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Quality Improvement Initiative to Increase Comprehensive Eye Exams in Patients With Diabetes

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QUALITY IMPROVEMENT INITIATIVE TO INCREASE COMPREHENSIVE EYE EXAMS IN PATIENTS WITH DIABETES

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Abstract

Diabetic retinopathy is the most common microvascular complication associated with poorly controlled diabetes. Yet, only 60% of the diabetic population receives an annual eye examination by an eye specialist. Retinal imaging increases surveillance of retinopathy, however, it does not take the place of a comprehensive eye examination by an ophthalmologist or optometrist. The aim of this quality improvement project was to increase comprehensive eye examinations in patients with diabetes aged 18 years to 75 years in a family practice that recently purchased a retinal imager. This quality improvement project occurred over a 10-week period. Project objectives included increasing comprehensive dilated eye examinations in diabetic patients, provider referral rates to eye specialists, and patient adherence to eye specialist referrals. Interventions included an educational session, diabetes eye exam checklist, patient reminder card, electronic medical record alert, and an informational brochure for patients to take home. After 10 weeks, the eye examination rate for patients with diabetes at the family practice increased from 45% to 63% and 67 new referrals were sent to eye specialists by providers. Providers at the clinic with the retinal imager were less likely to send out referrals. Lastly, patients who received reminder cards had an 85% adherence rate to referrals. The use of a checklist and an electronic alert increases provider referral rates to eye specialists, while a reminder card increases patient adherence to referrals. However, the presence of a retinal imager in a clinic reduces the likelihood that a patient will receive a referral to an eye specialist.

Keywords: diabetes, primary care, eye examinations, patient adherence, retinal imaging, diabetic retinopathy, diabetic eye disease

Diabetic retinopathy is the leading cause of blindness in working-age adults in developed countries (Hendrick, Gibson, & Kulshrestha, 2015). Diabetic retinopathy is the most common diabetic eye disease, followed by diabetic macular edema, cataracts, and glaucoma (National Eye Institute [NEI], 2015a). When left untreated, diabetic retinopathy can progress to proliferative diabetic retinopathy and diabetic macular edema, which can lead to vision loss (NEI, 2015a). Both diabetic retinopathy and diabetic macular edema (DME) can be detected by comprehensive dilated eye exams (NEI, 2015b). Thus, early detection and treatment is imperative in the protection against blindness in the diabetic population (NEI, 2015a). Despite this, only 60% of patients with diabetes receive an annual eye examination (Olsen et al., 2017).

Diabetes is currently the seventh leading cause of death within the United States and the number of individuals diagnosed with diabetes is expected to rise as the U.S. population ages and the prevalence of obesity increases (Centers for Disease Control and Prevention [CDC], 2017a). Currently, approximately 30.3 million individuals within the U.S. are diagnosed with diabetes, and an estimated 30.2 million of these individuals are 18 years of age or older (CDC, 2017b). Additionally, more than 84 million U.S. adults have prediabetes and as many as 90% of these individuals are unaware they have it (CDC, 2017b). At a global level, an estimated 422 million individuals have diabetes and this number is expected to reach 600 million people by the year 2035 (Goh et al., 2016; World Health Organization, 2018).

Poorly controlled diabetes leads to microvascular complications which include: retinopathy, neuropathy, and nephropathy (Riddle et al., 2018). Diabetic retinopathy is the most common of these complications and is a direct reflection of glycemic control and disease duration (Hendrick et al., 2015). Diabetic retinopathy is present in approximately 28.5% of U.S. adults with diabetes, and 4.4% have vision-threatening diabetic retinopathy (Murchison et al.,

2017). The number of U.S. adults with diabetic retinopathy is expected to double from the year 2010 to 2050, from approximately 7.7 million to 14.6 million adults (CDC, 2018). Diabetic retinopathy has also accounted for $492 million in direct medical costs, making this disease a major public health concern (Hendrick et al., 2015).

Limited vision has been associated with higher medical expenses, decreased health utility, and limited access to care (Gower et al., 2013). Improved diagnosis, management, and treatment of diabetic retinopathy could save the federal government as much as $108.6 million in annual costs (Murchison et al., 2017). Healthy People 2020 goals include increasing the number of adults who have timely comprehensive eye examinations and reducing visual impairment due to diabetic retinopathy, glaucoma, and cataracts (Office of Disease Prevention and Health Promotion, 2018). Moreover, patients with diabetes are 40% and 60% more likely to develop glaucoma and cataracts, respectively (Riddle et al., 2018).

Statement of the Problem

According to the American Academy of Ophthalmology, only 60% of individuals with diabetes have a yearly diabetic retinopathy screening (Olsen et al., 2017). Symptoms of diabetic retinopathy are not typically present in the early stages, and the disease can go unnoticed until visual effects have occurred (NEI, 2015a). As a result, the American Diabetes Association (ADA) recommends patients with diabetes attend annual dilated eye examinations by either an ophthalmologist or optometrist, and to do so more frequently if retinopathy is present and progressing (Riddle et al., 2018). Less-frequent examinations, such as every 2 years, have been proven cost-effective for individuals with well-controlled diabetes and at least one normal eye exam (Handelsman et al., 2015; Riddle et al., 2018). Despite these recommendations, only 50 to 60% of the diabetic population receives a timely dilated fundus examination (Murchison et al.,

2017). Barriers to eye examinations include the absence of symptoms in beginning stages, lack of knowledge about symptoms, and cost of examinations (Gower et al., 2013). More than one-third of patients with diabetes who have not had a comprehensive dilated eye examination within the past year reported not having a need for one (Chew et al., 2014). Additionally, non-adherence to eye examinations is more prevalent in Hispanic and African American populations, although diabetic eye disease is more likely to occur within these two groups (Gower et al., 2013).

Furthermore, inadequate assessment of diabetic eye disease and delayed referrals from primary care providers potentiates non-compliance with current recommendations (Jani et al., 2017; Silva et al., 2016). The National Committee for Quality Assurance (NCQA) has implemented the Healthcare Effectiveness Data and Information Set (HEDIS) to enhance processes of care and performance improvement within healthcare practices (NCQA, 2018a). HEDIS measures include the comprehensive diabetes care measures, which assess hemoglobin A1C (HbA1C) control, performance of eye examinations, nephropathy monitoring, and blood pressure control (NCQA, 2018a). Telemedicine has been increasingly used in primary care clinics; more specifically, retinal imaging is seen as a cost-effective way to increase retinopathy screenings and improve access to screening services in communities where eye professionals are not readily available (Bouskill, Smith-Morris, Bresnick, Cuadros, & Pedersen, 2018; Riddle et al., 2018).

Although retinal imaging meets the HEDIS measure for a diabetic eye exam, it does not replace a comprehensive dilated eye examination by an ophthalmologist or optometrist as recommended by both the American Association of Clinical Endocrinologists and American College of Endocrinology [AACE/AmCE], and the ADA (Handelsman et al., 2015; Riddle et al., 2018). In fact, gaps exist between retinopathy screening and treatment (Bouskill et al., 2018). For

example, as many as 80% of individuals diagnosed with vision-threatening diabetic retinopathy from retinal screening will not adhere to ophthalmologic follow-up appointments or complete treatment recommendations (Bouskill et al., 2018). Additionally, retinopathy screenings are performed by medical assistants (MAs), who are often unsupervised and are burdened with the increased responsibility of recruiting patients for screening, uploading retinal images, and ensuring ophthalmology referrals have been placed by physicians (Bouskill et al., 2018). In contrast, non-mydriatic retinal imaging techniques are more appealing as they eliminate patient barriers, such as need for mydriasis and additional appointment time (Liu et al., 2017). Retinal imaging within primary care clinics is also thought to increase retinopathy surveillance and patient satisfaction due to convenient point-of-care screening (Jani et al., 2017).

Given that up to 98% of diabetes-related vision loss cases can be prevented, primary care providers must be cognizant of key prevention measures related to diabetic eye disease (Goh et al., 2016). Adequate glycemic control, blood pressure management, appropriate screening, and timely referrals are crucial interventions that can be made by primary care providers (Goh et al., 2016). For instance, each percentage drop in HbA1C levels can equate to as much as a 35% microvascular risk reduction in patients with type 2 diabetes (Hendrick et al., 2015). Additionally, lowering elevated blood pressure is found to be beneficial in reducing retinopathy progression, although tight blood pressure goals of a systolic reading less than 120 mmHg have shown no benefit compared to a goal of less than 140 mmHg (Hendrick et al., 2015). Early detection and coordination among primary care providers and ophthalmologists, in addition to blood glucose and blood pressure management, can help prevent vision loss among the diabetic population (Hendrick et al., 2015).

Assessment

An assessment was conducted at a family care practice with two office locations in the northwest region of San Antonio, Texas. The practice is considered a patient-centered medical home (PCMH) and is recognized by the NCQA. Both clinics see children and adults and have on-site laboratory services. At the time of the assessment, the practice consisted of five physicians and a nurse practitioner (NP) with two of the physicians providing services at both clinic locations. Additional staff included six MAs, three secretaries, two billers, a practice administrator, an office manager, and a quality improvement licensed vocational nurse. Medicare, self-pay, and other commercial insurances were accepted at both clinic locations.

The main International Classification of Disease codes, 10th Revision (ICD-10) billed by the providers included: essential primary hypertension (I10), type 2 diabetes mellitus with hyperglycemia (E11.65), type 2 diabetes mellitus without complications (E11.9), mixed hyperlipidemia (E78.2), and hyperlipidemia, unspecified (E78.5). There were a total of 7,104 patients seen between August 1, 2017 and August 1, 2018. Of these patients, 1,324 were diagnosed with either type 1 or type 2 diabetes, which consisted of approximately 19% of the patient population. Approximately 92.3% of the patients with diabetes were between the ages of 18 years and 75 years of age. Additionally, patients with diabetes were primarily of Hispanic or Latino descent (56.9%), English speaking (89.1%), and using commercial-paying methods (78%). See table 1 for the full breakdown of the patient demographics.

Table 1

Demographics of Patients With Diabetes

Characteristic	n	%
Gender		
Male	727	54.9
Female	597	45.1
Age Group		
0-17	2	0.2
18-75	1222	92.3
75+	100	7.6
Ethnicity		
Central American Indian	1	0.1
Dominican	1	0.1
Hispanic or Latino/Spanish	753	56.9
Latin American/Latin, Latino	10	0.8
Mexican	14	1.1
Mexican American	6	0.5
Not Hispanic or Latino	335	25.3
Patient Declined	199	15.0
Puerto Rican	5	0.4
Primary Language		
English	1180	89.1
Japanese	1	0.1
Patient Declined	53	4.0
Sign Language	1	0.1
Spanish	89	6.7
Primary Insurance		
Commercial	1033	78.0
Medicare	246	18.6
Self-Pay	45	3.4

Note. $N = 1,324$.

