Original Article

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Referral Time for Diabetic Retinopathy Screening and Impact on the Visual Acuity of Patients in a Tertiary Hospital

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ABSTRACT

OBJECTIVE: To evaluate the referral time for the screening of diabetic retinopathy (DR) from the initial diagnosis of diabetes to retinal examination. We also compared visual results among groups screened at various duration of referral time.

METHODS: This cross-sectional study was conducted retrospectively from medical records for the poorer-seeing eyes of 100 patients with type 2 diabetes from January 2021 to December 2022 at the tertiary eye center. Patients were classified based on the time duration from the initial diagnosis of diabetes to retinal examination or imaging. Visual acuity (VA) and DR stages categorized by the period of referral time were compared among each group.

RESULTS: Seventy-five patients (75%) took > 2 months from the first diagnosis of diabetes to DR screening performed by an ophthalmologist. Twenty-three patients (23%) were diagnosed with DR at the first ophthalmic visit; among these, 16 had a referral time of > 2 months. Twelve patients were diagnosed with vision-threatening DR; six of these had diabetic macular edema. The receiver operating characteristic (ROC) curve analysis indicates that patients receiving ophthalmic examination within 91 days from the diagnosis of diabetes likely maintain a best-corrected VA of ≥ 20/50. This recommended period of referral time yielded an area under the ROC curve, sensitivity, and specificity of 70.63%, 61.90%, and 83.33%, respectively.

CONCLUSION: In clinical practice, a prolonged period for the first DR screening is relatively common and may result in more patients with vision-threatening DR. Proactive and systematic work should be undertaken to create patient awareness on the importance of detection of asymptomatic and early-stage DR to prevent irreversible visual loss.

KEYWORDS: diabetic retinopathy screening, patient awareness, referral time

INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood sugar levels, resulting from insufficient amounts of insulin or decreased insulin effectiveness. Type 2 diabetes is a significant global health concern[1,2], and the prevalence of diabetes is increasing continuously. According to the International Diabetes Federation, 537 million people (10.50% of the global population) were affected by diabetes in 2021, and this is projected to reach 783 million (12.20%) by 2045[3]. In 2021,

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approximately 2.30 million people died because of diabetes, with 48% of them dying before the age of 70[4]. In Thailand, approximately 4.40 million individuals have diabetes, ranking fourth in the Western Pacific region, following China, India, and Japan[5]

Diabetic retinopathy (DR) is a common ocular complication in individuals with diabetes, with a worldwide prevalence of up to 34.60%. The reports indicate a DR prevalence of 24%–31.40%[6] among individuals with type 2 diabetes. DR is a major cause of visual impairment globally, with the Vision Loss Expert Group reporting a 1.07% prevalence of vision impairment and a 1.25% prevalence of moderate to severe vision loss due to DR in 2015[7]. DR is the second leading cause of blindness after cataracts, contributing significantly to visual impairment[8]. The increasing prevalence of diabetes and the duration of diabetes contribute to the rising incidence of DR, which leads to vision loss[9]. Despite global efforts to reduce vision impairment, the early detection and timely treatment of DR remain crucial. Efficient screening, coupled with prompt referral for examination and treatment, can help prevent the development of DR-related visual impairments. However, challenges persist in implementing effective screening and timely interventions. The screening process aims to identify asymptomatic individuals, provide a diagnosis, and initiate treatment in the early stages, thereby preventing long-term complications[10]. DR, a serious complication of diabetes, can cause blindness if not promptly treated. Therefore, screening tests are essential for detecting asymptomatic individuals, allowing for early diagnosis and treatment. Nevertheless, general population screening for DR can be expensive and may not yield sufficient benefits if applied universally. By assessing risk factors such as age, body mass index (BMI), family history, and lifestyle choices, healthcare providers can pinpoint individuals who are at higher risk. This targeted approach not only optimizes resource allocation but also enhances early intervention opportunities for those most likely to benefit from screening. Additionally, it can help in implementing preventive measures for at-risk populations, ultimately reducing the overall incidence of diabetes, ultimately preventing long-term complications[11].

The guidelines for DR screening follow the 2023 Clinical Practice Guidelines for Diabetes. For patients with type 2 diabetes, eye examinations should be conducted promptly after diagnosis. Once the eye examination results are known, patients with DR should schedule an annual eye checkup. If DR is present, this is categorized as mild nonproliferative DR (NPDR), and patients should have eye examinations every 6 months. For moderate NPDR, eye examinations are recommended every 3–6 months while severe NPDR and proliferative DR (PDR) require follow up examinations by an ophthalmologist[12].

