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Assessment of Prediabetes Testing Practices Among Primary Care Providers in Mississippi

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Graduate Committee Approval

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hereby approves this research project as meeting partial
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Master of Science in Nursing

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DEDICATION

I would like to dedicate my research and all of my hard work to my wonderful, supportive fiancé, Heather, for all of your support and patience through all of my endeavors. To my son, Rhett, I hope you always remember that with perseverance and a vision you can achieve anything in this world. To my mother, Teresa, you have taught me to never become complacent and to always push myself to rise to every challenge in life to achieve my goals.

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ASSESSMENT OF PREDIABETES TESTING PRACTICES AMONG PRIMARY CARE PROVIDERS IN MISSISSIPPI

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ABSTRACT

Prediabetes is a condition in which a person has impaired glucose metabolism; however, his or her glucose levels do not meet criteria for the diagnosis of diabetes (ADA, 2019). Prediabetes is associated with an increased risk of developing diabetes and cardiovascular disease (ADA, 2019). Early diagnosis and treatment of prediabetes, including lifestyle interventions and medical management, are vital in preventing prediabetes from progressing to diabetes. The review of current literature indicates that prediabetes testing is not being properly utilized in primary care settings. The purpose of this study was to determine if primary care providers (PCPs) were performing prediabetes A1C screenings for patients 18 and older who were overweight, obese, or had a BMI that was 25 or greater, as well as one or more additional risk factors for prediabetes; the study also included patients who were 45 or greater without further risk factors. The intention was to bring awareness of the proper guidelines required of PCPs

in testing patients for prediabetes. It is the obligation of PCPs to test asymptomatic patients who are at risk of developing prediabetes or diabetes mellitus (ADA, 2019). Primary care providers can use this information to increase their knowledge and practice of performing appropriate testing on overweight and obese patients.

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Chapter I

Prediabetes and Dimensions of the Problem in Mississippi

The Centers for Disease Control and Prevention (CDC) estimate that 12.2% (30.3 million) of American adults have diabetes, and that 7.2 million of those people are undiagnosed (CDC, 2015). Perhaps even more startling than those figures is that the CDC reports that 33.9% (84.1 million) of adults (≥18) in the United States are prediabetic, according to their fasting plasma glucose or A1C (CDC, 2017). Prediabetes is a condition in which a person has impaired glucose metabolism; however, his or her glucose levels do not meet criteria for the diagnosis of diabetes (ADA, 2019). Prediabetes is defined by the American Diabetes Association (ADA) as having an A1C 5.7-6.4% or fasting plasma glucose of 100-125 mg/dl. The condition is associated with an increased risk of developing diabetes and cardiovascular disease (ADA, 2019).

Early diagnosis and treatment of prediabetes with lifestyle interventions and medical management are vital to prevent prediabetes from progressing to diabetes. Therefore, it is the obligation of primary care providers (PCPs) to test asymptomatic patients who are at risk of developing prediabetes or diabetes mellitus (ADA, 2019). The ADA is considered the authority on diabetes; therefore, they publish *Standards of Medical Care in Diabetes* to guide the care of patients with diabetes and those who may be at risk of developing diabetes. The ADA's guidelines state that testing should include the following populations: overweight and obese adults with one or more risk factors for diabetes, as well as adults 45 and older, regardless of BMI and risk factors. If prediabetes is not diagnosed in these populations, testing should be repeated every 3 years. It is

recommended that individuals who are diagnosed with prediabetes be screened annually, and women with a history of gestational diabetes be screened every 3 years for life (ADA, 2019). The testing should be conducted using one of three methods: the fasting plasma glucose (FPG), the 2-hour plasma glucose (2-h PG) value during 75g oral glucose tolerance test (OGTT), or A1C criteria (ADA, 2019). The goal of testing asymptomatic people with risk factors is to detect prediabetes early and prevent complications.

Considering the rate of prediabetes is prevalent in America, despite only 11.6% of the population with knowledge of their condition, many people will develop diabetes and never have the opportunity to slow down the progression or stop it altogether (CDC, 2017). There is sufficient evidence that microvascular complications occur in prediabetes; therefore, treatment is appropriate and necessary for this population of patients (Perreault et al., 2019). The ADA recommends intensive lifestyle intervention with diet, exercise, and weight loss and medical management with Metformin for prediabetic patients (ADA, 2019). Although the goal of treatment of prediabetes is regression to normoglycemia, it is important to consider the sequelae of untreated or undiagnosed diabetes in order to fully comprehend the magnitude of undiagnosed prediabetes. Prediabetes and diabetes are associated with increased risk of peripheral neuropathy, retinopathy, nephropathy, cardiovascular disease, peripheral artery disease (PAD), stroke, and infection (Brashers, Jones, & Huether, 2019). According to the CDC diabetic patients greater than 35 years old have the following rates of CVD: 17.8% coronary heart disease, 16% heart disease or stroke, and 31% other heart disease (CDC, 2015). The CDC also reported that 20% of diabetics have visual impairment and 77.6% of diabetics have one of the following lower extremity conditions:

PAD, ulcers, or neuropathy (CDC, 2015). While these numbers represent a more advanced stage of hyperglycemia, it is indicative of complications that may occur if prediabetes is not diagnosed and treated.

In Mississippi, diabetes affects 13.6% of the population (308,295), meaning the state has the highest rate of diabetes in the country (CDC, 2015). When prediabetes is not treated and progresses to diabetes, there are not only health consequences but there are also financial and economic implications as well. The financial burden of diagnosed diabetes in the United States for 2017 was "$327 billion, including $237 billion in direct medical costs and $90 billion in reduced productivity" (ADA, 2018). In 2012, the estimated cost of diabetes in Mississippi was $2.74 billion; this figure rounds out to costing Mississippians with diabetes approximately $10,402 for proper care and management (MSDH, 2013). When the potential complications of uncontrolled diabetes are considered, it explains why "people with diagnosed diabetes, on average, have medical expenditures ~2.3 times higher than what expenditures would be in the absence of diabetes" (ADA, 2018). Early detection of prediabetes is of utmost importance particularly when considering the health consequences and financial burden of diabetes.

Problem Statement

According to the National Health and Nutrition Examination Survey (NHANES), the rate of undiagnosed total diabetes is highest in people ages 20-44, and lowest in people ages 65-74 (Cowie, 2019). Mississippi has the highest rate of diabetes in the country which affects 13.6% (308,295) of the population (CDC, 2015). Primary care providers have the responsibility to test, diagnose, and treat patients for prediabetes. A possible explanation for the high rate of undiagnosed prediabetes in the adult population

is that PCPs are not screening according to the ADA's guidelines for prediabetes in asymptomatic adult patients (ADA, 2019). The complications of untreated diabetes begin early in the disease process and patients may be asymptomatic until significant damage has already occurred (Cowie, 2019). Overtime, high blood glucose from diabetes can damage blood vessels and the nerves that control the heart and blood vessels; therefore, the longer a person has diabetes, the higher their chances are for developing heart disease (NIH, 2017). According to the National Institute of Diabetes and Digestive and Kidney Disease, adults with diabetes are twice as likely to die from heart disease or stroke (NIH, 2017). The consequences of undiagnosed and/or untreated diabetes affects not only the quality of life of patients, it also has a major economic impact on society (ADA, 2018).

Statement of Purpose

The purpose of this study was to determine if primary care providers in Mississippi were performing prediabetes A1C testing for high-risk patients. This includes patients who are18 and older who are overweight, obese, or have a BMI that is 25 or greater and have one or more additional risk factors for prediabetes. In addition, patients who are 45 or older without further risk factors should be tested regularly. Overweight and obese individuals have increased body fat causing increased insulin resistance, which in turn increases the risk of prediabetes. In addition to exploring the frequency of testing, the researchers assessed the treatment plans for prediabetic patients, as recommended by the ADA. ADA recommendations include lifestyle modifications (diet, exercise, and weight loss) and medication management (Metformin) (ADA, 2019).

Significance of the Study

The significance of this study was to determine if Mississippi primary care providers are utilizing the recommendations set forth by the ADA in order to raise awareness of prediabetes in adult patients. Overall, the importance of this study is to educate PCPs and attempt to prevent lasting detrimental effects caused from undiagnosed diabetes. Among these are peripheral neuropathy, diabetic retinopathy, diabetic nephropathy, cardiovascular disease, peripheral artery disease, stroke, and infection.

Theoretical Framework

This research project was be guided by Nola Pender's Health Promotion Model (HPM). This model is appropriate for guiding this study because it focuses on health promotion and the overall well-being of people. The HPM provides a holistic approach to nursing care. Pender defines the goal of nursing care as "the optimal health of the individual" (Sakraida, 2018, p. 323). Through Pender's experiences in education, human development, nursing, and psychology, she formed the foundation for the HPM. The HPM recognizes not only individuals, but also the environment that surrounds them in regards to overall health. This model is highly focused on self-efficacy and the needed behaviors to enhance one's health throughout his or her life. The HPM looks at individual characteristics and experiences, behavior-specific cognitions and affects, and behavioral outcomes as a basis for promoting one's overall health. The HPM is easy to understand, and its utilization allows both patients and primary care providers to become more knowledgeable and empowered in health-promoting abilities. Based on the HPM, individuals are more likely to follow recommendations or guidelines if they can foresee the potential benefits of compliance, versus the possible consequences of non-

compliance. The HPM incorporates multiple theoretical assertions that include behaviors, commitment, barriers, competence, self-efficacy, influences, and the interpersonal and physical environment. With the prevalence of preventable diseases at an all-time high, health promotion should be at the forefront of primary care treatment. Application of the HPM has boundless potential to prevent disease and improve clinical outcomes in this setting. Further, primary care providers have the opportunity to educate, empower, and promote the health of their patients by utilization of the HPM (Sakraida, 2018).

Research Questions

1. Are primary care providers testing for prediabetes using the A1C of overweight or obese patients ages18 years old or older and have one or more of the following additional risk factors for prediabetes, history of CVD (angina, MI, or coronary stents) or a diagnosis of Essential Hypertension?
2. Are primary care providers testing for prediabetes using the A1C of patients 45 years old or older, regardless of risk factors?
3. For prediabetic patients with A1C results between the ranges 5.7% -6.4%, are PCPs prescribing Metformin and/or lifestyle interventions?

Definitions of Terms

Primary care provider

Theoretical: Taber's (2013) defines a primary care provider as "the health care provider (nurse practitioner, physician's assistant, or physician) to whom a patient first goes to address a problem with his or her health."

Operational: For the purpose of this study, the term primary care provider is defined as a nurse practitioner, medical doctor, or doctor of osteopathy providing care in one of the five clinics selected.

A1C Testing

Theoretical: Taber's (2013) defines Hb A1C as "hemoglobin A contains a glucose group linked to the terminal amino acid of the beta chains of the molecule."

Operational: For the purpose of this study, the term A1C is defined as a test for determining if a patient has prediabetes or diabetes mellitus that is documented in the medical record between January 1, 2017 and December 31, 2019.

Prediabetes

Theoretical: Taber's (2013) defines prediabetes as "early evidence either of autoimmune disease or impaired carbohydrate metabolism in patients who later develop overt diabetes mellitus."

Operational: For the purpose of this study, the term prediabetes is defined as patients having an A1C between 5.7-6.4% that is recorded in the medical record between January 1, 2017 and December 31, 2019 (ADA, 2019).

Overweight

Theoretical: Taber's (2013) defines overweight as "having weight in excess of what is normal for a person's age, height, and build. Having a BMI that exceeds the 95th percentile of other people of the same age. Having a body mass index greater than 25."

Operational: For the purpose of this study, the term overweight is defined as having a BMI between 25-29.9% that is recorded in the medical record.

