Article published online: 2025-12-02

THIEME OPEN ACCESS

Review Article

Consensus Guidelines for the Screening and Management of Diabetic Retinopathy in the Gulf Region

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J Diabetes Endocrine Practice

Abstract

Diabetic Retinopathy (DR) is the world's leading cause of preventable blindness among working age adults, and affects individuals with diabetes mellitus (DM), including type 1 and type 2 DM, among others. The global increase in the prevalence of DM has been accompanied by a parallel increase in the prevalence (20–40%) of DR, especially in countries like Saudi Arabia, United Arab Emirates, Kuwait, Qatar, Bahrain, and Oman. Research on DR in the Gulf region is limited; however, several common risk factors drive the development and progression of DR, including poor glycemic control, hypertension, and hyperlipidemia. There is also a need for effective screening and management programs for DR. The development of tailored region-specific guidelines for the Gulf region is key to effective DR prevention, early detection, and treatment. The current health care systems and information technology infrastructure are sufficiently well-developed to implement national DR screening programs and cohesive management strategies through primary and secondary care to have a major impact on reducing blindness in the Gulf region.

Keywords
- anti-VEGF
- diabetes mellitus
- diabetic macular edema
- diabetic retinopathy
- ophthalmic screening
- type 1 diabetes
- type 2 diabetes

DOI https://doi.org/10.1055/s-0045-1814081.
ISSN 2772-7653.

Thieme Medical and Scientific Publishers Pvt. Ltd., A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

Introduction

Diabetic retinopathy (DR), now referred to as diabetic retinal disease, is the leading cause of preventable blindness and globally affects 30 to 40% of working-age adults with diabetes.[1] Prevalence of DR in the Middle East region ranges from 20 to 40%, but data from the Gulf region are limited with small cohort sizes and inconsistent methodologies for diagnosing DR (►**Table 1**).[2–7] Men have a higher prevalence of DR compared with women,[8] as do individuals with type 1 diabetes (T1D) compared with type 2 diabetes (T2D).[9] Risk factors for DR include older age, diabetes duration, poor glycemic control, hypertension, hyperlipidemia, smoking, and comorbidities like chronic kidney disease and cardiovascular disease (CVD).[10,11]

Existing Guidance in the Gulf Region

We reviewed and compared existing guidance and practices within the GCC region (►**Table 2**). Saudi Arabia has specific guidelines on the screening and treatment of DR, risk stratification, and management of DR and diabetic macular edema (DME),[12] while Kuwait lacks a national guideline. The United Arab Emirates's National Diabetes Guidelines advocate annual retinal screening for all patients with diabetes,[13] but lack clarity on the frequency and methods of screening. Thus, there are no national screening programs, and the grading of DR varies among existing guidance across the GCC. Beyond improving glycemic control, some guidelines advocate the importance of managing hypertension and hyperlipidemia in patients with DR, but they lack detail on specific therapies.

The largest increase in DR is predicted to occur in the Middle East and North Africa and Western Pacific regions.[1] As a consortium of endocrinologists and ophthalmologists within the GCC, we believe there is an urgent need to provide guidelines for health care professionals, ensuring consistency and quality in the screening, diagnosis, and management of DR in the region.

Risk Factors Associated with Diabetic Retinal Disease in the Gulf Region

Nonproliferative DR (NPDR) is due to pathology of the small blood vessels resulting in the leak of fluid or blood into the retina with vision impairment. Proliferative DR (PDR) occurs when new blood vessels growing on the surface of the retina bleed into the vitreous of the eye, causing severe vision loss or blindness. DME occurs as a consequence of capillary fluid leakage.

Duration of T2D

The duration of T2D is a significant predictor of visual impairment,[8] with the odds of DR increasing by 7% per year of diabetes[14] and the duration of diabetes in patients with DR is almost double that of patients without DR.[15]

Age and Gender

The prevalence of DR is higher in patients ≥40 years of age.[16] The incidence of DR in patients below 50 years of age was 37%, rising to 78% in those 61 to 70 years of age.[17] Males have a significantly higher incidence of DR compared with females,[18] and the incidence of DR progression is lower in females.[19]

Glycemic Control

Epidemiologic studies have shown a relationship between HbA1c and the incidence of DR,[20] and large randomized controlled trials have demonstrated that tight glycemic control reduces both the incidence and progression of DR.[21] There is a strong association between glycemic control and DR risk,[22] with each 10% decrease in HbA1c resulting in a 39% decrease in the risk of DR in T1D in the Diabetes Control

Table 1 The prevalence of diabetic retinopathy in the Gulf region[2–7]

Country	Diabetic retinopathy prevalence rate	Method of assessment
Saudi Arabia	20%	Literature reviews combining 6 epidemiology studies from 1985 through 2019[2]
United Arab Emirates	37%	Cross-sectional studies with utilization of fundus photography, sampling 513 DM patients[3]
Kuwait	Up to 40%	Cross-sectional studies, in-person assessment[4]
Qatar	23.5%	Community-based survey with digital retinal photography of 540 patients with DM, to obtain age- and sex-adjusted prevalence[5]
Bahrain	25.8%	Community-based screening program with 17,490 patients with DM, with digital fundus photography, to identify prevalence and number of participants requiring treatment[6]
Oman	31%	Cross-sectional study with 442 patients with DM, utilizing digital retinal photography, to estimate total prevalence[7]

Abbreviations: DM, diabetes mellitus.