Patient demographics within the practice were similar to the surrounding communities. For instance, there were approximately 57,447 individuals living in the zip code surrounding clinic A as of 2016 (U.S. Census Bureau, 2016). Of these individuals, 49% were male, 51% were female, 59% were of Hispanic or Latino descent, and the median age was 31.5 years with a median household income of $65,294 (U.S. Census Bureau, 2016). Similarly, the community surrounding clinic B, consisted of 68,265 individuals as of 2016 (U.S. Census Bureau, 2016). Of these individuals, 58.5% were male, 51.5% were female, 66.6% of these individuals were of Hispanic or Latino descent, and the median age was 29.3 years with a median household income of $60,616 (U.S. Census Bureau, 2016). The median household income for these two areas were significantly higher than the $48,183 median household income for the entire City of San Antonio (U.S. Census Bureau, 2016).

Given that the practice was a PCMH as designated by NCQA, quality improvement activities centralized on NCQA performance measures (NCQA, 2018b). NCQA's comprehensive diabetes measures, particularly diabetic eye exams, were evaluated within the practice. At the time of the assessment, the practice was aiming to meet the HEDIS measure for diabetic eye exams of being greater than or equal to 60%. However, as of August 1, 2018 the practice was only at a 45% compliance rate with diabetic eye examinations. With that said, the practice recently purchased Retinavue, a non-mydriatic, 45-field retinal camera in hopes that this would increase diabetic examinations within the practice. Retinal cameras, such as Retinavue, meet the HEDIS measure for a diabetic eye examination and are thought to alleviate patient barriers for eye-examinations (Liu et al., 2017). Nonetheless, retinal imaging does not take the place of a comprehensive dilated eye examination by an ophthalmologist or optometrist (Handelsman et al., 2015; Riddle et al., 2018). Poor compliance with diabetic eye examinations can be attributed to

decreased provider referrals to ophthalmologists or optometrists, poor patient compliance with referrals, lack of patient education, and increased workload on ancillary staff (Bouskill et al., 2018; Goh et al., 2016; Gower et al., 2013).

There were 216 ophthalmology and optometry referrals made by the providers at the practice during the time period of August 1, 2017 to August 1, 2018. Given there were 595 patients lacking a documented eye examination within the practice's electronic medical record (EMR), the provider referral rate equated to approximately 36%. It should be noted that one provider who no longer works within the practice was included in the data collected. Additionally, the NP who had not yet joined the staff was also not included in the data. Moreover, the data collected was a reflection of the referral rate prior to the recent purchase of a retinal imager.

Referral rates for eye examinations varied across providers and results from these referrals were not always received by the office staff. Additionally, further insight was needed to determine if patients were following-up with eye specialist referrals. Therefore, telephone calls were made to selected patients with diabetes who did not have results of an eye examination within the past year in the clinics' EMR. Being that the clinic had a large Medicare population, a purposive sample of 71 Medicare patients out of 129 were called. This number was obtained using the clinics' EMR and consisted of patients in a Medicare Shared Savings Program who lacked documentation of a diabetic eye examination. Of the individuals called, 41 individuals were reached with 35 individuals providing a response to the telephone survey (appendix A). Households that were reached but were unable to respond to the survey included three who were Spanish-speaking, one patient on hospice-care, one patient who was deceased, and one patient who established care at a new clinic. Based on the telephone survey, approximately 66% of the

non-compliant patients had already had an eye examination within the past year but did not have their results sent to the practice. Additionally, 81% of the individuals who did not have an eye examination within the past year were “very interested” in being scheduled for retinal imaging at the practice. Patients reported barriers to eye examinations primarily as forgetting or not making an appointment (42%) and not having established care with an ophthalmologist or optometrist (25%).

Similarly, a purposive, randomized sample of non-compliant patients with diabetes using commercial insurance was obtained using the clinics’ EMR to determine reasons for patient non-compliance. An attempt was made to reach 20% of the 527 commercial payers, given that approximately 27% of Medicare patients provided survey results. Tables 2 and 3 display results from both Medicare patients and commercial payers. Out of the 105 telephone calls made, 33 patients were reached and responded to the telephone survey. Approximately 46% of the individuals reached reported having an eye examination within the past year yet did not have results sent to the practice. One patient reported being compliant as he had retinal imaging within the practice. Approximately 50% of individuals who did not have an eye examination within the past year stated they simply forgot about or did not schedule their appointment with an ophthalmologist or optometrist. Moreover, 41% of patients who did not have a recent eye examination reported they were “very interested” in retinal imaging within the practice.

The practice’s EMR alerted providers when quality improvement measures, such as diabetic eye examinations were not met. Self-reported eye examinations were used to document completion of an annual or biennial diabetic eye examination. However, the results of the eye examinations are required to satisfy the HEDIS measure of a diabetic eye examination. Despite this, providers have checked off meeting the diabetic eye examination requirement solely based

on patient history. Additionally, MAs were able to view unmet quality improvement measures and were able to ask patients whether they have had an eye examination within the past year. If patients reported having had an eye examination, MAs provided patients with a medical release form and this form was faxed to the appropriate eye specialist office by either the MA or front office staff. Results were then placed into a "bucket" within the EMR and to be acknowledged by the patient's provider.

Table 2

Telephone Survey Results for Medicare and Commercial Patients

Response when asked about eye exam within the past year.	Medicare payer sample n (%)	Commercial payer sample n (%)
Did not answer	30 (42.3%)	72 (68.6%)
Answered but did not respond to survey	6 (0.1%)	0 (0%)
Already had eye exam	23 (66%)	15 (45.5%)
Did not have an eye exam	12 (34%)	18 (54.5%)
Reasons for missed Eye Exam		
Lack of transportation	0 (0%)	0 (0%)
Exam cost	1 (0.1%)	0 (0%)
Exam location	0 (0%)	1 (5.6%)
Forgot/did not schedule appt.	5 (41.7%)	9 (50%)
Unsure why exam is needed	2 (16.7%)	3 (16.7%)
Appointment already made	1 (0.1%)	3 (16.7%)
Had retinal photography	0 (0%)	1 (5.6%)
Have not established care with ophthalmologist/optometrist	3 (25%)	1 (5.6%)

Table 3

Patient Likelihood to Schedule Eye Exam and Interest in Retinavue

Likert scale responses	Medicare payer sample n (%)	Commercial payer sample n (%)
Likelihood of scheduling eye appointment within 3 months		
Very likely	13 (37.1%)	10 (30.3%)
Somewhat likely	12 (34.3%)	17 (51.5%)
Very unlikely	10 (28.6%)	6 (18.2%)
Interest in Retinavue		
Very interested	10 (28.6%)	7 (21.2%)
Somewhat interested	5 (14.3%)	3 (0.1%)
Uninterested	20 (57.1%)	23 (69.7%)

The quality improvement nurse scheduled patients for Retinavue. These appointments were scheduled as 20-minute nurse visits. Pupils were usually not dilated for the Retinavue imaging. However, if needed, mydriatic drops were used for examinations. The use of mydriatic drops increased patient wait times during these appointments and required an accompanying adult to provide transportation. Retinal images were then sent to off-site ophthalmologists and retinal specialists, who provided results to the practice within one week. These results were then placed into the EMR's "bucket" to be read by providers. Providers were expected to contact patients if a follow-up visit with an eye specialist was required based off the retinal images. With that said, a gap existed in which providers were not consistently communicating normal findings to patients, nor the need to visit an eye-care professional.

Organizational Readiness for Change

The Practice Improvement Rating Capacity Scale (PIRCS) was utilized to assess the organization's readiness for a quality improvement initiative (Ouden, Cade & McCord, 2014). The PIRCS is a useful resource for practices looking to introduce a quality improvement initiative (Ouden et al., 2014). The scale is based on a synthesis of successful driving factors for quality improvement initiatives and assists project leaders in selecting motivated practices for a change intervention (Ouden et al., 2014). The PIRCS readiness for change is founded on a color-rating scale with red indicating the practice is not ready for change, yellow, a limited capacity for change, and green signifying that the practice is ready for a quality improvement initiative (Ouden et al., 2014). Additionally, each criterion of the scale is weighted on a scale of 1 to 3, with 1 being of least importance and 3 most important (Ouden et al., 2014). Criterion with a weight of 3 must all be passed in order for the organization to achieve a green level (Ouden et al., 2014). The practice administrator was interviewed with questions based off of the criterion provided by the scale (Ouden et al., 2014). An overall score of 255 with a green rating was calculated indicating the practice was ready for immediate quality improvement interventions (Ouden et al., 2014).

Stakeholders

Stakeholders are individuals or groups of individuals that can affect or be affected by organizational change (Bundy, Vogel, & Zachary, 2017). Stakeholders for this quality improvement project include patients and their families, providers, eye-care professionals, MAs, and the practice's front-office and administrative staff. Patients were directly affected by quality improvement initiatives as they were aimed at improving patient outcomes. Shared decision

making between patients and family members was promoted to optimize patient response to these initiatives (Agency for Healthcare Research and Quality [AHRQ], 2014).

Being that the practice was a PCMH, providers adhered to the five functions of the medical home which included: comprehensive care, patient-centered, coordinated care, accessible services, and quality and safety (AHRQ, 2014). In order to provide optimal diabetes management and comprehensive care, providers are not only expected to communicate with ophthalmologists and optometrists, but also endocrinologists, nephrologists, podiatrists, and dieticians (Kuo et al., 2015). Providers must also remain up-to-date on the latest diabetes recommendations and guidelines and provide patients with optimal systemic management to reduce the risk of microvascular complications in the diabetic population (Hendrick et al., 2015; Silva et al., 2016).

Quality improvement initiatives must coincide with the AACE/AmCE and ADA recommendations regarding comprehensive eye examinations in patients with diabetes (Handelsman et al., 2015; Riddle et al., 2018). The PCMH is also expected to coordinate care between health services provided by the community, to ensure diabetic patients have successful behavioral changes and reduce microvascular complications associated with diabetes (Haas et al., 2013). Quality and safety were promoted throughout the quality improvement initiative, as it encompassed evidence-based research and involved shared-decision making between patients and their families for appropriate health management (AHRQ, 2014). Furthermore, MAs were key stakeholders in the quality improvement initiative, as they were the initial contact with patients and were conducting retinal screenings within the practice. Payers and administrative staff were also impacted as payers ensure patients receive optimal, evidence-based care, to

reduce unnecessary indirect and direct costs which can further aid reimbursement for the practice (AHRQ, 2014).

Project Identification

The purpose of this quality improvement project was to ensure patients with diabetes at a family practice were receiving comprehensive diabetic eye examinations per the AACE/AmCE and ADA recommendations (Handelsman et al., 2015; Riddle et al., 2018). Table 4 summarizes project objectives, interventions, and anticipated outcomes. The objectives were as follows:

(1) The primary objective of this project was to increase the rate of comprehensive dilated eye examinations for patients with diabetes between the ages of 18 years to 75 years from 45% to greater or equal to 60% within 10 weeks of project initiation. This was assessed by ensuring providers received and documented results of a comprehensive dilated examination by either an ophthalmologist or optometrist within the practice's EMR.

(2) The second objective was to increase the provider referral rate to eye specialists for patients with diabetes aged 18 years to 75 years from 36% to 70% or greater after 10 weeks of project initiation. The objective was evaluated using the practices' EMR and completed checklists to track provider referral rates to ophthalmologists and optometrists.

