient's risk for developing prediabetes or type 2 diabetes. The provider or DNP student then, in real time, discussed the results of the screening with the patient. While discussing the results in real time, it allowed the provider or DNP student investigator to also discuss which risk factors in the screening were modifiable versus non-modifiable. If the patient was medium or high risk, the primary care practice would review if and when the patient had a hemoglobin A1C test completed. If no prior hemoglobin A1C had been completed or if they were a new patient with no baseline lab results, then a hemoglobin A1C was ordered. The patient was also provided with resources and additional education if they fell into the category of medium or high risk for developing pre-diabetes or type 2 diabetes. The project implementation began on October 11, 2021 and continued for the following two months.

Barriers and Facilitators

The support staff, management and administration all allowed the project to be implemented and assisted in any way possible. This was the biggest facilitator for this project. Additional facilitators included how open and receptive the patients were to the screening and allowing the DNP student investigator to participate during their healthcare visits.

The biggest barrier was staff buy in when implementing the intervention for this project. The project was offered to all providers to participate but only one nurse practitioner decided to opt in and participate. The other providers opted out of the study due to time constraints and/or burnout. The one participating nurse practitioner was very helpful on days the DNP student investigator was present to assist with the screenings. The nurse practitioner did not complete the new screening process on days when the DNP student investigator was not present due to time constraints in her schedule. The nurse practitioner felt as though it was difficult to implement independently without assistance from the DNP student with a busy schedule of 3-4 patients per hour. This was also identified as having potential impact on results for project evaluation and will be discussed with ideas for sustaining the screening implementation in practice.

A second barrier identified was not being able to input the screening into the electronic medical record (EMR). Due to time constraints the screening tool was unable to be implemented into the EMR and instead a paper form was used for the purposes of this project. The screening process was completed and separated from the paper chart using patient identifiers. In order to document the patient's risk, the risk was discussed and evaluated in the patient's assessment and plan of their EMR. The screening tool was

not scanned into the patient's EMR due to the screening tool being a quality improvement project and not yet implemented throughout the entire organization.

Summative Evaluation of Implementation Process

Inconsistencies among providers for prediabetic and type 2 diabetes screening was initially identified within the organization before this project implementation in a rural primary care practice. Prior to this project, no routine screening tool was used once inclusion and exclusion criteria were evaluated for the patient. There was also no screening tool that produced a risk calculation for diabetes for each patient individually. For the purposes of this project, it is difficult to know if the problem was alleviated due to low provider participation. Only 1 provider out of 5 in the office participated in the implementation process. The one provider that did participate had difficulty implementing without assistance from the DNP student due to time constraints for providing patient care. However, the screening tool did raise the provider's awareness to the participating provider about what the patient's individual risk was for disease development as reported by the nurse practitioner involved in the study when questioned for feedback after implementation.

The project's main goal was to increase provider awareness of a patient's risk of developing prediabetes or type 2 diabetes by implementing a standardized screening tool approach. An objective was to capture and identify those individuals that met inclusion criteria for diabetic risk screening that may have been otherwise not been identified if a screening tool was not used. Overall, this goal was met with identification of patients who were more at risk versus what the provider would have originally thought prior to the implementation of the screening tool. The screening tool and screening process

allowed more individuals to be screened and captured for diabetes risk. Likely, both steps of this standardized screening assisted in identifying patients who may have otherwise been missed. The first checklist including inclusion and exclusion criteria for screening. This was something that should have been evaluated for every patient prior to prediabetes screening that otherwise may have been overlooked. This method allowed a visual chart for providers to complete. All patients were evaluated with the checklist of inclusion and exclusion criteria. If a patient met inclusion criteria the patient was further screened with the Heikes screening tool. The DNP student also asked patients if they knew whether or not they had been previously screened for their risk using either another screening tool or hemoglobin A1C. If they were a current patient of the practice, a chart review was also completed to search for this information.

The screening was beneficial to patients in the target population. The screening raised patient awareness about the disease of diabetes and contributing risk factors. The screening tool algorithm identified most risk factors for diabetes development, which assisted the patient in understanding how the risk total was resulted. The participants asked pertinent questions and were receptive to the education provided about disease prevention after knowing their risk. Those patients that had not had a hemoglobin A1C completed in the last few years questioned why it was important and how they can evaluate their selves for symptoms in the future. Patients also asked pertinent questions about how they can lower their risk. This screening tool implementation allowed patient's to better understand their level of risk in developing diabetes. The standard of care was provided to all patients throughout the implementation of this project.

The raised awareness for both the patient and provider increased screening for patients in the population. For example, 9 out of the 40 sample participants that met inclusion criteria had never been screened at the organization for prediabetes or type 2 diabetes according to chart reviews. Of these 9 patients, 4 were new patients who reported they were never screened by a prior provider or were unaware if they were screened by another provider previously for prediabetes or type 2 diabetes. The limitation to this data is that 4 of these were new patients to the practice and the other 5 were already established. From chart reviews, it was able to be determined for those 5 patients who were already established in the practice, they had never been previously screened. It was difficult to know screening status for the new patients other than what was reported by them. Those 9 patients made up 22.5% of the sample population, meaning they were unaware about their risk for developing prediabetes or type 2 diabetes prior to this process. This process allowed for prompt identification of patients at risk for developing diabetes.

