

# Knowledge and practices of primary care physicians on the current referral system of diabetic retinopathy in Islamabad and Rawal-Pindi, Pakistan

Muhammad Shakaib Anwar<sup>1</sup>, Baila Shakaib<sup>1</sup>, Waseem Akhtar<sup>1</sup>, Erum Yusufzai<sup>1</sup>, Maham Zehra<sup>1</sup>, Hajira Munawar<sup>2</sup>, Kinza Azhar<sup>2</sup>

<sup>1</sup>Department of Ophthalmology, Rawal Institute of Health and Sciences, Islamabad 44000, Pakistan

<sup>2</sup>Medical College, Rawal Institute of Health and Sciences, Islamabad 44000, Pakistan

**Correspondence to:** Baila Shakaib. Department of Ophthalmology, Rawal Institute of Health and Sciences, Islamabad 44000, Pakistan. [bailashakaib@gmail.com](mailto:bailashakaib@gmail.com)

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## Abstract

• **AIM:** To assess the current knowledge and practices in diabetic eye care and referral system regarding diabetic retinopathy (DR) in health centers of Islamabad and Rawal-Pindi.

• **METHODS:** A cross-sectional study was carried out in 4 government and private health centers in Rawalpindi-Islamabad from May 2018 to Oct. 2018. A total of 38 Primary Care Physicians (general practitioners, family physicians, and internists) were recruited out of which data for 2 were either not returned, or were missing partially. Data were collected through a 27-item consented & validated, multiple-choice questionnaire based on physician characteristics, knowledge and practice of diabetic eye care and challenges faced due current DR referral system. Descriptive analyses for all variables were performed including, mean and standard deviation. Analytical analyses were also conducted to study association between different study variables.

• **RESULTS:** Mean scores of knowledge for general practitioners, family physicians, and internists were 41.7%, 42.0% and 46.6% respectively. A lack of knowledge, and suboptimal practices were observed regarding signs, symptoms, screening, testing, evaluation and referral of DR regardless of physicians' specialty, or years in practice. Lack of expertise regarding direct ophthalmoscopy, interpretation of findings, and referral to an ophthalmologist were noted. Physicians who performed consultation and counselling according to patients' needs referred more patients to an ophthalmologist than those who restricted their consultation

to a fixed amount of time and had more patients per unit time ( $P=0.01$ ). Physicians who had taken care of less than 5 number of patients with DR marked less incorrect answers with no significantly greater number or correct answers compared to physicians who had taken care of more than 5 number of patients with DR ( $P=0.044$ ). An association of more than 5 patients with DR taken care of with more need based patient consultation and counselling was also noted ( $P=0.017$ ). An evaluation of the current referral system for DR revealed major loopholes in the health care infrastructure, proper guidelines, properly functioning equipment, check and balances, and lack of guidance to physicians regarding acquiring and updating knowledge regarding DR.

• **CONCLUSION:** Lack of updated and adequate knowledge, practices among primary care physicians, and suboptimal diabetic eye care and referral system have contributed to late presentation of DR. Interventions are needed to improve current diabetic eye care, and knowledge and practices of primary care physicians.

• **KEYWORDS:** diabetic retinopathy; referral of diabetic retinopathy; diabetic retinopathy guidelines; primary care physicians

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## INTRODUCTION

Diabetes mellitus (DM) is one of the world's fastest growing chronic diseases<sup>[1]</sup>. World health organization (WHO) has estimated that the total number of people with diabetes would reach 366 million by 2030<sup>[2]</sup>. Diabetic retinopathy (DR), a specific microvascular complication of DM, is the fifth most common cause of acquired visual loss worldwide, and the leading cause of visual impairment

among working aged adults, thereby having a significant socio economic impact<sup>[3-4]</sup>.

The prevalences of DR due to diabetes mellitus type 1 (DM1) and diabetes mellitus 2 (DM2) were reported as 10% to 50% and 25.2% respectively<sup>[5]</sup>. Approximately 93 million people with non-proliferative diabetic retinopathy (NPDR), 17 million with proliferative diabetic retinopathy (PDR), 21 million with diabetic macular edema (DME) and 28 million with vision threatening diabetic retinopathy (VTDR) exist worldwide<sup>[6]</sup>. Patients with DR may lose sight as a result of development of DME and/or PDR<sup>[7]</sup>.

