TRENDS BETWEEN TYPE II DIABETES KNOWLEDGE AND GLYCEMIC CONTROL IN AN INTERPROFESSIONAL WELLNESS CLINIC

by

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This paper is submitted in partial fulfillment of the
requirements for the degree of

Doctor of Optometry
Ferris State University
Michigan College of Optometry

10 May, 2019

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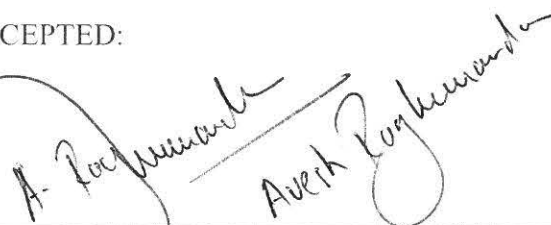Brooke V. Hermiz and Nilam R. Trivedi

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ABSTRACT

Background: There is interest in learning if a trend exists between type II diabetes knowledge and glycemic control in patients diagnosed with type II diabetes. Others may benefit from the findings in this study because the results will provide valuable information about how to best tailor patient education for patients diagnosed with type II diabetes. This may lead to patients having a better understanding about how to best control their blood sugar levels. *Methods:* Patients diagnosed with type II diabetes presenting to the University Eye Center at Ferris State University were invited to take a survey. The survey consisted of seven questions regarding basic diabetes knowledge in addition to demographic information. If seen in the Interprofessional Wellness Clinic, the patient's fasting blood glucose and HbA1c measured on the day of the appointment was collected and used in data analysis, otherwise the patient reported their most recent known and average levels. *Results:* The results of the patients' diabetic educational survey was compared to the reported blood glucose/HbA1c. This comparison helped determine if a correlation exists between diabetes education and glycemic control. *Conclusions:* Diabetes is a serious condition that is continually increasing in prevalence and can have a profound impact on ocular health. At the conclusion of this study, we hope to be able to use our results to educate patients on the importance of understanding their disease and how that may impact their glycemic control and quality of life.

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CHAPTER 1

INTRODUCTION TO TYPE II DIABETES AND INTERPROFESSIONAL HEALTH

CARE

Ranked now as the seventh leading cause of death in the United States, type II diabetes mellitus is a quickly growing disease that has become a national and global epidemic[1]. A 2015 report by the Centers for Disease Control and Prevention found that over 100 million adults in the U.S. have diabetes or prediabetes[2]. This number is expected to at least double, if not triple, by 2050--meaning that one third of U.S. adults may have diabetes at that time[3]. These alarming statistics demonstrate how vital it is to study type II diabetes and implement programs and healthcare facilities that will shift the paradigm of this disease from a pandemic to something that can be more effectively understood and managed by both patients and providers. This research study will examine patients' understanding of type II diabetes and if it correlates with the management of their condition.

The scope of this research project and paper will be limited to participants with type II diabetes. Type II diabetes is a chronic condition that impairs the body's ability to effectively use glucose in the body's cells due to insulin resistance. As a result, excess sugar builds up in the blood and can cause various problems throughout the body. In order to diagnose someone with type II diabetes, a few different types of blood tests are generally administered. A glycated hemoglobin (HbA1c) test indicates one's average blood sugar over the last three months. A HbA1c value of 6.5% or higher on two separate occasions indicates that one has diabetes. A value between 5.7% and 6.4% is classified as pre-diabetes, and a value less than 5.7% is considered normal. A fasting blood sugar

value of 126 mg/dL or higher on two separate occasions is suggestive of diabetes. A value between 100-125 mg/dL falls in the prediabetes category. A value less than 100 mg/dL is considered normal[4]. Patients with type II diabetes should check their fasting blood sugar once a day to self-monitor and keep their glycemic index at an appropriately controlled value. A random blood sugar test and oral glucose tolerance test are less commonly used than fasting blood sugar and HbA1c testing, but can also be used by doctors to diagnose type II diabetes[4].