Table 2 A comparison of existing guidance within the Gulf region

Country	Title	Program initiation date	Specific to DR?	Screening of DR present?	Screening methods	Guidance on special population	Risk stratification?	Are there protocols for DME management?	Regional or national guidance	Peer reviewed?
Saudi Arabia	Saudi Diabetes Clinical Practice Guidelines[12]	August 2021	No	Yes	Fundus photography	Yes	Yes	Yes	National	Yes
United Arab Emirates	Management of diabetic macular edema: guidelines from the Emirates Society of Ophthalmology[13]	July 2022	No	No	No	No	No	Yes	National	Yes
Kuwait	Diabetic retinopathy screening, stages, guidelines for referral	N/A	Yes	Yes	N/A	N/A	No	No	National	No
Qatar	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bahrain	Screening for diabetic retinopathy: the first telemedicine approach in a primary care setting in Bahrain	2003	Yes	Yes	Yes	No	No	No	National	No
Oman	Diabetes mellitus: national clinical management guidelines	2021	No	No	Fundus photography	No	No	Yes	National	Yes

Abbreviations: DR, diabetic retinopathy; DME, diabetic macular edema.

and Complications Trial (DCCT)[23,24] and 25% in T2D.[25] A rapid reduction in HbA1c levels can worsen DR in the short term; however, the long-term benefits on DR outweigh any short-term risks.[26]

Pregnancy and DR

Pregnancy in women with diabetes can accelerate the progression of DR[27] with the risk beginning from the second trimester and persisting up to 1 year postpartum,[26] especially in women with T1D.[28] Women with T2D are also at risk, while gestational diabetes mellitus (GDM) carries a lower risk of DR since it is usually temporary and less severe.

Hypertension

Hypertension may exacerbate DR by increasing endothelial shear stress and the release of vascular endothelial growth factor (VEGF), alongside altered retinal autoregulation and increased perfusion pressure.[29] There is strong evidence that tight blood pressure (BP) control in hypertensive diabetic patients significantly reduces visual loss from DR[27,30] and good BP control has been shown to significantly slow the progression of DR and visual loss, and decrease the need for laser photocoagulation.[31–33] The UK Prospective Diabetes Study (UKPDS) group demonstrated that each 10-mm Hg reduction in systolic BP lowers the risk of microvascular complications by 12%, although the benefit for normotensive diabetic patients remains unclear.[34] Current recommendations for BP control in adults with diabetes aim for levels below 130/85 mm Hg.[35]

Hyperlipidemia

Dyslipidemia increases the risk of DR, particularly DME.[36] The majority of patients with DR have high total cholesterol and triglycerides[37] and retinal hard exudates are associated with higher total cholesterol and low-density lipoprotein cholesterol levels in patients with DR.[38–40] Hard exudates, in turn, are associated with visual impairment and subretinal fibrosis from DME.[41]

Smoking

In a 25-year follow-up study, the prevalence of mild NPDR was higher in current compared with ex-smokers[42] and DR was significantly higher in smokers compared with non-smokers,[43] suggesting that smoking is a modifiable risk factor for DR.

Comorbidities

T2D patients with DR have a 1.7 times increased risk of stroke, coronary artery disease, and heart failure.[19] Additionally, the incidence of coronary artery disease is higher in patients with DR.[44] The prevalence of DR is higher in those with anemia,[19,45] which has been shown to exacerbate retinal hypoxia, contributing to DR progression.[46] Diabetic kidney disease is associated with DR[19] and patients with DR have a higher risk of nephropathy compared with those without DR.[47] Patients with microalbuminuria and macroalbuminuria have a two- and six-times higher risk of developing DR, respectively.[48]

Screening Methods and DR Grading

Defining Eligible Population for DR Screening

Defining clear eligibility criteria for DR screening is essential to prioritize high-risk individuals, streamline the referral process, and allow health care providers to manage patient flow and follow-up care more efficiently. Typically, screening for DR is prompted by the level of glycemic control, duration of diabetes mellitus (DM), and alteration in visual acuity (VA).