Obese

Theoretical: Taber's (2013) defines obese as "having a body mass index in excess of 30."

Operational: For the purpose of this study, the term obese is defined as having a BMI of 30 or above that is recorded in the medical record.

Cardiovascular disease (CVD)

Theoretical: Taber's (2013) defines cardiovascular disease as "any disease of the heart or blood vessels, including atherosclerosis, cardiomyopathy, coronary artery disease, peripheral vascular disease, and others."

Operational: For the purpose of this study, cardiovascular disease will be defined as any history recorded in the medical record of coronary stents, myocardial infarction, or angina, or any of the above.

Hypertension

Theoretical: Taber's (2013) defines hypertension as, "in adults, a condition in which the blood pressure is higher than 140 mm Hg systolic or 90 mm Hg diastolic on three separate readings recorded several weeks apart."

Operational: For the purpose of this study, hypertension is defined as a diagnosis of essential hypertension, ICD-10 code I10 recorded in the electronic medical record.

Metformin

Theoretical: Taber's (2013) defines Metformin as "an oral antidiabetic agent used to treat elevated blood sugar levels in patients with type 2 diabetes mellitus."

Operational: For the purpose of this study, Metformin will be defined as treatment recorded in the medical record for patients with an A1C of 5.7-6.4% between January 1, 2017 and December 31, 2019 (ADA, 2019).

Lifestyle Modification

Theoretical: Taber's (2013) defines lifestyle modification as "the act or result of changing a person's pattern of living and behavior, especially as distinguished from the behavior patterns or life choices of others."

Operational: For the purpose of this study, lifestyle modification is defined as any documentation of diet, exercise, or weight loss counseling in the electronic medical record.

Body Mass Index (BMI)

Theoretical: Taber's (2013) defines Body Mass Index as "an index for estimating obesity. A BMI can be obtained by dividing weight in kilograms by height in meters squared. A BMI ≥ 30 indicates obesity. A BMI greater than 40 indicates morbid obesity. A BMI <18.9 indicates underweight. A BMI of 25-29.9 is considered to be overweight."

Operational: For the purpose of this study, the term BMI is defined as a value used to identify overweight and obese patients and results are recorded in the medical record. Normal BMI 19-24.9, overweight BMI 25-29.9, obesity BMI ≥ 30.

Assumptions

Assumptions in this study included the following:

1. PCP were adherent to the ADA guidelines for assessing overweight and obese patients for prediabetes.

2. Data needed to conduct this research was easily accessible through chart reviews and consistent among all clinics included in the project.
3. Data collection was correctly interpreted by the researchers.
4. Researchers adhered to all information on the data collection worksheet while collecting data.
5. Frequency of ADA guideline adherence was measurable by the chart review method completed.
6. Data collected was gathered and stored in a legal, confidential manner and kept in an encrypted file.

Limitations

Limitations in this study included the following:

1. Small sample size of 500 charts reviewed in 5 Mississippi clinics.
2. Limited access to corporately-owned clinics due to Institutional Review Boards.
3. Limited time frame for research project completion.
4. Limited review of lab values to include only A1C results.

Summary

The primary goal of this study was to evaluate Mississippi primary care providers' (PCPs) screening practices for prediabetes in patients 18 years or older who are overweight or obese with one or more risk factors, as well as those ages 45 or greater, with or without risk factors. When prediabetes is discovered early, the development and progression of complications can be slowed or eliminated completely by utilization of recommended lifestyle modifications and medical treatment. According to the CDC,

there are 84.1 million American adults with prediabetes, and the rate of undiagnosed diabetes is highest in younger age groups, aged 20 to 44, which may be directly related to PCPs not abiding by the recommendations of the ADA (CDC, 2017; Cowie, 2019). Once the research project was completed, the researchers were able to determine whether overweight or obese adults were being tested for prediabetes in order to prevent complications of undiagnosed and untreated prediabetes. With the results of this study, the researchers plan to disseminate the findings to PCPs in Mississippi in an effort to increase testing practices and early treatment of prediabetes.

CHAPTER II

Literature Review

The purpose of this study was to determine if Mississippi primary care providers were utilizing the ADA testing guidelines for prediabetes in overweight and obese individuals. It is acknowledged that overweight and obese individuals have an increased risk of developing prediabetes. Detection and treatment of prediabetes is imperative for diabetes prevention, and the following review of current literature indicates that prediabetes testing is not being properly utilized in all primary care settings. The intention was to provide primary care providers with the awareness of the proper guidelines for testing overweight and obese patients for prediabetes. Once an at-risk patient has been identified, it is imperative that proper testing following ADA guidelines takes place to prevent both progression to type 2 diabetes mellitus and complications of prolonged elevated glycemic exposure. This chapter will provide previously explored data on prediabetes screening in overweight and obese patients. The literature reviews illustrate the benefits of prediabetes testing in overweight and obese individuals and benefits of early intervention.

Testing Practices and Adherence to Guidelines

Mehta, Mocarski, Wisniewski, Gillespie, Venkat Narayan, and Lang (2017) studied primary care physicians' knowledge of and adherence to current screening guidelines from the American Diabetes Association (ADA) and United States Preventive Services Task Force (USPSTF) for type 2 diabetes. The team studied the relationship between self-reported adherence to screening guidelines and actual practice application of

the guidelines, as well as referral practices to diabetes prevention and self-management education programs (DPP/DSME). According to the Centers for Disease Control and Prevention (CDC), in 2012, diabetes affected 29.1 million people, with 28% previously undiagnosed. The rate of prediabetes in Americans aged ≥20 years is 86 million with 90% unaware of it. Early detection of diabetes is critical; however, the rate of screening per the ADA/USPSTF's guidelines have been shown to be suboptimal (46%-85%). This study sought to further understand primary care physicians' screening practices and management of newly diagnosed patients with prediabetes and diabetes. Although no hypothesis was stated by the researchers, the objectives of the study were clearly stated. No stated theoretical framework was utilized in this study.

Mehta et al. (2017) utilized online surveys for physicians and electronic medical record reviews (EMR) to conduct this study. Strict patient and physician inclusion and exclusion criteria were utilized. The physician's National Provider Identifier (NPI) number was used to link the survey with the patients for comparison of survey and practice. Eligible patients were followed for 3 years to determine if the screening guidelines were followed. Types of screening tests included fasting or random plasma glucose, oral glucose tolerance test, and hemoglobin A1C.

The physician surveys included questions regarding demographics and practice settings, preferred screening test, factors considered when determining whether to screen patients, preferred guidelines, attitude toward ADA/USPSTF screening guidelines, and recommendations for lifestyle modifications or referrals to DPP/DSME program. Equations were utilized to determine the alignment between physician survey responses and clinical evidence from EMR. Mehta et al. (2017) utilized multivariable logistic

regression models to determine whether physician and practice characteristics influenced adherence to screening guidelines.

In the study conducted by Mehta et al. (2017), 305 physician surveys were completed, with 281 of these physician surveys linked to EMR data of 123,990 patients. The results indicate that 76% of physicians considered screening guidelines important, but that 78% of physicians also rely on clinical experience in determining when to screen patients. Of the physicians surveyed, 71% reported use of ADA's guidelines, 64% reported use of USPSTF's guidelines, and 38% reported use of both ADA and USPSTF guidelines. The results of the physician surveys indicate that, while guidelines are reportedly relied upon in practice, only 26% of the physicians use them 100% of the time and 53% use them more than 70% of the time. When assessing concordance of physicians self-reported utilization of screening guidelines with actual practice, one-third of physicians who reported using the guidelines did not use them in clinical practice. Findings in this study indicate that physicians may not be aware of guidelines, but instead are relying on similar fundamental concepts in screening for diabetes. Screening for prediabetes and diabetes was completed 71% of the time for patients eligible within the 3 years reviewed by researchers in this study. Physicians indicated that hemoglobin A1C (60%) was their preferred screening method for prediabetes and diabetes. According to physician survey responses, approximately 95% of patients diagnosed with diabetes or prediabetes were provided education on lifestyle and diet alterations. Regarding physicians' referral to DPP/DSME, 45% of patients diagnosed with prediabetes and 67% of patients diagnosed with diabetes were referred to these programs.

In the study conducted by Mehta et al. (2017), the characteristics of the physicians surveyed are similar to characteristics of physicians in the United States in general. Therefore, the survey responses can be generalized to physicians across the country. The patient population included a large cohort of patients (123,990), who were followed for 3 years by the surveyed physician. Both the generalizability of the physician sample and the large cohort of patients are strengths in this study; however, there were several limitations noted, as well. This study included surveys which are subject to nonresponse-bias and recall bias, and it utilized retrospective EMR reviews, which are subject to missing or incorrect data and gaps in the medical record. Also, free text data included in the EMR was not accessible to researchers which could limit information necessary for this study. Nurse Practitioners (NPs) and Physician Assistants (PAs) were not included in the PCP population; however, NPs and PAs provide care for a large portion of patients in the United States. Mehta et al. (2017) indicated that areas for future research would include identifying barriers to consistent screening and DPP/DSME enrollment and identifying changes in policy by Medicare and other insurance plans regarding reimbursement of HbA1C for screening.

Tseng, Greer, O'Rourke, Yeh, McGuire, Clark, and Maruthur (2017) performed a descriptive analysis with the purpose of assessing primary care providers' (PCPs) knowledge of recommended screening for diagnosing prediabetes, management of prediabetes, and PCPs' attitudes and beliefs about prediabetes in general. An estimated 70% of prediabetic individuals eventually develop diabetes (Tseng et al., 2017). The ADA is one organization that has established guidelines for screening and management of prediabetes. This study utilized those guidelines to identify any gaps in care provided

by PCPs preventing early diagnosis. According to the ADA, prediabetes is diagnosed with one of the following laboratory tests: fasting glucose of 100-125mg/dl, hemoglobin A1C of 5.7-6.4%, or 2-h post-stimulation glucose of 140-199 mg/dl. Prediabetes is associated with increased mortality, increased risk of autonomic neuropathy, and idiopathic polyneuropathy. Studies have shown that lifestyle interventions are effective in preventing diabetes. There was no theoretical framework identified in this article.

The research objectives being analyzed in this study included the following: PCPs' knowledge of risk factors that should prompt prediabetes screening, laboratory criteria for diagnosing prediabetes and guidelines for management of prediabetes, management practices surrounding prediabetes, and attitudes and beliefs about prediabetes. The results of this study were intended to increase PCPs' awareness and knowledge of ADA guidelines concerning prediabetes, illustrate the importance of screening for prediabetes, and exhibiting proper management of prediabetes (Tseng et al., 2017).

This study was conducted at an annual provider retreat in 2015 that consisted of 156 adult PCPs from 40 multispecialty clinics across the mid-Atlantic region. A convenience sampling method was utilized for this nonexperimental descriptive research study. All 156 of the PCPs in attendance were invited to participate in the survey; 140 of which agreed to participate, yielding 96% participation. All of the participants were given a $10 gift card. PCPs participating included physicians, nurse practitioners, and physicians' assistants. The survey included multiple questions, addressing the following: knowledge of risk factors that should prompt prediabetes screening, laboratory criteria for diagnosing prediabetes, guidelines on recommended therapy for prediabetes,

management practices for prediabetes, attitudes and beliefs regarding prediabetes, and its management concerning lifestyle modification and the use of Metformin (Tseng et al., 2017). There were multiple variables of interest included in this study; however, none were distinguished as dependent or independent variables. This study was exempted by the John Hopkins University School of Medicine Institutional Review Board (Tseng et al., 2017). Survey data was entered into Microsoft Access (2013) to quantify the data obtained. For questions that used a Likert scale, the researchers dichotomized the answers.