If blood sugar remains uncontrolled, the detrimental effects of type II diabetes can be seen throughout the body's organs. Uncontrolled glucose can injure nerves throughout the body and cause numbness, tingling, and pain[1]. Patients with diabetes are encouraged to self-examine their feet once a day for any cuts, blisters, or other injuries that may lead to infection[5]. Diabetes also has a strong association with cardiovascular disease due to damage of both large and small blood vessels throughout the body. As a result, the condition predisposes patients to hypertension, stroke, and heart attack[4]. Lastly, diabetes can affect the eyes by increasing the risk of diabetic eye disease, which includes cataracts, glaucoma, diabetic retinopathy, and diabetic macular edema[6]. All of these forms of diabetic eye disease can cause severe vision loss if a patient's underlying condition is not properly managed. According to the American Diabetes Association, nearly 30% of adults with diabetes had retinal damage as a result of diabetes[3]. For this reason, annual dilated comprehensive eye examinations are imperative and the standard of care for patients diagnosed with diabetes.

The complications associated with type II diabetes can be minimized through diet, exercise, and medication, all of which help to control glycemic index. Additionally,

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Mayo Clinic recommends that people with diabetes exercise at least 30 minutes a day, five days a week, with a minimum recommendation of 150 minutes of exercise per week[4]. Controlling blood pressure, quitting smoking, and using prescription medications as directed all help to minimize the complications associated with type II diabetes.

The widespread bodily effects of type II diabetes, along with the alarming statistics regarding the increasing prevalence of diabetes, highlights the importance of interprofessional healthcare for these patients. Interprofessional care is defined as "the coordinated care of patients by a collaborative team of health care providers"[7]. For patients with type II diabetes, endocrinologists, dieticians, optometrists, podiatrists, pharmacists, nephrologists, and cardiologists are all vital in the management of the condition.

Ferris State University's Interprofessional Wellness Clinic was developed in 2004 in an effort to create a collaborative clinic between the disciplines of optometry, pharmacy, and nursing in effectively managing patients with diabetes[8]. The clinic encompasses the philosophy of collaborative care and highlights the comprehensive nature of diabetes management. After checking in, the patient has their blood drawn by nursing students and overseeing faculty in order to determine blood glucose level, HbA1c, and a lipid panel. Height, weight, blood pressure measurement, and a foot exam are also performed at this point. Additionally, a 24 hour diet recall and nutrition counseling is offered. Next, the patient receives a comprehensive eye examination including a dilated fundus examination from optometry students and overseeing faculty. Patients are then examined by pharmacy school students and overseeing faculty to discuss the use of all pharmaceutical agents and any recommended changes. Patients are

educated and counseled on diabetes management from every discipline at every stage of the appointment. At the end of the appointment, a collaborative letter is written and sent to the patient's primary care physician, as well as any specialty providers that the patient is seeing[8].

One of the most important components of effective health care management is a patient's understanding and awareness of their own condition. Although the concept of interprofessional care aims to merge multiple healthcare disciplines to provide the most comprehensive care for a patient, patient awareness and understanding is key to managing a condition long-term. This is especially true for a condition with widespread systemic effects such as type II diabetes. The objective of this research study was to determine if a trend exists between type II diabetes knowledge and glycemic control in patients presenting to an interprofessional diabetes clinic. This study will shed light on the trends that may exist between a patient's understanding of the basic facts about their condition and how well they manage it. This will allow better understanding of where to implement more extensive educational programs so that patient outcomes can be improved. As future optometrists, we certainly will be examining a large number of patients with diabetes on a daily basis. Therefore, it is important for us to analyze how well patients understand their condition, and how this may be implicated in our role as providers offering more appropriate patient education.

The study took the form of a survey distributed to patients with type II diabetes and comprised of a demographic section, along with a diabetes knowledge quiz comprising of seven basic questions about type II diabetes and management of the condition, such as a normal blood sugar value, the recommended amount of exercise, and

the appropriate specialty providers. Additionally, the survey included optometry-specific questions as related to diabetes, such as the appropriate time period for a comprehensive examination for a patient and the purpose of a dilated fundus examination. The patient's quiz results were compared to the patient's HbA1c and fasting blood sugar recorded at the time of the visit. It was hypothesized that participants who scored higher on the diabetes knowledge quiz would demonstrate better overall control of their condition, as seen with a lower blood sugar and/or HbA1c level.