Because DR has few symptoms until visual loss develops and the present treatments, photocoagulation and anti-vascular endothelial growth factor (VEGF) injections, are only effective at slowing the progression of retinopathy and reducing visual loss, but not restoring lost vision<sup>[8]</sup>, regular DR screening becomes critical<sup>[9]</sup>. Two gold standard methods recognized for DR screening are comprehensive dilated eye slit lamp ophthalmic examination by a trained health professional (e.g., ophthalmologist)<sup>[10]</sup> and stereoscopic 7-field fundus photography by a trained photographer with image interpretation by an experienced grader<sup>[11]</sup>. Both methods require the specialist equipment and professionals from specialist clinics<sup>[12]</sup> and, in most health care systems, is preceded by screening by non-ophthalmologists.

To facilitate timely screening and appropriate treatment, American Diabetes Association (ADA) has established a comprehensive set of guidelines<sup>[13]</sup>. It recommends an initial dilated and comprehensive eye examination by an ophthalmologist or optometrist within 3-5y after the onset of diabetes for DM1, repeated annual examinations by an experienced and knowledgeable ophthalmologist or optometrist for both DM1 and DM2 and prompt treatment for severe macular edema, NPDR and PDR. Women with preexisting diabetes planning pregnancy should have comprehensive eye examinations in the first trimester with subsequent follow ups for macular edema<sup>[14]</sup>.

Although visual loss due to DR can be reduced by 60% if treated timely, the proportion of blindness due to DR ranges from 3% to 7% in the Southeast Asia and Western Pacific regions, and is as high as 15%-17% in developed regions such as the Americas and Europe. In 2010, WHO declared that DR accounts for approximately 4.8% of cases of blindness (37 million) worldwide<sup>[15]</sup>. Out of above 35% blind and 40% with visual impairment due to DR<sup>[6]</sup> belonged to South Asia. Factors such as socio-economic status, young age, low income, lack of education, less comorbidity, insulin use, high specialists' fee, lack of patient cooperation, and not enough education on diabetes have been shown to lead to patients' non-adherence to eye examinations, timely follow up, and guidelines.

It has been proven that patient-physician relationship is a two way street<sup>[16]</sup>. Improving physician's compliance with guideline-recommended care remains a challenge; timely referral of DR for evaluation is facing one of such challenges. Furthermore, busy primary care practices lacking organizational support and computerized tracking systems, telecommunication, sustainability, outstripped capacity and resources for implementation of DR eye care further increases the burden of DR eye care on health care system and economy<sup>[17]</sup>. With a limited health care budget and growing morbidity due to DR, it is vital to delve into issues surrounding physicians' knowledge and practices and current health care system for DR.

The present study, to the best of our knowledge, is the first of its kind to be carried out in the area to assess the knowledge and practices of primary care physicians regarding DR as they are mostly the first physicians whom patients with diabetes come in contact with. The study also analyzed the challenges surrounding the current diabetic eye care system and referral of patients with DR to an ophthalmologist.

## SUBJECTS AND METHODS

**Ethical Approval** Ethical approval was obtained from Rawal Institute of Health and Sciences Ethical Approval Committee. A consent form was provided to each physician prior to participation in study, indicating the purpose of the study, benefits of participation and the right to withdraw. A serial number was assigned to each participant to maintain confidentiality. Data was accessible only to the members of the research team.

**Study Population and Setting** A cross-sectional study was carried out in 4 government and private health centers of Rawalpindi-Islamabad from May 2018 to Oct. 2018. Primary care physicians<sup>[1]</sup> holding MBBS degree and license from Pakistan Medical and Dental Council and having completed one year of house job were recruited through purposive sampling. Physicians who had treated and properly followed up at least 5 patients with diabetes were included. While a total of 38 physicians were recruited for the study, only 36 physicians were included for statistical analyses as data for 2 was either not returned, or was missing partially.