However, we recommend the following criteria for screening:

Patients eligible for screening for DR include:

- Individuals with pre-diabetes deemed at risk of DR.
- All individuals with T1D and T2D.
- All individuals with DM in remission (spontaneous or post-intervention).
- Individuals at increased risk of DR (in pregnant mothers with T1D or T2D, see above)

Patients not eligible for screening for DR include:

- Individuals with GDM.
- Patients with DR under regular care by their ophthalmologist.

The Process for Identifying and Referring Patients with DM

The DR screening process begins with the general practitioner, family physician, endocrinologist, or other clinician identifying eligible patients for the screening program. For patients with a reduction in VA, a direct referral to an ophthalmologist for immediate evaluation is recommended.

Key strategies include:

- Diabetes registers: maintaining a national registry of patients with diabetes to direct them for regular screening.
- Referral systems: to be managed manually or electronically through the patient's health records and made easily accessible in the system.
- Patient invitation and reminder systems: annual reminders, such as SMS notifications, to ensure patient attendance to screening appointments.
- Reminder systems in place for best practice, particularly in institutes or clinics using EMR

Screening Sites

Screening in locations close to the population improves patient compliance and is more cost-effective.

Recommendations for screening at fixed and mobile locations:

A. Fixed locations

- Local health centers and primary care facilities, conveniently located near patients.
- Centralized screening in hospitals, providing closer access to treatment.
- Contracted optometrists or private eye clinics, enhancing accessibility for patients.

Table 3 Recommended scheduling and follow-up for DR screening[46,57,58]

Diagnosis	Referring for the first visit	Follow-up visit
Pre-diabetes	At the identification of pre-diabetes status	Based on grading
Type 1	Five years after diagnosis or at the age of 12 years (whichever occurs first)[57]	Based on grading
Type 2/Maturity onset diabetes of the young (MODY)/latent autoimmune diabetes in adults (LADA)/Type 3c	At the time of diagnosis of their diabetes[58]	Based on grading
Pregnancy with Type 1 or Type 2	At first antenatal visit[46]	After 28 weeks of pregnancy

Abbreviation: DR, diabetic retinopathy.

B. Mobile or opportunistic screening

In low- and middle-income countries with limited workforce or technological resources, mobile services or opportunistic screening are often used. However, these screening services can also be used in high-income countries for the convenience of those being screened. Telemedicine-enabled screening can also be used to facilitate the screening process by allowing image capture in primary care centers and then sending it to optometrists or ophthalmologists for grading and assessment.

Screening Intervals

Diabetes duration is a significant risk factor for developing DR.[49] ►**Table 3** outlines a recommended schedule for screening individuals with DM. The American Academy of Ophthalmology recommends beginning screening 5 years after diabetes onset,[50] with re-screening annually. Canadian guidelines recommend screening 5 years after diabetes onset if the diagnosis is made after puberty[51] and re-screening annually. The American Diabetes Association recommends screening within 5 years of onset for individuals with T1D, at onset for individuals with T2D with close monitoring depending on the grading of retinopathy, and every trimester and for 1 year postpartum for pregnant women with pre-existing T1D or T2D.[52,53] Women with GDM do not require retinal screening during pregnancy.[46] However, those with T1D or T2D and planning conception should undergo a retinal examination prior to the pregnancy, at the antenatal visit, and at 28 weeks.

Core Components of a Diabetic Eye Screening Program

The screening examination for DR should be brief enough to encourage widespread adoption while still providing sufficient detail to allow for informed referrals. The use of non-mydriatic cameras is recommended to enhance screening efficiency. Clinical history and health records, VA, retinal examination, and intraocular pressure (IOP) assessment are the core components in a screening program.

Essential initial steps in the screening pathway:

- Patient history and assessment of VA.
- Digital retinal fundus photography.
- Referral to ophthalmology.

Grading and Outcomes

A standardized classification system, such as the International Council of Ophthalmology classification of DR and macular edema, is required for unified grading and consistent management across various settings. ►**Table 4** illustrates the recommendations for resource-dependent screening schedules and classification of retinopathy and DME.

A structured pathway is illustrated in ►**Fig. 1** to guide effective screening and referral for DR.

The Role of Artificial Intelligence in Screening and Diagnosis

Artificial intelligence (AI) has transformed DR screening, with Food and Drug Administration (FDA) and European Conformity-approved AI engines now available for this purpose. AI systems, like EyeArt AI, have shown higher diagnostic utility for detecting more than mild DR (sensitivity: 96.5%, specificity: 88%) compared with retinal specialists (sensitivity: 59.5%, specificity: 98.9%).[54] AI-based screening offers faster image grading and diagnosis, reduced dependence on specialists, and improved access to screening in underserved or remote areas. AI-based predictive analytics can predict DR progression to personalize treatment planning.

Barriers to Screening in Rural Areas

Addressing access barriers in rural areas of the GCC region should involve the deployment of mobile units equipped with retinal imaging technology, using telemedicine for consultations and follow-ups with urban specialists, training local health care providers in initial screening and teleophthalmology tools, and launching government-led public health initiatives to raise awareness about DR and the importance of regular screening.