The outpatient clinic at the Ophthalmology Department in Vajira Hospital has implemented these guidelines, patients receiving services at the hospital who are diagnosed with diabetes will have their blood test results evaluated. They will then be referred from various units to the eye examination room for an initial assessment and schedule an appointment or meet with an ophthalmologist based on the screening criteria. Guidelines for diabetic retinopathy screening referral, categorizing patients into three groups as shown in the **Figure 1.**

The Faculty of Medicine Vajira Hospital, Navamindradhiraj University, has seen a continuous increase in the number of patients with diabetes in the outpatient department with 14,196, 16,972, and 18,051 patients in 2020, 2021, and 2022, respectively. This rise in patient numbers emphasizes the importance of maintaining high-quality screening procedures.

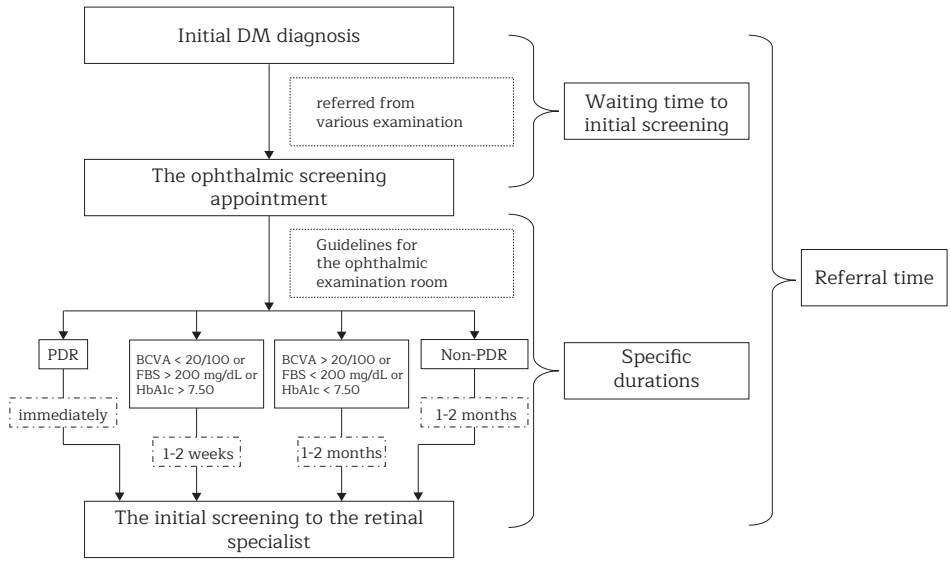

Figure 1 Guidelines for diabetic retinopathy screening referral

The various hospitals have made efforts to extensively screen patients with diabetes for DR[13]. This involved using tools to aid in screening for DR and educating technical staff and nurses in primary care units to assist with screening. However, despite these efforts, the number of ophthalmologists in Thailand (approximately 1,300) is inadequate when compared to the 4 million patients with diabetes in 2023[14]. State organizations have formulated guidelines for DR screening to benefit other units that can implement them[15]. Nevertheless, the number of screened patients remains insufficient. In countries such as the United States, the United Kingdom, Australia, and New Zealand[16,17], screening guidelines from the International Council of Ophthalmology and the American Diabetes Association are followed. According to international guidelines, patients without DR (NO DR) should have eye exams every 1–2 years. For those with DR, it is classified as mild NPDR, with exams recommended every 6–12 months. Moderate NPDR should be checked every 3–6 months, while severe NPDR and PDR require follow-ups every 1–3 months and less than a month, respectively. Patients with DR from moderate NPDR onward and with visual acuity over 20/40 should be referred to an ophthalmologist. However, despite the high prevalence of DR, only 62.30% of patients with diabetes receive screening examinations in the United States, and a study by Scanlon and colleagues established guidelines in medical practice for referring these for retinal screening. These guidelines included quality standards recommending that patients undergo retinal examinations within 3 months of diagnosis; additionally, patients who have not undergone screening before should receive retinal screening within 3 years from the time of diagnosis[18]. A review of literature both in Thailand and internationally shows that research is lacking on the delay in referring patients. Meanwhile, the number and severity of patients with diabetes and DR are increasing, particularly in younger age groups. Consequently, efficient and rapid assessments for DR screening are needed, as well as effective referral strategies. This study aims to study the duration of DR screening from the beginning of the first diagnosis of diabetes to the appointment in the ophthalmology clinic and examination by an ophthalmologist and examination of the results of visual acuity (VA) levels and compare them between groups screened at different time duration.