Following statistical analysis, key statistics about the participants were identified including the following: 93% physicians, 72% female, 55% white, 23% Asian, 14% African American, and 59% practicing at least 10 years. Key results pertaining to the objectives included that only 6% of PCPs identified all the risk factors for prediabetes, with 17% identifying correct laboratory parameters of fasting glucose and hemoglobin A1C for diagnosing prediabetes. Nearly 90% reported follow-up within 6 months for patients with prediabetes. Less than 11% referred patients to a behavioral weight loss program as initial management of prediabetes. In addition, 99% reported counseling patients on the value of diet and physical activity as initial management; however, only 45% chose 150 minutes or more of recommended physical activity. Ninety-six percent agreed on the importance of diagnosing prediabetes and 86% agreed that patients with prediabetes progress quicker than those with normoglycemia. Of those surveyed, 96% reported that lifestyle modifications reduce that progression and 78% agreed that the use of Metformin reduces the progression also. During a post-hoc analysis, those who were neutral or disagreed with Metformin's ability to reduce the progression from prediabetes

to diabetes were less likely to prescribe Metformin. Multiple barriers to lifestyle modification and the use of Metformin were identified. Interventions for improvement in practice were also identified. Critical gaps were identified concerning PCPs' knowledge and current practice standards to include the lack of using evidence-based practice guidelines. Areas for future research include addressing knowledge gaps related to prediabetes screening and diagnosis, as well as the lack of behavioral weight loss program utilization in prediabetics (Tseng et al., 2017).

Tseng et al., (2017), reported the following strengths in this study: high response rate (90%), use of a comprehensive and detailed survey, and access to the first reported data on PCPs' knowledge related to prediabetes. The researchers identified limitations to include that the sample may not be generalizable, may recall bias, and may cause social desirability bias. This study is highly relevant to the current research project, as both are concerned with bringing awareness to the ADA guidelines and the importance of early diagnosis. This research study recommends future research to address knowledge gaps related to prediabetes screening and diagnosis. Thus, this study explores these two important facets in combating prediabetes.

Mainous, Tanner, Scuderi, Porter, and Carek used a cohort study analyzing a survey to evaluate practicing primary care physicians' attitudes toward prediabetes screening and perceived barriers to diabetes prevention. The investigators submitted questions related to diabetes prevention in the survey. The survey was limited to only United States members of Council of Educational Research Alliance (CERA) affiliated organizations for participation. This study was approved by the American Academy of Family Physicians Institutional Review Board. There was no theoretical framework

identified in this study. The researchers noted that, to their knowledge, this was the first study to focus on attitudes towards prediabetes and how those attitudes affect diabetes prevention among practicing family physicians in the United States of America (Mainous III, Tanner, Scuderi, Porter, & Carek, 2016, p. 670).

The researchers analyzed a survey completed by 1,248 practicing physicians over a two-month time span in 2016. The survey addressed questions related to diabetes prevention, demographics, current diabetes prevention practices, physicians' attitudes toward diabetes prevention, and perceived barriers to diabetes prevention. The genders included in this study were 50.4% male and 40.6% female (p=<.0001). Ethnicities included were 4.4% Hispanic, 81.8% were non-Hispanic white, 4.4% were non-Hispanic black, and 9.4% were Asian/other (p=.003). The age range of the practicing physicians were 20-60+ years and the physician's years in practice ranged from 1-30+ years. The physicians included in the survey were 90.7% MDs, 8.9% DOs, and 0.4% other (Mainous III et al., 2016).

Results of the study concluded that female physicians, younger physicians, minority physicians, and physicians who have been practicing fewer years have a more positive attitude toward the idea of using prediabetes as a diagnostic concept. The survey results showed that 58% of the sampled physicians focused on dietary modifications, weight loss, and increasing leisure time physical activity. The survey concluded that 52.1% of physicians used blood glucose concentrations for their primary mode of testing. A total of 52.4% of the surveyed physicians were following the national guideline or screening recommendation (p=<.0001). The primary method of identifying someone at risk of developing diabetes used in this study was assessing BMI, testing blood glucose

concentrations, inquiring about family history, and other (p=.11). Overall, the study showed that physicians with a positive attitude toward the idea of using prediabetes as a diagnostic concept were more likely to use the American Diabetes Association as their primary guideline for prediabetes screening. The data collected showed that 35.5% of physicians used the current USPSTF guidelines and 25.2% of physicians used the American Diabetes Association guidelines for screening (p=.0001) (Mainous III et al., 2016).

Numerous perceived barriers were identified from the survey. Of the surveyed physicians, 83.2% chose sustaining patient motivation as an extreme barrier to diabetes prevention. Other barriers included: patients' medication compliance, insurance coverage of education for patients, time needed to educate patients on diet and lifestyle change, economic resources of patients, and time for patient follow-ups (Mainous III et al., 2016).

The weakness identified in the study was that new guidelines from the ADA and USPSTF were released four months before the survey was sent out to participating physicians. Therefore, the researchers noted they could not be sure if the physicians who responded were following recently released guidelines within four months of this study, or if the physicians were following the guidelines that were current four months prior (Mainous III et al., 2016).

This article relates directly to our research on assessment of diabetes screening practices of primary care providers in Mississippi. The overall results of this article clearly show that further education on following current guidelines, embracing positive

attitudes toward prediabetes screening, and educating patients are all crucial in diabetes prevention.

Undiagnosed Prediabetes

Selvin, Wang, Lee, Bergenstal, & Cornesh (2017) proposed that prior epidemiologic studies overestimated the amount of undiagnosed diabetes. Left untreated, T2DM can result in renal disease or failure, retinopathy, cardiovascular and peripheral vascular disease, gastroparesis, wound complications, etc. (Hollier, 2018, p. 223). The prior epidemiologic studies had shown that one-quarter to one-third of diabetics are undiagnosed, so the authors conducted a cross-sectional study of U.S. adults 20 years of age or older. Selvin et al. (2017) wanted to provide national estimates of undiagnosed diabetes by using confirmatory tests. In their study, they used the Hemoglobin A1C (HbA1C) and plasma glucose concentrations as confirmatory tests. They used the American Diabetes Association (ADA) guidelines for unclear diagnoses; in other words, a second test should be required to diagnose diabetes. No theoretical framework was identified in this study.

Selvin et al. (2017) proposed the question of whether undiagnosed diabetes estimates from 1988-1994 were overestimated based on the ADA guidelines. The authors conducted a cross-sectional study using survey results from 1988-1994 and 1999-2014. These surveys were from National Health and Nutrition Examination. The authors included non-pregnant U.S. adults 20 years of age and older. They used data from NHANES III- and 4-year survey cycles. They excluded persons with missing fasting glucose or HbA1C, as well as those who self-reported insulin use, but did not report a diabetes diagnosis. The authors wanted to ensure to abide by the ADA guidelines.

Selvin et al. (2017) admitted there were several limitations to their study. First, they admitted they limited their study to the fasting glucose and HbA1C levels in a single blood sample, rather than a second blood sample for confirmation. Secondly, they had surveys which allowed self-reporting of persons diagnosed with diabetes, which may have caused miscalculation. Thirdly, they used only fasting blood glucose measurements in morning samples of NHANES surveys, which is considered less precise. Lastly, NHANES surveyed only non-institutionalized adults, which likely left out a segment of the population.

Selvin et al. (2017) were able to defend their hypothesis of overestimation. They were able to determine a significant decrease from 1988-1994 (16.3%) and 2011-2014 (10.9%). The study showed that the U.S. is doing a better job of screening and diagnosing than was inferred. The authors were also able to determine age and body mass index (BMI) as the major risk factors for diabetes. They pointed out that all patients 45 years of age and older should be screened for T2DM, and that men are more likely to be undiagnosed. Insurance coverage, lack of access to health care, and missed screening practices were discovered to be factors indicating why these undiagnosed diabetics remain undiagnosed (which could create the framework for possible guideline changes in the future).

This study implies that if we, as primary care providers, can decrease the lack of medical care access, increase insurance coverage of screening, and decrease the amount of missed screening practices of those who are high risk the amount of undiagnosed diabetes could be greatly decreased. If primary care providers can decrease undiagnosed diabetes, then the burden created by the complications of T2DM can also be decreased.

Complications of untreated prediabetes and diabetes

Perreault, Pan, Schroeder, Kalyani, Bray, Dagogo-Jack, White, Goldberg, Kahn, Knowler, Mathioudakis, and Dabelea, (2019) as part of the Diabetes Prevention Program Outcomes Study (DPPOS), examined the effects of the Diabetes Prevention Program (DPP) on participants and whether the transition from prediabetes to normoglycemia affected the development of microvascular disease in participants. The DPP was a randomized control clinical trial that utilized intensive lifestyle intervention, Metformin, and placebo to determine the possibility of preventing or delaying the progression of prediabetes to diabetes. There is sufficient evidence to support that microvascular complications occur in prediabetes; and therefore, treatment is appropriate and necessary for this population of patients. Past research has sought to determine the exact threshold at which diabetic complications occur; however, it has proven to be a difficult task and "it may be time to revisit whether prediabetes is actually an earlier form of diabetes" (Perreault et al., 2019, p. 1814).

The hypothesis and research questions were not clearly stated, but Perreault et al. (2019) sought to determine the relationship between development of normoglycemia in prediabetic participants and the prevalence of microvascular disease. The researchers also studied whether the lower prevalence of microvascular disease was related to lower cumulative glycemic exposure. Perreault et al. (2019) did not utilize a theoretical framework for this study.

During the DPP, participants in twenty-seven U.S. research centers were randomized into three groups: intensive lifestyle intervention, Metformin, or matching double-blind placebo. The participants were adults who were overweight or obese (BMI

≥24) and had a diagnosis of prediabetes (fasting plasma glucose 95-125mg/dl and 2-hour plasma glucose 140-199mg/dl). The DPPOS consisted of 85% (2775 participants) of the original cohort from the DPP, with a median follow up of fifteen years. The measured outcomes of the DPPOS were development of diabetes or regression to normoglycemia, and the prevalence of aggregate microvascular disease which was defined as one or more of the following: retinopathy, neuropathy, and nephropathy (Perreault et al., 2019).

Currently, the recommendations for managing prediabetes focus on behavior modification and weight loss. Perreault et al. (2019) with the DPPOS found that of the participants in the group assigned to intensive lifestyle modification there was a 31% increased risk of developing diabetes for those who did not regress to normoglycemia during the DPP when compared to the placebo group. Approximately one-third of the participants in the DPP returned to normoglycemia at some point during the program, and this was associated with lower risk of aggregate microvascular disease development. The researchers noted the relationship between aggregate microvascular disease and regression from prediabetes to normoglycemia and found that there was a 22-30% lower prevalence of microvascular disease in these participants who achieved normoglycemia. In models adjusted for age, sex, race/ethnicity, and baseline A1C, regression to normoglycemia was associated with lower prevalence of aggregate microvascular disease (p=0.005); this relationship was also found in the univariate model (p<0.001) and treatment group model (p=0.011). Despite these findings, the relationship between achievement of normoglycemia and lower rates of microvascular disease was not significant in models considering average A1C over time (p=0.63) or follow up diabetes status (p=0.40). Average baseline A1C (5.96 ± 0.51) and follow up A1C (6.10 ± 0.70)

for patients who never achieved normoglycemia during the DPP were significantly higher than those of participants who regressed to normoglycemia during the DPP at baseline (5.81 ± 0.47) and at follow up (5.76 ± 0.49) (p<0.0001).