The Patient Care Pathway

Clear referral and treatment pathways are required, emphasizing the coordinated multidisciplinary approach needed to manage DR in the GCC region. ►**Fig. 2** outlines this pathway for individuals with undiagnosed or diagnosed diabetes with

Table 4 Classification of retinopathy and DME, along with screening schedules[50,89]

	Classification	Grading	Resource setting	Re-examination or next screening schedule[50]	Ophthalmology referral required?
Retinopathy	No apparent DR, mild NPDR with no DME	–	High and low	1 year	No
	Mild NPDR	Microaneurysms are present[89]	High	9 months	No
			Low	1–2 years	No
	Moderate NPDR	Increased number and severity of microaneurysms and hemorrhages[89]	High	3 months	Yes
			Low	6–12 months	Yes
	Severe NPDR	Extensive retinal hemorrhages, venous beading, and intraretinal microvascular abnormalities[89]	High and low	≤3 months	Yes
	PDR[b]	Neovascularization	High and low	≤1 week	Yes
Diabetic macular edema (DME)	Noncentral-involved DME	Refer management and treatment pathway of individuals with DME with CI DME (VA 6\12 or worse)	High and low	3 months	High: Yes Low: No[a]
	Center-involving DME		High and low	1 month	Yes

Abbreviations: DR, diabetic retinopathy; NPDR, nonproliferative diabetic retinopathy.
[a]Recommended if laser resources available.
[b]Pregnant women are recommended to undergo DR screening during pregnancy.

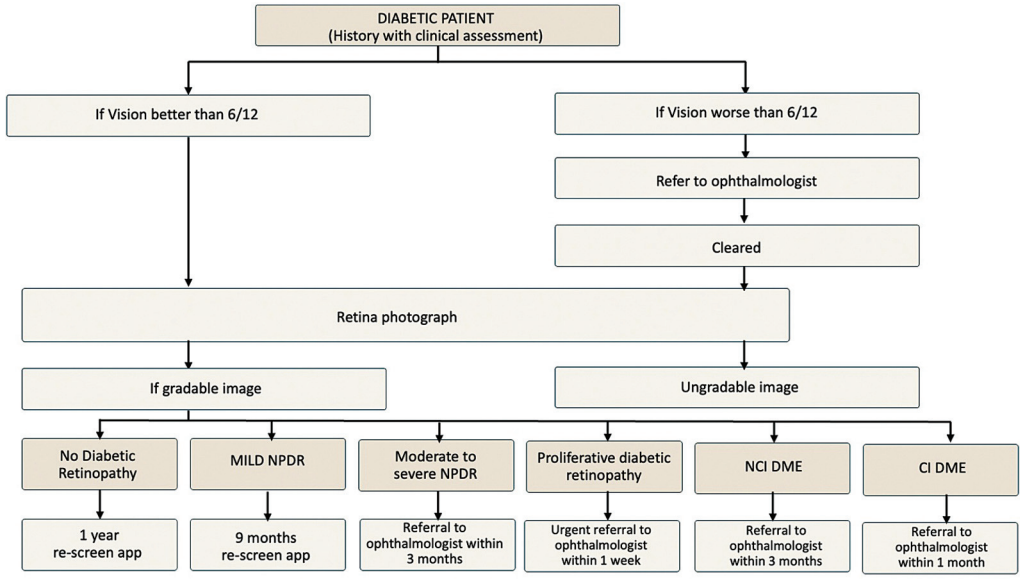

Fig. 1 Flow chart outlining screening and referral of individuals with diabetes according to the severity of retinopathy.

appropriate and timely pharmacological or surgical intervention.

Medical Management of Diabetic Retinopathy

The development and progression of DR can be mitigated by reducing HbA1c levels, BP, dyslipidemia, anemia, and proteinuria.[37,44,55–62]

Glycemic Control

To slow the development and progression of DR, we recommend optimizing glycemic control, targeting an HbA1C of ≤7% (≤53 mmol/mol). The DCCT and the UKPDS trials showed that intensive glycemic control (HbA1C < 7% [<53 mmol/mol]) significantly reduced the onset and progression of DR,[25,63] with effects lasting up to 10 years post-trial.[64,65] Similarly, the ACCORD Eye study reported a lower rate of retinopathy progression with intensive glycemic control compared with standard therapy.[66–68] Although the ADVANCE Retinal Measurements study (AdRem) found no significant reduction in the development or progression of retinopathy with intensive glycemic control.[69] Rapid improvement in glycemia can lead to a temporary early worsening of retinopathy, but this effect is outweighed by the long-term benefits.[70] SGLT2 inhibitor use has been associated with a lower risk of sight-threatening DR in adults with T2D and moderate CVD risk, while GLP-1 receptor agonists do not confer increased DR risk compared with DPP-4i and sulfonylureas.[71,72] A retrospective analysis (TriNetX) has shown that GLP1-RA with insulin is associated with a higher risk of DR and DME compared with SGLT2i with insulin.[73] Pioglitazone is not recommended in people with DME due to potential worsening of DME.[74]