METHODS

This cross-sectional study was approved by the internal review board of the Faculty of Medicine Vajira Hospital, Navamindradhiraj University. The certificate of approval number in this project is 164/2023. All information had been evaluated for research ethics and was used for research purposes only. No personal information is disclosed. The study enrolled individuals diagnosed with type 2 diabetes, like a diagnosis from internal medicine/endocrinologist for type 2 who received diabetes and DR screening services at Vajira Hospital from January 1st, 2021, to December 31st, 2022. The sample size of 100 patients (one eye with visual impairment per participant) was determined using the infinite population mean formula an appendix.

Inclusion criteria were eligible patients who received diabetes screening services at Vajira Hospital. This included new patients referred from various units for the assessment of DR. Eligible patients had blood test results, including HbA1c (hemoglobin A1c) and FBS levels, and had undergone pupil dilation. Additionally, there were results from retinal examinations that can identify the severity level of the disease in the hospital's data recording system and the patients did not have any eye conditions such as cataracts or glaucoma.

Exclusion Criteria were patients who received diabetes screening and DR examinations at Vajira Hospital and had been diagnosed and referred from various centers. Due to the lack of information, clear data could not be obtained and those with a history of eye conditions that may have affected the assessment, such as glaucoma or other eye diseases.

The data collection instrument comprised two parts: Part 1) Personal and health status factors, including gender, age, BMI, HbA1c levels, and fasting blood sugar (FBS) levels. Part 2) Time and results of eye examination record 2.1) Record of the duration for patients from the initial diagnosis of diabetes to the ophthalmology appointment 2.2) Duration of diabetic patients who have an ophthalmology appointment and have undergone an eye examination by an ophthalmologist. 2.3) Results of the DR examination and VA measurements from the examination by an ophthalmologist. 2.4) Number of patients with diabetes referred from various screening units for DR screening.

Statistical analysis for general information was described by percentages. Comparison data of DR and NO DR were analyzed via mean, standard deviation, and paired t-test of variance considering p-values of < 0.05 as significant. Afterward, the independent-samples Mann–Whitney U test was used to compare best-corrected visual acuity (BCVA) (logMAR) data between the DR and NO DR groups across various screening duration and calculate the appropriate cutoff value for referring diabetic patients for DR screening using a BCVA (logMAR) of 0.4, using the Euclidean index method.

Statistical analyses for this study were performed using STATA (StataCorp, College Station, TX) software version 13 for data analysis. The analysis includes descriptive statistics (percentages, mean, median, percentiles, standard deviations, and interquartile ranges (IQR)) to summarize continuous variables. Frequency and percentages were used in summarizing categorical variables. Comparisons of the levels of visual impairment and the severity of DR based on the time duration during which patients were referred.

RESULTS

This study involved a review of medical records of 100 patients, of whom 50% were male. The average age was 60.43 (± 12.40) years, ranging from 19 to 86 years. The average BMI was 26.71 (± 12.40) kg/m^2 (17.26–43.60 kg/m^2) The average duration of diabetes was 3.30 (± 4.00) years (0–16.30 years). The mean HbA1c level was 7.83 (± 1.79) (5.20–13.50). The average FBS level was 153.32 (± 50.44) mg/dL

(85–307 mg/dL) (**Table 1**). In total, 27 cases of DR were found (27%). These were further categorized as follows: NPDR stage at 20%, with the majority being at the moderate NPDR stage at 13%, followed by mild NPDR stage at 5%, the least found being severe NPDR stage at 2% and found PDR stage at 7%. In addition to these stages, both NPDR and PDR cases were found to have diabetic macular edema (DME) in 6% with NPDR combined with DME at 3% and PDR combined with DME also at 3%. Furthermore, 12 cases (12%) were identified with vision-threatening diabetic retinopathy (VTDR) include stages severe NPDR, NPDR with DME and PDR with DME requiring immediate treatment (**Table 2**).

Table 1 Demographic and clinical characteristics of diabetic patients compared between those with and without DR (n = 100)

Parameters	DR (n = 27) n (%)	No DR (n = 73) n (%)	P-value
Gender			
Male	15 (55.56)	35 (47.95)	
Female	12 (44.44)	38 (52.05)	0.50
Age (years)			
< 60	15 (55.56)	28 (38.36)	0.14
Mean ± SD	48.29 ± 9.87	51.46 ± 3.62	
BMI (kg/m^2)			
≥ 23 (obesity)	17 (62.96)	60 (82.19)	0.07
Mean ± SD	28.17 ± 3.60	28.35 ± 4.40	
Duration of DM (years)			
≥ 10	1 (3.70)	7 (9.59)	0.25
Mean ± SD	10 ± 0	13.20 ± 1.76	
HbA1c (%)			
≥ 7	19 (70.37)	42 (57.53)	0.24
Mean ± SD	9.26 ± 1.83	8.51 ± 1.69	
Fasting Blood Sugar (mg/dL)			
≥ 130 not control	22 (81.48)	38 (52.05)	0.003*
Mean ± SD	190.50 ± 58.59	173.92 ± 58.59	