**Data Collection** Data were collected through a 27-itemed, consented & content validated, questionnaire created by the research team. A member of the research team trained specially for the purpose by the primary investigator was given the task to collect data and instructed the participants to answer the questions without referring to internet, or any textbook or colleague. The questionnaire contained 4 sections: the first section was based on demographics and physician characteristics including years in practice and number patients with DM and DR taken care of. The second section contained

questions regarding knowledge about DR as a disease, its screening evaluation, treatment, knowledge regarding referral and relevant physical examination and its findings. The third section comprised of questions regarding physicians' practices with respect to examination of DR, screening and referral practices, patient education regarding DR, and updating physician's knowledge about DR. The fourth and last section was a survey containing questions regarding DR screening, evaluation, referral systems and infrastructure of current health care system in Islamabad and Rawal-Pindi.

**Data Analysis** Data were entered and analyzed using SPSS version 20. Scores were displayed in form of percentages and analyzed using mean and standard deviation as measures of central tendency. Analysis of variance (ANOVA) and *t*-test for independent samples were used to evaluate differences in means of scores obtained by general practitioners, family physicians, and internists. A Chi-square test of independence was used to analyze whether the difference in knowledge and practice was dependent on years in training, specialty or number of patients with DM taken care of. A *P* value of <0.05 was set throughout the analysis to define a result as statistically significant.

To evaluate knowledge and practices, scoring of the questionnaire was done by awarding plus one for a correct answer and zero for a "not sure", wrong, or missing answer. The final scores for knowledge and practices were calculated out of 100. The wrong answers regarding knowledge and practices were, however, counted and coded for separately from missing of "not sure" answers while entering and analyzing data.

## RESULTS

**Participant Characteristics** Totally 64% of participants were women while the remaining 36% were men. Majority of the participants, 75% (*n*=27) were general practitioners (Table 1). Ages ranged from 25 to 65y with a mean age of 33.10±11.2y. Most of the participating physicians, 61% (*n*=22) had spent less than 5y in practice. The 64% (*n*=23) of the participants had taken care of more than 30 patients with DM during their practice, and only 6% (*n*=2) had taken care of less than 5, and 10-15 patients with DM, each, during their practice. Most of the participants, 44% (*n*=16), had not taken care of any patient with DR during their practice, and only 14% (*n*=5) had taken care of more than 5 patients with DR during their practice. Although the questionnaire was distributed to include equal number of participants from each category of specialty, a number of forms were never returned. Mean scores of knowledge for general practitioners, family physicians, and internists were 41.7%, 42.0% and 46.6% respectively. The mean percent incorrect responses were 13.5%, 13.3% and 12.4% respectively.

**Table 1 Physician demographics and background characteristics**

Category	Physicians ( <i>n</i> =36) <i>n</i> (%)
Sex	
Male	13 (36)
Female	23 (64)
Specialty	
General practitioner	27 (75)
Family physician	2 (6)
Internist	7 (19)
Years in practice	
<5y	22 (61)
6-10y	5 (14)
11-15y	2 (6)
16-20y	2 (6)
>20y	5 (14)
Number of patients with DM taken care of	
5	2 (6)
10-15	2 (6)
15-20	4 (11)
20-25	5 (14)
>30	23 (64)
Number of patients with diabetic retinopathy taken care of	
Less than 5	11 (31)
More than 5	5 (14)
None	16 (44)
Not sure	4 (11)

**Table 2 Knowledge regarding best first line test for diagnosis of retinopathy deemed appropriate by physicians**

Test	Physicians (%)
Comprehensive dilated fundus examination	80.0
Handheld ophthalmoscope	5.0
Fundus fluorescein angiography	10.0
I don't know	5.0

**Knowledge** For the best initial screening exam for DR most physicians, 80% correctly chose comprehensive dilated fundus examination (Table 2). Although most physicians recognized long duration of diabetes, and uncontrolled glycemic levels as risk factors for DR, 20% knew that blood lipid levels were one of the three main predictors of progression of DR including hypertension and diabetic kidney disease (Table 3). Only 30% rightly considered pre-existing diabetes in pregnant woman a risk factor for DR while 35% incorrectly recognized gestational diabetes as risk factor. Only 9% of physicians correctly understood that DR presents with no symptoms in very early stages. An overall lack of knowledge was observed regarding time for initial screening for DR in DM1 and DM2 (Table 3).