The agency and healthcare workers were very accepting of the project implementation. However, currently the healthcare burnout is high among the organization, as we are still facing a pandemic which has created a barrier to change. Other barriers identified were the inability to use medical assistants to assist with the process and inability to have the screening tool incorporated in the electronic medical record prior to project implementation. These will be further discussed in the sustainability section of this paper.

The Analysis and Discussion of Findings

The final sample size for this DNP project, the implementation of Heikes screening tool in a rural primary care office, consisted of forty participants using convenience sampling. The age ranges were from 21 years old to 84 years old. The totals for each race were 42.5% African American participants, 47.5% Caucasian participants and 10% Hispanic participants. There were 65% female participants and 35% male participants. Participant's BMIs ranged from 23.6 to 47.2. The final totals from the screening tool resulted in 12.5% people at low risk, 37.5% at medium risk and 50% at high risk for the development of type 2 diabetes after meeting inclusion criteria. This can be seen in *Table 1* below. An observation made from this data is that half of the sample screened high risk after inclusion and exclusion criteria from the American Diabetes Association, showing the risk factors identified from this were ideal for capturing who needed diabetic screening. In *Table 2* and *Table 3* also show the results of risk percentage for prediabetes and type 2 diabetes. These risk percentages were directly from the Heikes screening tool. *Table 2* and *Table 3* show the frequency of participants in each risk category and percentage result. The data also shows from this sample there were 9 identified participants out of 40 who were not previously screened or unaware of previous screening but met screening criteria for this project. Of these 9 participants, 4 were new patients and 5 were established patients with the practice. This can be seen in *Table 1*. This is 22.5% of the sample population that could have gone unrecognized for being at risk if not for the standardized screening tool and process that were implemented during this project. These results were obtained during the data collection process, the DNP student investigator performed chart reviews and asked patients if they had known

prior screenings completed to evaluate their risk for diabetes. If the patient was already an established patient, a chart review was also completed to identify if a screening tool had been used prior or a hemoglobin A1C had been ordered prior.

With the data collected during the implementation of Heikes screening tool, the sample's data on waist circumference and diabetes risk category of low, med or high as a result of Heikes screening tool was used to run an independent t-test using SPSS statistical analysis software. For the purposes of this test, waist circumference was divided into two categories. Category 1 was characterized as having a waist circumference less than 38.4in since this is the waist circumference reference used in Heikes screening tool. Category 2 was characterized as participants with a waist circumference larger than 38.4in. The t-test results can be seen in *Table 4* with the highlighted category of equal variances not assumed since that was shown within the data through SPSS. This data reveals those patients who fell into category 2 for waist circumference had a 6.65% higher risk of being in the high-risk category for diabetes development through the Heikes screening tool. In fact, the data showed with 95% confidence that on average waist circumference in group 2 will have between 2.80% and 10.50% more risk for being high-risk for developing diabetes according to Heikes screening tool. This shows a relationship between waist circumference and risk for developing prediabetes and type 2 diabetes. With this information, patients can also be taught that by modifying their waist circumference, they can attempt to lower their risk for development of prediabetes and type 2 diabetes.

This sample is assumed to be representative of the rural population served in this area for primary care. Pre-data was collected two months prior to implementation of

Heikes screening tool in order to compare if the pre- and post-implementation populations were similar. This was done to also determine if the sample was representative of the rural primary care office's population. The pre-data population consisted of sixty-nine patients that were at the practice for either new patient appointments, physical exams or chronic condition follow-ups. The pre-data gender percentages, females consisting of 52.2% of the populations and males consisting of 47.8% of the population. The sample using during project implementation with Heikes screening tool, females consisting of 65% of the sample and males consisting of 35% of the sample. The pre-data population included 33.3% African American patients, 1.4% Asian patients, 11.6% Hispanic patients and 53.6% Caucasian patients. The sample population included 32.5% African American patients, 0% Asian patients, 10% Hispanic patients, and 47.5% Caucasian patients. With this information we can see that the data is comparable in similarity. For the purposes of this project, we cannot conclude that this data can be generalized to the general public, but we can show that the data found compares to the average patients seen within this rural primary care clinic.

Table 1

Descriptive Statistics of Sample

Characteristics	**n**	**%**	**Range (Low-High)**	**Mean (SD)**
Age			21-84 years old	48.40 (±15.05)
Gender				
Female		65%		
Male		35%		
Race/Ethnicity				
African American		32.5%		
Caucasian		47.5%		
Hispanic		10%		
Previously Screened				
Yes	31	77.5%		
No (from established pts)	5	12.5%		
Unknown/No (new pts)	4	10%		

Table 2

Samples Heikes Results

Heikes Risk Categories	**n**	**%**
Low	5	12.5%
Medium	15	37.5%
High	20	50.0%

Table 3

Prediabetes Risk and Diabetes Risk from Heikes

Risk From Heikes Screening	N	%
PDM Risk		
11.90%	4	10.0%
28.00%	1	2.5%
35.40%	13	32.5%
37.90%	1	2.5%
45.30%	1	2.5%
47.80%	17	42.5%
52.70%	2	5.0%
54.20%	1	2.5%
DM Risk		
0.20%	4	10.0%
0.30%	2	5.0%
0.60%	1	2.5%
1.80%	13	32.5%
8.20%	1	2.5%
9.60%	1	2.5%
9.90%	1	2.5%
15.60%	17	42.5%

Table 4

Independent Samples T-test

	T	Df	p	Mean difference	SE difference
Value	-3.554	25.229	< 0.001	-6.650	1.871

Sustainability of Change Recommendations

In order to produce a sustainable screening process, the areas discussed will need to be addressed after evaluating the data to continue this process successfully for the rural primary care facility. The results show this screening technique can assist in identifying and capturing more patients who may be at risk for developing prediabetes and type 2 diabetes. The project was a good foundation but with some improvements can be better suited for sustainability over time and improve quality of care provided.