During follow-up, the relationship between A1C and prevalence of aggregate microvascular disease was studied, and the risk of developing aggregate microvascular disease increased from 10% to nearly 80% across the A1C range of 4-11%. As the A1C range increased, the prevalence of nephropathy also increased to 40% at an A1C of 11%. For A1C <6% the prevalence for retinopathy was <10%; however, at A1C of >6% the prevalence increased sharply and at A1C of 11% the prevalence of retinopathy was 65%. The researchers found that peripheral neuropathy prevalence was approximately 12%, and it did not differ across A1C ranges from 4-11%. The researchers concluded that when DPP participants transitioned from prediabetes to normoglycemia, there was a decreased prevalence of aggregate microvascular disease, particularly retinopathy and nephropathy (Perreault et al., 2019).

Perreault et al. (2019) noted that a strength of the DPPOS was that the study provided longitudinal outcome data of a large, well-described cohort who participated in the DPP. One of the limitations of the DPPOS is that it was an observational study conducted post-intervention of the DPP. For the participants who were confirmed as diabetic during the DPP, the DPPOS did not reassess those participants' glycemic status which could have regressed back to normoglycemia. The methods for assessing for microvascular disease were not standardized, thus the results are not standardized. The presence of a microvascular disease was not an exclusion criterion from participating in

the DPP; therefore, participants may have had microvascular disease prior to beginning the DPP, which would alter the results and limit the findings of the study.

Perreault et al. (2019) utilized generalized estimating equations to examine the prevalence of aggregate microvascular disease in participants who achieved normoglycemia during the DPP. Individual relationships between normoglycemia and the presence of retinopathy, nephropathy, and neuropathy were established using logistic regression models. The relationship between follow-up A1C and microvascular disease were described using generalized additive models. Perreault et al. with the DPPOS indicates the need for early detection and intervention to prevent complications of prediabetes. Therefore, patients must be tested, and PCPs must intervene early in the disease process for best outcomes (Perreault et al., 2019).

Whitley, Hanson, and Parton used a prospective longitudinal study to compare diabetes screenings between standard practices vs. systematically offered point-of-care (POC) hemoglobin A1c (HbA1c) tests in patients aged 45 years or older (Whitley, Hanson, & Parton, 2017, p.162). Whitley et al. determined differences in identifying unknown chronic hyperglycemia in a single-physician family medicine clinic (Whitley, Hanson, & Parton, 2017, p.162). The researchers in this study intended to prove the importance between using systematic point-of-care HbA1c testing versus the standard practices that are being used.

The researchers used a standard practice arm and an active screening arm. The standard practice arm evaluated 709 patients, with the final number being 324 after their exclusion criteria. The active screening arm evaluated 689 patients, with the final screening number being 164 after their exclusion criteria and configuration of patients

who were unable to participate. Patients who met the inclusion criteria were those aged 45 years or older. Patients who were excluded from the study were patients who were pregnant, had a past medical history of diabetes (type 1 or type 2), had an HbA1c test in the past 12 months or had steroid use (injectable or oral) in the past 3 months (Whitley, Hanson, & Parton, 2017, p. 162). After the patients verbally confirmed their eligibility, they were offered a free POC HbA1c. The participants were mostly Caucasian and there were more females than males. The age range of the participants ranged from 45-91 years of age. A body mass index of morbidly obese (BMI greater than 40), obese (BMI 30-40), overweight (BMI 25-29), and healthy weight (BMI 18.5-25) were used in screening patients. In the active screening arm only 37% of patients had a HbA1c less than 5.6%. This resulted in 53% having a HbA1c in the prediabetes range (5.7%-6.4%) and 10% of patients having a Hba1c greater than 6.5% (Whitley, Hanson, & Parton, 2017). The glycemic outcomes were compared between the active and standard practice arms. The X^2 analysis method showed that the glycemic outcomes vs methods (active vs standard) were statistically different from one another (p=0.005) (Whitley, Hanson, & Parton, 2017 p. 163).

This study by Whitley et al. (2017) concluded that 63% of patients who were systematically screened were unknowingly living in chronic hyperglycemia states compared to 41% under standard practice testing. The researchers also noted that in standard practice, blood glucose was the most common screening method used. HbA1c is durable and more accurately reflects sustained hyperglycemia over a 3-month period as compared to fasting or random glucose (Whitley, Hanson, & Parton, 2017, p. 163-164).

Overall, the researchers presented a thorough article with research that directly relates to the importance of screening systematically to diagnose prediabetes and diabetes. The researchers noted that they did not investigate what influenced or prevented the clinicians from screening patients. Future research areas identified included (1) how to improve screening programs for chronic hyperglycemia, (2) methods to facilitate glycemic curve, and (3) benefits of these screening and health initiatives on outcomes, including reductions in microvascular complications, economic cost impact, and change in quality of life (Whitley, Hanson, & Parton, 2017, p. 164).

Whitley et al. highlights the number of patients going undetected with prediabetes due to the lack of screening. The current research interests focus on whether primary care providers are screening according to the American Diabetes Association guidelines, which requires PCPs to diagnose patients who are overweight or obese with one or more additional risk factors for prediabetes using HbA1c testing. This study proves that diagnosis by glucose alone may initially be missed until the glycemic curve fully shifts upward, crosses the diagnostic threshold, and bothersome symptoms develop, impacting quality of life. (Whitley, Hanson, & Parton, 2017, p. 164).

HbA1c may be the superior screening method because it can effectively identify individuals at risk early on in the disease process. The data collected in this study clearly shows that systematically screening for prediabetes with HbA1c in patients who are overweight or obese, in age range, or have one or more risk factors set forth by the American Diabetes Association, have a better outcome and are diagnosed as prediabetic earlier. Diagnosing patients with prediabetes early in the disease process provides the patients with a far better prognosis, including less microvascular changes and ultimately

give the patients more control over their long-term health with diabetes. The results of this study show that further education on following current guidelines, systematically screening, and the importance of HbA1c testing versus blood glucose are imperative to providing the best of quality of care for patients (Whitley et al., 2017).

Interventions

Stentz, Brewer, Wan, Garber, Daniels, Sands, and Kitabchi (2017) performed a randomized, controlled trial for the purpose of assessing the effect of a high protein (HP) diet versus a high carbohydrate (HC) diet, on remission of prediabetes to normal glucose tolerance. Obese, prediabetic, male and female subjects were evaluated after undergoing 6 months of dietary interventions. Researchers also looked at insulin sensitivity, weight loss, lean and fat body mass changes, inflammatory markers, and cardiovascular risk (CVR) factors of the subjects. According to the Centers for Disease Control and Prevention (CDC) National Diabetes Statistics Report of 2014, there are 29.1 million people with diabetes, 8.1 million of which are undiagnosed. Obesity is the most prevalent risk factor for diabetes with 90% of diabetics being either overweight or obese (Stentz et al., 2017).

Treatment of obesity plays a vital role in the prevention or delay of diabetes and treatment of those diagnosed with prediabetes. Studies have shown that reductions in obesity lead to improved glycemic control and overall health. Per the American Diabetes Association (ADA) guidelines, any one of the following labs are diagnostic for prediabetes: A1c 5.7-6.4%, fasting plasma glucose (FPG) 100-125mg/dL, or 75-g oral glucose tolerance test (OGTT) 140-199mg/dL. The ADA recommends diet and exercise,

as well as the consideration of prescribing Metformin as the standard of care for prediabetes. Metformin has side effects and is often needed long term. Therefore, this study is focused only on the benefits of a HP diet over a HC diet on remission of prediabetes to normal glucose tolerance, insulin sensitivity, weight loss, lean and fat body mass changes, inflammatory markers, and CVR factors of the subjects included in the study. There was no theoretical framework identified in this study.

The research objective being analyzed in this study by Stentz et al. (2017) included determining the effect of a HP diet vs a HC diet on the remission of prediabetes, the effects on metabolic parameters, and the effects on lean and fat body mass after 6 months of dietary interventions. The results of this study were intended to provide education and research on the effectiveness of HP dietary interventions in accomplishing remission of prediabetes to normal glucose tolerance (NGT).

This study was conducted at the General Clinical Research Center (GCRC), which is where all participants were seen weekly during the study. Of the 223 subjects that were screened by phone, 178 of them signed a consent to participate. There was an extensive list of exclusion and inclusion criteria resulting in only 38 subjects meeting all of the criteria to be included in the study. The subjects were randomized into diet groups to include 18 subjects in the HP group and 20 subjects in the HC group. Of the 38 participants, 14 total subjects dropped out within a few weeks leaving 12 subjects in each group that completed the 6-month study. Independent variables included the HP diet and the HC diet. Dependent variables included the participant's test results upon completion of the study. This study was approved by the Institutional Review Board of the University of Tennessee Health Science Center (UTHSC) (Stentz et al., 2017).

At baseline all subjects underwent a history and physical (H&P), height, weight, blood pressure (BP), waist circumference, standard OGTT, mixed meal tolerance test (MTT), and multiple other lab and diagnostic tests. Each participant's caloric needs were determined based on their resting metabolic rate (RMR), then 500kcals/day were subtracted to promote a weight loss of 1-2 lbs. a week. Subjects were then given a diet plan and either HP or HC pre-packaged frozen meals, three meals a day plus snacks were provided. The subjects had some choices regarding their meals but were expected to follow the meal plan once it was given to them. They were weighed and picked up their meals and daily menu record at their weekly visits to GCRC. At the end of the 6-month trial, the subjects were re-assessed, and all lab and diagnostic testing were repeated for a comparison analysis (Stentz et al., 2017).

Statistical analysis was conducted with SAS V.9.3 (SAS Institute, Cary North Carolina, USA), utilizing the Wilcoxon rank-sum test and the Wilcoxon signed-rank test. The main outcomes examined included the remission of prediabetes, insulin sensitivity, CVR factors, inflammatory cytokines, and changes in lean and fat mass with comparison from baseline to 6 months post trial. At baseline, the two groups were not statistically different. However, at 6 months, the HP diet group had a 100% remission of prediabetes to NGT, compared to the HC diet group with only a 33% remission. Remission of prediabetes to NGT is considered if the subject at 6 months meets both of the following: FPG <100mg/dL and a 2-hour OGTT <140mg/dL. Both groups had significant weight loss. The HP group showed significant improvement over the HC group regarding HgA1c and insulin sensitivity also. CVR factors were reduced in both groups; the HP group showed a greater reduction. The HP group showed greater improvement in insulin

sensitivity and glucose disposal evidenced by the OGTT and insulin results. On both the OGTTs and MTTs, the HC group had higher glucose and insulin levels at 6 months. The HP group showed a significant increase in lean mass (LM) % and a decrease in fat mass (FM) %; whereas the HC group showed a decrease in both the LM and FM (Stentz et al., 2017).

Stentz et al., 2017, reported the strengths of this study, which included a randomized control trial with all food and diet plans being provided at weekly visits. This is also the first study on lifestyle interventions that showed at 100% remission of prediabetes, and the use of adjustable diet plans for approximately $13 per day. Identified weaknesses included a small sample size and a possible limitation due to the testing method used with African Americans in regard to insulin sensitivity.

This study will benefit the current research project by providing data to support the use of a HP diet in those diagnosed with prediabetes as part of the lifestyle modifications that are recommended by the ADA to move patient from prediabetes to normal glucose tolerance. In the current research, we are examining interventions utilized or implemented by the PCP for treatment or management of prediabetes including diet and nutrition education. This article is relevant to the current research interest in that it shows 100% remission of prediabetes to normal glucose tolerance with the use of the HP diet. Participants on the HP diet showed significant improvement in insulin sensitivity (p=0.001), cardiovascular risk factors (p=0.04), inflammatory cytokines (p=0.001), oxidative stress (p=0.001), and increased lean body mass percentage (p=0.001), at 6 months compared to the HC diet participants (Stentz et al., 2017).