Abbreviations: BMI, body mass index; DM, diabetes mellitus; DR, diabetic retinopathy; HbA1c, hemoglobin A1c; kg/m^2, kilogram per square meter; mg/dL, milligrams per deciliter; n, number; SD, standard deviation
Data are presented as number (%), mean ± standard deviation or median.
*Statistically significant p-value < 0.05, pair t-test

Table 2 Prevalence, Type, and Severity of DR

Diabetic retinopathy	Total n = 100 n (%)
NO DR	73
DR	27
NPDR	20
Mild NPDR	5
Moderate NPDR	13
Severe NPDR	2
PDR	7
VTDR	12

Abbreviations: DME, diabetic macular edema; DR, diabetic retinopathy; n, number; NPDR, non-proliferative diabetic retinopathy; PDR, proliferative diabetic retinopathy; VTDR, vision-threatening diabetic retinopathy
Data are presented as number (%).

Patients with diabetes at initial diagnosis undergo evaluations to schedule ophthalmic screenings for DR. The findings indicated that 67% had a screening duration of > 6 months (67%), 25% had duration of < 2 months, and 8% had duration of 2–6 months among patients with DR, 50% had screening duration of 2–6 months, 44% had duration of < 2 months, and 17.91% had duration of > 6 months. The median duration was 27 months, with an IQR of 8.8 weeks to 6 years. The range was from 0 to 15.90 years. Patients with diabetes scheduled for screenings are examined by ophthalmologists for DR, 47% had screening duration > 8 weeks, 41% had duration of 2–8 weeks, and 12% had duration of < 2 weeks. Among patients with DR, 40% had duration of 2–8 weeks, 38.46% had duration of < 2 weeks, and 12.77% had duration of > 8 weeks. The median duration was 7 weeks, with an IQR of 3 weeks to 3 months. The range was from 0 to 15.70 weeks (**Table 3**).

The VA results are presented based on different screening time duration and are categorized into two groups. **Group 1**: Time duration from the initial diagnosis of diabetes to the scheduled ophthalmology appointment. To categorize patients into two groups, the median BCVA (logMAR) in the NO DR group with a duration ≥ 2 months, was 0.50 (0.30–0.60) and with a duration < 2 months was 0.50 (0.28–0.63). The median BCVA (logMAR) for the DR group with a duration ≥ 2 months was 0.50 (0.40–0.75) and with a duration < 2 months was 0.40 (0.30–0.60). **Group 2**: The time duration since the scheduled appointment of a patient with an ophthalmologist. In this group, two patient subgroups are identified in the NO DR group; the median BCVA (logMAR) was 0.50 (0.40–0.83) with a duration of 2 weeks, 0.45 (0.30–0.60), with a duration of 2–8 weeks, and 0.40 (0.30–0.60) with a duration of > 8 weeks. In the DR group, the median BCVA (logMAR) was 0.40 (0.35–1.10) with a duration of < 2 weeks, 0.45 (0.40–0.60) with a duration of 2–8 weeks, and 0.40 (0.08–0.68) with a duration of > 8 weeks (**Table 4**).

Table 3 Analyzes factors related to diabetic retinopathy based on the screening time duration (n = 100)

Parameters	Total (n = 100) n	DR (n = 27) n (%)
• The time duration for diabetic patients starts from the beginning of the first diagnosis of diabetes until they receive an appointment for an ophthalmology examination.		
> 2 months	25	11 (44)
2-6 months	8	4 (50)
< 6 months	67	12 (17.91)
• The time duration for diabetic patients who have scheduled appointments with an ophthalmologist and undergo examination by an ophthalmologist.		
> 2 weeks	13	5 (38.46)
2-8 weeks	40	16 (40)
< 8 weeks	47	6 (12.77)

Abbreviations: DR, diabetic retinopathy; n, number
Data are presented as number (%).