Currently, there is no standard of care for patient education between interprofessional health care providers, highlighting the need for this research. This study's findings will allow better understanding of the importance of patient understanding in managing medical conditions and perhaps start to develop guidelines for appropriate and standardized patient education across various disciplines. Patient education is not taught, but is recognized as an important tool in self-care and patient-based self-management[9].

CHAPTER 2

METHODS

Participants:

All patients attending appointments at the Interprofessional Wellness Clinic at University Eye Center at Ferris State University in Big Rapids, Michigan, United States of America were invited to participate in the survey study. 10 surveys were completed and returned to the front desk staff.

Inclusion/Exclusion Criteria:

This research project required participants to be formally diagnosed with type II diabetes before completion of the survey. Patients of all ages, genders, races, ethnicities, and education levels were able to participate. Participants were excluded if they fell in the classification pre-diabetes or had type I diabetes.

Materials:

This study used an informed consent form containing the objective and procedures of the study, along with researchers' contact information. The consent forms stated that participation was voluntary, participants were able to end participation at any time or refuse to answer any question, and that all data collected would be anonymous. The survey was approved by the Institutional Review Board of Ferris State University prior to distribution. Participants were instructed not to include their name or any identifying information on the survey. Survey data was gathered using paper surveys distributed upon appointment check-in at University Eye Center, and collected at the end of the appointment by the clinic personnel.

Design and Procedure:

This study made use of a survey distributed in Big Rapids, Michigan between April 2018 and January 2019. All patients with type II diabetes with appointments at the University Eye Center at Ferris State University were invited to participate in the study. After completing an informed consent form, participants completed the survey through self-administration. The survey included sociodemographics (seven items), along with multiple choice questions about general knowledge of diabetes (seven items). Six of the seven general diabetes items each had four multiple choice answer options, with one option being the correct choice per the American Diabetes Association's recommended guidelines. The last item included nine possible answer options, with seven of the nine being correct. For this particular item, participants were not told how many correct answer options there were. Participants also had the option to answer "other" on any item and write in their own answer.

Out of the seven general diabetes knowledge items, there were questions about the proper frequency of checking blood sugar (one item), a normal HbA1c value (one item), and the recommended amount of exercise for a patient with diabetes (one item). There were also questions about the frequency at which a patient should receive a comprehensive eye examination (one item), the purpose of a dilated eye examination in a patient (one item), and the frequency at which a patient should check their feet (one item). The last survey item questioned patients about which interprofessional care providers are important for a patient with diabetes (one item). Variables in this study were number of correct items on the diabetes knowledge quiz and a patient's average

HbA1c and fasting blood sugar. A trend between the number of correct items on the diabetes knowledge quiz and the duration of a patient having the disease was also studied.

CHAPTER 3

RESULTS

Throughout the course of this study, ten individuals completed the survey. Of the respondents, only four filled out the survey in its entirety, where the other six partially completed the survey. Majority of the patients participating in this study were examined in the Michigan College of Optometry University Eye Center Interprofessional Diabetic Wellness Clinic, where the others were examined in the Michigan College of Optometry University Eye Center Primary Care Clinic. The age of the participants ranged from 44 to 71 years old with three male participants and seven female. Eight respondents identified as Caucasian, one as African American and one as Hispanic/Latino. Participants were asked a variety of questions beginning with sociodemographics and concluding with seven multiple choice questions regarding general knowledge of diabetes and its relation to ocular health. In terms of highest education level attained, three participants reported a high school education, three participants reported completion of an Associate's degree, one reported completion of trade school/vocational training, one reported completion of a Bachelor's degree, one reported completion of a Master's degree, and one reported completion of some college without a degree . All patients participating in this survey stated that they considered themselves educated on type II diabetes.