Moin, Damschroder, Youles, Makki, Billington, Yancey, and Richardson (2016) proposed implementing an algorithm for overweight or obese veterans to be screened for prediabetes. One in four veterans is diabetic, and some may be overlooked for screening. Moin, et al. (2016) proposed that a prediabetes algorithm for overweight or obese veterans may increase screening practices. Type 2 Diabetes prevention is a national goal for the Veterans Health Administration (VHA).

Moin, et al. (2016) conducted an implementation project with the Veterans Affairs (VA) Diabetes Prevention Program (DPP) between 2012 and 2015. Information was gathered from the VHA through electronic medical records (EMRs) from 2012-2015. Over the prior six to twelve months, interviews, and/or laboratory tests were used to classify patient's status as normal glycemic status, prediabetes, or diabetes. There was no theoretical framework identified.

Moin, et al. chose a group of veterans who had attended orientation for MOVE!, a weight loss program. In order to be considered in the study, the veterans must live less than a one-hour distance from the testing facility and had to be referred, either by a clinician or self-referral. The veteran also had to have a BMI of 25 or more and one additional obesity-related conditions, such as hypertension (HTN). Moin, et al. excluded patients previously diagnosed as diabetic or prediabetic. The sample included 1,830 patients, at three Veterans Affairs Medical Centers (VAMCs), who were evaluated including medical sites on the West Coast, Midwest, and East Coast.

Moin, et al. proposed an algorithm in which the different sites implemented in different manners. All sites invited MOVE! participants to attended laboratory

screenings if they had no prior history of prediabetes or diabetes. The laboratory screening relied on A1C testing.

Moin, et al. found 29% (n=530) had normal glycemic status, 28% (n=504) were prediabetics, and 43% (n=796) were diabetics. Normal glycemic patients were, on average, 53 years of age with BMI of 34.8. Prediabetics were on average 58 years of age, had a BMI of 34.8, and an A1C of 6.0. Diabetics were, on average, 61.5 years of age and had a BMI of 37.1. Comorbidities occurred more frequently among diabetic patients than normal glycemic status patients.

Moin, et al. discussed multiple different points to be considered. They felt population-wide diabetic screening was lifesaving, despite being controversial. They discussed the need for considering when screening should take place and felt there was a lack of awareness that prediabetes is a medical problem. Also, short office visits with long problem lists could result in decreased priority on prediabetic screening. Each of these points of discussion were valid considerations.

Moin, et al. found multiple limitations to their study. First, they found that lack of confirmatory testing limited validation. Next, they found that their population only included mostly male Veterans. Lastly, they found that using only Veterans who attended MOVE! program orientation may have excluded other high-risk Veterans, as many may not have been referred or attended the MOVE! orientation. Although there were limitations, this study did produce an increase in screening based on the algorithm.

The current research project examining prediabetes screening practices in overweight individuals will help providers understand gaps in early diagnosis and

management of prediabetes. Secondly, as included in the current research, Moin, et al. excluded patients with a history of diabetes and prediabetes. Next, the current research also includes a population with a BMI above 25. Current research also includes A1C as its chosen screening practice, as in this study. Lastly, this study will answer the question of if primary care providers testing for prediabetes with A1c for all adult patients that are overweight or obese and have one or more risk factors (first degree relatives with diabetes, hypertension (blood pressure above 140/90), high risk race or ethnicity, or history of cardiovascular disease (stents, myocardial infarction, angina).

Theoretical Framework

Nola Pender's Health Promotion Model (HPM) is a theoretical model that "depicts the multifaceted natures of persons interacting with their environment as they pursue health" (Pender, 1996). This theory proposes that an individual's past experiences and personal factors impact health promoting behaviors. The HPM considers the following factors and their relationship to the development of a health promoting behavior: prior related behavior; personal factors, including biological, psychological, and sociocultural; perceived benefits; perceived barriers; perceived self-efficacy; activity-related affect; interpersonal influences; situational influences; commitment to plan; and immediate competing demands and preferences (Pender et al., 2006).

Two examples of how the HPM can be used in research and in patient care are the Health Promoting Lifestyle Profile (HLPL) and the Exercise Benefits-Barriers Scale (EBBS), which were developed using the HPM as a basis. These instruments are utilized by health care providers to assess health promoting lifestyle characteristics of patients and to educate patients in this area (Pender et al., 2006).

Primary care providers (PCP) are involved in the HPM by empowering the patient through education and development of an action plan to alter the environmental influences and perceived barriers to action. Benefits of using the HPM in practice are that it is applicable across the lifespan, and it is suitable for use in numerous settings. The goal of the HPM is to empower patients to overcome perceived barriers, competing demands, situational influences, and interpersonal influences to achieve a health promoting behavior (Pender et al., 2006).

The HPM was utilized in two of the following research articles to gain better understanding of health promoting behaviors in urban black women and in urban adolescents (Hepburn, 2018; Norris & Ayres, 2016). Eden, Orleans, Mulrow, Pender, and Teutsch, as part of a panel of experts for the United States Preventative Services Task Force (USPSF), studied the effects of PCP counseling on adults and its effect on development and maintenance of physical activity over the long-term which is a health promoting behavior (Eden et al., 2002).

In a study conducted by Norris and Ayres on the theoretical relationship between psychosocial factors and health promoting behaviors of adolescents, the researchers recognized that behaviors developed during adolescence will affect a person throughout his or her life. During this developmental phase, it is critical to begin health promoting behaviors early to avoid development of preventable disease in adulthood. Researchers guided their study by using Nola Pender's HPM. The researchers focused their study on the relationship between the specific health promoting behavior of physical activity and the following psychosocial factors: perceived benefits, perceived barriers, self-efficacy, parent social support, and friend social support (Norris & Ayres, 2016).

Norris and Ayres hypothesized that "perceived benefits (BE), self-efficacy (SE), parent social support (PS), and friend social support (FS), are positively related to health-promoting physical activity behaviors (HPB) in urban adolescents, and perceived barriers (BA) are negatively related to health promoting physical activity (HPB) in urban adolescents" (Norris & Ayres, 2016, p. 17-18). The study was a correlational research design conducted in an urban high school with a diverse population of 108 participants who were fluent in English and enrolled in grades 10-12. The sample of participants was selected using a convenience sampling strategy. Once parental signed consent and student verbal assent were received, the participants were given a questionnaire, which included demographic information and the Adolescent Lifestyle Profile (ALP-R2) which is a modified version of the Health Promoting Lifestyle Profile II (HLPL-II). This instrument was used to measure the relationship between independent variables (BE, BA, SE, PS, and FS) and physical activity as a health promoting behavior (Norris & Ayres, 2016).

Of the participants in the study, 45.4% were male and 54.6% were female with the mean age of 16.9 years. The sample included 41.1% African Americans, 37.4% Caucasians, 19.6% Hispanic, and 1.9% Asian Americans, and according to school level socioeconomic data, approximately two-thirds of the students were from low-socioeconomic backgrounds. Relationships between the independent variables of perceived benefits, perceived barriers, self-efficacy, parent social support, and friend social support with development of health promoting behaviors were calculated using Pearson's correlation and multiple regression analysis. The results of the study support the researchers' hypotheses and "positive relationships were found between BE (r=0.580,

p=0.000), SE (r=0.599, p=0.000), PS (r=0.519, p=0.000), FS (r=0.670, p=0.000), and HPB, whereas a negative relationship was found with BA and HPB (r= -0.474, p=0.000)," (Norris & Ayres, 2016, p. 19). Norris and Ayres concluded that the five psychosocial factors tested were significant indicators of development of health-promoting behaviors. Friend social support was the most predictive, and parent social support was the least predictive of development of a health-promoting behavior in adolescents. A strength of this study was that the sample represented minority and low-income adolescents, which recent research suggests has disparities in health-promoting behaviors. The importance of establishing health promoting behaviors in adolescence is of vital importance to prevent disease development and progression in adulthood (Norris & Ayres, 2016).

Health-promotion behaviors among urban black women were studied by Hepburn for the purpose of gaining a better understanding of the variables that affect these behaviors. Hepburn's study focused on the following research question: "What are the relative contributions of health literacy, self-efficacy, and readiness for change to health promotion behaviors in urban Black women?" (Hepburn, 2018, p. 3). The study was guided by Nola Pender's HPM, and the specific psychosocial factors that were assessed from the HPM were self-efficacy and development of health-promoting behaviors (Hepburn, 2018).

This study was a nonexperimental descriptive cross-sectional study, which included a sample of 132 black women between the ages 30-64 living in a U.S. metropolitan area. Data was collected using pen-and-paper surveys at the Clinical

Translational Science Center at Bellevue Hospital in 2015. The survey included a demographic profile, a health literacy instrument (Newest Vital Sign, [NVS]), a self-efficacy scale (New General Self-Efficacy Scale, [NGSE]), a readiness for change questionnaire (Health Risk Instrument, [HRI]), and health promotion behavior profile (Health Promotion Lifestyle Profile II, [HLPL-II]). Data analysis included correlation of study variables using Pearson correlation statistic. Spearman's rho was used to describe the relationship between responses of obese participants (BMI≥30) and normal weight participants (BMI<25) (Hepburn, 2018).

Of the participants in the study conducted by Hepburn, 43.2% were obese, 29.9% were overweight, and 23.1% were normal weight. In this study, obesity (BMI≥30) was correlated with fewer health promotion behaviors and obese participants were "less likely to seek regular medical care (r_s=-.316, $p < .05$) or control their hypertension (r_s= -.297, $p < .05$) than those with a normal BMI" (Hepburn,2018, p. 8). Hepburn reports that 57.6% of participants scored low on the HLPL-II which indicates that they are less likely to engage in health promotion activity; and therefore, these participants were more likely to suffer from hypertension (r_s= -.120, $p < .05$) and to be prescribed anti-hypertensive medications (r_s= -.005, $p < .05$). Low HLPL-II scores were correlated with diets low in fruits and vegetables (r_s= -.114, $p < .05$) and with lack of regular exercise (r_s= -.162, $p < .05$); on the other hand, participants with high HLPL-II scores were more likely to exercise regularly (r_s= -.365, $p < .001$). Hepburn reported that health literacy was limited or inadequate in 67% of the study's participants. Participants' readiness for change was assessed using the HRI and the results indicated that 67% of

participants would like to change but are not actively involved in changing (Hepburn, 2018).

Hepburn concluded that a participant's health literacy, self-efficacy, and readiness to change were related to participation in health promoting behaviors ($p < .001$); with the most significant correlation existing between readiness for change and health promotion behaviors. The study population was similar demographically to the U.S. census demographic statistics for black women; therefore, the results can be generalized to this population. Due to the nature of the study, one limitation was that participants who were illiterate or did not speak or read English were excluded; therefore, the sample may have been affected. Hepburn suggested further research to explore the discrepancy between BMIs in black and white women.

Eden, Orleans, Mulrow, Pender, and Teutsch conducted a study to examine whether physical activity counseling provided to adults in primary care settings was effective in improving and maintaining physical activity levels. Since many of the chronic diseases in the United States can be directly linked to a sedentary lifestyle, it is of utmost importance that clinicians are involved in promoting physical activity.

The Healthy People 2010 guidelines recommended that adults should engage in "30 minutes of moderate activity on 5 or more days per week or 20 minutes of vigorous activity three or more times per week" (Eden et al., 2002, p. 208). Despite this recommendation, only 25% of Americans actually achieve that goal and 29% of Americans report participating in no regular physical activity. In 1996, the United States Preventative Services Task Force (USPSF) recommended that clinicians counsel patients on increasing physical activity levels based on the evidence that increased physical

activity is beneficial to overall health and disease prevention. Eden et al. prepared this study for the USPSTF to address the following questions: "Do adults counseled by primary care clinicians improve or maintain physical activity behavior?" and "If so, what types of interventions are most effective?" (Eden et al., 2002, p. 208).