Table 4 Visual acuity of patients at different screening time duration (n = 100)

• The time duration for diabetic patients starts from the beginning of the first diagnosis of diabetes until they receive an appointment for an ophthalmology examination.					
Parameters	**n (%)**	**Duration**			
		< 2 months		**≥ 2 months**	**P-value**
NO DR	73 (73)	14		59	
Median (IQR) BCVA (logMAR)		0.50 (0.28-0.60)		0.50 (0.30-0.60)	0.93
DR	27 (27)	11		16	
Median (IQR) BCVA (logMAR)		0.40 (0.30-0.60)		0.50 (0.40-0.75)	0.42
• The time duration for diabetic patients who have scheduled appointments with an ophthalmologist and undergo examination by an ophthalmologist.					
Parameters	**n (%)**	**Duration**			
		< 2 weeks	**2-8 weeks**	**> 8 weeks**	**P-value**
NO DR	73 (73)	8	24	41	
Median (IQR) BCVA (logMAR)		0.50 (0.40-0.86)	0.45 (0.30-0.60)	0.4 (0.30-0.60)	0.64
DR	27 (27)	5	16	6	
Median (IQR) BCVA (logMAR)		0.40 (0.35-1.10)	0.45 (0.40-0.60)	0.4 (0.08-0.68)	0.69
• **Median (IQR) BCVA (logMAR)**				**P-value**	
Group 1 NO DR	73 (73)	0.50 (0.30-0.60)			
Group 2 DR	27 (27)	0.40 (0.40-0.60)		0.86	

Abbreviations: BCVA, best-corrected visual acuity; DR, diabetic retinopathy; IQR, interquartile range; n, number
Data are presented as number (%), mean ± standard deviation or median (interquartile range).
P-value by Independent-Samples Mann-Whitney U test

The Receiver Operating Characteristic (ROC) curve is analyzed to find an appropriate threshold using the ROC analysis method. The area under the ROC curve is calculated as 70.63% (**Figure 2**) When determining the suitable threshold for referring diabetic patients for DR screening with a specified BCVA (logMAR) of 0.40 using the duration from screening for DR after the initial diagnosis of diabetes until the eye examination with an ophthalmologist by the Euclidian's index, a cutoff point at 91 days is identified. This cutoff point has a sensitivity of 61.90% and a specificity of 83.33%.

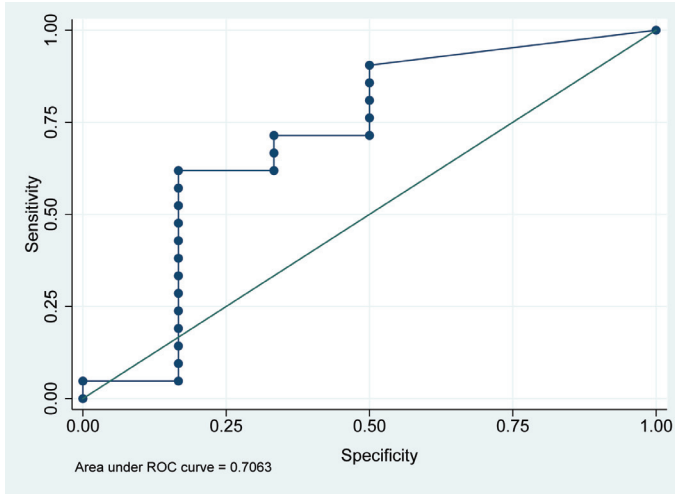

Figure 2 ROC curve

The units sending patients for diabetes for screening on eye monitors are categorized as follows: endocrinology, 62 cases (62%), general medicine, 23 cases (23%), primary care, 5 cases (5%), cardiology, 5 cases (5%), and nephrology, 4 cases (4%). According to statistics from the endocrine unit in 2021 and 2022, there were 3,235 and 3,221 patients, respectively, but only 1,154 and 1,005 patients, receiving assessments, before referring them to the Ophthalmology Department.

DISCUSSION

This study showed that in a clinical context, despite clear guidelines for patient referrals between departments in the hospital, patients still experience delays in receiving ophthalmic evaluations compared with the screening guidelines for DR set by the 2023 Diabetes Mellitus Clinical Practice Guidelines. According to these guidelines, patients with type 2 diabetes should undergo retinal examination promptly after diagnosis. However, approximately 67% of the patients experienced delays in receiving eye screenings beyond 6 months, and approximately 27% were found to have DR from their initial eye examination. These results align with the research conducted by Bresnick et al.[19] who reported a significant delay of up to 44% in patients receiving eye examinations even after being prescribed diabetes medications in primary care[20]. Each year, the eye clinic experiences an average of about 7,200 patients who miss their appointments, with diabetic patients making up one-third of the total. The lack of importance and awareness among diabetic patients can lead to delays in examinations and treatment, potentially resulting in severe DR. The reasons for missed appointments may include a lack of understanding of the importance of health screenings or issues related to accessing services, such as inconvenient times and travel distances. Additionally, patients may lack support from their families. The clinic should implement campaigns to raise awareness about the importance of appointments, provide clear information, and utilize new communication methods, such as sending reminder messages and making follow-up calls, encouraging patients to attend their scheduled appointments. Reducing the number of missed appointments requires continuous improvement in information sharing and supported from healthcare professionals. If both the clinic and patients cooperate, it will help reduce the incidence of severe DR and ensure timely treatment.