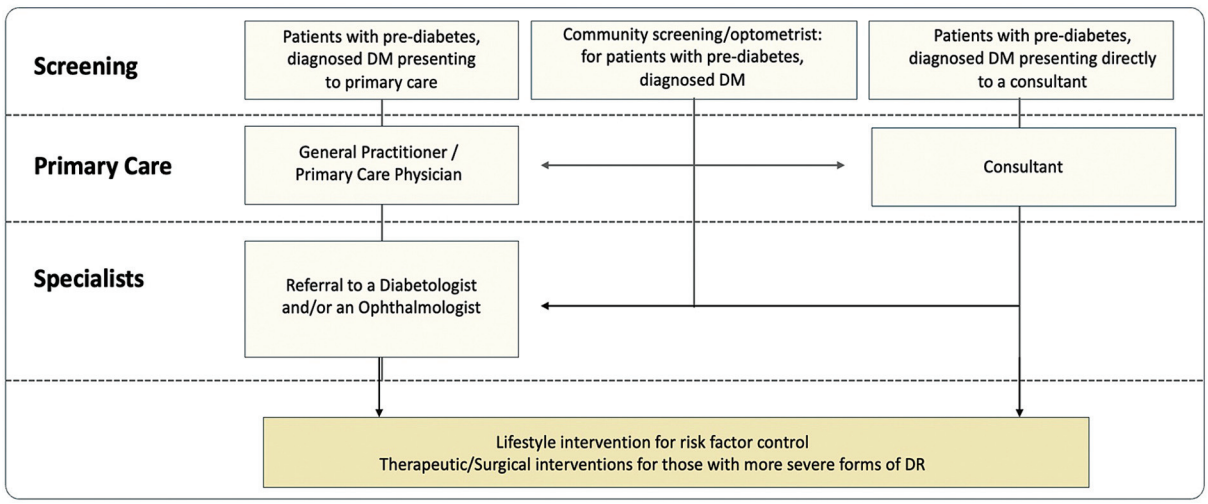

Fig. 2 The diabetic retinopathy patient care pathway.

Blood Pressure Control

BP lowering is important for reducing DR as mentioned earlier. For the primary prevention of DR in normotensive individuals with DM, there is insufficient evidence to recommend renin–angiotensin–aldosterone system (RAAS) inhibitors. In 223 normotensive, normoalbuminuric T1D patients, neither the angiotensin-converting enzyme (ACE) inhibitor enalapril nor the angiotensin receptor blocker (ARB) losartan reduced retinopathy progression.[75] ACE inhibitors appear more effective than ARBs in reducing the risk of retinopathy incidence and progression, although evidence is limited in patients with multiple comorbidities and optimal dosing remains unclear.[76]

Lipid-Lowering Therapy

Diabetic dyslipidemia is a key factor in the progression of DR and improving serum lipid levels, particularly triglycerides may slow the progression of DR.[77–79] Studies such as the FIELD, ACCORD Eye, and LENS trials have shown that fenofibrate added to statins significantly reduces the risk of DR progression and reduces the need for retinal laser therapy.[80] Fenofibrate reduced both the need for laser therapy and the progression of retinopathy in patients with pre-existing retinopathy (FIELD).[81] In the LENS trial, there was a 22.7% reduction in the progression of, or need for the treatment of DR, or maculopathy in the fenofibrate group versus placebo in individuals with both T1D and T2D.[82]

Antiplatelet Therapy

A systematic review showed that acetylsalicylic acid (ASA) therapy neither reduces nor increases the incidence or progression of DR.[83] Furthermore, ASA use is not associated with an elevated risk of vitreous hemorrhage or DME.[84,85]

Ophthalmic Management of Diabetic Retinopathy

NPDR ranges from mild to severe, and accurate identification of severity is key to predicting disease progression, visual loss, and guiding appropriate treatment and follow-up intervals. The minimum referral guidelines are as follows.

Visual Acuity and Symptoms

- Refer if VA is below 6/12 (20/40) or if there are symptomatic vision complaints.

Classification of DR

- Refer based on the simplified International Classification of DR (►**Table 4**).

Unobtainable Visual Acuity or Retinal Examination

- Refer to an ophthalmologist if VA or retinal examination cannot be performed.

Variation in the resource setting of the country may also determine whether an individual is referred to an ophthalmologist (►**Table 5**).