(3) The third objective was to ensure patients were 80% adherent to ophthalmology and optometry referrals by either having had an eye examination by an ophthalmologist or optometrist within the past year or having scheduled an appointment with an eye specialist within the next three months. Adherence to referrals was evaluated after 10 weeks of project initiation by contacting patients via telephone.

Table 4

Project Objective, Interventions, and Anticipated Outcomes

Objective	Intervention	Anticipated Outcomes
1) The rate of comprehensive dilated eye examinations for diabetic patients between the ages of 18 years to 75 years will increase within the practice.	1) Educational session for providers and staff. 2) Use of a diabetes eye exam checklist by providers and staff. 3) Patient reminder card 4) EMR alert 5) NEI brochure	Documentation of completion of comprehensive eye examinations will increase from 45% to 60% or greater.
2) Increase the provider referral rate to eye specialists	1) Educational session for providers 2) Use of a diabetes eye exam checklist by providers 3) EMR alert	Provider referral rates to eye specialists will increase from 36% to 70% or greater.
3) Patients with diabetes will adhere to ophthalmology and optometry referrals.	1) Patient reminder card 2) NEI brochure 3) Follow-up telephone calls to inquire whether patients have received a comprehensive eye examination or scheduled an appointment with an eye specialist within the next 3 months.	Patients will be 80% adherent to eye specialist referrals.

Summary and Strength of the Evidence

Several studies discuss diabetic eye disease, particularly diabetic retinopathy and its implication for primary care. Current literature discusses barriers to eye examinations, along with the use of retinal photography in primary practice to alleviate such barriers. One study in particular, the Clearsight trial, plans to evaluate whether patients who receive on-site retinal photography have higher rates of eye disease detection and ophthalmology referrals versus participants who undergo usual screening methods (Liu et al., 2017). The Clearsight trial will be completed in December 2019 (Liu et al., 2017). The ADA recommendations for retinopathy screening and comprehensive dilated eye examinations are based on various randomized-control trials, meta-analyses, systematic reviews, and expert consensus (Riddle et al., 2018). Additionally, these studies emphasize the importance of glycemic control and its ability to reduce microvascular complications (Riddle et al., 2018).

Differences in diabetes care across different practices and providers were evaluated by Kuo et al. (2015) and Lindenmeyer et al. (2014). Moreover, several patient barriers to obtaining eye examinations were studied by Gower et al. (2013) which included transportation and scheduling conflicts; while Murchison et al. (2017) discovered that increased visual impairment, patient involvement in care, and non-smoking status were associated with adherence to eye examinations. The adaptation of retinal imaging in primary care clinics has been associated with increased detection of retinopathy, yet it does not directly correlate with patient compliance with follow-up recommendations (Jani et al., 2017). Interventions to increase retinopathy screenings in primary care included printed educational materials and patient reminder cards (Zwarenstein et al., 2014). However, these interventions were unconvincing without supplemental interventions aimed at behavior change (Zwarenstein et al., 2014).

Review of Literature

Literature was reviewed by using the University of the Incarnate Word's library database and searching for keywords such as "diabetes," "eye examinations," "diabetes management," and "primary care." The Johns Hopkins Nursing Evidence-Based Practice evidence rating system was used to rate the literature as either Level I, II, III, IV, or V (Dang & Dearholt, 2017). According to the Johns Hopkins evidence rating system, randomized control trials, experimental studies, and systematic reviews of randomized control trials with or without meta-analyses constitute as Level I evidence (Dang & Dearholt, 2017). Level II evidence being quasi-experimental studies or systematic reviews of both quasi-experimental studies and randomized control trials (Dang & Dearholt, 2017). Quantitative non-experimental and qualitative studies are rated as Level III evidence, while Level IV evidence consists of clinical practice guidelines and expert consensus (Dang & Dearholt, 2017). Lastly, integrative interviews, quality improvement reports, or general summaries of evidence without critical appraisal are considered Level V evidence (Dang & Dearholt, 2017).

The ADA recommendations for preventing or slowing diabetic retinopathy are based on well-conducted, randomized control trials (Riddle et al., 2018). Large-prospective randomized control studies, such as the United Kingdom Prospective Diabetes Study (King, Peacock, & Donnelly, 1999) as well as studies conducted by Chew et al. (2010), Gubitosi-Klug et al. (2016), and Nathan et al. (1993), provide the basis for recommendations on achieving near normal glucose levels in patients with diabetes (Riddle et al., 2018). The ADA states that achieving near normal glycemic levels may prevent or delay the onset of diabetic retinopathy (Riddle et al., 2018). Additionally, angiotensin-converting enzyme (ACE) inhibitors and angiotensin II receptor blockers (ARBs) have been found effective in reducing blood pressure in diabetic patients, thus

reducing diabetic retinopathy progression (Riddle et al., 2018). This recommendation was based off of a cohort study by Shih et al. (2016), therefore had a Level IV evidence level. Although tight systolic blood pressure goals of less than 120 mmHg have not provided additional benefit per a randomized trial by Chew et al. (2010). Moreover, in patients with dyslipidemia, the addition of fenofibrate can slow the progression of diabetic retinopathy, especially in patients with mild non-proliferative diabetic retinopathy (Riddle et al., 2018). The benefits of fenofibrate addition were based off Level I evidence from multicenter, randomized control trials by Chew et al. (2014).

ADA recommendations on frequency of diabetic eye examinations and screenings are also based on well-conducted cohort studies and meta analyses (Riddle et al., 2018). The ADA recommends eye examinations in patients with diabetes be performed by either an ophthalmologist or optometrist familiar in diagnosing diabetic retinopathy (Riddle et al., 2018). Patients with type 1 diabetes are recommended to have an initial comprehensive dilated eye examination within five years of diagnosis (Riddle et al., 2018). Additionally, patients diagnosed with type 2 diabetes are recommended to have a comprehensive dilated eye examination at the time of diagnosis (Riddle et al., 2018). Recommendations for screening for type 1 and type 2 diabetes were supported by the Canadian Ophthalmological Society Guidelines for Management of Diabetic Retinopathy (Hooper et al., 2012). Moreover, the ADA recommends for subsequent eye examinations to occur annually and then at intervals of every 1 to 2 years in the presence of one or more normal eye examinations (Riddle et al., 2018).

Meanwhile, expert consensus has determined that retinal photography does not supplement a comprehensive eye examination (Riddle et al., 2018). However, a retrospective cohort analysis by Walton et al. (2016) and a meta-analysis by Bragge et al. (2011) both found

that retinal photography can increase access to retinopathy screenings in areas lacking readily available qualified eye professionals (Riddle et al., 2018). Additionally, retinal photography is thought to be cost-effective and efficient, as ophthalmologists' expertise may be reserved for more complex examinations per a retrospective, correlational study by Ahmed et al. (2006). This differs from recommendations by the ADA which advocate for in-person examinations with examination results being delivered to and documented by the referring provider (Riddle et al., 2018).

Diabetes care by provider. A retrospective cohort study by Kuo et al. (2015) compared cost and processes of care by NPs and physicians. A national sample of 64,354 Medicare beneficiaries receiving primary care by either an NP or physician in 2009 was obtained (Kuo et al., 2015). Processes of care were based on the HEDIS measures for diabetes comprehensive care which included: annual eye examinations, screening of low-density lipoprotein (LDL-C) cholesterol, HbA1C testing, and nephropathy monitoring (Kuo et al., 2015). Continuity of care was measured by the Modified Modified Continuity Index (MMCI), with a higher MMCI indicating better continuity of care (Kuo et al., 2015). Medication adherence using the medication possession ratio (MPR) and the use of potentially inappropriate medications defined by the Beers criteria were also examined (Kuo et al., 2015). The Medicare provider analysis and review files, carrier files, and outpatient standard analytical files were used to approximate the Medicare paid amount (Kuo et al., 2015).

Two cohorts evaluated by Kuo et al. (2015) included 14,811 patients who received primary care by NPs and 49,543 from physicians. The study found that patients receiving care from NPs had decreased rates of eye examinations and HbA1C testing (Kuo et al., 2015). However, these patients had equal rates of nephropathy monitoring and lipid testing, when

compared to patients receiving care from physicians (Kuo et al., 2015). Additionally, NPs were more likely to refer patients to specialties such as cardiology, endocrinology, and nephrology (Kuo et al., 2015). The use of potentially inappropriate medications was also slightly higher in patients cared for by NPs versus physicians (Kuo et al., 2015). Cost of care by both NPs and physicians were noted to be similar between both groups of individuals (Kuo et al., 2015). Limitations of the study included that NPs were more likely to care for patients less medically-complex than those cared for by physicians (Kuo et al., 2015). Patterns of care, such as foot care and dietary advice, were also not included and cost of care did not account for home health, medications, or durable medical equipment (Kuo et al., 2015). This study provided insight regarding barriers to optimal reduction of microvascular risk factors in patients with diabetes (Kuo et al, 2015). Also, consistency in care between providers was imperative to address poor patient compliance with diabetic eye examinations. Moreover, the authors recommended a longitudinal study to further evaluate the differences in care and health outcomes for patients seen by NPs and physicians (Kuo et al, 2015).

Comparison of diabetes management among providers was also evaluated by a Level III retrospective correlational study by Lutfiyya et al. (2016). This study compared patient outcomes and healthcare costs among Medicare patients seen by NPs and physicians (Lutfiyya et al., 2016). Health outcomes that were evaluated included rates of lower extremity amputations, eye exams, lipid screening, flu shots, number of patients with foot ulcers, and HbA1c testing (Lutfiyya et al., 2016). Additionally, number of inpatient admissions, inpatient days, inpatient mortality, length of stay, and number of provider visits were also evaluated by each provider (Lutifyya et al,. 2016).

Patients with type 2 diabetes were included in the study and data was extracted from a random, cross-sectional sample of five percent of Medicare beneficiaries seen in primary care offices in the year 2012 (Lutfiyya et al., 2016). International Classification of Diseases, Ninth Revision (ICD-9) diagnostic codes were used in the data collection, and the codes specifying type 2 diabetes or unspecified diabetes were included (Lutfiyya et al., 2016). Data was collected on the 199,185 patients seen by primary care physicians and 4,385 patients seen by NPs during the 1-year time period (Lutfiyya et al., 2016). The medical productivity index (MPI) was used to categorize health status of patients with MPI 40 being least healthy and MPI 80 representing Medicare beneficiaries with the lowest disease burden (Lutfiyya et al., 2016). Study findings favored NPs as patients seen by NPs had better quality of care and lower healthcare costs (Lutfiyya et al., 2016). These results were also noted in the Medicare beneficiary group considered to be the least healthy as inpatient admissions, inpatient days, and number of provider visits were statistically less for patients cared for by NPs versus physicians (Lutfiyya et al., 2016). Furthermore, this study's findings differ from the findings by Kuo et al. (2015) as the number of eye exams ordered by NPs were significantly higher than those ordered by physicians (Lutfiyya et al., 2016).