This study analyzed the relationship between the duration of diabetes screening and DR concerning BCVA. Patients were classified into two groups based on the screening interval. Both groups were further divided for comparison between those with NO DR and those with DR. In Group 1, where the screening duration was ≥ 2 and < 2 months, the BCVA values in both the NO DR and DR groups were not significantly different ($p < 0.05$). However, in the DR group with appointments scheduled with in < 2 months, a reduced BCVA was observed, with a BCVA (logMAR) of 0.6 or equivalent to 20/80, compared to a BCVA (logMAR) of 0.5 or equivalent to 20/63, for those with appointments ≥ 2 months who had better vision and no significant statistical correlation was present. This finding aligns with the theoretical framework that indicates that VTDR affecting VA often reaches an advanced stage or has progressed for some time. For instance, in the proliferative stage of DR, the development of new blood vessels typically occurs outside the macular area, leading to relatively normal vision. Neovascular complications only arise from these new blood vessels in the last stages and can result in vitreous hemorrhage, tractional retinal detachment, or central DME, which significantly affect vision. These complications begin to affect the outer retinal layers or ellipsoidal layers of the macula. The reason why VA is not directly correlated with the stage of DR described above can cause patients to

neglect regular eye examinations. Therefore, healthcare providers must emphasize the characteristics of the disease, highlighting the often-asymptomatic nature of DR until an advanced stage is reached. This awareness can encourage patients to undergo regular eye examinations before the disease progresses, preventing potential complications and preserving their vision.

This study revealed a 27% prevalence of diabetes with DR. This is a 27% prevalence of symptoms or conditions related to vision, such as DR. This finding can help assess the need for screenings and inform the management of care for patients with diabetes and a 12% prevalence of VTDR. Patients in this group underwent treatment, with 6% requiring immediate treatment. Most cases had moderate NPDR (13%), followed by PDR (7%). This study revealed that one-third of the patients developed DR, with VTDR occurring in 12% of cases. Of those with VTDR, half required immediate treatment. These findings closely resemble the prevalence of DR reported by Pawaranggoon with a DR prevalence of 27.72%[20] but less than that reported by Puangmee et al. with a DR prevalence of 46.40%[1] at a service tertiary care center. Studies by Kongtham, Boontakanon, and Bumrungsena reported a DR prevalence of 10.02%[8], 8.52%[6], and 6.91%[21] (in a service primary care center), respectively. The differences in the prevalence of DR arise from variations in the emphasis of services provided at different healthcare levels. Primary healthcare units focus on proactive services for both at-risk and general populations. Secondary care centers emphasize treating complex diseases and managing patients with complications. Tertiary care centers in hospitals, like Vajira Hospital, offer services and referrals to service recipients within the city area. Emphasizing proactive examination, assessment, and referral from primary to tertiary care can contribute to early detection and severe reduction in the incidence of DR.

The analysis of general data for its correlation with DR demonstrated that FBS levels significantly impact the incidence of DR ($p < 0.05$), which is consistent with results by Jindapet et al[22]. The average FBS level in the DR group was 190.50 ± 58.59 mg/dL, which was higher than the NO DR group with an average of 173.92 ± 58.59 mg/dL. Normal FBS levels typically range from 70 to 100 mg/dL, and elevated FBS levels increase the risk of developing DR. However, factors such as gender, age, BMI, duration of diabetes, and HbA1c did not show a significant relationship with the occurrence of DR, which is consistent with results in Rodchua et al[23].

Patients with faster screening experienced a reduction in VA, and in the DR and NO DR group, those with appointments < 2 weeks had worse BCVA than those with longer wait times. However, no significant relationship was present between these factors. This suggests that the screening criteria used by the ophthalmology department have established an appropriate screening guideline. If patients are found to have reduced VA, they will be referred to an ophthalmologist more quickly. Additionally, there are other eye conditions, such as cataracts, which not only reduce the patient's vision but also make it more difficult to detect DR because cataracts can obscure the retina during examination. This is also a factor that affects reporting results, making it a variable that needs to be excluded from the study. This study investigated the duration for DR screening referrals by calculating an appropriate cutoff point. A logMAR value of 0.4, or BCVA = 20/50, indicates a good level of eyesight. This criterion has been established as an outcome to determine the appropriate timeframe for patient referral. Determined by the receiver operating characteristic (ROC) analysis, was 91 days. If patients receive screening from other units and are scheduled for an ophthalmology appointment within 3 months, they can maintain a BCVA of 20/50, which is consistent with