When evaluating the overall results of the diabetes educational survey items, the scores from lowest to highest were as follows: 0% (one participant), 14.3% (one participant), 28.6% (one participant), 42.9% (one participant), 57.1% (five participants), and 85.7% (one participant). Figures 1 and 2 show the correlation between the survey score and the fasting blood sugar level and HbA1c, respectively. The R^2 value of two

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data sets measures the linear relation where a value of 1 indicates the input variable directly impact the output where as a value of 0 indicates no relation between the input variables and output. R^2 values were computed for fasting blood sugar, HbA1c, and duration of type II diabetes vs. respondents' quiz scores. R^2 values for question 7 were also separately analyzed in order to examine how well respondents understood the multidisciplinary care model as related to type II diabetes.
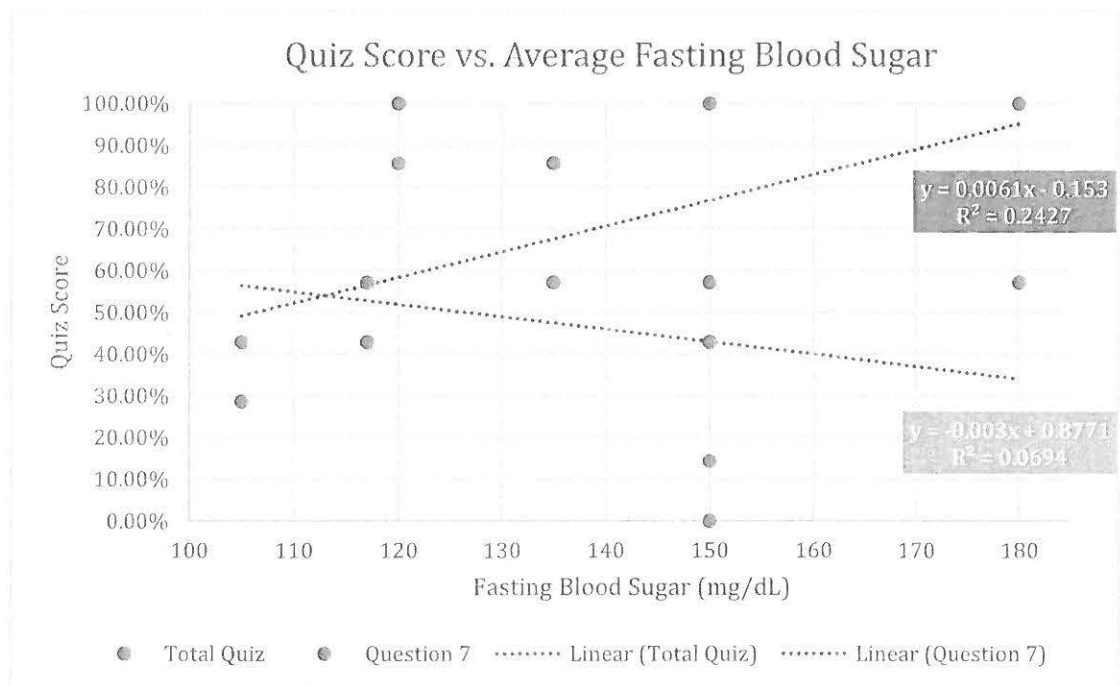