Barriers to obtaining eye examinations. Murchison et al. (2017) conducted a 4-year retrospective correlational study reviewing the charts of 1,968 diabetic patients at an urban eye hospital. The purpose of this Level III study was to examine individual factors that affect adherence to follow-up eye care in patients diagnosed with diabetes (Murchison et al., 2017). Billing and administrative data was compiled from patients 40 years and older (Murchison et al., 2017). The data collected was on individuals who had an initial ophthalmology or retinal specialist visit within the past 4 years (Murchison et al., 2017). Claim files identified patients

using the ICD-9 diagnostic codes, which specified the diagnosis of diabetes and level of diabetic retinopathy (Murchison et al., 2017). Trained coordinators and research assistants also reviewed charts to include patient demographics, HbA1C levels, glucose levels, medications, visual acuity, eye examinations, and diagnosis of eye disease (Murchison et al., 2017)

The study found that rates of follow-up eye examinations were low across all age and ethnic groups and depended on the severity level of diabetic retinopathy (Murchison et al., 2017). Follow-up with recommendations were less likely in patients with mild or no diabetic retinopathy, which was hypothesized to be due to lack of perceived need of ophthalmic care (Murchison et al., 2017). Another reason for decreased eye-care follow up in this population was thought to be decreased contact with health providers due to the patients being generally younger as well as less availability due to prior commitments (Murchison et al., 2017). Contrarily, increased adherence with follow-up eye examinations was seen in patients with visual impairment versus patients with normal vision (Murchison et al., 2017). Patients who smoked were less likely to adhere to recommendations than those who did not smoke (Murchison et al., 2017). Chart reviews also showed patients who had missing documentation of self-reported HbA1C results were less likely to follow up with recommendations versus those who did have results documented (Murchison et al., 2017). The authors of this study inferred that this may be due to increased patient self-management and involvement in diabetes care (Murchison et al., 2017). Moreover, weaknesses of this study included that HbA1C levels and ethnicity were self-reported and data for eye examinations was not collected at other clinics.

Barriers to eye examinations were also evaluated by Gower et al. (2013). The Level III single-qualitative study used telephone-based questionnaires to identify barriers in attending free eye-examinations at a clinic serving low-income, uninsured patients. The clinic was affiliated

with the Prevent Blindness Ohio initiative and patients were initially screened for decreased visual acuity as well as for a history of diabetes, glaucoma, or eye problems (Gower et al., 2013). Those who screened positive for decreased visual acuity, diabetes, glaucoma, or eye problems were invited to participate in a free-professional eye examination within the next three months (Gower et al., 2013). Participants who did not partake in the free eye examinations were then contacted by trained interviewers at the John Hopkins School of Medicine (Gower et al., 2013). Standardized interviewing techniques were utilized and three attempts were made to contact individuals (Gower et al., 2013). Participants were given a $20 grocery card and were contacted to reschedule their missed appointment (Gower et al., 2013).

Interviewers attempted to reach the 238 individuals who did not attend their scheduled eye appointment with a total of 93 individuals being reached (Gower et al., 2013). Approximately 77% of the individuals reached stated they were interested in receiving a free eye examination with no demographic differences noted between those who wanted an exam and those who did not (Gower et al., 2013). When asked, the main reasons for missed appointments included lack of transportation, forgetting the appointment, and scheduling conflicts (Gower et al., 2013). Moreover, participants stated that same day appointments, reminder phone calls, and free transportation would positively impact keeping future appointments (Gower et al., 2013).

A Level III qualitative study by Lindenmeyer et al. (2014) was aimed at identifying modifiable and non-modifiable factors affecting patient uptake on screening for diabetic retinopathy. A total of nine general practices were purposively selected in different socioeconomic areas (Lindenmeyer et al., 2014). Participating practices identified medical staff members, administrative staff, and screeners to be interviewed. A purposive sample of 38 patients were interviewed across all nine practices (Lindenmeyer et al., 2014). Results to

questions regarding modifiable factors identified that both good communication and staff motivation were imperative to screening success (Lindenmeyer et al., 2014). Respondents also identified that allocating a room to set up screening equipment was a perceived barrier in screening uptake (Lindenmeyer et al., 2014). Additionally, calling patients prior to appointments or after missed appointments was found to increase screenings (Lindenmeyer et al., 2014). Moreover, reminding patients during routine visits about screenings and addressing other problems such as hypertension, increased not only screenings but continuity of care (Lindenmeyer et al., 2014).

Non-modifiable factors that were identified as barriers included materials written in English for patients from ethnic minority backgrounds at three of the nine practices (Lindenmeyer et al., 2014). Transportation was also identified as problematic in areas where public transport was unavailable (Lindenmeyer et al., 2014). The study concluded that a collaborative approach with shared responsibility was integral in improving retinopathy screening uptake (Lindenmeyer et al., 2014).

Retinal screenings in primary care. Jani et al. (2017) conducted a Level II quasi-experimental study to evaluate telemedicine screenings for retinopathy in a rural and underserved area. Demographics and social determinants of health were also collected and compared with diabetic retinopathy prevalence and the need for ophthalmology referrals (Jani et al., 2017). Patients who were 18 years of age or older with either type 1 or type 2 diabetes were included in the study (Jani et al., 217). Exclusion criteria included the of inability to undergo retinal screening due to cognitive or physical impairment or documentation of a retinal examination within the past year (Jani et al., 2017). Patients were enrolled for retinal screening at five primary care clinics within the North Carolina Diabetic Retinopathy Telemedicine Network (NCDRTN)

(Jani et al., 2017). Patients were enrolled the same day as their provider visit and nursing staff, technicians, and ancillary staff were trained to operate the retinal cameras (Jani et al., 2017). Moreover, the clinics' EMRs were also used to identify and recruit patients in need of retinal screening (Jani et al., 2017).

Each clinic was provided with educational materials provided by the National Eye Institute (NEI) (Jani et al., 2017). Education was delivered using brochures, posters, flipcharts, online videos in both English and Spanish, and didactic sessions on retinal screening were provided to physicians and staff (Jani et al., 2017). The mean rate of retinal screening across all five clinics prior to implementation was 25.6% and increased to 40.4% after the use of the telemedicine network (Jani et al., 2017). Out of 1,323 patients, 79.7% had no evidence of diabetic retinopathy, 11% had diabetic retinopathy without a need for ophthalmology referral, and 9.3% had significant levels of diabetic retinopathy warranting a referral (Jani et al., 2017). Furthermore, approximately 60% of referred patients completed these referrals (Jani et al., 2017).

Study findings also revealed that advanced diabetic retinopathy was associated with a longer duration of diabetes and higher HbA1C levels thus increasing the need for ophthalmology referrals (Jani et al., 2017). Moreover, racial and ethnic minorities were found to have lower rates of diabetic eye examinations, but telemedicine reduced these barriers by increasing access to screening (Jani et al., 2017). Telemedicine was also thought to facilitate referrals to ophthalmology for patients at risk for vision loss and increased patient satisfaction through the use of point-of-care testing (Jan et al., 2017).

Bouskill et al. (2018) conducted a Level III qualitative research study to monitor medical personnel workflows and perspectives on retinopathy screening and follow-up. A total number of 23 staff members were interviewed from three federally qualified health centers (Bouskill et al.,

2018). Results showed that staff workarounds to screenings were more prevalent in overpopulated clinics and areas with limited budgets (Bouskill et al., 2018). MAs were found to be responsible for many tasks associated with diabetic retinopathy screening and scheduling and were performing screenings without guidance from physicians or nurses (Bouskill et al., 2018). Moreover, 80% of patients with vision-threatening diabetic retinopathy detected by retinal screening were not likely to complete follow-up recommendations (Bouskill et al., 2018). Although telemedical screening in primary care clinics methods provided increased detection of diabetic retinopathy, the added burdens on medical staff caused resource constraints and increased the likelihood for irregularities in workflow (Bouskill et al., 2018).

Patient and provider reminders. A Level II cluster-randomized control trial by Zwarenstein et al. (2014) involved 5,048 general practitioners aimed at increasing retinal screening in diabetic patients in primary care clinics. Interventions included providing free, evidence-based educational materials on a postcard-sized insert to patients (Zwarenstein et al., 2014). Additionally, clinicians provided patients with take-home reminders, reminding them to make an appointment for an eye examination (Zwarenstein et al., 2014). Reminders containing promptings for optimal retinopathy screenings and a newsletter were mailed each provider (Zwarenstein et al., 2014).

The study participants included approximately 179,833 patients with diabetes aged 30 years or older across 4,231 practices (Zwarenstein et al., 2014). The study found that patients 65 years of age and older were more likely to visit their primary care provider (PCP) and to report a recent eye examination (Zwarenstein et al., 2014). However, study findings were inconclusive as there was no improvement in retinal screenings compared to control groups (Zwarenstein et al., 2014). Zwarenstein et al. (2014) concluded that a prior assessment was not conducted, therefore,

printed educational materials for providers and patient reminders may have not alleviated barriers to screenings. Moreover, the study found that printed educational materials alone were not sufficient in closing the evidence-practice gap (Zwarenstein et al., 2014). Rather, complementary interventions focused on behavior change may be of added benefit (Zwarenstein et al., 2014).

Mendu et al. (2014) aimed to increase utilization of chronic kidney disease (CKD) guidelines within a primary care practice using a checklist. A Level IV prospective, nonrandomized study was conducted over a one-year period and incorporated the use of a CKD checklist within the clinic's EMR (Mendu et al., 2014). The CKD checklist was developed based on the latest CKD guidelines and aimed to improve patient outcomes within the clinic (Mendu et al., 2014). Prior to the use of the checklist, the clinic's 13 providers were given a 30-minute educational lecture regarding CKD management (Mendu et al., 2014). Educational materials and the checklist were also given to all providers (Mendu et al., 2014). The intervention group was selected by the clinic's medical director and included four primary care providers assigned to use the CKD checklist while the remaining nine providers were placed into the control group (Mendu et al., 2014).

Inclusion criteria for the study included the presence of CKD while patients with a glomerular filtration rate (eGFR) of less than 15 ml/min were excluded from the study (Mendu et al., 2014). A total of 368 patients were seen at the clinic over a one-year period with 105 of these patients being in the intervention group (Mendu et al., 2014). Patient demographics were similar between both groups, however, patients in the intervention group were older, more likely to report a history of malignancy, and had a higher serum creatinine level and systolic blood pressure than the control group (Mendu et al., 2014). Patients within the intervention group had

increased rates of adherence to CKD guidelines compared to the group seen by providers who did not use the CKD checklist (Mendu et al., 2014). Study limitations include potential provider bias regarding the use of the CKD checklist, other quality improvement initiatives within the clinic warranting provider attention, and the need for long-term follow-up to determine adequate CKD management (Mendu et al., 2014). Use of a checklist was deemed a successful intervention to increase provider adherence to clinical guidelines within a primary care practice (Mendu et al., 2014).

Methods

A survey from the purposive, randomized sample of 71 Medicare-payer diabetic patients and 105 commercial insurance-payer diabetic patients who lacked documentation of an eye examination result within the past year in the practice's EMR showed that a large number of these patients had already received an eye examination by either an ophthalmologist or optometrist. Approximately 66% of the Medicare-payer patients and 46% of the commercial insurance-payer patients self-reported that they had received an eye examination within the past year. That being said, a gap existed in which the ophthalmology and optometry clinics did not consistently fax results of diabetic eye examinations back to the practice. The survey also revealed that of the individuals who did not have an eye examination within the past year, 41.7% of Medicare-payer diabetic patients and 50% of commercial insurance-payer diabetic patients stated they simply forgot about their appointments or had not scheduled their appointments.