Management of PDR

Individuals with PDR can be treated with laser therapy or anti-VEGF therapy. High-risk PDR is associated with vitreous or preretinal hemorrhage and requires expeditious panretinal photocoagulation (PRP) to reduce the risk of severe vision loss. The management of PDR focuses on reducing neovascular stimuli to regress new vessels by laser photocoagulation and managing complications from fibrovascular traction with vitreo-retinal surgery.[86]

Laser Therapy for PDR

PRP remains the standard of care for PDR, and treatment should not be delayed to prevent vision loss.[87]

PRP Technique

The Diabetic Retinopathy Study first established PRP as an effective treatment for high-risk PDR,[88] while the Early Treatment Diabetic Retinopathy Study further demonstrated its long-term benefits.[89] Traditional PRP uses green argon lasers to deliver 1,200 and 2,000 burns (500 µm spot size, 100 milliseconds exposure time). Newer 577 nm yellow lasers use pattern-based grids with smaller burns (200–400 µm) and shorter pulses (20–30 milliseconds) to limit scarring and visual field loss. Multi-spot laser delivery systems like the Pascal Photocoagulator allow shorter pulse durations, which are less painful, while also preserving central and peripheral vision. A single-session PRP is as effective as multiple sessions in terms of preserving retinal thickness and VA.[90]

General PRP Guidelines

The general PRP principles involve covering as much retinal area as possible while avoiding direct treatment of blood vessels. Burns are typically applied over two or more sessions, except in cases where the patient may not return for follow-up, where a single session is preferred. Patient compliance and proper follow-up are required to ensure regression of neovascularization. Neovascularization at the disc is more likely to completely regress after laser treatment compared with neovascularization elsewhere. The magnification factor of laser lenses significantly affects spot size settings, and modern indirect laser lenses may require adjustments to achieve the desired spot size. Indicators of disease regression post-PRP include reduced venous changes, absorption of retinal hemorrhages, and disc pallor. In cases where PDR does not regress or there is a recurrence of neovascularization, additional laser photocoagulation is recommended. Vitreous hemorrhage is a potential complication post-PRP and identifying the hemorrhage source is crucial for treatment. Small vitreous hemorrhages tend to be asymptomatic and, once resolved, do not typically recur, provided sufficient retinal ablation has been achieved.

Anti-VEGF Therapy for PDR

Recent data suggest that in patients with PDR, anti-VEGF therapy is superior to PRP in terms of VA benefits, DME prevention, and the adverse effects associated with visual

Table 5 Testing and treatment recommendations based on countries' resource availability[50,89]

Aspect	High resource setting	Low–intermediate resource settings
Ancillary tests	Optical coherence tomography (OCT): Most sensitive method to identify DME and to quantify its assessment. Provides detail on the type of DME (e.g., diffuse, cystic changes), sub-retinal fluid/detachment, and vitreoretinal traction.	Similar to high-resource settings but may have limited access to advanced technologies like OCT and fluorescein angiography.
	Fundus photography: Useful for recording disease activity and determining the detailed severity of the disease.	
	Fluorescein angiography: Not required for diagnosing DR, PDR, or DME (diagnosed through fundus examination). Guides evaluation of retinal non-perfusion, retinal neovascularization, and microaneurysms or macular capillary non-perfusion in DME.	
Treatment	Optimize medical treatment: Improve glycemic control if HbA1c >58 mmol/mol (>7.5%) along with managing systemic hypertension or dyslipidemia.	Follow the same guidelines as high-resource settings. PRP is preferred for treating severe NPDR.
	No DR, mild or moderate NPDR: Follow recommended intervals (Table 3) with dilated eye examinations and retinal imaging as needed. Treat DME if present.	
	Severe NPDR: Monitor closely for progression to PDR. Consider early pan-retinal photocoagulation (PRP) for patients at high risk of progression or poor compliance with follow-up. Factors influencing PRP timing include poor follow-up compliance, impending cataract extraction, pregnancy, and status of the fellow eye.	
	PDR: Treat with PRP. Evidence supports anti-VEGF injections (e.g., ranibizumab) as a safe and effective treatment for PDR. Other intravitreal anti-VEGF agents (aflibercept and bevacizumab) are also highly effective against retinal neovascularization.	

Abbreviations: DR, diabetic retinopathy; NPDR, nonproliferative diabetic retinopathy; VEGF, vascular endothelial growth factor.
Note: Note that the ancillary tests for low-resource settings are similar to high-resource settings but may have limited access to advanced technologies such as OCT and fluorescein angiography. Additionally, treatment in low-resource settings follows the same guidelines as high-resource settings. However, PRP is preferred for treating severe NPDR.

field loss, as well as the need for future pars plana vitrectomy (PPV) or additional PRP. Indeed, studies have shown a definitive role for anti-VEGF drugs alone for treating PDR. Analysis of the CLARITY trial indicated a significantly greater improvement in VA after 1 year for those receiving aflibercept compared with PRP.[91] The DRCR Protocol S trial showed that patients treated with ranibizumab had fewer vitrectomies, lower rates of center involving-DME (CI-DME), and better VA than those receiving PRP. By year 5, DME occurred in only 22% of ranibizumab-treated eyes versus 38% with PRP, with half of the PRP group requiring retreatment and experiencing greater visual field loss.[82] Furthermore, patient compliance and follow-up are key requirements for those using anti-VEGF therapy alone.