**Table 3 Knowledge of percentage of physicians regarding screening of DR in terms of time for initial dilated comprehensive fundus examination for both type 1 and type 2 DM, and lab investigations that could help predict progression of DR**

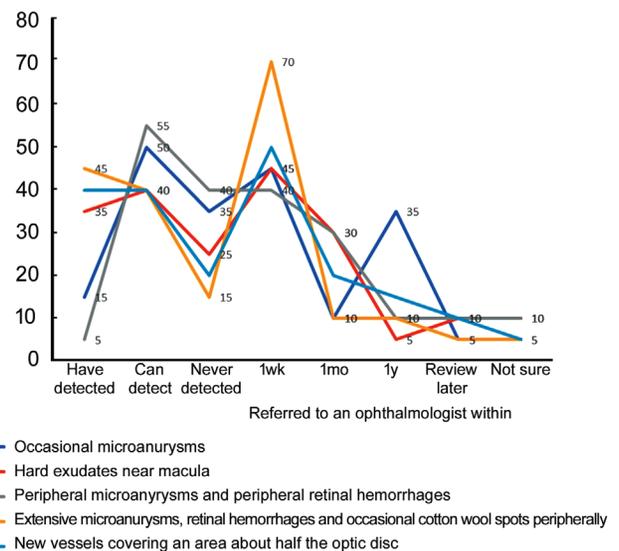
Time of initial dilated comprehensive fundus examination	Physicians (%)		Lab investigations that could help predict prognosis of diabetic retinopathy	Physicians (%)
	DM1	DM2		
At the time of diagnosis	45	40	Serum lipid levels	20
One year after diagnosis	10	10	Blood pressure monitoring	30
Within 3-5y of diagnosis	40	35	HbA1c	70
On developing visual disturbance	5	5	Fasting blood sugar	75
I am not sure	0	10		

**Table 4 Practices of primary health care physicians in terms of performance of ophthalmoscopy and updating knowledge regarding DR by primary health care physicians**

Regarding performing ophthalmoscopy in clinics	Percent (%)	Update on knowledge regarding diabetic retinopathy	Percent (%)
I perform it regularly in my clinic with pupil dilation	5.0	I don't, I continue with what I know	25.0
I can perform it but do not perform regularly	55.0	Internet and social media	55.0
I do not know how to perform it well and do not perform it	40.0	Journals, guidelines, conferences	50.0
		Pamphlets	30.0
		Books	40.0

Very few physicians had detected signs of DR on ophthalmoscopy correctly (Figure 1) and knew the right time of referrals for DM1 and DM2 (Table 3). These included both internists and general practitioners (GPs). Only 8% of the physicians knew that panretinal photocoagulation is treatment modality of DR, while 40% knew about intravitreal corticosteroids, 45% knew about anti-VEGF, and only 25% knew about vitrectomy as being treatment modalities for DR.

While most of the physicians claimed to have always consoled their patients regarding raised blood lipid levels and their risk factors (85%), very few (20%) actually ordered lab tests for them; counselling itself was considerably fair. Although 75% of the physicians claimed that they updated their knowledge on DR regularly, as opposed to 25% who did not update their knowledge at all, through mentioned sources --which were internet and social media, journals, guidelines, conferences, pamphlets, and books (Table 4) —the responses to questionnaire revealed that either the knowledge was not properly updated, unreliable resources were being used, or rationale behind the guidelines was not adequately understood. A *t*-test for independent samples was performed to analyze whether the number of patients with DR taken care of had a significant impact on physicians' responses to the questionnaire regarding DR. The result revealed that physicians who had taken care of less than 5 number of patients with DR marked less incorrect answers than those who had taken care of more than 5 patients and the difference was statistically significant ( $P=0.044$ ) with no significant relation with the number of correct responses ( $P=0.210$ ). This could be due to limited knowledge and exposure, and thus more responses were left blank. Physicians' years in practice, age and gender did not



**Figure 1 Responses regarding being able to detect signs of DR and the referral accordingly.**

display any statistically significant difference in knowledge and practice.