Economic Considerations

This project does not have a substantial economic impact on cost of implementation. The cost to perform these screenings would mainly just include implementing the screening into the electronic medical record (EMR). The facility and organization already have a designated IT department capable of creating and inputting screenings into the EMR. The project was completed with paper charting, but ideally would be moved into the EMR for sustainability. By using the EMR for screening, it improves project sustainability by allowing less time spent inputting information from paper charting and keeps all patient data in one location. An additional economic consideration is if the project may capture more patients at risk, therefore utilizing more testing for hemoglobin A1Cs. Overall, the economic impact for costs from this quality improvement project is low.

However, this project could have a large economic impact for savings on the healthcare system by identifying patients at risk for prediabetes and type 2 diabetes, therefore potentially avoiding diabetic complications. A recent research study completed by Yang et al. (2020) consisted of 47,166 participants with diabetes. In this research, the

authors concluded that the most expensive complications of diabetes are end-stage renal disease ($94,231 vs $98,981 for T2DM), congestive heart failure ($31, 202 vs $7062 for T2DM), and myocardial infarction ($45,251 vs $8572 for T2DM) (Yang et al., 2020, p.1). By improving screening for patients to evaluate risk of developing prediabetes or type 2 diabetes, it can create an opportunity to intervene earlier and potentially decrease expenses related to complications with type 2 diabetes. This has the potential to have a large impact on savings economically.

Implications for Practice

Leaders in the DNP role are expected to identify gaps in providing quality patient care and find ways to close those gaps. Those in a DNP role are working both as a leader and clinically delivering care to patients. It is important to remain current on the most up to date evidence-based practice. This standardized diabetic screening process is closing the gap of inconsistencies in screening between providers.

Process and Outcome Recommendations

After reviewing the project process and speaking with the provider involved in the project, there are a few recommendations on how to improve sustainability with this screening method. The biggest recommendation was to involve medical assistants in the process to ease the time constraints on the provider. For example, step 1 of the project is to see if the patient fits inclusion criteria for screening. This is a simple checklist that can be done prior to the patient being seen by their provider. Ideally, the medical assistant could complete the checklist during intake and relay if the patient needs the screening form completed.

A second recommendation is to incorporate this screening into the electronic medical record (EMR). For the purpose of this project, the screenings were completed on paper charts. It caused a time delay to have paper instead of a built-in screening in the EMR. Having the screening in the EMR would also make it easily accessible to the provider, serve as a reminder that a patient requires screening and would provide prompt identification of individuals at risk. By incorporating medical assistants and moving the screening into the electronic health record, I am confident this project can be sustainable for many years to come.

Dissemination Plan

The final step for this project is to disseminate findings by creating a presentation opportunity and discuss the findings, as well as suggestions for sustainable change. Additionally, a manuscript of this quality improvement project will be submitted to the Journal of Family Medicine and Primary Care in the spring of 2022. This information should be shared to help other rural primary care providers wanting to implement a diabetic screening tool in the primary care setting.

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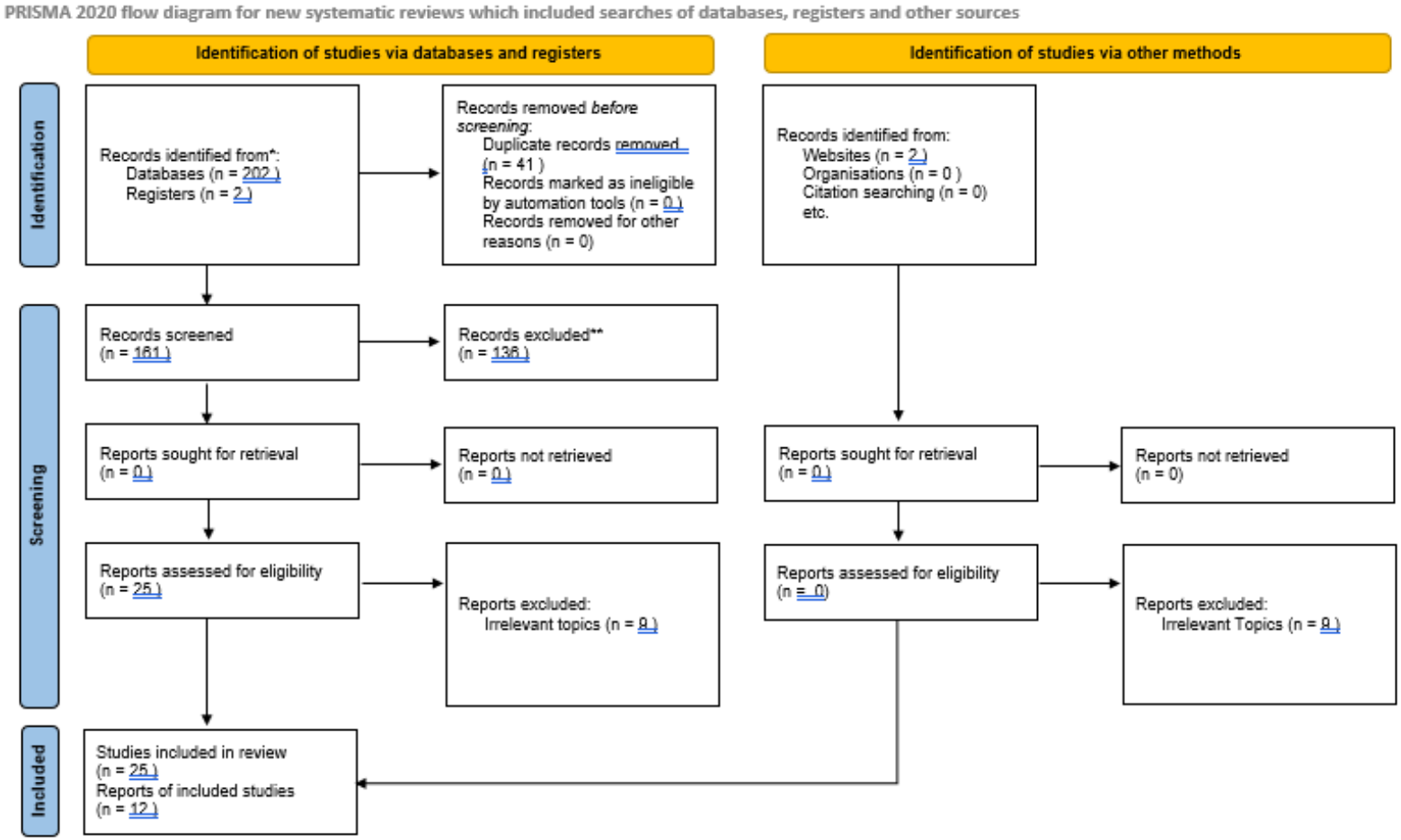
Appendix A: PRISMA Table



*Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers).
**If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

Appendix B

Table of Evidence

Citation	Conceptual Framework	Design/Purpose	Sample/ Setting	Measurement of Major Variables	Study Findings	Appraisal of Worth to Practice	Strength & Quality of Evidence
Costa-Pinel, B., Mestre-Miravet, S., Barrio-Torrell, F., Cabre -Vila, J. J., Cos-Claramunt, X., Aguilar-Sanz, S.´., Sole´ - Brichs, C., Castell-Abat, C., Arija-Val, V., & Lindstro, J. (2018). Implementation of the DP-TRANSFERS project in Catalonia: A translational method to	Descriptive analysis	Identified at risk patients, then provided educate modules to patients at risk on lifestyle changes A 3-level (center, professionals and participants) descriptive analysis was conducted using cluster sampling to assess results and barriers identified one year after implementation	1819 people were screened	1458 (80.1%) followed the lifestyle intervention, with 1190 (81.6% or 65.4% of those screened) participating in the basic module and 912 in the continuity module (62.5% or 50.1%, respectively).	The Catalan DE-PLAN project clearly showed that the overall incidence of diabetes could be reduced in high-risk individuals following the intensive intervention compared with the standard care regime	Education modules can assist patients at risk for diabetes by reducing their risk	Level 2

improve diabetes screening and prevention in primary care. *Plos One*, 1-18.							
Cristo Rodrıguez-Perez, M. A., Orozco-Beltra´n, D., Gil-Guille´, V., Domınguez-Coello, S., Almeida-Gonzalez, D., Brito-Dı´az, B., Marcelino-Rodrıguez, I., Carratala´-Munuerab, M.´. C.´., Gomez-Moreno, N., Navarro-Perez, J., Brotons-Munto, F., Pertusa-Martinezb, S., & Cabrera de Leo, A. (2017).	Cross-sectional study	Participating PCPs underwent standardized training to collect the necessary data to calculate DIABSCORE for patients The DIABSCORE results were compared to a lab draw and compared on how to diagnose type 2 diabetes. Then a questionnaire was completed by participants	Convenience sampling The study was undertaken in the Canary Islands (n= 4664) and the Valencian Community (n= 5844)	The participants from the Canary Islands were almost 1 year younger (p< 0.001), included 2% more men (p< 0.018), had greater abdominal obesity (p< 0.001), and a higher frequency of a family history of type 2 diabetes (p< 0.001) The mean DIAB-	The DIABSCORE was an efficient and cost-effective method of screening for type 2 diabetes,and it was used with high satisfaction of patients and professionals. In one community the DIABSCORE was screened at a higher cost than screening for Hemoglobin A1c, in the other communities the screening was less costly	The DIABSCORE screening tool screens similar to the Heikes screening tool as far as questions to screen for. The DIABSCORE was as effective as lab blood draws and is a more noninvasive and cost effective way to screen patients for	Level 3

Clinical applicability and cost-effectiveness of DIABSCORE in screening for type 2 diabetes in primary care. *Diabetes Research and Clinical Practice, 130*, 15-23.				SCORE values from the Canary Islands (p< 0.021), plasma glucose (p< 0.001), andHbA1c (p= 0.033) were also higher		type 2 diabetes.	
Dhore, P. B., Tiwari, S., Mandal, M. K., Purandare, V. B., Sayyad, M. G., Pratyush, D. D., & Unnikrishnan, A. G. (2016). Design, implementation and results of a mobile clinic-based diabetes screening program from India. *Journal*	Survey over 2 years	A structured course (see File S1, available as Supplementary Material to this paper) was used to provide one-day training to the ASHAs in the basics of diabetes in order to impart awareness to the rural population The MDC-based diabetes screening program was	Between September 2012 and December 2014, 475 villages were surveyed, covering a population of 1 098 532	709 (4.8%) of the participants were diagnosed with type 2 diabetes through the screening	The MDC provided effective diabetes screening, in-creased awareness, and reached remote rural populations	There is opportunity for more education about screening and diabetes in rural areas	Level 3