Figure 1: *Quiz Score vs. Average Fasting Blood Sugar*

Figure 1 indicates that there was a weak to no correlation between the participants' overall quiz score and their fasting blood sugar, as seen with the R^2 value of 0.0694. However, there was a slight linear relation between the participants' score on question 7 and their fasting blood sugar, as seen with the R^2 value of 0.2427. Thus, a patient's fasting blood sugar level cannot be estimated with high certainty given the quiz score, nor the question 7 score.
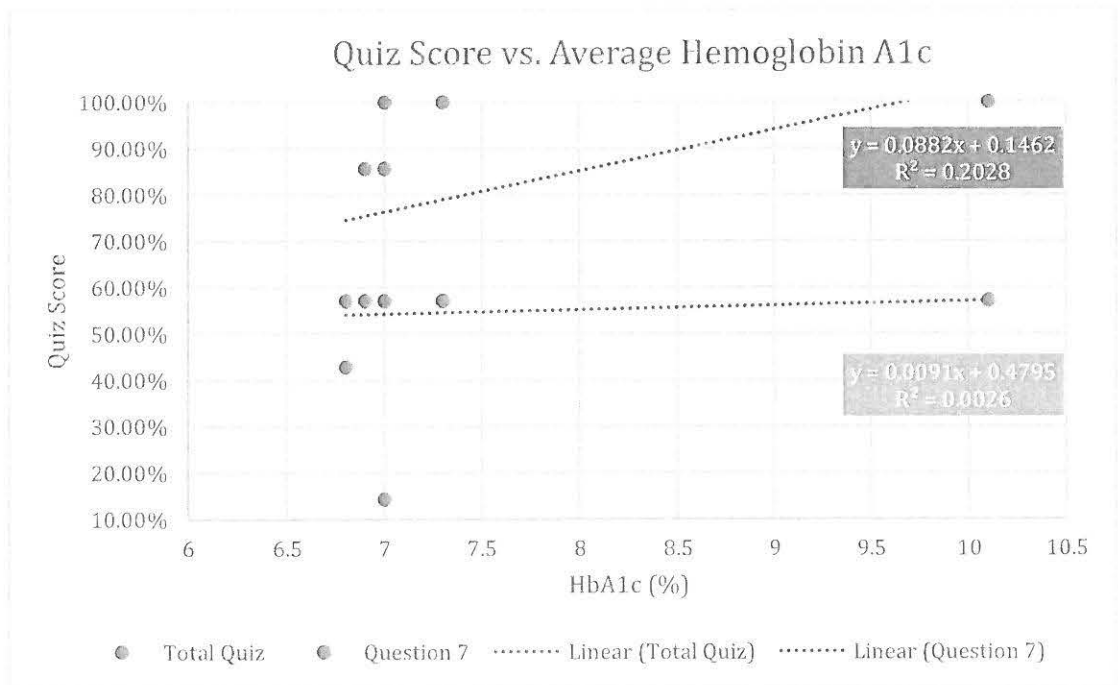
Figure 2: *Quiz Score vs. Average Hemoglobin A1c*

Figure 2 indicates that there was a weak to no correlation between the participants' overall quiz score and their HbA1c, as seen with the R^2 value of 0.0026. However, there was a slight linear relation between the participants' score on question 7 and their HbA1c, as seen with the R^2 value of 0.2028. Thus, a patient's HbA1c cannot be estimated with high certainty given the quiz score, nor the question 7 score.
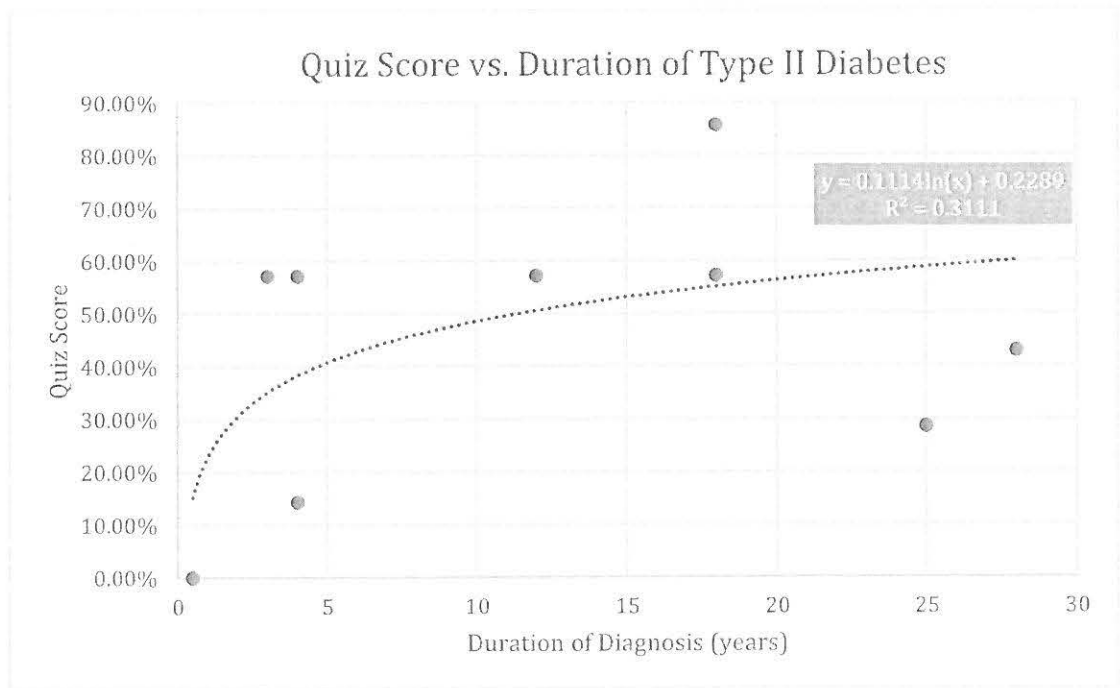
Figure 3: *Quiz Score vs. Duration of Type II Diabetes*