Moreover, 81% of Medicare-payer diabetic patients who lacked documentation of an eye examination stated they were "very interested" in retinal imaging at the practice compared to 41% of commercial insurance-payer diabetic patients. A randomized review of 30 patient charts revealed that providers were marking the quality metric of diabetic eye examination as "met"

based off patient history rather than documented examination results. Further investigation revealed that providers were not consistently referring patients to eye specialists when a documented eye examination was lacking in the EMR. Lastly, the recent purchase of Retinavue by the practice has prompted the use of retinal imaging as a substitute for a comprehensive eye examination by an eye specialist given that it meets the HEDIS measure of an eye examination. Yet, retinal imaging does not take the place of a comprehensive eye examination by an eye specialist (Riddle et al., 2018).

Project Interventions

Educational session. A 15-minute educational session was provided to the providers and staff at each clinic location on January 28, 2019. The session provided information regarding ADA retinopathy screening guidelines and the NEI's (2015b) definition of a comprehensive diabetic eye examination (Riddle et al., 2018). The educational session consisted of a 10-minute presentation for providers and discussed appropriate documentation of referrals and referral results in accordance with the clinics' policies and procedures. Each provider was then given a copy of the 2018 ADA *Standards of Medical Care in Diabetes-Retinopathy Screening* and a copy of the practice's policies and procedures manual. The presentation also discussed utilization of the diabetes eye exam checklist (appendix B) for providers and staff, the EMR alert notification, and patient informational brochures and reminder cards.

MAs received an additional one-on-one educational session regarding the utilization of the diabetes eye exam checklist, patient informational brochure, and the need to assess the EMR for eye examination results at the initial patient encounter. Front office staff also received a one-on-one educational session regarding distribution of the checklist to patients with diabetes upon check-in. The diabetes eye exam checklist was placed in a designated folder readily visible to the

office staff, labeled “diabetes eye exam checklist.” Moreover, all clinic staff were made aware that retinal imaging does not replace the need for a comprehensive diabetic eye examination by an eye specialist.

Diabetes eye exam checklist. The diabetes eye exam checklist was developed and provided to the front office staff (appendix B). The checklist aimed at closing-the-loop on referrals made by the clinic providers and the referral results received from eye specialists. Additionally, the checklist ensured that providers, MAs, and patients were all aware of their roles in helping to reduce the microvascular complications associated with diabetes. Most importantly, the checklist helped increase the likelihood that patients with diabetes received an eye examination by either an ophthalmologist or optometrist according to practice standards. Front office staff provided the checklist to patients who had a diagnosis of diabetes upon check-in. Patients then filled out designated sections of the checklist. The designated sections for patients to fill out were highlighted in yellow and included: patient name, date of birth, and insurance company. Also, if known, patients filled out the date and result of their last HbA1C. Inquiry regarding patients’ HbA1C results was supported by Murchison et al. (2017), as self-reporting of HbA1C levels by patients was found to be associated with increased diabetes self-management. If the date or result of the last HbA1C was not known, MAs searched for this information using the clinic’s EMR. Additionally, patients were asked to check off whether they have had an eye examination within the past year, and if applicable, to provide information regarding the date of the eye examination and the contact information of the eye specialist that performed the examination. Patient involvement in care is thought to increase adherence to timely eye examinations (Murchison et al., 2017).

Once patients were called back to the examination room they handed the checklist to the MA. Given that the patient flow process within the clinic involved MAs reviewing patient medications and quality metrics before the provider greeted the patient, MAs were able to complete the checklist during this process. The checklist permitted MAs to review and fill out the patient's latest HbA1C result, current blood pressure reading, and whether the patient was on an ACE inhibitor, an ARB, or a statin. This was necessary as adequate management of blood pressure, blood glucose, and lipid levels has been correlated with a reduction of microvascular complications, such as diabetic retinopathy (Hendrick et al., 2015; Riddle et al., 2018; Silva et al., 2016). A list of commonly used ACE inhibitors and ARBs was provided on the back of the checklist for the MAs to refer to. If patients reported having had an eye examination within the past year, a medical release form was faxed to the appropriate eye clinic by the MA or front office staff. Whoever faxed the medical release form initialed the checklist in order to note that the release had been sent to the eye specialist's office.

Subsequently, the checklist was handed to the provider, who reviewed the completed information. Providers were then able to determine whether patients were in need of either an ophthalmology or optometry referral. Meanwhile, the providers were able to address measures to reduce diabetes-related microvascular complications as the checklist prompted providers to address HbA1C results, blood pressure, and statin therapy. The diabetes eye exam checklist remained with the patient and was handed to the front office staff upon checkout. The perforated portion at the bottom of the checklist was torn off and handed to those patients who received a referral to an eye specialist during their visit. The perforated section served as a reminder card for patients and is discussed as a separate intervention in the project intervention section. The completed checklist was then be placed in a designated health information portability and

accountability act (HIPAA) compliant folder labeled, “Completed Diabetes Eye Exam Checklists” and remained with the front office staff for review.

Reminder card. The perforated portion of the checklist served as a reminder card for patients who received either an ophthalmology or optometry referral during their office visit. When this portion was filled out, it was torn off by the front office staff upon checkout and handed to the patient. The reminder card included a written reminder for patients to schedule an appointment for an eye examination. It also included the referring provider’s name and contact information, referral date, patient’s name, patient’s date of birth, and the fax number of the clinic where referral reports could be sent. This was done in hopes that the patient would give the perforated portion of the checklist to the eye specialist’s office. The fax number was provided to help ensure that eye examination referral reports were sent back to the practice so these reports could be reviewed and documented by the referring providers.

EMR alert. EMRs of patients with diabetes scheduled during the 10 weeks of project implementation were reviewed to assess for documentation of an eye examination within the past year. The project leader and quality improvement nurse then set an EMR alert for patients lacking a diabetic eye examination prior to their office visit. The alert appeared in yellow at the top of the EMR and read “needs diabetic eye exam.” Once the diabetic eye examination was addressed and the corresponding eye examination results documented, the alert was cleared by the documenter.

Brochure. A brochure provided by the NEI was placed in all examination rooms explaining diabetic eye disease (appendix C). The brochure provided patients with information regarding prevention, signs and symptoms, and treatment of diabetic eye disease. Additional resources such as the NEI contact information were also provided. The brochure was placed in

each room to serve as a visual cue for clinical staff to address diabetic eye disease and for patients to receive supplemental information. Patients were able to take the brochure home and refer to the information as needed. The primary language of patients with diabetes within the practice was English (89.1%). However, brochures were also provided in Spanish.

Setting and Population

This quality improvement project took place in clinic A and clinic B of a family practice within the northwest region of San Antonio, Texas. At the time of the intervention, providers working within the practice included 4 physicians and 2 NPs as one physician left the practice and 2 NPs joined the staff. Both clinical sites saw children and adult patients with the majority of patients between the ages of 18 years to 75 years. Providers would see up to 30 patients per day. The community surrounding both clinics consisted primarily of individuals of Hispanic or Latino descent with a median age of approximately 30 years and a median household income greater than the general San Antonio population (U.S. Census Bureau, 2016). Approximately 1,324 patients with diabetes were seen within the practice from August 1, 2017 to August 1, 2018. The diabetic patient population for both clinics was primarily English speaking and predominantly utilized commercial-insurances.

Organizational Barriers and Facilitators

Barriers. Several barriers were noted within the practice. As previously stated, the practice was a PCMH with quality metrics being evaluated in accordance with HEDIS measures set by the NCQA. With that said, a discrepancy existed between the NCQA definitions for a diabetic eye examination and the ADA and AACE/AmCE recommendations (Handelsman et al., 2015; Riddle et al., 2018). Retinavue was recently purchased by the practice and was available at clinic A for the purpose of increasing diabetic eye examinations, given that Retinavue meets the

HEDIS measure for an eye examination. Retinal imaging does not substitute for a comprehensive eye examination by an eye specialist according to the clinical guidelines for diabetic eye examinations established by the ADA and AACE/AmCE (Handelsman et al., 2015; Riddle et al., 2018). Additional barriers included the recent change in clinic administration since the initial assessment of the practice. Another physician had also recently left the practice. These changes were seen as a potential barrier to continuity of care affecting patient flow within the practice.

Facilitators. The practice was a PCMH that evaluated quality metrics on an ongoing basis in accordance with HEDIS measures set by the NCQA. Comprehensive diabetes measures are part of the quality metrics and include diabetic retinopathy screenings. Monthly leadership meetings allowed staff and providers to review the clinics' progress towards meeting the HEDIS measures as provided by the NCQA. Quality improvement tools such as the plan-do-study-act (PDSA) worksheet were utilized to improve performance in meeting the quality measures and assist in reviewing the clinics' progress. Communication was an integral part of the leadership meetings. The meetings were frequently co-led by the practice administrator and one of the providers. The MAs, front office staff, and the quality improvement nurse also participated in these monthly meetings.

Other facilitators include the use of the EMR by all of the staff within the practice, which promoted continuity of care and patient safety. Patients were able to access their information such as laboratory results and appointment reminders through the patient portal. The patient portal was also used to promote communication between the practice and the patients, therefore the clinic staff encouraged all patients to enroll in the service.

Ethical Considerations

Patient-safety was promoted by the practice, as it is an essential component of a PCMH. This quality improvement project was derived from evidence-based guidelines and systematic reviews. Therefore, it was in compliance with established clinical practice guidelines and aimed to ensure that patients received optimal and safe patient-care. Patient consent to medical services by the practice was used as consent for this project. Interventions were aimed at improving practice processes and did not involve direct patient contact. Patient privacy was upheld in accordance with HIPAA requirements with patient information reported as an aggregate for this project. This quality improvement project was submitted to the Institutional Review Board (IRB) of the University of the Incarnate Word and deemed not regulated research. Therefore, this project did not require approval by the IRB.

Evaluation Plan

EMR Review

For those patients who reported having an eye examination within the past year, the EMR was audited to ensure eye examination results were received and documented. The EMR was reviewed to ensure 100% of the patient charts that lacked a documented diabetic eye examination, had an EMR alert reading “needs diabetic eye exam.” These evaluations were done on the EMRs for patients seen during the 10-week project implementation period. Additionally, the project leader ensured the EMR alert was only cleared after eye examination results were received and documented.

Completed Eye Exam Checklist Folder

Follow-up occurred with MAs and front office staff once-a-week to determine whether there was at least a 60% compliance rate in utilizing the diabetes eye exam checklist. This was

done by reviewing completed checklists in the designated folder labeled “Completed Diabetes Eye Exam Checklists” at the front desk of clinic A and clinic B. This was compared to the number of patients with diabetes seen within the clinics that week according to the EMR. The “Completed Diabetes Eye Exam Checklist” folder was reviewed to ensure that the perforated portion was provided to patients who had received a referral. It was also reviewed to determine whether clinical staff documented that the medical release form was faxed to the eye specialist if the patient received an eye examination within the past year but was lacking documentation of results in the EMR.