of Diabetes, *8*, 590-593.		imple mented by Chellaram Diabetes Institute (Pune, India)					
Heike, K. E., & Eddy, D. M. (2008). Diabetes risk calculator. *Diabetes Care*, *31*(5), 1040-1045.	Logistic regression assisted in developing the tool. Classificatio n and regressive tree method	Developed a screening tool appropriate for the US population. Data was used from NHANES to develop and validate the tool	No sample	Tool results showed 80% sensitivity and max specificity Validations were performed with split data sets	The Heikes screening tool, also known as the diabetes risk calculator, is the only current screening approved to assist in diagnosing prediabetes and type 2 diabetes.	Heikes successfully developed a screening tool for detecting prediabetes and undiagnosed diabetes using questions specific to each individual	Level 3
Nhim, K., Khan, T., Gruss, S. M., Wozniak, G., Kirley, K., Schumacher, P., Luman, E. T., & Albright, A. (2018). Primary care providers' prediabetes screening,	Survey	DocStyles[a] cross-sectional web-based survey admin-istered by Porter Novelli The 2016 DocStyles survey contained 144 questions	N=1,506	Pearson chi-square tests were used to assess bivariate associations between PCPs' self-reported behaviors regarding	Overall, 27% of PCPs screened patients for prediabetes using the CDC or ADA risk test, 97% ordered recommended blood tests, and 23% referred patients to CDC-	Screening for prediabetes was at a low rate for PCPs	Level 3

testing, and referral behaviors. *American Journal of Preventative Medicine*, *55*(2), 39-47.		addressing provider age, gender, race/ethnicity, specialties, years of practice, work settings/locations , patients' average household incomes, and attitudes and counseling behaviors on a variety of health issues.		prediabetes screening, testing, and referral and their awareness of the CDC-recognized LCP and the STAT toolkit	recognized LCP classes significant differences in the proportion of PCPs who screened using a risk test by race/ethnicity (22.8% of non-Hispanic whites, 39.0% of non-Hispanic blacks, po0.001) and use of EHRs (17.4% of those not using EHRs vs 38.8% of those using them, po0.001).		
O'Brien, M. J., Bullard, K. M., Zhang, Y., Gregg, E. W., Carnethon, M. R., Kandula, N. R., & Ackermann, R. T. (2018). Performance of the 2015 US	Analysis of surveys	Cross-sectional analysis of survey and laboratory data collected	Probability sample design Participants aged 40 to 70 years with overweight/ obesity were considered	The performance characteristics of the limited criteria were as follows: sensitivity 47.3% (95% CI, 44.7–50.0%); specificity	Overall, 49.7% of the sample population without diagnosed diabetes had dysglycemia The current evidence found that expanded	the expanded USPSTF criteria will result in more dysglycemia results for patients and allow the provider the opportunity to enfore	Level 3

preventive services task force screening criteria for prediabetes and undiagnosed diabetes. *JGIM*, *33*(7), 1100-1108.			eligible for screening according to the limited criteria Full eligible adults N = 3643 Adults with dysglycemia n = 1990	71.4% (95% CI, 67.3–75.2%); PPV 62.0% (95% CI, 57.8–66.1%); and NPV 57.8% (95% CI, 54.9–60.8%)	criteria provided a greater benefit for screening patients than limited criteria	lifestyle modifications	
Paglialunga, S., Bond, R., & Jaycox, S. H. (2018). Evaluation of HbA1c screening during outreach events for prediabetes subject recruitment for clinical research. *Trials*, *19*(60), 1-7.		The aim of this study was to examine the recruitment efficiency of prediabetes and type 2 diabetes participants at various community events marketed to a Hispanic population Provided free hemoglobin A1c	Convenienc e sampling 401 participants at Hispanic events expressed interest 391 participants agreed to the Hemoglobin A1c screening	($p < 0.05$) Significantly higher incidence of prediabetes in age group 45-65 years of age An estimated 9.4% of the adult population	The average HbA1c value for all participants screened was 6.0 ± 1.4%, which falls within the prediabetes range, indicating a high risk of insulin resistance	The underserved Hispanic population could be going undiagnosed with prediabetes The Hispanic culture could use more resources for screening for prediabetes	Level 2

		screening and education After events, participants were called to see if they were interested in participating in future clinical trial studies		has type 2 diabetes		and type 2 diabetes	
Poltavskiy, E., Jung Kim, D., & Bang, H. (2016). Comparison of screening scores for diabetes and prediabetes. *Diabetes Research and Clinical Practice, 118,* 146-153.		Intervention: screening using CDC screening tool and ADA screening tool to compare diabetes diagnosis	Adult participants (N = 9391) without known DM from the National Health and Nutrition Examination Surveys 2009–12 were included	Compare CDC and ADA screening methods for type 2 diabetes	A total of 45% of participants reported they were physically active for 5 or more days of a week. All predictors except for 'macrosomic baby (>9 lb)' were statistically significant, with the AUC of 0.77 for the ADA score and 0.73–0.74 for the CDC score	Average age of 46 years, 48% were men Self-reported obesity by patients was less than BMI indicated obesity. The ADA score performed somewhat but nearly uni-formly better, and we believe this is partly due to	Level 3