The review conducted by Eden et al. was a systematic review of controlled trials, case-control studies, and observational studies, which were conducted between 1994 and March 2002. These were found either in the Cochrane Database of Systematic Reviews, the Registry of Controlled Trials, MEDLINE, Healthstar, or Best Evidence databases. Of the studies found, seven randomized controlled trials and one non-randomized control trial met the inclusion criteria for this review.

The studies were analyzed by the researchers and rated as "good," "fair," and "poor." Two of the studies were considered "good," five were considered "fair," and the other was deemed "poor;" and it was excluded from the review. Data was abstracted from the included studies and information regarding "setting, patient participants, providers, interventions, adherence, and outcomes" was reviewed (Eden et al., 2002, p. 209). Of most interest to Eden et al. was "the proportion of patients who met the Healthy People 2010 goal in the 'long term'" which was defined as 6 months after randomization (Eden et al., 2002, p. 209).

In this review, six of the studies indicated that counseling for increasing physical activity was either modestly effective or not effective at all at 6 to 24 months. Two of the trials demonstrated no effect on physical activity from counseling at 6 or more months. Three of the studies in this review addressed multiple behaviors, including physical activity, with two of these studies reporting short and long-term adherence to increased

physical activity. However, the results indicate an increase in the number of exercise sessions or in time spent exercising, not at increase in the number of participants engaging in physical activity. The interventions that were related to increased adherence were a written prescription for physical activity and more intensive counseling interventions for women than men (Eden et al., 2002).

Data reviewed by Eden et al. provided limited details on the counseling intervention, follow-up rate, baseline differences in physical activity, and provider adherence to counseling; therefore, the results of this review do not clearly relate clinician counseling to increased physical activity in patients. Eden et al. determined that "although research suggest that counseling can be effective in some specific situations, the evidence is insufficient to generally conclude that counseling is effective" (Eden et al., 2002, p. 214).

The Health Promotion Model will be used in guiding this study to better understand the relationship between providers and patients in a collaborative effort to achieve better health. The provider must be knowledgeable on current screening regulations, diagnostic criteria, and treatment practices to be able to service their population. The patients are encouraged to take control of their care by utilizing information provided to lessen their chances of developing possible life-threatening diseases. During this research project, the researchers hope to recognize high-risk populations, identify screening practice service failures, and single out where care and education have been lacking. This research will help guide and reinforce the education of providers in standards of practice to ensure the best possible care is being provided. With early testing, planning, and lifestyle modification, providers can play a vital role in

decreasing the risk of transition from prediabetes to diabetes. With this proactive treatment plan of high-risk populations, PCPs can enact change that targets that population to reduce risks of diabetes, which will decrease chances of diabetic related complications.

Summary

The research articles were gathered to support the relevance of the current research project. The research data worksheet was formed following a thorough review of the literature and the ADA guidelines for prediabetes. This data worksheet was used to assess prediabetes testing practices among PCPs in Mississippi. The current research showed there is a deficit in adequately testing for prediabetes. Many barriers like patient compliance and insurance coverage attributed to physicians not properly testing patients. The primary intention in surfacing current research was to allow primary care providers to evaluate whether they were appropriately screening patients for prediabetes.

Chapter III

Methodology

The Centers for Disease Control and Prevention (CDC) estimate that 12.2% (30.3 million) of American adults have diabetes and that 7.2 million of those people are undiagnosed (CDC, 2015). In Mississippi, diabetes affects 13.6% of the population (308,295), and the state has the highest rate of diabetes in the country (CDC, 2015). High-risk patients are patients who are overweight or obese and have certain comorbidities including, but not limited to, CVD and essential hypertension. These high-risk patients should be diligently tested for prediabetes and educated on lifestyle modification techniques that will decrease their chance of becoming prediabetic or diabetic.

The purpose of this study was to determine if primary care providers were performing A1C testing for prediabetes for patients 18 and older that are overweight, obese, or have a BMI that is 25 or greater and have additional risk factors for prediabetes. The purpose of this study was also to determine if patients who are 45 or older without further risk factors were being tested appropriately according to ADA guidelines. Of the patients found to have been tested, the researchers determined if lifestyle modifications and/or prescriptions were being provided to prevent prediabetes or to prevent transition from prediabetes to diabetes.

Design of the Study

The researchers utilized a nonexperimental, quantitative research design utilizing retrospective chart reviews to determine if primary care providers were adhering to ADA

guidelines for testing overweight and obese patients for prediabetes. The study focused on the following two adult populations: overweight and obese adults with an additional risk factor for diabetes and adults over 45 years old with or without risk factors. The data collection worksheet was utilized by the researchers to determine if these populations of patients were tested appropriately, diagnosed according to ADA guidelines for prediabetes, and treated according to the ADA guidelines for prediabetes. The researchers also determined if patients age 45 years and older were being tested according to ADA guidelines. Data was collected by accessing electronic medical records (EMRs) using systematic sampling of adult patients age 18 years or older. The researchers collected data by accessing charts in five primary care clinics in Mississippi. The researchers determined, in those confirmed to be prediabetic, if they were receiving treatment and/or lifestyle modifications on prevention of transition to diabetes.

Research Setting

This study took place in five primary care clinics in Mississippi. The researchers gathered data between the hours of 8 a.m. and 5 p.m. under staff supervision.

Population and Sample

This study took place in five primary care clinics in Mississippi. The first target population was patients who were 18 years and older, who were considered obese or overweight based on diagnosis code or BMI who also presented with one or more risk factors for CVD or a diagnosis of Essential Hypertension. The second target population was patients who were 45 years and without other risk factors. The researchers conducted a retrospective chart review on electronic medical records of adult patients aged 18 years or older using a systematic sampling technique. Charts were selected

based on inclusion dates of January 1, 2019 to December 31, 2019 and age ≥18 years. From this list, systematic sampling was utilized; every 5th chart was included in the study, totaling 100 charts per clinic. Once the EMRs were selected for the study, the researchers utilized a data collection worksheet to determine if those EMRs met inclusion criteria for the study of: age ≥18 with either a diagnosis of overweight or obesity or BMI >25 and presence of additional risk factors of hypertension or cardiovascular disease, or age ≥45 with no BMI requirement and no additional risk factors. The systematic convenience sample originally consisted of 500 charts, which divided up to 100 from each clinic. Of those, 434 met the above requirements.

Protection of Subjects

Approval was obtained from the Mississippi University for Women Institutional Review Board prior to data collection. Data was gathered through retrospective chart reviews that included no direct patient contact. Data collected remained confidential and in the sole possession of the researchers and did not contain any personal or identifiable information. Because the study was completed through retrospective chart reviews, it included no risk or direct benefit to the patients. Informed consent was obtained by every clinic manager where the study took take place. At the conclusion of the study, all forms of data collection were shredded and permanently erased.

Methods of Data Collection

The researchers reviewed 100 charts each from five primary care clinics in Mississippi to determine if primary care providers were testing, treating, and educating patients that are 18 years and older who were confirmed to be obese or overweight and had risk factors for CVD or a diagnosis of essential hypertension. There was also a

secondary population to determine if patients who were 45 years and older with no identifiable risk factors were being tested, treated, and educated, as well. The researchers utilized the data collection worksheet to examine the testing practices of PCPs by reviewing documentation in the medical record between January 1, 2017 and December 31, 2019. Data was collected between 8 a.m. and 5 p.m. in each of the five clinics while under staff supervision. Charts were included if they met the inclusion criteria for the study listed above. Exclusion criteria included patients under the age of 18 years old, patients who were pregnant during time of study, and patients who had a previous diagnosis of diabetes. The researchers collected all necessary data in one day utilizing the EMR. The data was recorded on a data collection worksheet that consisted of inclusion criteria and applicable continuum of care results.

Methods of Data Analysis

The researchers designed a data collection worksheet that was utilized for the chart reviews. The data collection worksheets included the following information: age, gender, race, provider type, payor source, diagnosis, testing, and treatment/education. The data was analyzed using descriptive statistics including, but not limited to, frequency distributions and percentages. The data was analyzed using SPSS 26 software. Chi-square testing of independence was also conducted to discover if there were any relationship between categorical variables. Data was analyzed for provider adherence to ADA guidelines for testing and treatment of patients that are considered high risk for developing diabetes.

Summary

The researchers assessed whether PCPs in Mississippi were testing for prediabetes according to the ADA guidelines. The researchers determined, in those confirmed to be prediabetic, if they were receiving treatment and/or lifestyle modifications on prevention of the transition to diabetes. The researchers also determined if patients age 45 years and older were being tested regardless of BMI according to ADA guidelines. The researchers gathered their data within clinic business hours of 8 a.m. and 5 p.m. under staff supervision. The researchers utilized a randomized sample of 100 patients from five different clinics in Mississippi. The researchers also maintained patient privacy and protection by maintaining confidentiality and properly disposing of any data collected after the study was completed. Data was analyzed including patient demographics, research criteria, and treatment options listed above that adhere to ADA guidelines.

Chapter IV

Presentation of Findings

Left untreated, prediabetes can progress to diabetes. Progression to diabetes can impose an astronomical burden. Diabetes complications may go unnoticed because patients may be asymptomatic, and significant damage may have already occurred by the time they are diagnosed (Cowie, 2019). With screening practices of overweight and obese patients, the level of undiagnosed prediabetes and damage from undiagnosed diabetes can be reduced. The American Diabetes Association (ADA) has published *Standards of Medical Care in Diabetes* to guide patient care for those at risk for developing diabetes or who have already developed diabetes. The guidelines state that overweight and obese adults with one or more risk factors should be screened (ADA, 2019).

The primary goal of this study was to evaluate Mississippi primary care providers' (PCPs) screening practices for prediabetes in patients 18 years or older who are overweight or obese with one or more risk factors, as well as those 45 or greater with or without risk factors. The risk factors examined were angina, MI, coronary stents, and hypertension. After determining screening practices, the study further examined PCPs' management of prediabetes. The management practices examined were if the PCP prescribed Metformin and/or lifestyle modifications (diet/exercise) on patients identified as prediabetic.

A nonexperimental, quantitative research design utilizing retrospective chart reviews in five different primary health clinics in Mississippi was used to evaluate the research questions. All charts reviewed were electronic medical records. The patients

were systematically selected, were 18 years or older, obese or overweight, and had at least one additional risk factor for diabetes. Also, patients ≥ 45 years old were included with no body mass index (BMI) or risk factor requirements. Pregnant women and patients with previous diagnoses of diabetes were excluded. The data was collected from charts dated January 1, 2019 – December 31, 2019. Further information collected included patient demographics (age, gender, race, and payor type), provider type, diabetes diagnosis history, A1C screening, A1C result, and interventions. Although 500 patient charts were reviewed as initially proposed, only 434 patient charts were included due to the exclusion criteria.

Participant Profile

Age: The sample population was divided into 18-44 years of age and 45 years of age or older. Of the sample population, 38.2% were 18-44 years of age. The remaining 61.8% of sample population were 45 years of age or older.

Gender: The sample population was divided into male and female. Of the sample population, 42.4% were male. The remaining 57.6 % of the population were female.

Race: The sample population was divided into African American, Caucasian, and other. The sample population was 30.9% African American, 65% Caucasian, and 3.9% other race.

Provider type: The provider categories were divided into Nurse Practitioner, Medical Doctor, Doctor of Osteopathy, and Physician Assistant after data collection, the categories were narrowed to Medical Doctor and Nurse Practitioner. The providers were 72.8% Nurse Practitioners and 27.2% Medical Doctors.

Payor Source: The Payor sources were divided into Medicare/Medicaid, Commercial, Private Pay, and none. Medicare/Medicaid made up 29.7%, Commercial made up 60.8%, Private pay made up 4.8%, and None made up 3.7%.