Patient Telephone Calls

The EMR and the “Completed Diabetes Eye Exam Checklist” folder were reviewed to identify patients who received referrals during their clinic visit. Patients who received referrals were called after 10 weeks of project implementation and were asked whether they had received a comprehensive eye examination by an eye specialist or if they had made an appointment within the next three months with an eye specialist. Patients were considered adherent if they had received a comprehensive eye examination by an eye specialist or had scheduled an appointment with either an ophthalmologist or optometrist within the next three months.

Results

Approximately 393 patients with diabetes between the ages of 18 and 75 years were seen at the practice between February 7, 2019 and April 18, 2019. During the implementation of this project, 304 (77.4%) checklists were completed, 67 new eye specialist referrals were documented within the practice’s EMR, and 60 patient reminder cards were distributed. A total of 197 males (50.1%) and 196 females (49.9%) were included in this quality improvement

project. A majority of these patients reported their ethnicity as Hispanic or Latino (52.4%) (figure 1).

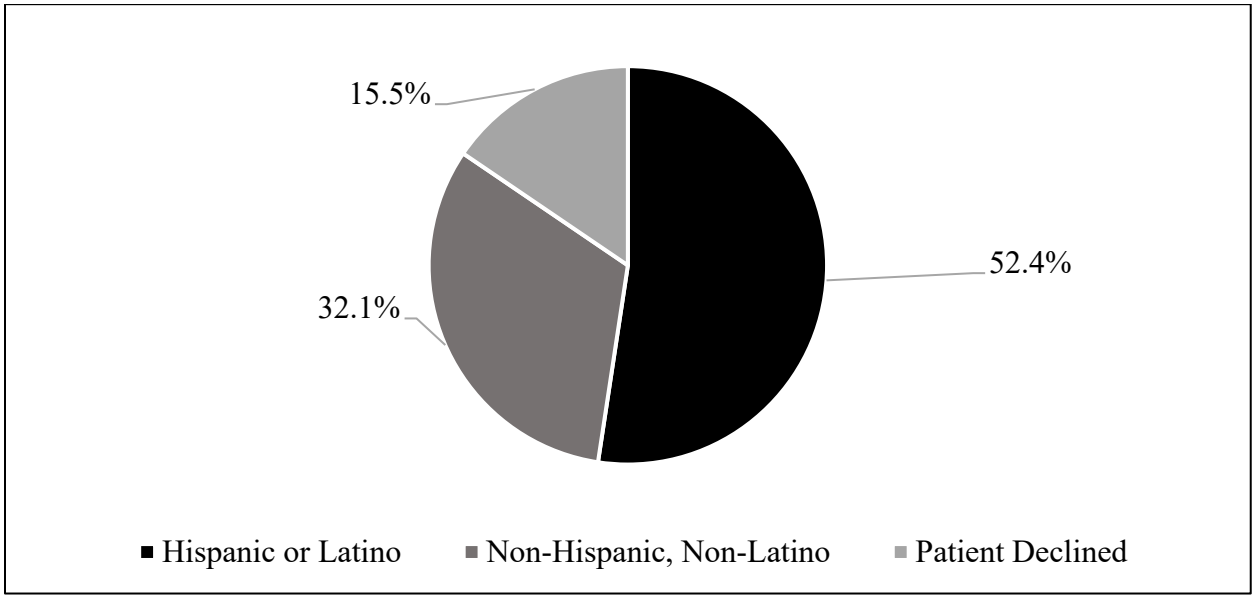

Figure 1. Participant ethnicity percentages.

Objective 1

Increase the rate of comprehensive dilated eye examinations for patients with diabetes between the ages of 18 years to 75 years from 45% to greater or equal to 60%.

Results for Objective 1

In reviewing the 304 completed checklists, 103 (33.9%) patients reported already having had an eye examination within the past year yet they did not have documentation of these results within the practice's EMR. Patients provided the contact information of their eye specialists on the checklists and these results were faxed to the practice to be documented in the EMR. Additionally, 84 (21.4%) individuals had documentation of retinal imaging within the practice, which accounted for 57.5% of patients lacking a documented eye examination by an eye specialist. Figure 2 displays the pre- and post-intervention eye examination rate for patients with diabetes at the practice.

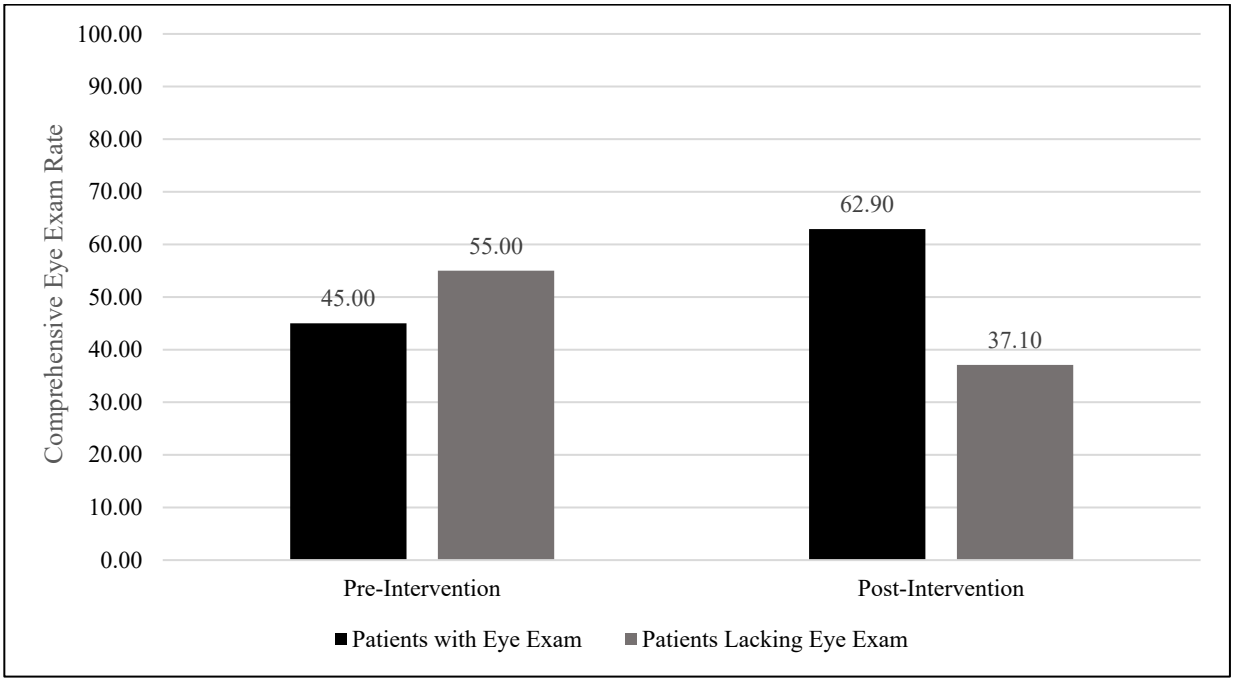

Figure 2. Eye examination rate pre- and post-intervention.

Objective 2

Increase the provider referral rate to eye specialists for patients with diabetes aged 18 years to 75 years from 36% to 70% or greater. The EMR was reviewed weekly to determine whether patients who did not receive an eye examination within the past year received a referral to an eye specialist during their clinic visit. Additionally, the diabetic eye exam checklists were reviewed to determine whether patients received reminder cards in addition to the EMR referral.

Results for Objective 2

When looking at referrals made for patients lacking documentation of an eye examination by an eye specialist, the average provider referral rate prior to implementation of the project was 36%. After the 10-week project implementation period, EMR audits revealed a 45.9% provider referral rate to eye specialists for patients lacking a documented eye examination (figure 3). It

was also noted that 45 (67.2%) of the referrals occurred at Clinic B, while 22 (32.8%) were from Clinic A (figure 4).

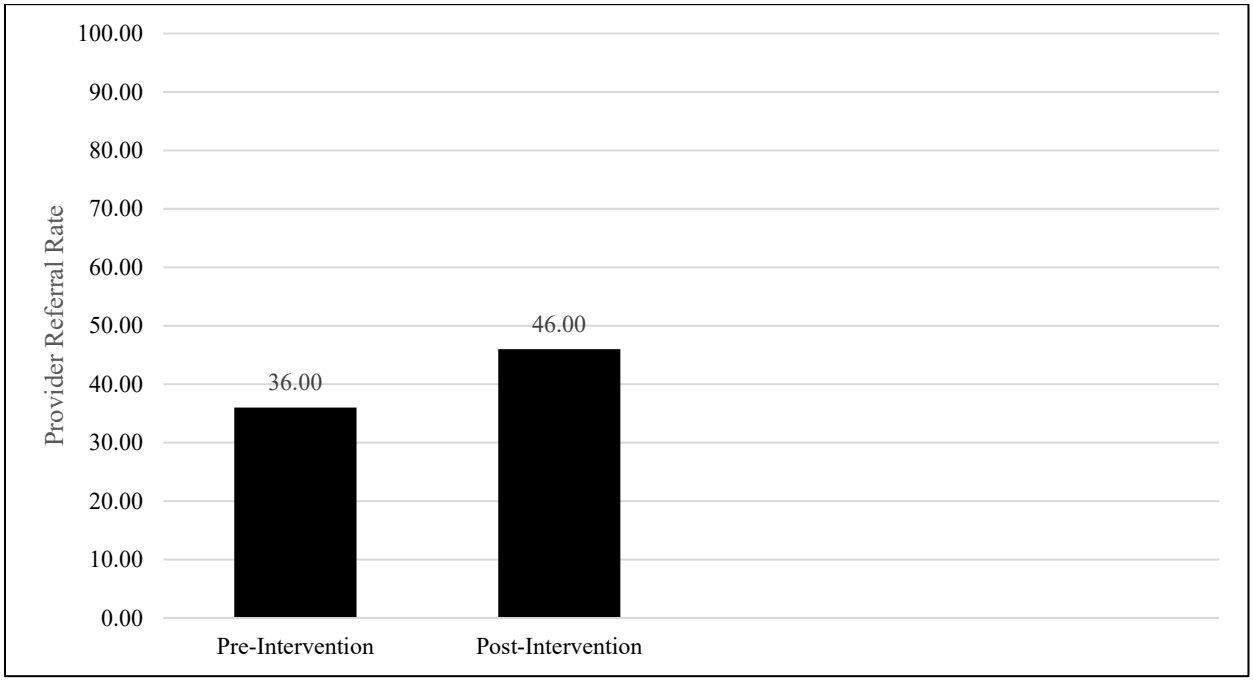

Figure 3. Provider referral rate to eye specialists.