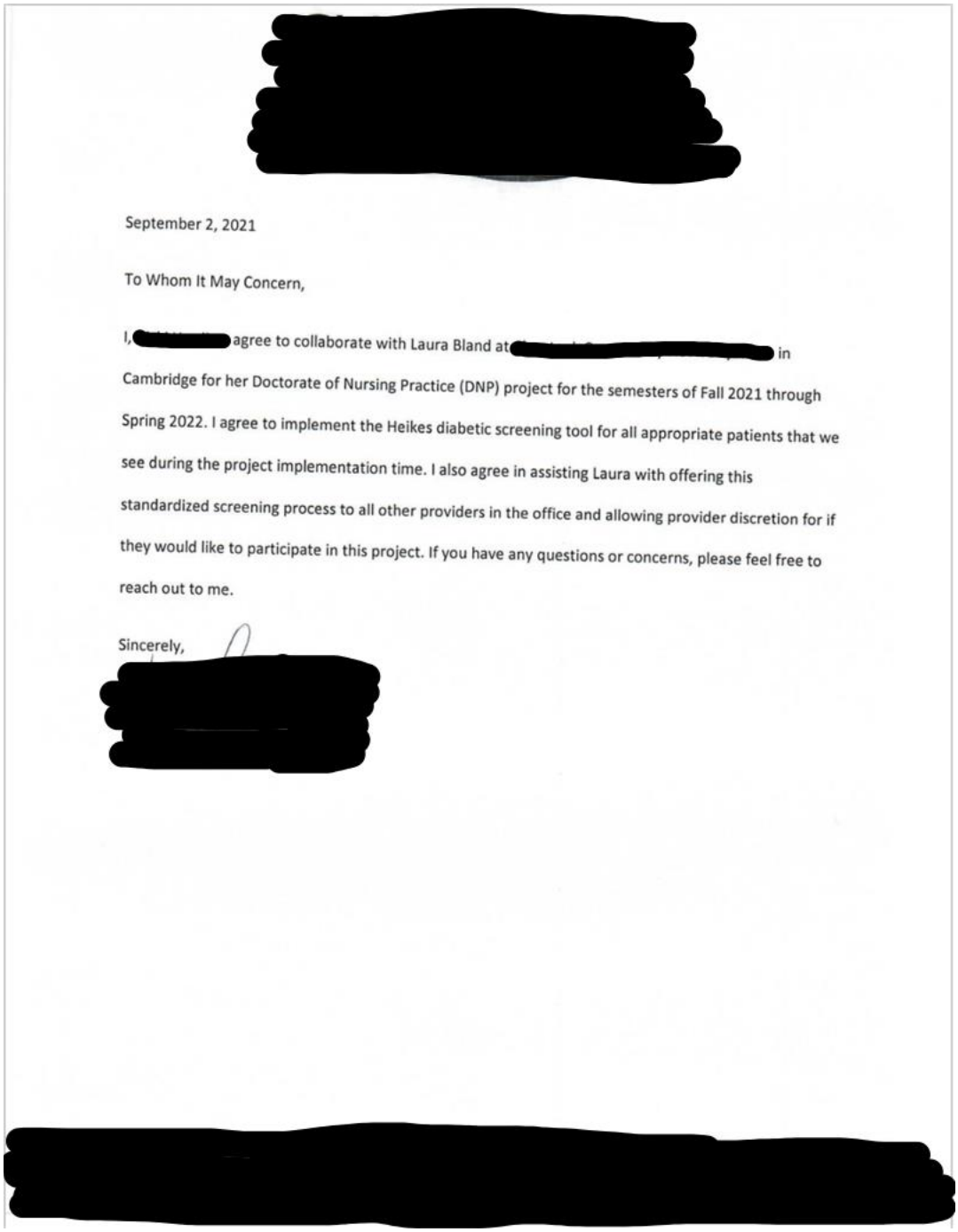
						multiple categories used for age and obesity which show strong mono-tonicity in disease prevalence	
Tseng, E., Greer, R. C., O'Rourke, P., Yeh, H.-C., McGuire, M. M., Clark, J. M., & Maruthur, N. M. (2017). Survey of primary care providers' knowledge of screening for, diagnosing and managing prediabetes. *JGIM*, *32*(11), 1172-1178.	Descriptive analyses of survey questions	used multivariate logistic regression to determine the association between provider characteristics and these outcomes	at 40 practice sites across the mid-Atlantic region. N= 140 adult PCPs	Multivariate logistic regres- sion was used to determine the association between pro-vider characteristics (gender, race/ethnicity, years since training, specialty and provider type) and knowledge, management, and attitudes and beliefs about prediabetes.	Six percent of PCPs correctly identified all of the risk factors that should prompt prediabetes screening Only 17% of PCPs correctly identified the laboratory parameters for diagnosing prediabetes based on both fasting glucose and hemoglobin A1c	PCPs had gaps in knowledge of prediabetes risk factors There was also a noted gap in knowledge for PCPs to identify prediabetes labs	Level 3