**Practice** Only 5% of the physicians knew how to do direct ophthalmoscopy and performed it regularly (Table 4), 55% claimed they knew how to perform it but did not perform it regularly, and the remaining 40% neither knew how to perform ophthalmoscopy properly, nor performed it regularly, irrespective of their specialty, years in practice or number of patients with DM or DR taken care of. Only 45% of the physicians referred patients both with DM1 and DM2 for screening and regular follow up (Table 5). While 50% followed up patients after their visit to ophthalmologist, 25% believed it was solely ophthalmologists' responsibility.

**Table 5 Practices of primary health care physicians in terms of referral to an ophthalmologist and follow up of patients with DR**

Patients referred to an ophthalmologist by the physician	Physicians (%)	Patients with diabetic retinopathy followed up by the physician	Physicians (%)
All diabetic patients only if they have visual disturbances	35	Yes always	50.0
All diabetic patients	45	Only patients who may require treatment from an ophthalmologist	25.0
Patients with DM2 for screening and routinely follow ups	5	No, it's ophthalmologists' responsibility	25.0
Never referred a patient	15		

**Table 6 Physicians responses to the survey regarding current diabetic eye care**

Challenges faced in clinic during screening of diabetic retinopathy	%	Challenges faced with respect to diabetic eye care and referral system	%	Methods of referral to an ophthalmologist	%
I cannot detect signs of DR properly on direct ophthalmoscopy	10	Not sure	30	Through an automatic hospital referral system that does not function well	5
Patients do not want to be dilated	35	No proper referral system	10	Ask patients to take an appointment themselves to see an ophthalmologist themselves as they please.	10
No dilating drops available	25	No follow up system	25	Ask patients to take an appointment themselves to see an ophthalmologist and follow up	15
Ophthalmoscope is either not charged or not working properly	15	Lack of log registers for maintaining record	25	Using a referral form which they use to get appointment	30
I fear dilating drops may cause angle closure glaucoma	30	Lack of staff to schedule referral	35	Using a referral form and after their appointment I follow them ups	60
No ophthalmoscopes available	20	Lack of reminder system	35		
If I detect, I don't know how to manage those signs of DR	25	Lack of diabetic guideline pamphlets	15		
		Lack of counselling for diabetic eye care by physician or nurse	15		
		Patients not willing to bear expense of ophthalmologist's appointment	20		
		Poor clinic and hospital management	10		
		Lack of feedback sessions to improve quality care	30		
		Lack of regular training and teaching sessions for physicians and staff regarding diabetic eye care	35		

Section 4 of the questionnaire contained a brief survey containing questions with "select all that apply" statements as responses regarding the current health care infrastructure and referral system pertaining to DR. The table displays answers opted for by percentage of physicians in response to challenges faced in clinic during screening of DR, challenges faced with respect to diabetic eye care and referral system, and current methods of referral to an ophthalmologist.

An analysis of variance (ANOVA) was performed to assess the difference between the mean number of ophthalmological referrals made by physicians who tailored their consultation and counselling according to patients' needs without any particular time limit in mind, physicians who restricted their consultation and counselling to less than 5min, 5-15min, and 15-30min separately. The results revealed that the physicians whose consultation and counseling times were based on the patients' needs made significantly more referrals for DR to an ophthalmologist ( $P=0.01$ ).

A Chi-square test for categorical variables confirmed a significant association between time required for consultation and counselling and number of patients with DR seen throughout career ( $\chi^2=24.77$ ,  $P=0.003$ ). Physicians who

had seen less than 5 number of patients with DR averaged a consultation with counselling around 15min while those who had seen more than 5 number of patients with DR tailored their consultation and counselling time according to patients need and took more time. Those physicians who took more time for consultation and counselling, referred more patients ( $\chi^2=20.19$ ,  $P=0.017$ ).