Vitreo-Retinal Surgery in PDR

Indications for PPV include nonclearing vitreous hemorrhage, tractional retinal detachment, and dense pre-macular sub-hyaloid hemorrhage. Advances in surgical techniques, including use of suture-less 23G, 25G, and 27G vitrectomy systems, have made PPV safer and more effective with improved visual recovery.

Treatment of DR in Children with T1D

Current pediatric DR management guidelines are largely extrapolated from adult clinical trials, recommending treatment for DME and PDR.[92] Anti-VEGF therapy is the primary treatment for CI-DME, although its prevalence is low in children with T1D. PRP is commonly used for PDR management, though anti-VEGF drugs also show positive effects.

Diabetic Macular Edema Management

DME, a leading cause of vision loss in diabetic patients, is driven by hyperglycemia-induced vascular dysfunction, inflammation, and microvascular leakage. Management of DME depends on the severity of visual loss and macular involvement. Thorough clinical examinations, including assessments of VA, IOP, slit-lamp examination, gonioscopy, and dilated fundus examination, are essential. Optical coherence tomography and fluorescein angiography aid in accurate diagnosis and treatment planning.

For patients with good vision, observation is recommended. For those with worsening VA, FDA-approved anti-VEGF agents, including ranibizumab, aflibercept, brolucizumab, and faricimab, are considered first-line

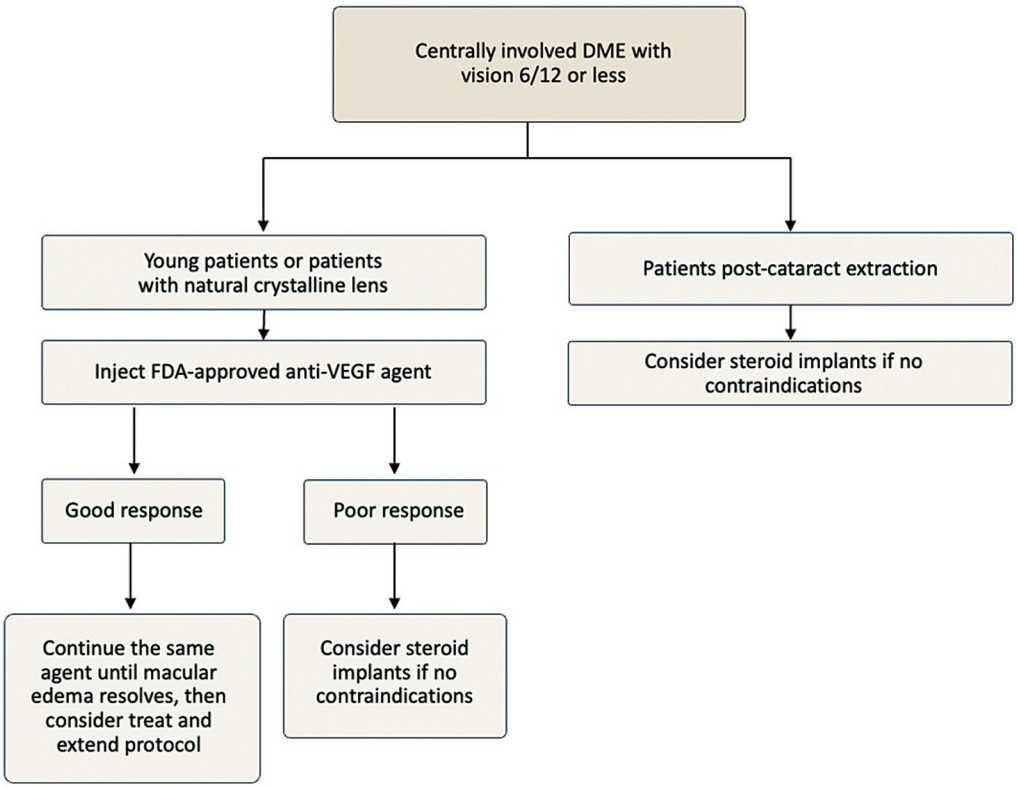

Fig. 3 Flow chart outlining screening and referral of individuals with diabetes according to the severity of DME and CI-DME (VA 6/12 or worse). DME, diabetic macular edema.

treatments. Corticosteroid implants may be used when anti-VEGF therapy is ineffective or contraindicated. Laser photocoagulation remains an adjunct option, while vitrectomy may be considered for persistent DME with vitreoretinal traction.