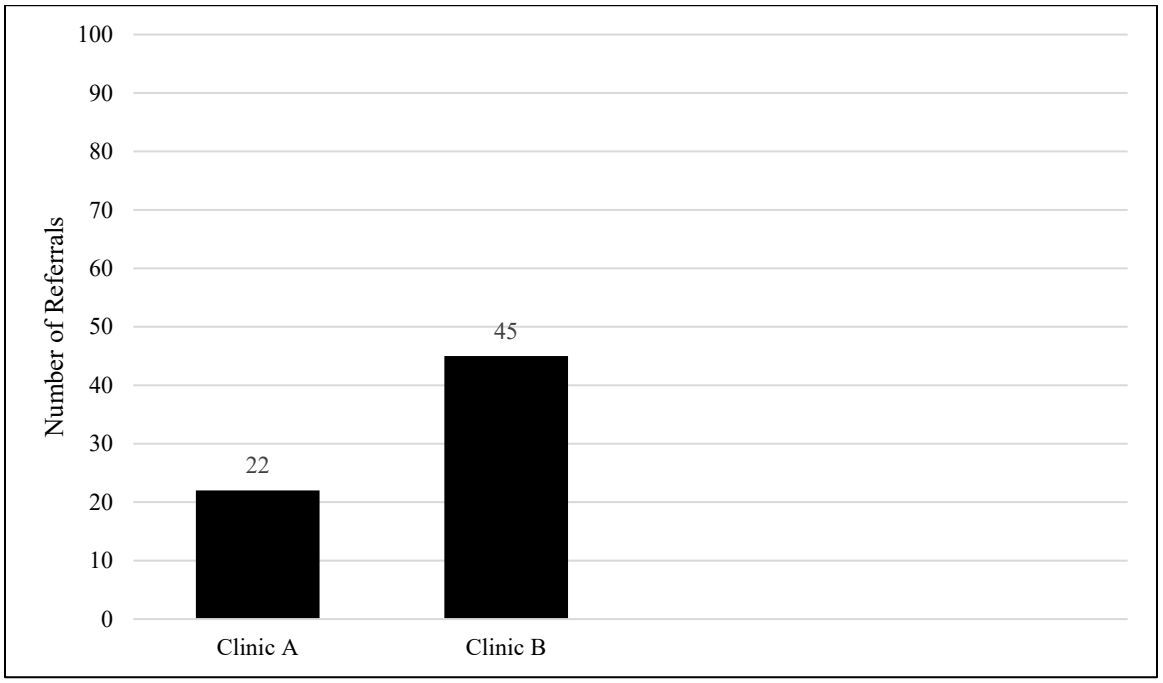

Figure 4. Number of referrals sent to eye specialists by clinic.

Objective 3

Eighty percent of patients will adhere to referrals by either having had an eye examination by an ophthalmologist or optometrist within the past year or having scheduled an appointment with an eye specialist within the next 3 months.

Results for Objective 3

Telephone calls were made to the 67 patients who received new referrals to eye specialists. Out of the 67 calls made, 33 individuals were reached and provided responses. Twenty-four respondents reported having had an eye examination, four individuals stated they had an eye examination scheduled within the next three months, and five individuals stated they did not have an eye examination scheduled. With that said, the overall adherence rate to referrals was 85% compared to 56% prior to implementation of this project (figure 5). Additionally, 18 eye examination results had already been received and documented within the practice's EMR as a result of the reminder card.

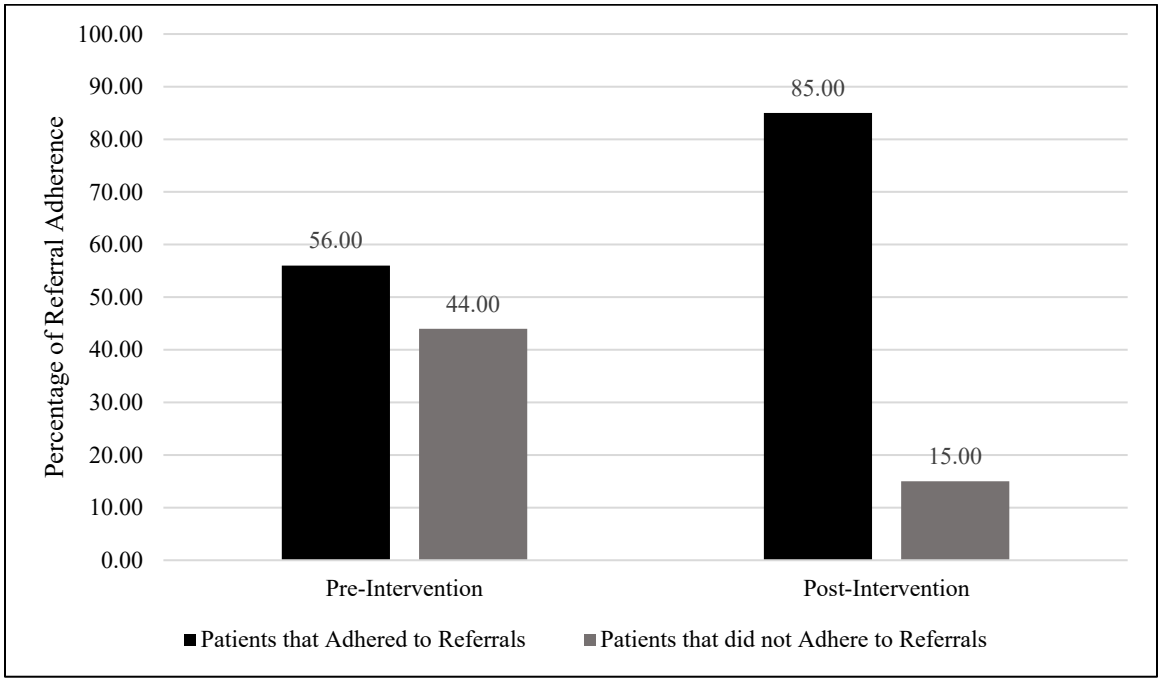

Figure 5. Percentage of referral adherence for patients with diabetes.

Discussion

Individuals with diabetes are more likely to develop serious vision-threatening eye disease sooner and more frequently than individuals without diabetes (Riddle et al., 2018). Therefore, this quality improvement initiative was designed to increase annual comprehensive eye examinations by eye specialists in patients with diabetes. This was achieved through implementation of a diabetic eye exam checklist, patient reminder card, an EMR alert, eye disease brochures, and staff and provider education within a family practice.

The diabetes eye exam checklist was used to increase surveillance of eye examinations in patients with diabetes and to increase provider referrals to eye specialists, thus closing-the-loop on referrals sent from the family practice clinics and results received from the referred eye specialist. More importantly, the checklist was implemented to ensure patients with diabetes were receiving eye examinations in concordance with the AACE/AmCE and ADA guidelines (Handelsman et al., 2015; Riddle et al., 2018). The MAs, front-office staff, providers, and patients were all involved in the implementation and utilization of the diabetes eye exam checklist. A collaborative approach is recommended during change processes by Lindenmeyer et al. (2014). However, the 77.4% compliance rate with using these particular checklists can be attributed to misplacement of the checklists by office staff, the large patient population seen by the practice, and the fact that a majority of documentation at the practice is done using an EMR. These findings are consistent with Bouskill et al. (2018) who found that change interventions may lead to increased workload on MAs and ancillary staff especially in clinics with a high patient population. Moreover, acute patient visits were also found to be a contributing factor for checklists not being completed during implementation of this project.

The checklist facilitated providers adherence to the current ADA guidelines as it not only prompted them to address whether the patient had an eye exam by an eye specialist, but also addressed microvascular risk factors associated with diabetic eye disease. The top-portion of the checklist listed microvascular risk factors that contribute to diabetic eye disease and required the patient and the MA to fill out information that helped to identify patients that had positive risk factors for diabetic eye disease. Out of the 393 patients seen, 280 (71.2%) were on either an ACE inhibitor or an ARB and 301 (76.6%) were on a statin medication. Additionally, 351 (89.3%) had a documented HbA1C result in the clinics' EMR with 194 (49.4%) of these patients having had a documented HbA1C level of 7 g/dL or less. Further review of the EMR revealed that providers were also addressing blood pressure and cholesterol management during these patient visits. This finding correlates with Mendu et al. (2014) who increased provider compliance with CKD guidelines and management through the use of a checklist in a primary care setting. Also, patients who filled out the HbA1C result were more likely to have had an eye examination by an eye specialist. Murchison et al. (2017) had a similar finding as patients who self-reported a HbA1C result were more likely to follow-up with eye examinations.

The average rate of eye examinations continues to increase at the practice as results from eye specialists continue to be faxed over to the practice in order to be documented in the EMR. The short time-period of this project hindered the tracking of these results as some eye specialist offices took as long as several weeks to fax results. Furthermore, the front office staff had to call some offices more than once to ensure that the eye examination results would be received. Therefore, for the purpose of this project, documentation of an eye examination in addition to patients documenting the contact information of an eye specialist was considered compliant as results continue to be faxed and received by the practice.

An unexpected outcome that was noted centered on the fact that the MAs in clinic A were using the diabetes eye exam checklist to screen patients for retinal imaging rather than using the checklist to identify patients in need of an eye examination by an eye specialist. Both the MAs and providers stressed the monetary incentive associated with retinal imaging since the practice was reimbursed for each retinal image taken using the Retinavue. Given that the Retinavue was only available at clinic A, providers from clinic A were more likely to use the Retinavue to screen patients with diabetes for retinopathy compared to clinic B. Of the patients who received retinal imaging, only 12 (14.3%) also had documentation of an eye examination by either an ophthalmologist or optometrist within the past year. Eight (9.5%) of the patients who received retinal imaging with the Retinavue had documented eye disease but were lacking a referral to an eye specialist. These results are similar to the findings provided by Bouskill et al. (2018) and Jani et al. (2017), which found that telemedicine increased screening for retinopathy yet did not necessarily correlate with increased patient follow-up with an eye specialists.

The patient reminder card was utilized to prompt patients to schedule an appointment with the ophthalmologist or optometrist they were referred to, as well as provide the eye specialists with the family practice's fax number to expedite sending the results back to the family practice. Patient adherence to eye specialist referrals did increase with the use of the reminder card since it decreased the likelihood that patients would forget their appointments which was similar to findings by Gower et al. (2013). This is in contrast to Zwarenstein et al. (2014) who found that patient reminder cards did not increase follow-up appointments with eye examinations. It was interesting to note that 18 (75%) of the 24 patients that received a referral and followed-up with an eye specialist already had documentation of their results in the clinics' EMR by the end of the project. This suggests that the reminder card not only increased patient

adherence to referrals but increased the timeliness of results being faxed to the family practice clinic.

The EMR alert was used to prompt providers to address the issue of whether patients received their annual eye examination. However, it should be noted that the EMR alert was cleared by providers at clinic A once retinal imaging was completed, rather than having results from an actual eye examination by an eye specialist. Similar findings were seen by Zwarenstein et al. (2014) who found that provider reminders alone did not suffice in increasing patient eye examinations. It is important to remember that thorough understanding and familiarity of evidence-based guidelines is crucial in increasing the success of a change intervention (Zwarenstein et al., 2014). Additionally, patient self-efficacy was promoted through the use of the NEI brochures as patients gained further insight regarding diabetic eye diseases to encourage behavior change and follow-up (Zwarenstein et al., 2014).