Figure 3 indicates that there was a minor logarithmic correlation between the participants' overall quiz score and the duration of their type II diabetes diagnosis, as seen with the R^2 value of 0.3111. The respondent who scored 0% had been diagnosed with type II diabetes for only six months, reported the highest level of education as trade/vocational school, had a last fasting blood sugar reading of 205 mmol/L, and did not report the last known HbA1c. On the other hand, the respondent who scored 85.7% had been diagnosed with type II diabetes for 18 years, reported the highest level of education as a Master's degree, had a last fasting blood sugar reading of 156 mmol/L, and an HbA1c of 7.5%. Therefore, a patient's duration of diagnosis can be estimated with some certainty given their quiz score.

Two other participants diagnosed with type II diabetes for 20 and 18 years both had fasting blood sugar levels within the normal range at 105 mmol/L and 128 mmol/L,

respectively, although they received a lower score on the educational survey of 42.9% and 57.1%, respectively. Most other participants did not have any significant correlation in their survey results to their last fasting blood sugar/HbA1c levels and/or the duration of their disease. Figures 1, 2 and 3 show the comparison of the participants' survey scores to their HbA1c, fasting blood sugar level, and duration of their type II diabetes diagnosis, respectively. For example, a patient diagnosed with type II diabetes for 12 years had a last fasting blood sugar reading of 209 mmol/L, a last HbA1c reading of 10.1%, and a score of 57.1% on the educational survey.

When analyzing the responses to each individual item, there were a surprising amount of similarities in whether the respondents as a whole answered that item correctly or not. For example, the lowest scored items were items two and three, which asked the normal fasting blood sugar level in a patient with type II diabetes and how much exercise a patient with type II diabetes should have at a minimum per week, respectively. With regards to both of these items, only two out of the ten respondents answered each item correctly. In contrast, eight out of the ten respondents answered item four correctly, which asked how often a patient with type II diabetes should receive a comprehensive dilated eye exam. Seven out of the ten (70%) respondents answered item six correctly, which asked what the most important reason was for patients with type II diabetes to undergo a yearly comprehensive eye exam.

CHAPTER 4

DISCUSSION & CONCLUSION

The purpose of this study was to determine if a correlation exists between type II diabetes knowledge and glycemic control in patients diagnosed with type II diabetes. Unfortunately, due to the small number of respondents as well as incompleteness of the educational surveys, the results varied and were mainly inconclusive. An additional drawback to this study included the educational surveys being distributed only to patients with type II diabetes at the Michigan College of Optometry University Eye Center, which comprises a small and fairly rurally located patient base.

Two out of the ten respondents contained survey results that did relate to the original hypothesis of this study, which was that a lower score on the educational survey would correlate with a higher fasting blood sugar and/or HbA1c level. Most respondents who had been diagnosed with type II diabetes for a longer duration of time tended to have better glycemic control and an average or higher score on the educational survey. Respondents who were more recently diagnosed with type II diabetes more commonly had an average or higher fasting blood sugar/HbA1c level and an average or lower score on the educational survey. This may be attributed to better glycemic control over a longer period of time and/or more knowledge on the disease due to a longer duration of diagnosis. Patients who have had type II diabetes for a longer period of time also may have a more advanced form of the disease, attributing them to needing more health care providers and specialists.

In regards to the responses to the individual survey items, most of the respondents did poorly on the items relating to specific diabetes facts. Surprisingly, the items that

were answered correctly by the majority of the respondents were relating to eye health. Although a correlation may exist between type II diabetes knowledge and glycemic control, further research with a larger population base would need to be conducted in order to have more conclusive results.