results obtained by Scanlon et al[18]. The area under the ROC curve, which is considered relatively good, Patients with this level of vision will be considered for appropriate care and follow-up according to effective treatment guidelines for DR. This will help ensure that the management and treatment are more appropriate and effective the ophthalmology department has established clear screening criteria and has retinal specialists available for examination every day, allowing patients to receive treatment more quickly and these can be used as a criterion for referral guidelines to reduce vision loss. However, research is limited on the relationship between the level of visual impairment and the severity of DR. Upon examining the data, referrals from various screening units still suffer delays, potentially because of factors such as inadequate screening, patients presenting at a later stage of diabetes diagnosis, missed appointments, or patient neglect of examinations[24]. These factors contribute to delays in scheduling appointments. Emphasizing the importance of diabetic screening via eye exams will help patients with diabetes receive screenings with relatively good visual outcomes early on. These patients could maintain good VA because healthcare facilities have fast-track screening systems that offer quick turnaround times. Additionally, since most patients reside in Bangkok where transportation is convenient and costs are lower, they have increased opportunities for regular screenings than patients in rural or remote areas who face financial and transportation challenges and delays in appointment scheduling cause frustration and neglect, resulting in patients with diabetes missing eye screenings, leading to vision loss. Studying these factors further is crucial for developing future enhancements in service quality.

Additionally, a study was conducted on the units involved in the referral process for screening patients. It was found that the endocrine unit had the highest proportion in referring patients for screening, accounting for 62%. This highlights the importance of this unit in screening and assessing diabetic patients in various aspects, such as hands, feet, and eyes. According to statistics from the endocrine unit in 2021 and 2022, only 35.67% and 31.20% of patients, respectively, received assessments before being referred to the Ophthalmology Department. However, determining the number of diabetic patients receiving services in each unit is quite challenging due to data redundancy, which may hinder the accurate collection of the actual numbers. Following this, the general medicine unit, primary care unit, cardiology unit, and nephrology unit play significant roles in managing diabetic patients. However, the referral of patients to the ophthalmology department for eye health examinations still requires improvement in efficiency to ensure that patients receive appropriate and timely care. This study thus underscores the importance of establishing an effective system for tracking and referring patients to enhance the efficiency of screening and treatment for diabetes patients comprehensively.

CONCLUSION

Most patients with diabetes are undergoing eye examinations and DR assessments later than recommended in clinical practice guidelines. From the initial diagnosis of diabetes during screenings in various clinics to referrals and appointments for ophthalmic examinations with ophthalmologists, patients should be referred within three months to maintain good vision. However, it is still observed that more than 60% experience delays in referrals and assessments. This delay occurs from the initial diagnosis of diabetes during screenings in various clinics to subsequent referrals and appointments for ophthalmic examinations with ophthalmologists. Therefore, raising awareness among patients for early DR screenings could help reduce the incidence of severe DR. Moreover, receiving an early diagnosis of DR in the initial stages,

even when vision appears normal, can prevent permanent vision impairment from advanced stages of the disease. This emphasizes the importance of timely and proactive screening to prevent the progression of DR.

CONFLICT OF INTEREST

The authors report no conflict of interest for this article.

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DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this article. Future enquiries can be directed to the corresponding author.