Limitations

The use of retinal imaging at clinic A was a major limitation throughout implementation of this project and further magnified the discrepancy between NCQA quality metrics and AACE/AmCE and ADA recommendations. The purchase of a retinal imager impacted provider referral rates, as the practice received reimbursement with each use of the retinal imager. In addition to this monetary incentive, providers did not refer patients with normal results to ophthalmologists or optometrists due to the fact that certain insurance plans would not cover both retinal imaging and an eye specialist examination within the same year. It was also noted that the practice developed a new policy during the implementation of this project that required patients with specific insurance plans to receive retinal imaging using the Retinavue. This further supports the assertion that reimbursement for retinal imaging took precedence over referrals to

eye specialists. The data also supported this finding as it was noted that the checklist was used to schedule 10 patients for retinal imaging rather than referring the patients to an eye specialist as originally intended.

Another limitation included how the front office staff used the eye exam folders. Completion of eye examination checklists was hindered at the beginning of this project due to the misplacement of the checklists by front office staff and the MAs. This was attributed to the high patient volume at both clinics and the fact that the checklist was not incorporated into the EMR. The short 10-week duration of the project intervention was also a limitation. A longer time-period for implementation would have permitted a more comprehensive review of eye examination results documented from previous eye specialist referrals in addition to those received from the new referrals. This would have likely affected the overall compliance rate.

Recommendations

Project sustainability after completion of this quality improvement initiative will be contingent upon several recommended project revisions. One recommendation would be to input the diabetic eye exam checklist into the practice's EMR for easier accessibility instead of using a separate diabetes eye exam checklist folder. The MAs and front office staff would then be able to print the checklist as patients checked into the clinic, thus decreasing printing costs of checklists that were pre-printed for patients who were scheduled to be seen at the clinic but failed to show up for their scheduled appointments.

The greatest challenge in sustainability of this project is the inconsistency between the practice's policies and procedures and the current AACE/AmCE and ADA recommendations for a diabetic eye examination. In order to promote project sustainability, a policy change within the practice would have to occur to facilitate patient follow-up with an eye specialist. More

importantly, policies and procedures of the practice should be revised to eliminate preferential usage of the retinal imaging for reimbursement payments rather than what is best for the patients based on current clinical practice guidelines. It is important for providers to continue participating in ongoing education in order to successfully ensure patients receive eye examinations that are consistent with current practice guidelines. MAs should also receive ongoing training regarding the need for eye examination referrals even when patients receive retinal imaging within the practice.

Implications for Practice

The findings of this quality improvement project demonstrate that provider and staff education, use of a diabetes eye exam checklist, patient reminder card, EMR alert, and informational brochures can help to increase adherence rates to current clinical practice guidelines for diabetic eye examinations. More importantly, the use of a retinal imager within a practice significantly impacts whether or not a patient received an appropriate referral to either an ophthalmologist or optometrist. In order to promote adherence to AACE/AmCE and ADA clinical practice guidelines, clinical policies should be revised to reflect current evidence-based practice guidelines. Providers within the practice should consider incorporating current clinical practice guidelines when managing the care of patients with diabetes to prevent microvascular complications such as diabetic retinopathy.

Furthermore, this quality improvement initiative exemplifies the role of the doctorate-prepared advanced practice registered nurse in fostering changes in practice based on current evidence. By analyzing and disseminating current practice guidelines, the advanced practice registered nurse is promoting improved patient treatment that is based on the most current evidence. This project highlights the challenges that many practitioners may face where clinic

policies do not always coincide with up-to-date practice guidelines. With that being said, it is the advanced practice registered nurse's responsibility to serve as the change agent, advocating for change that is consistent with current practice guidelines. In this case it is to help ensure providers adhere to the AACE/AmCE and ADA practice guidelines that promote the best possible patient outcomes.

Conclusion

Throughout this project, it was evident that there was a gap in patients with diabetes obtaining eye examinations with eye specialists and the results of these eye examinations being documented in the family practice clinics' EMR. The diabetes eye exam checklist significantly increased surveillance of these completed eye examinations and prompted providers to send out referrals for patients who denied having a recent eye examination. The patient reminder card increased the likelihood that patients who received referrals would follow-up with either an ophthalmologist or optometrist. Additionally, the fax number on the reminder card expedited the results of the eye examinations being received by the family practice.

Additionally, findings from this quality improvement project suggest that adherence to AACE/AmCE and ADA guidelines can be promoted through the use of educational training, checklists, reminder cards, EMR alerts, and brochures. However, it should be noted that the use of a retinal imager can significantly lower rates of referrals to eye specialists. Although retinal imaging may increase surveillance of diabetic retinopathy, it does not guarantee that patients with documented eye disease are consistently being referred to ophthalmologists or optometrists for further comprehensive eye examinations. In order to promote optimal diabetes care that is congruent with clinical practice guidelines, providers may need to evaluate whether point-of-care testing such as retinal imaging is truly in the best interest of the patient. Appropriate, regular

comprehensive eye examinations by a qualified provider is essential in reducing morbidities associated with diabetic eye disease. Providers must review and incorporate current clinical guidelines into practice to ensure patients with diabetes receive appropriate comprehensive eye examinations thereby increasing surveillance of diabetic eye disease and reducing the rate of vision loss within this population.

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Appendix A: Patient Telephone Survey

Question 1.

"Hello, I am _____ and I am working with Family Medical Home. How are you doing today? I am just following up with you because we noticed you have been diagnosed with diabetes, and we wanted to make sure all of our patients with diabetes have had an eye exam within the past year. However, we do not see your results in our chart. Were you able to get one done? If not, could you help me understand why it did not occur?"

[ ] Already had eye exam within the past year
[ ] Lack of transportation
[ ] Exam cost
[ ] Forgot about the appointment/ Did not schedule exam
[ ] Unsure why exam is needed
[ ] Already scheduled exam
[ ] Have not established care with an ophthalmologist
[ ] Other _____

Question 2.

How likely are you to schedule an appointment with your ophthalmologist within the next 3 months?

[ ] Very Unlikely
[ ] Somewhat Likely
[ ] Very Likely

Question 3.

We now offer retinal screenings at our clinic. How interested are you in having your eyes screened for diabetic retinopathy using retinal imaging at our clinic?

[ ] Uninterested
[ ] Somewhat Interested
[ ] Very Interested

Appendix B: Diabetes Eye Exam Checklist

Diabetes Eye Exam Checklist

Today's Date:

Patient Information

Patient Name:_____ Patient DOB:_____

Insurance:_____

Date of Last HbA1c:_____ Result: _____

Blood Pressure: _____* On ACE /ARB? No ☐ Yes ☐ _____

On Statin? No ☐ Yes ☐ _____

Eye Exam Screening

Eye exam within the last year? Yes ☐ No ☐

If "Yes":

Date of exam:_____

Name of ophthalmologist/optometrist:_____

Telephone Number:_____

☐ Medical release form signed and faxed to patient ophthalmologist/optometrist

If "No":

Referral Sent Today? No ☐ Yes ☐

If referral not sent today, reason:_____

Does patient want Retinavue today? No ☐ Yes ☐

If "No", reason:_____

*Refer to List of Common ACE Inhibitors and ARBs on back of this checklist

Developed based on the 2018 American Diabetes Association guidelines and the National Diabetes Education Program

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Schedule your eye exam with your eye doctor ASAP! Please provide this to your eye doctor

Eye Exam Referral

Referral Date: _____

Patient Name:_____ Patient DOB:_____

Referring Provider:_____Telephone Number:_____

Please Fax Results to: _____

List of Common
Angiotensin Converting Enzyme (ACE) Inhibitors and Angiotensin II Receptor Blockers (ARBs)

ACE Inhibitors

Generic	Brand
benazepril	Lotensin
captopril	Capoten
enalapril	Vasotec
fosinopril	Monopril
lisinopril	Prinivil, Zestril
moexipril	Univasc
perindopril	Aceon
quinapril	Accupril
ramipril	Altace
trandolapril	Mavik

ARBS

Generic	Brand
candesartan	Atacand
eprosartan	Teveten
irbesartan	Avapro
losartan	Cozaar
telmisartan	Micardis
valsartan	Diovan

*Based off "Cardiac Medications" provided by the American Heart Association (2015)

Appendix C: Brochure

8 What are some other common diabetic eye diseases?

Cataract and glaucoma are other eye diseases that are more common in people with diabetes. They are two times more likely to get cataract and glaucoma than someone without diabetes. Cataract can be treated with surgery. Glaucoma can be treated with both surgery and medicines.

9 What can you do to protect your vision?

All people with diabetes should keep control of their blood sugar, blood pressure, and blood cholesterol while continuing to have a comprehensive dilated eye exam at least once a year. Women with diabetes who are pregnant should see their eye care professional as soon as possible and all through their pregnancy.

For more information, contact—

National Eye Institute
National Institutes of Health
2020@nei.nih.gov
www.nei.nih.gov

National Eye Health Education Program NEHEP

NIH National Eye Institute

NIH . . . Turning Discovery Into Health®

NIH Publication No. 12-3252 (revised 2012)

Don't lose sight of

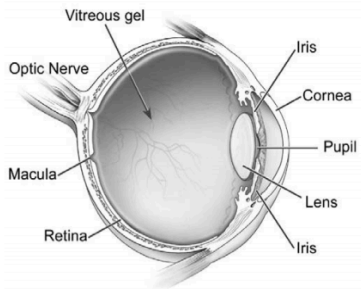
Diabetic Eye Disease

Information for people at risk

1 What is diabetic eye disease?

It is a group of eye problems that people with diabetes may get. All of these eye problems can lead to vision loss or blindness. Here are some of these eye problems:

- **Diabetic retinopathy**—Causes harm to the blood vessels in the retina. The retina is the layer of tissue in the back of the eye that is sensitive to light.
- **Cataract**—Causes your eye lens to get cloudy.
- **Glaucoma**—Causes damage to the optic nerve that can lead to vision loss.



2 Who is most likely to get diabetic eye disease?

Anyone with diabetes can get this disease. The longer someone has diabetes, the more likely they are to get diabetic eye disease.

3 Which diabetic eye disease do most people get?

Diabetic retinopathy is a leading cause of blindness in people with diabetes. This disease happens when blood vessels in the retina get weak and leak fluid. It also happens when new blood vessels grow on the surface of the retina. As the new blood vessels grow on the surface of the retina, they can bleed into the eye and block vision.

Normal vision.

A scene as it might be viewed by a person with diabetic retinopathy.

4 What are the symptoms of diabetic retinopathy?

In the early stages of the disease, many times there are no symptoms or pain. As some blood vessels get weak and leak fluid or bleed, vision may start to blur.

5 How do you know if you have it?

An eye care professional can tell if you have diabetic retinopathy by giving you a comprehensive dilated eye exam. During the exam, drops are placed in your eyes to widen, or dilate, the pupils. Then a special lens is used to look at the retina for damage to blood vessels. After the exam, your vision may be blurry for a period of hours.

6 How is diabetic retinopathy treated?

Laser eye surgery can close or shrink the new abnormal blood vessels that can leak blood into the eye and cause vision loss. It can also slow or stop the fluid leakage from retina vessels that can cause vision loss. Newer treatments include injections of drugs into the eye to prevent this leakage and this often leads to improved vision.

7 Can it be prevented?

People with diabetes can dramatically slow or prevent the development of this eye disease by keeping their blood sugar, blood pressure, and blood cholesterol under control and having regular eye exams to check on the eye disease.