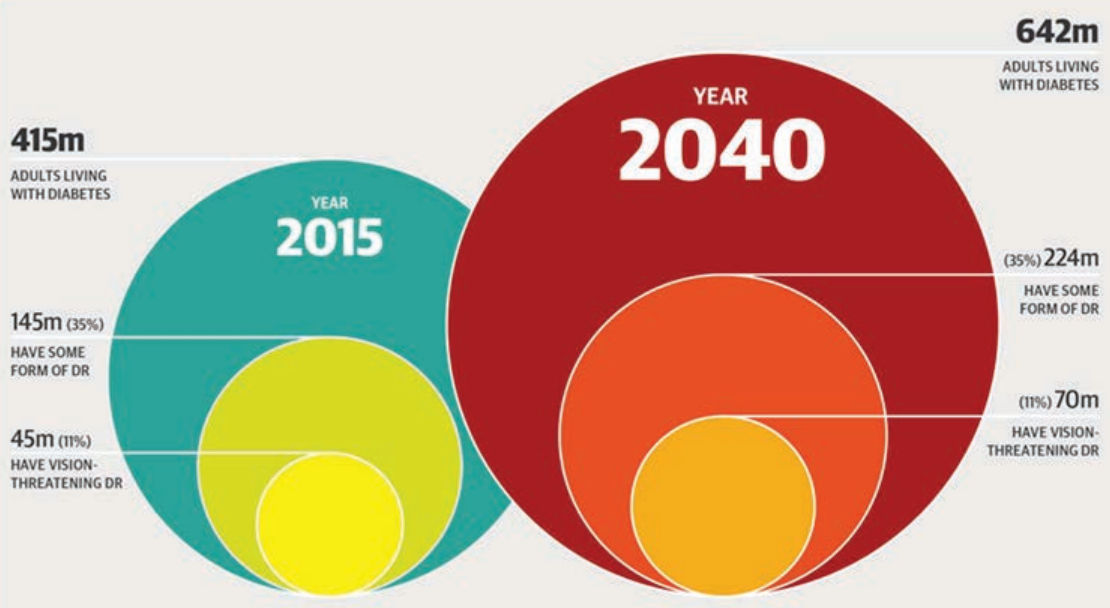
Strengthening diagnosis and treatment of diabetic retinopathy in the South-East Asia Region



Global burden of diabetes and diabetic retinopathy (IAPB vision atlas)
June 2020

IAPB

World Health Organization
REGIONAL OFFICE FOR South-East Asia

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Foreword-I

Vision is our most dominant sense. It plays a critical role in every facet and at every stage of a person's life. The WHO South-East Asia Region has in recent years made significant efforts to increase access to quality eye health services to achieve universal health coverage and ensure no one is left behind, in line with the Region's Flagship Priorities and Sustainable Development Goal 3.

WHO's first World Report on Vision, published in 2019, shows that at least one billion people globally suffer from preventable vision impairment that is yet to be addressed. Unaddressed refractive error and cataract continue to account for the majority of the burden, however eye care programmes are increasingly facing newer challenges, mainly related to ageing, population growth and lifestyle factors. Diabetic retinopathy is one such challenge.

Diabetic Retinopathy is a disease of the retina and its blood vessels that is caused by the long-term impact of diabetes mellitus. It is an increasingly significant cause of vision impairment and blindness in the Region, where the prevalence of diabetes is rising. The International Diabetes Federation estimates that the number of people with diabetes in seven of the Region's countries is likely to increase from 87.6 million in 2019 to 115.1 million by 2030. This will in turn increase the prevalence of diabetic retinopathy, with estimates suggesting the age-adjusted prevalence of the disease will increase from 11.3% in 2019 to 12.2% in 2030. Immediate and decisive action is required to control diabetes and with it, diabetic retinopathy.

The ravages caused by diabetic retinopathy are preventable. There is strong evidence that effective management of diabetes and associated systemic conditions postpones and reduces the incidence of sight-threatening retinopathy, and also improves prognosis. Periodic eye examinations by ophthalmologists, accompanied by standard treatment of diabetic retinopathy, can postpone serious loss of vision.

The following guidelines, which are aligned with the integrated people-centred eye care model recommended by the World Report on Vision, highlight the critical need for countries to adopt a coordinated and multisectoral approach to reduce the incidence of diabetes and the onset of diabetic retinopathy.