Management of DME can be guided as per the following grading:

- Non-CI DME (VA 6\9 or better): consider focal laser at 1,000 to 1,500 µm.
- CI DME (VA 6\9 or better): observation and consider anti-VEGF treatment if symptomatic.
- CI DME (VA 6\12 or worse): refer to ►**Fig. 3**.

DR and Driving

Driving is a complex task that relies heavily on vision, including key functions such as visual field, color perception, contrast sensitivity, night vision, glare resistance, depth perception, and control of double vision. While patients with DM who wish to drive should meet a minimum VA standard, several countries have adopted more stringent visual function standards, recognizing the importance of peripheral and color vision in navigating traffic signals and hazards. Patients with DR have reduced contrast sensitivity, increased glare sensitivity, and reaction times, sometimes necessitating restrictions on night driving. Patients with DR should undergo visual assessments to evaluate their fitness to drive by ophthalmologists or optometrists.

GCC Working Committee Recommendations

The GCC Working Committee makes the following recommendations to ensure that drivers with DR maintain visual function levels that support safe driving practices, balancing individual needs with public safety.

- An ophthalmologist can strongly advise patients with DR to adhere to the following vision requirements for safe driving and may recommend cessation of driving if requested by the local government's authority.
- All patients with DR must meet minimum VA standards: for private vehicles (noncommercial), a VA of at least Snellen 6/12 (decimal 0.5) with both eyes open or in the only eye if monocular; for public/commercial vehicles, a VA of at least Snellen 6/7.5 (decimal 0.8) in the better eye and Snellen 6/60 (decimal 0.1) in the poorer eye, using corrective glasses where needed.
- If glasses are worn to meet the minimum standards, they should have a corrective power that does not exceed +8 diopters in any meridian of either lens.
- Aside from baseline screening, any DR patient involved in a road traffic accident should ideally have their visual function reassessed by an ophthalmologist.
- A local expert review board should determine the suitability of issuing a restricted driving license or a temporary or permanent denial for those who partially or completely fail the vision-specific requirements.

Table 6 Challenges and recommendations to help tackle DR within the GCC

Focus	Challenge	Recommendation
Screening	There is no current systematic screening process in place within the GCC and this makes DR detection difficult	• A standardized screening approach must be adopted with specific guidance on screening intervals and DR diagnosis • Standardized use of national diabetes registers across the region to help identify individuals at risk of developing DR
DR prevalence/incidence	Establishing the true DR prevalence and incidence within the GCC region	A national diabetes register in each country within the GCC will help identify patients who need to be screened for DR diagnosis
Prevention of DR	A lack of risk factor identification and control	Greater emphasis must be placed on prevention through risk factor control through funding and education. This will help reduce the burden of DR within the GCC and help prevent vision loss
Care standardization	There are disparities in the care pathway for patients who are at risk of developing DR and for those who have been diagnosed with DR	A standardized care pathway needs to be adopted across the region to help improve the overall levels of detection and care for patients with DR. This can be achieved through collaboration between researchers, medical professionals, and health authorities.
Access to care and detection of DR	There are disparities in the care pathway for patients who are at risk of developing DR and for those who have been diagnosed with DR	• Further resources must be provided to rural areas to improve detection. Governments need to allocate funding to tackle this issue and help prevent vision loss in patients at risk of DR • The use of AI in detecting DR can help reduce the overall burden of illness

Abbreviations: AI, artificial intelligence; DR, diabetic retinopathy; GCC, Gulf Cooperation Council.

Challenges within the Region, Call to Practice, and Future Recommendations

DR care can be enhanced through a collective effort by addressing shared challenges across the GCC region. ►**Table 6** highlights key focus areas and recommendations essential for improving future outcomes.

Conclusion

The prevalence of DR is predicted to increase, particularly in the GCC region and is closely linked to poor glycemic control, hypertension, and hyperlipidemia. Given the region's advanced health care infrastructure and growing IT capabilities, there is a significant opportunity to establish national screening initiatives and integrated care pathways that could substantially reduce the incidence of vision loss due to DR. Our guideline provides a standardized region-specific care pathway via a collaborative multidisciplinary approach for effective DR management in the GCC. National screening programs, consistent management, and access to advanced therapies will prevent vision loss and enhance the quality of life for individuals with diabetes, reducing the social and economic burdens associated with preventable blindness.

Author Contributions

All authors contributed to the writing and review of the manuscript. F.A. is the principal editor and first author for the manuscript.

Data Availability Statement

All data generated during this initiative are included in this article. Further inquiries can be directed to the corresponding author.

Conflict of Interest Statement

The authors have no conflicts of interest to declare. All co-authors have read and approved the contents of the manuscript and there is no financial interest to report.

Acknowledgments

We would like to thank Abbott for providing a research grant to help produce this document. We would also like to thank the support of the medical writing services from Aman Malhi and editing **services from MEDCON Middle East.**

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