**Diabetic Retinopathy Referral System** The results displayed multiple loopholes in the screening and referral system (Table 6). Physicians shared their fears of causing angle closure glaucoma, patients not willing to be dilated and lack of properly functioning ophthalmoscopes. Patients' unwillingness to pay for ophthalmologists' appointments, lack of trained staff and deficiencies in referral system were also noted. Most

**Table 7 Physicians' opinions on the need to improve their knowledge and practice regarding diabetic eye care**

Physicians' opinions	Percent (%)
No, I think I know enough, and my practice is appropriate	10
I think I do not need to improve my knowledge, but I have to improve my practice	10
I think I need to improve my knowledge, but my practice is fine	5
I think I need to improve both my knowledge and practice	75

of the physicians believed that there was a need for proper training and teaching sessions for physicians. Totally, 90% of the physicians agreed there was a need to improve their practice or knowledge, or both. Although their scores revealed lack of knowledge regarding DR and suboptimal practice, the remaining 10% were content with their content with their current knowledge and practice (Table 7).

**DISCUSSION**

Primary physicians are mostly the first in line to provide diabetic care. The present study revealed that although there is lack of knowledge and suboptimal practices regarding DR among primary health care physicians, the means to fill these loopholes are also suboptimal. While a greater percentage of physicians is keen to improve their current knowledge and practices, over evaluation of one's knowledge and practices also exist amongst physicians.

A recent survey in urban Indonesia reported that less than 50% of the patients with diabetes were informed the need for eye examinations by their physicians<sup>[18]</sup>. Kraft *et al*<sup>[19]</sup>, in their study, reported that 45% percent of the physicians surveyed responded with high chances of referring all of their patients with DM1 to an eye care specialist annually as did 35% of the physicians for referring their patients with DM2. As comparable to the results of present study, fewer physicians reported high chances of routine in-office fundus examination.

Another study reported that even though both ophthalmologists and optometrists received and read the National Health and Medical Research Council (NHMRC) guidelines, Australia, very few demonstrated statistically significant or clinically relevant changes in professional behavior; implementation of guideline reminder systems was considered a solution<sup>[20]</sup>. This finding is comparable to that of the present study where the physicians claimed to have acquired knowledge from different sources of information but that information did not translate into their applicable knowledge and practices. This could be due to lack of awareness of the rationale behind the guidelines, time for communication, reimbursement, resources, computerized tracking systems, organizational support and limited education about effective communication during continued medical education programs<sup>[16]</sup>.

Streja and Rabkin<sup>[21]</sup> carried out a retrospective chart audit for patients and a retroactive questionnaire for physicians

to evaluate physician characteristics associated with implementation of measures for preventive care in patients with DM. They discovered that physician practice style was the most common physician characteristic impacting physicians' decision for ophthalmology referral, along with serum high-density lipoprotein, cholesterol measurement and urinalysis. Physicians with high number of patient encounters per unit time showed a lower level of implementation of outcomes. Only few were to be referred to an ophthalmologist for a dilated fundus examination. These findings were similar to those of our study where the physicians who tailored their consultation and counselling according to the needs of the patients ended up referring more patients to an ophthalmologist compared to those who restricted their consultation to a set amount of time or encountered more patients per unit time as a result of less time spent per consultation.

Physicians also overestimated the percentage of referrals advised, and level of care offered, thus forming a poor correlation between physicians' stated belief and performance, as also revealed by the present study where physicians were content with their current knowledge and performance even though they displayed lack of knowledge regarding DR and suboptimal practice<sup>[22]</sup>. A mini clinic setting, with more time for patient care was considered to be associated with improved level of care and screening for patients with DR.