Overweight, Obese, or BMI ≥25: Within the last three years, has the patient been diagnosed as overweight, obese, or have a BMI ≥25? The criteria were broken into yes and no. The results indicated 74.3% were diagnosed as obese, overweight, or had a BMI of 25 or more within the prior 3 years. The results indicated 25.7% had no diagnosis of overweight, obese, or BMI greater than 25 within the prior 3 years.

Age ≥18 years with one or more risk factor: Is the patient ≥18 years of age with one or more risk factor for CVD or Essential Hypertension? The categories were broken into yes and no. It was found that 13.8% had risk factors of CVD or Essential Hypertension, and it revealed 86.2% did not have one or more risk factors for CVD or Essential Hypertension.

Age ≥ 45: Is patient ≥45? The patient sample revealed that 61.8% of the patient population was 45 years or older, and 38.2% were younger than 45 years of age.

A1C: Was an A1C completed? The sample population revealed that 35.3 % of the population were screened by A1C, 40.6% were not screened, and 24.2% were not recorded.

A1C Result: Did A1C fall between 5.7%-6.4% (prediabetes)? The sample population revealed 19.1% of the population A1C screenings fell within the prediabetes range (5.7%-6.4%), 15.9% of the population were screened and did not have an A1C within the prediabetes range, and 65% were not recorded.

Interventions Implemented: If prediabetes was indicated, what interventions were implemented? Lifestyle modifications were initiated in 22.5%, Metformin were initiated in 53.5%, and both Lifestyle modifications and Metformin were included in 23.9% of the sample populated who were screened and revealed to be diagnosed with prediabetes.

It was determined that A1C screening was necessary in 74.7% of the population, according to the guidelines.

Findings

The total sample population included 434 patients. Of the 434, 342 (74.65%) met the ADA guidelines for testing. Of the 324 who met the testing guidelines, 149 (34.33%) were tested. There were 166 patients who were in the 18-44 age range, and 103 patients out of the 166 had a diagnosis of obesity, overweight, or a BMI over 25. Of the 103, 56 (33.73%) had an additional risk factor for diabetes.

Research Question 1: Are primary care providers testing for prediabetes using the A1C of overweight or obese patients ages18 years old or older and have one or more of the following additional risk factors for prediabetes, history of CVD (angina, MI, or coronary stents) or a diagnosis of Essential Hypertension?

In this study, of the 18-44-year-old range (N=166), 56 (33.76%) met the testing guidelines. Of the 33.76% that met the criteria, 21 (37.5%) were tested.

Research Question 2: Are primary care providers testing for prediabetes using the A1C of patients 45 years old or older, regardless of risk factors?

Of the 268 patients who were 45 years old or older, 128 (47.76%) of them were tested.

Research Question 3: For prediabetic patients with A1C results between the ranges 5.7% -6.4%, are PCPs prescribing Metformin and/or lifestyle interventions?

The ADA recommends lifestyle modifications such as diet, exercise, and/or weight loss as well as medication management (Metformin) to decrease the risk of progression from prediabetes to diabetes. The study revealed 83 patients identified in the sample population as prediabetic. Of the 83 identified, 71 had an intervention recorded.

Trends among provider type: It is always intriguing to see the difference in provider types and their screening practice differences. Nurse practitioners were the provider type for 316 of the 434 sample patients. Medical Doctors were the provider type for 118 of the 434 sample patients. For the patients in the 18 to 24 age group (N=166), 56 (33.76%) met the guidelines for testing. Of those that met the guidelines, only 21 patients were tested. Of the 21 patients that were tested, 15 of those patients were tested by nurse practitioners and 6 by medical doctors. There was a total of 268 patients who were 45 years of age and older. According to the testing guidelines, all of these patients should be tested. Only 128 (47.76%) were tested for prediabetes. However, there were no statistically significant differences in screening practices by provider type found in this sample (p=0.449).

Interventions for those diagnosed as prediabetic: The study revealed that 83 patients identified in the sample population were prediabetic. Of the 83 identified as prediabetic, 71 of those patients had an intervention recorded. Providers were broken down by categories: 22.5% recommended lifestyle modifications, 53.5% initiated Metformin therapy, and 23.9% used both lifestyle modifications and Metformin therapy. Of the 71 patients, nurse practitioners provided 62 of those patients with lifestyle

modifications, Metformin, or both (lifestyle modifications and Metformin); whereas, medical doctors provided 9 patients with Metformin or both (lifestyle modifications and Metformin).

Summary of Findings

The researchers' findings from the retrospective review of 500 patient charts from five different primary health clinics in Mississippi are presented in this chapter. The data analyzed from the patient demographics and research questions are presented. There were no statistically significant findings between provider types found in this sample. However, this sample clearly shows that an A1C test was not completed when it was needed, according to ADA guidelines. The data shows that a total of 324 (74.65%) patients met the guidelines for screening and should have been screened; however, only 149 (34.33%) were screened. There was a total of 268 patients who were 45 years of age and older and according to the ADA guidelines all of these patients should have been screened; only 128 (47.76%) of those patients were screened. This study has shown that there is a detrimental flaw in primary care providers screening practices for prediabetes in Mississippi.

Chapter V

Summary and Conclusions

The primary goal of this study was to evaluate Mississippi primary care providers' (PCPs) screening practices for prediabetes in patients 18 years or older who are overweight or obese with one or more risk factors, and those 45 or greater with or without risk factors. The specific patient populations that were examined in this study included two subgroups: patients between ages 18 and 44 who had a BMI ≥ 25 with one or more additional risk factors including history of CVD (angina, MI, or coronary stents) or a diagnosis of Essential Hypertension and patients 45 years of age and older. According to the American Diabetes Association (ADA), these two subgroups should be screened for prediabetes because they are at increased risk of developing diabetes. For patients who are identified as prediabetic, the ADA recommends interventions to slow disease progression, including lifestyle modifications (diet, exercise, and weight loss) and medication management (Metformin) (ADA, 2019). This research study was guided by the ADA guidelines for screening asymptomatic adult patients. The researchers used Nola Pender's Health Promotion Model (HPM) as the theoretical framework to guide this study. The HPM, when utilized in primary care, allows the provider to educate, empower, and promote the health of their patients, and consequently, prevent progression of chronic disease (Sakraida, 2018).

In this study, the researchers conducted retrospective chart reviews in five different primary care clinics in Mississippi. A systematic, convenience sample of 100 electronic medical records (EMR) from each clinic was obtained, and EMRs meeting

inclusion criteria were included in the study. The sample size was 434. The researchers used a data collection worksheet to obtain necessary information from the EMR. Informed consent was obtained by all clinical managers prior to data collection. All data collection was completed during regular business hours and under the supervision of office personnel. Data collection was completed by researchers during March 2020. Descriptive statistics were used to explain research findings including frequencies and cross-tabulations. A chi-square test of independence was utilized to determine relationships between variables and outcomes. Once data collection was completed, the data collection worksheets were destroyed by shredding paper documents and/or deleting electronic copies.

The data collection worksheet was used to gather necessary information to answer the following research questions.

Are primary care providers testing for prediabetes using the A1C of overweight or obese patients ages18 years old or older and have one or more of the following additional risk factors for prediabetes, history of CVD (angina, MI, or coronary stents) or a diagnosis of Essential Hypertension?

Are primary care providers testing for prediabetes using the A1C of patients 45 years old or older, regardless of risk factors?

For prediabetic patients with A1C results between the ranges 5.7% -6.4%, are PCPs prescribing Metformin and/or lifestyle interventions?

Interpretation of findings:

Five hundred charts were reviewed, and after exclusion criteria were applied, the sample included 434 patient charts. The charts included in the study met inclusion

criteria of ≥ 18 years of age and patients who had a diagnosis of diabetes or were pregnant were excluded. The sample was divided into two subgroups based on age; of the sample, 38.2% were 18-44 years of age and 61.8% were 45 years or older. Demographic information was also collected, and the sample included 42.4% males, 57.6% females, 30.9% African American, 65% Caucasian, and 3.9% other race. The primary care provider type was obtained during data collection and Nurse Practitioners made up 72.8% while Medical Doctors made up 27.2%. Payor source was also noted, and 60.8% of the population had commercial insurance, 29.7% had Medicare/Medicaid, 4.8% were private pay, and 3.7% had no payor source. A diagnosis of overweight, obesity, or BMI ≥ 25 was included in the worksheet, and 74.3% of patients in the study had at least one of these diagnoses in their chart during the last three years. A history of CVD (angina, MI, or coronary stents) or a diagnosis of Essential Hypertension were listed as risk factors for prediabetes and were included in the worksheet. For the population only 13.8% of patients had one of these risk factors documented in the EMR. Testing of at-risk patients was assessed by whether or not an A1C was completed. In this study, 37.5% of patients 18-44 years of age had an A1C completed and 47.76% of patients 45 years and older had an A1C completed. Of the patients tested with A1C for prediabetes, 19.1% of the population met diagnostic criteria for prediabetes. For patients who met criteria for prediabetes diagnosis, interventions were assessed and 85.5% of prediabetic patients had an intervention recorded in the EMR. Metformin was given to 53.5%, recommended lifestyle changes were provided to 22.5%, and both Metformin and lifestyle modifications were used for 23.9%.

Of the 434 patients included in the sample, 342 (74.65%) from both subsets met criteria for testing. Providers tested 149 (34.33%) of patients from both subsets meeting criteria. No statistically significant difference in testing practice was found between nurse practitioners and medical doctors (Nurse Practitioners vs. Medical Doctors), $X^2(2, N=324) = 1.6$, $p=0.449$. For the 149 patients who were tested, 83 (55%) were identified as prediabetic. The subsample of patients aged 18 to 44 included 166 patients, and 56 (33.76%) of these patients met testing criteria. Primary care providers performed A1C testing on 21 (37.5%) of this subset. No statistically significant difference in testing practice was found between nurse practitioners and medical doctors, $X^2(2, N=56) = 1.38$, $p=0.499$. One hundred and three (62%) of patients in the 18 to 44 subgroup had a diagnosis of overweight, obesity, or BMI ≥ 25 during the last three years, but only 56 (33.73%) had documented risk factors in the EMR. Due to the nature of this research project, it was not feasible to include all of ADA's risk factors for prediabetes in the study; however, if all of the risk factors were included, it is likely there would have been more patients meeting testing criteria. The subsample of patients age 45 and older included 268 patients. Primary care providers performed A1C testing on 128 (47.76%) of this subset. No statistically significant difference in testing practice was found between nurse practitioners and medical doctors, $X^2(2, N=268) = 1.96$, $p=0.498$. There were 83 patients identified as prediabetic and interventions were recorded in 71 (85.5%) of these records. Interventions for prediabetic patients included the following: metformin 53.5%, lifestyle modifications 22.5%, and both metformin and lifestyle modifications 23.9%. No statistically significant difference in interventions utilized were noted between provider types, $X^2(2, N=71) = 3.468$, $p=0.177$.

According to the review of literature, prediabetes affects nearly 86 million Americans and 90% of these people are unaware of their condition. The literature also reveals that screening of patients according to ADA/USPSTF's guidelines is suboptimal with rates of 46%-85% (Mehta et al., 2017). The current research study reveals that primary care providers in Mississippi are testing asymptomatic, at-risk patients at a substandard level. For both subgroups, primary care providers tested 34.33% (n = 149) of patients who met criteria. The researchers concluded that primary care providers appropriately tested 37.5% of patients aged 18-44 and 47.76% of patients 45 years of age and older.