Tung, E. L., Baig, A. A., Huang, E. S., Laiteerapong, N., & Chua, K.-P. (2016). Racial and ethnic disparities in diabetes screening between Asian Americans and other adults: BRFSS 2012–2014. *JGIM*, 423-429.	Analysis of pooled cross-sectional data	Analyzed pooled cross- sectional data from the 2012–2014 Behavioral Risk Factor Sur-veillance System (BRFSS), an annual nationally representative telephone-based survey that collects information on the health-related risk behaviors and preventive health practices of U.S. residents.	N = 526,000 Study population included adults who should be screened for type 2 diabetes based on the American Diabetes Association (ADA) guidelines between 2012 and 2014.	could not directly examine the role of patient preference and attitudes toward healthcare, we conducted three analyses that indirectly examined these factors.	The weighted percentage of Asian American adults receiving recommended diabetes screening was 47.1 %, which was lower than the percentage for non-Hispanic whites (59.2 %), non-Hispanic Pacific Islanders (50.3 %), non-Hispanic American Indians or Alaskan Natives (55.6 %), non-Hispanic blacks (60.2 %), Hispanics/Latinos (58.1 %), and adults classified as multiracial or other (58.8 %)	Patients in ethnic groups at higher risk for prediabetes or diabetes were under screened	Level 3
Ugwu, E., Young, E., & Nkpozi, M. (2020). Diabetes care	Cross-sectional study	Diabetes knowledge and practices were evaluated using a self-administered	76 eligible participants Participants included	Duration of medical practice more than 10years (OR 10.1; P	Although FBG was the most frequently employed method of	Clinically PCPs in south Nigeria could use additional	Level 3

knowledge and practice among primary care physicians in southeast Nigeria: A cross-sectional study. *BMC Family Practice*, *21*(128), 1-11.		questionnaire (supplement 1) that was developed by the researchers for this purpose The questionnaire demonstrated good internal consistency of responses with Cronbach's alpha coefficient of 0.753 and 0.835 for each spilt group, and a correlation between groups of 0.829, indicating a very strong reliability.	PCPs in Southeast Nigeria Majority male population	0.034) and non-participation in diabetes train- ing (OR 6.5; P 0.027) were significant predictors of poor diabetes knowledge in the study population	diabetes diagnosis by the study participants, yet, nearly three-quarters of the PCPs lacked correct knowledge of diabetic range FBG It was observed that only 5 out of the 64 PCPs (7.8%) correctly knew all the three glycemic cut-offs and nearly half did not have correct knowledge of any single glycemic value for diagnosis of DM.	education on diagnosing diabetes	

Ying Lee, C. M., Versace, V. L., Malo, J. A., Shaw, J. E., Dunbar, J. A., & Colagiuri, S. (2018). Screening for diabetes prevention with diabetes risk scores – A balancing act. *Diabetes Research and Clinical Practice, 135*, 120-127.	Two-step approach	individuals at high risk of diabetes identified initially by specific risk factors or through screening with a non-invasive diabetes risk assessment tool Participants were excluded if they had known diabetes	Included 4864 participants of the Australian Diabetes, Obesity and Lifestyle study who were aged !40 years, did not have known diabetes at baseline, and attended the five-year follow-up	AUSDRISK assessment	For the AUSDRISK only scenario, the population prevention potential is 51%.	The highest NNP was seen in the scenarios which included an AUSDRISK assessment followed by a blood test to detect previously undiagnosed diabetes A formal risk assessment along with a blood test helps to reduce costs for entering patient's into a diabetes program	Level 3

Appendix C: Letters of Support from Agency



[redacted]

September 2, 2021

To Whom It May Concern,

I, [redacted] agree to collaborate with Laura Bland at [redacted] in Cambridge for her Doctorate of Nursing Practice (DNP) project for the semesters of Fall 2021 through Spring 2022. I agree to implement the Heikes diabetic screening tool for all appropriate patients that we see during the project implementation time. I also agree in assisting Laura with offering this standardized screening process to all other providers in the office and allowing provider discretion for if they would like to participate in this project. If you have any questions or concerns, please feel free to reach out to me.