Interprofessional care to patients with diabetes is essential to maintaining suitable health conditions. Because an interprofessional clinic is available at the University Eye Center at the Michigan College of Optometry, one item on the survey was specifically related to this topic. When participants were asked what medical professionals are imperative to managing diabetes, three of the ten respondents were able to choose all seven correct answers out of a total of nine options.

Multidisciplinary medical care is of vital importance to patients' success in maintaining a healthy lifestyle and managing their diabetes. This study revealed that only 30% of patients understand all areas of systemic health that need to be monitored when being diagnosed with diabetes. 70% of patients are lacking care due to not being properly educated on these facts. As shown in figures 1 and 2, majority of the respondents in this study did not correctly answer the item relating to multidisciplinary diabetic care, although this item showed a higher R^2 value compared to participants' performance on the other quiz questions. Since this question pertained to interdisciplinary care, this is somewhat promising in realizing that patients understand the multidisciplinary approach in the diagnosis and treatment of type II diabetes.

Type II diabetes mellitus is continuously increasing in prevalence in the United States with 1.5 million new patients diagnosed every year[10]. Diabetes is also the leading cause of vision loss for Americans under the age of 74[11]. It is imperative for health care

professionals to take action in order to help reduce the incidence and worsening of diabetes in the future. This includes properly educating patients on the disease, discussing the importance of proper glycemic control, as well as making patients aware of the devastating outcomes that may arise due to poorly controlled blood glucose.

The outcome of this study should be a learning tool for all medical professionals involved in the care of patients and reiterates the importance of patient education. Patients should be thoroughly educated about their disease at the time of diagnosis as well as throughout the remainder of their care in order to prevent systemic damage in the future. This education will likely be spread by word of mouth to family and friends and could potentially help to further reduce the prevalence of diseases such as diabetes. With more widespread education, patients will gain proper education regarding modifiable risk factors and the benefits of tight glucose control. Eye care professionals play a significant role in managing patients with diabetes. We have the ability to re-educate patients on all aspects of the disease and discuss the potential effects that high blood glucose can have on the eyes. According to the American Optometric Association, in 2017, 401,000 cases of diabetic retinopathy were diagnosed by optometrists in patients who did not even know they had diabetes[11]. Early detection with yearly eye exams is essential in preventing permanent vision loss. As we begin working in our optometric careers, we look forward to seeing how interprofessional care will continue to grow and positively influence patient outcomes.

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PARTICIPANT SURVEY

ID: _____

Diabetes Knowledge Survey:

Please circle the most correct answer to the best of your current knowledge with regards to the American Diabetes Association's recommended guidelines in management of type 2 diabetes.

1. How often should a type 2 diabetic check their blood sugar?
    a. Once a day
    b. Twice a day
    c. Once a week
    d. Twice a week
    e. Other: _____

2. What is a normal blood sugar level in a type 2 diabetic before eating a meal?
    a. A1C = 7% (FBS = 154)
    b. A1C = 7.5% (FBS = 169)
    c. A1C = 8% (FBS = 183)
    d. A1C = 8.5% (FBS = 197)
    e. Other: _____

3. How much exercise should a type 2 diabetic get every week at minimum?
    a. 60 minutes
    b. 100 minutes
    c. 150 minutes
    d. 200 minutes
    e. Other: _____

4. How often should a type 2 diabetic get a comprehensive dilated eye examination?
    a. 6 months
    b. 1 year
    c. 2 years
    d. As needed
    e. Other: _____

5. How often should a diabetic check their feet?
    a. Once a year
    b. Once a month
    c. Once a week
    d. Once a day
    e. Other: _____

6. What is the **most** important reason that diabetic patients need regular eye examinations?
    a. To ensure the pressure in the eye is at an appropriate value
    b. To verify the eyeglass prescription is up to date
    c. To monitor the health of structures in the back of the eye
    d. To ensure the patient can see well at all distances
    e. Other: _____

7. In addition to a primary care physician (PCP), circle **all** health care providers below that are important in managing patients with diabetes:

    a. Pharmacist   d. Optometrist   g. Endocrinologist
    b. Nurse   e. Audiologist   h. Dentist
    c. Podiatrist   f. Dietitian   i. Radiologist
    j. Others: _____