Furthermore, as previous studies observed, the lack adherence to instructions, untimely referral and false positive diagnoses by non-ophthalmologists appears to be linked to lack of adequate expertise and understanding of ophthalmic diseases, screening equipment and imaging<sup>[23]</sup> --such as screening in the presence of inadequate pupil dilation, lack of dilating eye drops, ophthalmoscopes with suboptimal functioning, and single field photography. Conversely, some photographers without specialist training have been found to report false positive results and subsequent unnecessary referrals to ophthalmologists<sup>[12]</sup>. The reason for this could be, according to the present study, lack of proper knowledge and practice regarding observation of signs of DR on the fundus and what intervention and time of referral they call for. However, with adequate training improvement in sensitivity, specificity and accuracy of family physicians for DR evaluation has been observed<sup>[10]</sup>.

The last section of the questionnaire focused on the current health care infrastructure and referral system for DR. Generally, multiple modifiable loopholes in the current health care system exist including no proper system for referral, suboptimal practicing environment, unavailability or improperly functioning equipment, lack of checks and balances, and lack of ongoing updated training session. This reveals lack of funds, proper utility of funds, policy making and proper guidance regarding practices and update of knowledge for future physicians.

It was the first of its kind in-depth study to assess knowledge and practices of primary care physicians in the region along with evaluating referral system. The methods employed to assess knowledge had been guided through previous studies carried out in other parts of the world.

The study has a small sample size and a larger sample size would have allowed a better correlation. Generalizability is also limited. Most of the participants were GPs. Equal numbers of family physicians and internists would have accentuated any significant results.

In conclusion, knowledge and standard of diabetic eye care are well below optimal, regardless of the physicians' specialty, practice size or years of experience. Although physicians claim to update their knowledge, the results reflect that the knowledge is not being updated regularly or the resources being unreliable (e.g., social media, some internet sources). This could also be due to lack of awareness of the rationale behind the guidelines, lack of time for communication. There is, thus, a dire need to improve screening and referral system through reducing cost and training physicians and staff. Our study proves that the late presentation of DR is not only due to non-compliant patients, rather physicians and healthcare system are also responsible.

Preparation of DR guidelines should be as an authentic and verified source of knowledge for understanding DR and its proper referral and follow up. We recommend annual or 2-yearly symposia with assessments should be made mandatory. Teaching and training sessions should be conducted regularly in health care centers and should be made mandatory. Trained optometrists should be employed in primary health care clinics for screening to reduce cost and missed follow ups.

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#### REFERENCES

- 1 Lee R, Wong TY, Sabanayagam C. Epidemiology of diabetic retinopathy, diabetic macular edema and related vision loss. *Eye Vis (Lond)* 2015;2:17.
- 2 Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of

diabetes: estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004;27(5):1047-1053.

- 3 Cheung N, Mitchell P, Wong TY. Diabetic retinopathy. *Lancet* 2010;376(9735):124-136.

- 4 Ting DS, Cheung GC, Wong TY. Diabetic retinopathy: global prevalence, major risk factors, screening practices and public health challenges: a review. *Clin Exp Ophthalmol* 2016;44(4):260-277.

- 5 Yau JW, Rogers SL, Kawasaki R, Lamoureux EL, Kowalski JW, Bek T, Chen SJ, Dekker JM, Fletcher A, Grauslund J, Haffner S, Hamman RF, Ikram MK, Kayama T, Klein BE, Klein R, Krishnaiah S, Mayurasakorn K, O'Hare JP, Orchard TJ, Porta M, Rema MH, Roy MS, Sharma T, Shaw J, Taylor H, Tielsch JM, Varma R, Wang JJ, Wang NL, West S, Xu L, Yasuda M, Zhang XZ, Mitchell P, Wong TY, Meta-Analysis for Eye Disease (META-EYE) Study Group. Global prevalence and major risk factors of diabetic retinopathy. *Diabetes Care* 2012;35(3):556-564.

- 6 Leasher JL, Bourne RR, Flaxman SR, Jonas JB, Keeffe J, Naidoo K, Pesudovs K, Price H, White RA, Wong TY, Resnikoff S, Taylor HR, Vision Loss Expert Group of the Global Burden of Disease Study. Global estimates on the number of people blind or visually impaired by diabetic retinopathy: a meta-analysis from 1990 to 2010. *Diabetes Care* 2016;39(9):1643-1649.