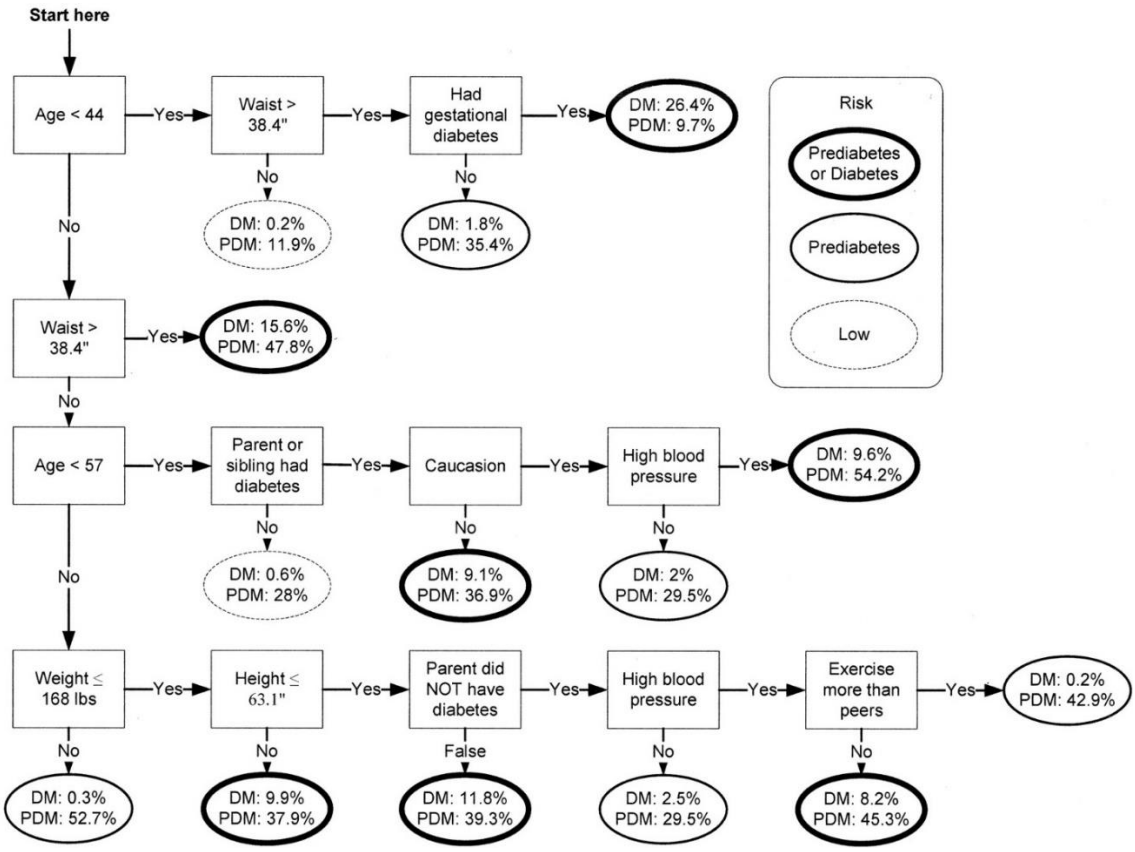
Sincerely,

[redacted]

[redacted]

Appendix D: Heike's Screening Tool

Identification number: _____



Totals:

DM Risk: _____

PDM Risk: _____

Appendix E: SWOT Analysis Table

Strengths: • Many providers at Choptank are already aware of the treatment guidelines for patients who are diagnosed for prediabetes and type 2 diabetes • The system at Choptank is also easily able to adapt to any new processes implemented within the system	**Weaknesses:** • Not all providers in the practice screen for prediabetes and type 2 diabetes • Not all of the providers at Choptank can identify the risk factors that increase a patient's risk for prediabetes and type 2 diabetes • The providers at Choptank are not all aware of Heikes screening tool or the fact that it is the gold standard of care.
Opportunities: • The patients at Choptank are considered underserved and are both at higher risk for diabetes and at a higher risk for being undiagnosed • There is an opportunity to standardize the prediabetes and diabetes screening process so that all patients are equally receiving the same screening	**Threats:** • The lack of standardization for screening allows delay in early diagnosis for prediabetes and type 2 diabetes

Appendix F: Recruitment and Consent Form

My name is Laura Bland, and I am a graduate student at Salisbury University. I would like to invite you to participate in my research study to standardize a screening process for establishing a patient's risk for prediabetes and type 2 diabetes. You may participate if you are over the age of 45 or meet the additional criteria for screening.

As a participant, you will be asked to answer a brief screening questionnaire.

Risks include discussing sensitive topics such as weight, family history and diabetes.

Benefits to participating are increasing awareness about current and future risks for developing prediabetes or type 2 diabetes.

Privacy will be ensured with all screening tools during the entire course of the project. All participants will be given an identifying number and personal information will be removed. All forms will be kept in a locked cabinet and will not leave this primary care office.

Participation is voluntary. Your participation in this research will not impact your standing or relationship with Salisbury University or this primary care office.

If you would like to participate in this research study, please sign the informed consent form.

Do you have any questions now? If you have questions later, please contact me at ljackson10@gulls.salisbury.edu.

If you have any adverse effects or concerns about the research, please contact the primary investigator Anastacia Keenan or the Office of Graduate Studies and Research at Salisbury University at 410-548-3549 or toll free 1-888-543-0148. This research is approved by the Salisbury University's IRB under protocol number 4.

Patient Name: _____ Date: _____

Patient Signature: _____

Appendix G: Inclusion/Exclusion Criteria

Identification number: _____

Section 1:

- ☐ Check is patient's age is over 45 years old (If no, then continue to Section 2)

Section 2:

- ☐ BMI is less than 25 or less than 23 if of Asian nationality (stop here if you check this box)
- ☐ BMI is equal to or greater than 25 or 23 if of Asian nationality (if yes continue to Section 3)

Section 3:

Check all boxes that apply below about patient:

- ☐ physical inactivity defined as not routinely exercising
- ☐ a first degree relative with diabetes
- ☐ high risk racial or ethnic group
- ☐ history of gestational diabetes
- ☐ a woman who delivered a baby weighing more than 9lbs
- ☐ HDL cholesterol less than 35
- ☐ triglycerides more than 250
- ☐ history of hypertension
- ☐ history of an A1C higher than 5.7%
- ☐ conditions associated with insulin resistance such as PCOS
- ☐ history of cardiovascular disease.

Appendix H: Timeline

Semester	Estimated Timeframe	Task
Spring 2021	May 2021	Have completed and approved IRB Proposal
Fall 2021	October-December 2021	Collect pre-data at facility
Fall 2021	October 2021	Identify educational gaps between providers at facility that will need additional education before implementation
Fall 2021	October 2021	Educate staff on how to incorporate screening tool into daily workflow
Fall 2021	October 2021	Educate providers on use of screening tool and how to implement
Fall 2021	October 2021	Finalize protocol for screening tool with facility operators
Fall 2021	October 11, 2021	Implement screening tool into clinical areas of a rural

		primary care facility of Maryland
Fall 2021	December 2021	Collect data for post implementation of screening tool
Winter 2022	January 2022	Collect final post data for project
Winter 2022	January 2022	Analyze data from project implementation
Spring 2022	April 2022	Present and Disseminate findings