In a study conducted by Tseng et al., only 6% of providers correctly identified all of the risk factors for prediabetes. Consequently, a possible explanation for the lack of testing could be that primary care providers are unaware of all the risk factors for prediabetes. For the current research study, the researchers only studied the use of A1C for diagnosis of prediabetes, however, the ADA includes fasting plasma glucose and random plasma glucose as diagnostics. Mainous et al. surveyed physicians regarding prediabetes and found that 52.1% of physicians used blood glucose concentrations for their primary mode of testing. Subsequently, primary care providers in Mississippi may also use other diagnostics not captured by the current study and may actually be screening according to ADA's guidelines. Mainous et al. also found that the primary method of identifying someone at risk of developing diabetes was assessing BMI, testing blood glucose concentrations, asking about family history, and other (p = 0.11).

For the current research project, 55% (n = 83) of patients who were tested met diagnostic criteria for prediabetes. Whitley, Hanson, and Parton (2017) found that 53%

of patients who were screened according to guidelines met diagnostic criteria for prediabetes which is consistent with the findings of the current study. For patients who were diagnosed with prediabetes, the primary care providers in this study ordered interventions 85.5% of the time (n = 83). This number is consistent with findings in the literature review (Mehta et al., 2017; Tseng et al., 2017). The interventions for prediabetic patients included in this study were Metformin (53.5%), lifestyle modifications (22.5%), and both Metformin and lifestyle modifications (23.9%). For the purpose of this study, lifestyle modification is defined as any documentation of diet, exercise, and/or weight loss counseling in the electronic medical record. Stentz et al. 2017 in a randomized, controlled trial of high protein versus high carbohydrate diets found that 6 months into the study, the high protein diet group had a 100% remission of prediabetes, compared to the high carbohydrate diet group with only a 33% remission. The results of the study by Stentz et al. highlight the critical importance of diet education for patients who are prediabetic.

Summary of findings

The researchers concluded that primary care providers in Mississippi tested 34.33% (n = 149) of the patients who met the guidelines for testing. This number may be skewed, however, since the study did not include all of ADA's risk factors for prediabetes nor did it include plasma glucose values in the data collection. Primary care providers tested 37.5% of the 18-44 age group and 47.76% of the ≥45 age group. 62% (n = 103) of the 18-44 age group had a diagnosis of overweight, obesity, or BMI ≥ 25 during the last three years, but only 33.73% (n = 56) had documented risk factors that were included in the current study. 55% (n = 83) of patients who were tested for

prediabetes were indeed diagnosed with prediabetes. Primary care providers initiated interventions in 85.5% of patients identified as prediabetic. No statistically significant difference in testing practice or interventions was found between nurse practitioners and medical doctors.

Limitations

The limitations of this study which were identified prior to data collection were that only a small geographical area was studied, along with a small sample size being collected. The study occurred within only five primary care clinics in Mississippi. The researchers had a projected sample size of 500 patients (100 from each clinic) and of those only 434 met requirements. A setting and sample this small did not provide adequate generalization of the state of Mississippi or the United States as a whole. The first target population of patients who were 18 years and older who were considered obese or overweight based on diagnosis code or BMI, who also presented with one or more risk factors for CVD or a diagnosis of Essential Hypertension provided another limitation of a loose definition of CVD that was included in this study. The definition that was supplied by the researchers was "patients with any history recorded in the medical record of coronary stents, myocardial infarction, or angina." This neglected patients with peripheral vascular disease, atherosclerosis, cardiomyopathy, and others not listed. This study also neglected patients who had exhibited signs and symptoms of a form of CVD that had not been formally diagnosed.

Limitations were also identified during data collection. Utilizing only retrospective chart reviews denied the quality aspect of the study. The treatment options of prescription of Metformin, lifestyle modification, and/or both were adequate in

treatment avenues, but neglected the quality of education provided in regard to lifestyle modification. This did not account for the type of education provided such as exercise, diet, a personalized plan, or all of the above. Another limitation was the formats of the patients' charts that were utilized and reviewed for data collection. Some charts provided ease of access, as well as a detailed list of medical history, while some charts failed to include BMI calculations and were difficult to navigate to determine the medical history of patients. This could have increased the likelihood of human error of the researchers' determination of who is included due to BMI or comorbidities, which could have caused them to overlook important data.

Implications

An estimated 30.3 million American adults have diabetes in the United States and of those 7.2 million are undiagnosed (CDC, 2015). In Mississippi, over 308,000 adults are diabetic, which means the state accounts for the highest rate of diabetes in the country (CDC, 2015). The CDC reports that 84.1 million adults in the United States are prediabetic (CDC, 2017). Prediabetes increases the patient's risk for developing diabetes, cardiovascular disease, peripheral neuropathy, retinopathy, nephropathy, stroke, infections, and many other potential life-threatening and life-altering conditions (ADA, 2019). With these high rates of prediabetes and under 12% of the population being aware of their condition, many people progress to developing diabetes and develop target organ damage of some sort without ever having knowledge of the detrimental effects (CDC, 2017). The ADA recommends lifestyle modification in the form of diet, exercise, and weight loss along with early Metformin use for the prediabetic patient to prevent complications (ADA, 2019). To provide education on these lifestyle modifications, the

providers must be educated themselves on the signs and symptoms of prediabetes and stay up to date on current screening guidelines.

This study was intended to provide education to primary care providers and illuminate a gap in knowledge regarding testing practices. With the results of this research study, the provider can adapt and transform their practice to adhere to testing guidelines and reduce the detrimental effects of this condition. Providers have a fiduciary responsibility to their patients to be aware of these problems and to act on their behalf to test, diagnose, and treat patients according to current guidelines. Research has proven that regular screening according to CDC guidelines, as well as early treatment of prediabetic patients, can greatly reduce the chances of developing target organ damage and progression to diabetes (CDC, 2017).

Recommendations

Recommendations for this study primarily include correction of the limitations. For future research, it would improve generalization of the U.S. population with an increased sample size, as well as increasing the geographical area studied. It would provide a more in-depth representation of the quality of the education provided, plus how the patients feel about their diagnosis could be identified. It is also pertinent to determine the patient's ability to adhere to the lifestyle modifications and medication regimen provided. If the researchers in future studies were able to interview patients in person versus this study only including retrospective chart reviews these limitations could be rectified. Recommendations for future study would also include a qualitative review of the providers and how they feel about their ability to recognize and diagnose prediabetes. It is important to determine if they feel that it is a condition that can be reversed with

early lifestyle modification, Metformin use, or both or not. If they feel that they cannot stop progression to diabetes they may be more likely to treat only when the patient is found to have diabetes.

Summary

This study was a retrospective chart review study that showed the quantity of the patients who were tested and where trends of fallout occurred. The study failed to determine the qualitative aspect of the reason the patients were not screened or treated according to guidelines. Studies have been conducted to prove that early detection through proactive testing practices, as well as early intervention, can decrease the prevalence of this condition and reduce the amounts of patients who progress to diabetes. There are limitations to this study that can be corrected and improved upon for further testing, but this study provides a substantial foundation of realization that there is a problem within the practice of testing and early treatment education and prescriptive intervention. Further research will aid in determining the reason as to why the proactive testing and treatment practices are not being adhered to in some areas or by some providers.

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APPENDIX A

Data Collection Worksheet

1. Age:

   18-44 (1)

   45+ (2)

2. Gender:

   Male (1)

   Female (2)

3. Race:

   African American (1)

   Caucasian (2)

   Other (3)

4. Provider type:

   Nurse Practitioner (1)

   Medical Doctor (2)

   Doctor of Osteopathy (2)

   Physician Assistance (4)

5. Payor Source:

   Medicare/Medicaid (1)

   Commercial (2)

   Private Pay (3)

   None (4)

6. Within the last three years, has patient had either a diagnosis of ICD-10 E66.3 Overweight, ICD-10 E66.9 Obesity, or a BMI of 25 or greater?

   Yes (1)

   No (2)

7. Is patient ≥18 years old with presence of one or more risk factor for CVD (angina, MI, or coronary stents) or a diagnosis of ICD-10 I10 Essential Hypertension?

   Yes (1), if yes skip to #9

   No (2), if no proceed to #8

8. Is patient ≥45 years old?

   Yes (1), if yes proceed to #9

   No (2), if no exclude from data collection

9. Was an A1C test completed?

   Yes (1)

   No (2)

10. Did A1C test results fall between (A1C 5.7-6.4%) prediabetes?

    Yes (1)

    No (2)

11. If prediabetes was indicated, what interventions were utilized/implemented by PCP?

    Lifestyle Modification (1)

    Metformin (2)

APPENDIX B

IRB Approval of Mississippi University for Women

The W Mississippi University for Women
A Tradition of Excellence for Women and Men

Provost and Vice President for Academic Affairs
1100 College St. MUW-1603
Columbus, MS 39701-5800
(662) 329-7142
(662) 329-7141 Fax
www.muw.edu

January 28, 2020

Dr. Sueanne Davidson
College of Nursing and Health Sciences
1100 College St. W-910
Columbus, MS 39701

Dear Dr. Davidson:

I am pleased to inform you that the members of the Institutional Review Board (IRB) have reviewed the following proposed research and have approved it as submitted:

Name of Study:	Assessment of prediabetes testing practices among primary care providers in Mississippi.
Research Faculty/Advisor:	Sueanne Davidson
Investigators:	Marlana McFarland

I wish you much success in your research.

Sincerely,

Scott Tollison

Scott Tollison, Ph.D.
Provost and Vice President for Academic Affairs

ST/tc

pc: Irene Pintado, Institutional Review Board Chairman

APPENDIX C

Consent to Conduct Study

To Whom It May Concern:

We are graduate students enrolled in the Family Nurse Practitioner program at Mississippi University for Women. As a program requirement, we are conducting a research project entitled: Assessment of Prediabetes Testing Practices of Primary Care Providers in Mississippi. The goal of this research project is to determine if primary care providers in Mississippi are testing asymptomatic patients, who are at risk of developing diabetes, according to the American Diabetes Associations recommendations. We will collect data by retrospective chart reviews obtaining the following information: patient ≥18 years old; demographic information; provider type; payor source; diagnosis of overweight (ICD-10 code E66.3), diagnosis of obesity (ICD-10 code E66.9), or BMI ≥25; diagnosis of cardiovascular disease or hypertension (ICD-10 code I10); hemoglobin A1C result; and prediabetes diagnosis intervention. We are requesting permission to review medical records within your practice that meet these criteria. We are aware that we will need to maintain confidentiality throughout the entire process.

We agree to undergo or consent to any HIPAA requirements set forth by your practice regarding patient privacy and confidentiality. All data collected during the chart review will be recorded on a Data Collection Worksheet and stored under lock and key with access only to the researchers. The data collected will not include any personal or identifiable information for the patient or the clinic. The data will be kept confidential and destroyed by incineration at the conclusion of the study, per HIPPA guidelines.

We understand that your participation in this study is strictly voluntary and you may withdraw your consent and participation at any time up until data collection is complete. Once the study is complete, the results will be made available to you and may be beneficial as use as a quality assurance measure. If you have any questions concerning this study, please contact the following committee members: Dr. Sueanne Davidson, committee chair (Office: 662-329-7323 or Cell: 205-399-1433), Marlana McFarland (662-315-0427), Blake McCaulley (662-415-7826), Erica Mosley (601-616-2377), Yvette Munn (601-490-0619), or Lindsay Wynne (662-710-2255).

Sincerely,

Blake McCaulley, Marlana McFarland, Erica Mosley, Yvette Munn, and Lindsay Wynne

I have read the above letter of consent and agree to the utilization of this clinic for the abovementioned research project. It is my understanding that HIPPA regulations will be strictly followed and that confidentiality will be maintained for each chart reviewed. I also understand that the results of the study will be made available to at the conclusion of the study.

_____

Signature, Name, Title, Date