- 7 Roy S, Kern TS, Song B, Stuebe C. Mechanistic insights into pathological changes in the diabetic retina: implications for targeting diabetic retinopathy. *Am J Pathol* 2017;187(1):9-19.

- 8 Gao L, Xin Z, Yuan MX, Cao X, Feng JP, Shi J, Zhu XR, Yang JK. High prevalence of diabetic retinopathy in diabetic patients concomitant with metabolic syndrome. *PLoS One* 2016;11(1):e0145293.

- 9 Ackland P. The accomplishments of the global initiative VISION 2020: The Right to Sight and the focus for the next 8 years of the campaign. *Indian J Ophthalmol* 2012;60(5):380-386.

- 10 Rosses APO, Ben ÂJ, Souza CF, Skortika A, Araújo AL, Carvalho G, Locatelli F, Neumann CR. Diagnostic performance of retinal digital photography for diabetic retinopathy screening in primary care. *Fam Pract* 2017;34(5):546-551.

- 11 Wong TY, Sun J, Kawasaki R, Ruamviboonsuk P, Gupta N, Lansingh VC, Maia M, Mathenge W, Moreker S, Muqit MMK, Resnikoff S, Verdager J, Zhao PQ, Ferris F, Aiello LP, Taylor HR. 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):1608-1622.

- 12 Bragge P, Gruen RL, Chau M, Forbes A, Taylor HR. Screening for presence or absence of diabetic retinopathy: a meta-analysis. *Arch Ophthalmol* 2011;129(4):435-444.

- 13 Introduction: Standards of medical care in diabetes-2019. *Diabetes Care* 2019;42(Suppl 1):S1-S2.

- 14 Egan AM, McVicker L, Heerey A, Carmody L, Harney F, Dunne FP. Diabetic retinopathy in pregnancy: a population-based study of women with pregestational diabetes. *J Diabetes Res* 2015;2015:310239.

- 15 Resnikoff S, Keys TU. Future trends in global blindness. *Indian J Ophthalmol* 2012;60(5):387-395.

- 16 An J, Niu F, Turpcu A, Rajput Y, Cheetham TC. Adherence to the American Diabetes Association retinal screening guidelines for population with diabetes in the United States. *Ophthalmic Epidemiol* 2018;25(3):257-265.
- 17 Nare S, Mohan S, Satagopan U, Natarajan S, Kumaramanickavel G. Diabetic Retinopathy: Clinical, Genetic, and Health Economics (An Asian Perspective). In: Prakash G, Iwata T, eds. *Advances in Vision Research, Volume II: Genetic Eye Research in Asia and the Pacific*. Singapore: Springer Singapore; 2019:345-356.
- 18 Adriono G, Wang DD, Octavianus C, Congdon N. Use of eye care services among diabetic patients in urban Indonesia. *Arch Ophthalmol* 2011;129(7):930-935.
- 19 Kraft SK, Marrero DG, Lazaridis EN, Fineberg N, Qiu C, Clark CM Jr. Primary care physicians' practice patterns and diabetic retinopathy. Current levels of care. *Arch Fam Med* 1997;6(1):29-37.
- 20 Grimshaw JM, Russell IT. Achieving health gain through clinical guidelines II: Ensuring guidelines change medical practice. *Qual Health Care* 1994;3(1):45-52.
- 21 Streja DA, Rabkin SW. Factors associated with implementation of preventive care measures in patients with diabetes mellitus. *Arch Intern Med* 1999;159(3):294-302.
- 22 Al Rasheed R, Al Adel F. Diabetic retinopathy: Knowledge, awareness and practices of physicians in primary-care centers in Riyadh, Saudi Arabia. *Saudi J Ophthalmol* 2017;31(1):2-6.
- 23 van Eijk KN, Blom JW, Gussekloo J, Polak BC, Groeneveld Y. Diabetic retinopathy screening in patients with diabetes mellitus in primary care: Incentives and barriers to screening attendance. *Diabetes Res Clin Pract* 2012;96(1):10-16.