REFERENCES

1. Puangmee N, Kumteam K, Prakhunhungsit S. The prevalence and risk factors of diabetic retinopathy in type 2 diabetes mellitus patients in the eye clinic, Siriraj hospital. Thammasat Med J 2017;17(3):336-45.
2. Jeong IS, Kang CM. Time to diagnosis and treatment of diabetes mellitus among Korean adults with hyperglycemia: using a community-based cohort study. Int J Environ Res Public Health 2022;19(19):12090.
3. International Diabetes Federation. IDF diabetes Atlas, 10th edition [internet]. 2021 [cited 2023 Jul 1]. Available from: https://diabetesatlas.org/idfawp /resource-files/2021/07/IDF_Atlas_10th_Edition_2021.pdf
4. World Health Organization. Global report on diabetes. WHO report [internet]. 2016 [cited 2023 Jul 2]. Available from: https://www.who.int/publications/i/item/9789241565257.pdf
5. Aekplakorn W, Chariyalertsak S, Kessomboon P, Assanangkornchai S, Taneepanichskul S, Putwatana P. Prevalence of diabetes and relationship with socioeconomic status in the Thai population: national health examination survey, 2004-2014. J Diabetes Res 2018; 2018:1654530.
6. Boontakanon J. Prevalence and factors associated with diabetic retinopathy type 2 diabetes mellitus in primary care unit at Kasetsomboon hospital. Med J Srisaket Surin Buriram Hosp 2022;37(2):341-51.
7. Chua J, Lim CXY, Wong TY, Sabanayagam C. Diabetic retinopathy in the Asia-Pacific. Asia Pac J Ophthalmol (Phila) 2018;7(1):3-16.
8. Kongtham T. Prevalence and factors associated with diabetic retinopathy in type 2: diabetes mellitus patients at Mae Hong Son province. Med J Srisaket Surin Buriram Hosp 2020; 35(1):13-25.
9. Mahgoub S. The impact of delay in diabetic patient's referral for diabetic retinopathy screening on the level of retinopathy detected in adult Sudanese diabetic Sudanese patients. Al-Basar Int J Ophthalmol 2017;4(2): 49-53.
10. de Fine Olivarius N, Siersma V, Almind GJ, Nielsen NV. Prevalence and progression of visual impairment in patients newly diagnosed with clinical type 2 diabetes: a 6-year follow up study. BMC Public Health 2011;11:80.
11. Das T, Takkar B, Sivaprasad S, Thanksphon T, Taylor H, Wiedemann P, et al. Recently updated global diabetic retinopathy screening guidelines: commonalities, differences, and future possibilities. Eye (Lond) 2021;35(10): 2685-98.
12. Diabetes Association of Thailand under The Patronage of Her Royal Highness Princess Maha Chakri Sirindhorn. Clinical practice guideline for diabetes [internet]. 2023 [cited 30 Sep 2024]. Available from: https://www.dmthai.org/new/index.php/sara-khwam-ru/bukhlakr-thangkar-phaethy/cpg/naewthang-wech-ptibati-sahrab-rokh-bea-hwan-2567

13. Nitikarun P, Bunyong R. Coverage of diabetic retinopathy screening and prevalence of diabetic retinopathy in public health regional service provider 6th, Thailand 2016. J Prapokklao Hosp Clin Med Educat Center 2018;35(2):118-27.
14. Silpa-archa S, Ruamviboonsuk P. Diabetic retinopathy: current treatment and Thailand perspective. J Med Assoc Thai 2017;100 Suppl 1:S136-47.
15. The Centers for Disease Control and Prevention (CDC), Thailand's Ministry of Public Health (MOPH). Guidelines for screening, monitoring, and managing diabetes-related eye diseases [internet]. 2015 [cited 11 Aug 2023]. Available from: file:///C:/Users/USER/Downloads/Documents/4.pdf
16. Wong TY, Sun J, Kawasaki R, Ruamviboonsuk P, Gupta N, Lansingh VC, et al. Guidelines on diabetic eye care: the international council of ophthalmology recommendations for screening, follow-up, referral, and treatment based on resource settings. Ophthalmology 2018;125(10):1608-22.
17. Spurling G, Askew D, Jackson C. Retinopathy--screening recommendations. Aust Fam Physician 2009;38(10):780-3.
18. Scanlon PH, Aldington SJ, Stratton IM. Short report: complications delay in diabetic retinopathy screening increases the rate of detection of referable diabetic retinopathy. Diabet Med 2014;31(1):439-42.
19. Bresnick G, Cuadros JA, Khan M, Fleischmann S, Wolff G, Limon A, et al. Adherence to ophthalmology referral, treatment and follow-up after diabetic retinopathy screening in the primary care setting. BMJ Open Diabetes Res Care 2020;8(1):e001154.
20. Pawaranggoon W. Prevention of diabetic retinopathy in type-2 diabetes patients Nunah Hospital Bangkok. Chiangrai Med J 2017;9(2):73-82.
21. Bumrungsena K. Prevalence and risk score to predict diabetic retinopathy in diabetic patient, Singhanakorn hospital, Songkla province, Thailand. Weekly Epidemiological Surveillance Report, Thailand 2018;49(38):593-8.
22. Jindapet E, Jantasiro W, Hajeese W. Factors related to severity of diabetic retinopathy in noninsulin-dependent diabetes mellitus patients in Ra-ngae hospital, Narathiwat Province. J Prachomklao Coll Nurs, Phetchaburi Province 2021;4(2):127-38.
23. Rodchua A, Viriyasirisakul P, Issaviranont S. Discriminant analysis of factors affecting diabetic retinopathy severity among diabetic patients at Banphaeo Hospital (Public Organization). Christian University J 2022; 28(1):15-28.
24. Vengadesan N, Ahmad M, Sindal MD, Sengupta S. Delayed follow-up in patients with diabetic retinopathy in South India: social factors and impact on disease progression. Indian J Ophthalmol 2017;65(5):376-84.