Programme managers must identify and implement evidence-based, well planned and feasible strategies at all levels of the health system. The guidelines specifically focus on the need for preventive, diagnostic and therapeutic interventions that are standardized and which are clear and can easily be implemented at all levels of care.

WHO recommends that these expert-developed guidelines and recommendations be reviewed after three years and before five years. Together we must continue to identify and apply the best, most effective interventions to prevent and treat diabetic retinopathy for the health and well-being of all people in our Region.

Dr Poonam Khetrapal Singh
Regional Director
WHO South-East Asia Region

Foreword-II

It gives me great pleasure to introduce the South-East Asia Eye Health Expert Group's "Strengthening diagnosis and treatment of diabetic retinopathy in the South-East Asia Region". The expert group was formed by the World Health Organization (WHO) and the International Agency for the Prevention of Blindness (IAPB) for the Region. The two organizations have a long history of collaboration in this Region and around the world. The impact of the global initiative, "VISION 2020: The Right to Sight" and the World Sight Day which is celebrated on the second Thursday of October every year, have been key successes in the past. "Treatment and operational guidelines for diabetic retinopathy for South-East Asian countries", is one more example of this fruitful collaboration in the South-East Asia Region.

IAPB would like to place on record our appreciation of Dr Poonam Khetrapal Singh, Regional Director of the WHO South-East Asia (SEA) Region, for supporting and approving this document. My sincere gratitude also goes to Dr Thaksaphon Thamarangsi, Director, Department of Healthier Populations and Noncommunicable Diseases (HPN) WHO SEA Region Office, and Dr Patanjali Nayar, Regional Adviser, whose support and guidance were instrumental in organizing an eye health expert meeting in Kathmandu in December 2019. The meeting led to the formation of a diabetic retinopathy (DR) expert group, and culminated in the preparation of this document.

I am also very thankful to Dr Taraprasad Das, IAPB Regional Chair for the SEA Region. Dr Das is a global authority on vitreoretinal disease. He took the lead in the preparation and publication of this very useful document.

Data from the Vision Loss Expert Group shows that blindness and vision impairment due to diabetic retinopathy (DR) are emerging global eye health challenges, more so among the populations of SEA countries. The early detection and treatment of DR is a crucial part of service delivery. If not detected on time, it can lead to irreversible blindness or vision impairment. The operational and treatment guidelines on diabetic retinopathy for SEA have highlighted these issues in the Region. They provide coherent solutions and recommendations that are very useful for those providing eye care services from the primary to tertiary level. I do hope that hospital networks, governments and all relevant stakeholders, use these guidelines and benefit from their advice. Together, we can work towards tackling many issues related to blindness and vision impairment due to DR in the Region.

Peter Holland

CEO, IAPB

Preface

Diabetes is a global epidemic and diabetic retinopathy (DR), the commonest microvascular complication of diabetes, is an emerging cause of visual impairment and blindness. It is estimated that by 2040, 642 million people will have diabetes, 35% (224 million) of them will have some form of diabetic retinopathy, and 11% (70 million) will have sight-threatening retinopathy. The Vision Loss Expert Group reported that, despite global efforts, the prevalence of DR increased by 25% between 1990 and 2015 (crude prevalence 1990: 0.032%; 2015: 0.04%), while the prevalence of other causes of visual impairment have decreased. This disparity is due to a rise in the world's population, an increase in the numbers of people with diabetes, increased longevity and ageing populations.

Paradoxically, there is a higher prevalence of diabetes and diabetic retinopathy in low- and middle-income countries, than in high-income countries. The International Diabetes Federation (IDF) has estimated that in 2019, South-East Asia was home to 87.6 million people with diabetes, while 30.6 and 9.6 million people possibly had diabetic retinopathy and sight-threatening retinopathy, respectively. Diabetes mellitus (DM) is also responsible for reduced, quality-adjusted life years and early death. Adding to the problem is the concurrent global rise in the cost of diabetes care, and unequal planned expenditure on diabetes, in low- and middle-income countries.

There is a need for a systematic approach. Over the years, many country-specific and global guidelines of evidence-based diabetic retinopathy have been developed. The scopes of these guidelines are nearly similar: screening to detect sight-threatening retinopathy, referral for appropriate care, and treatment using the latest technique and technology. Many countries in the SEA Region do not have diabetic retinopathy treatment and operation guidelines, despite being home to the largest population with diabetes. The International Agency for the Prevention of Blindness (IAPB) formed a South-East Asia Diabetic Retinopathy Expert Group and sought help from the WHO SEA Regional Office in New Delhi to convene a three-day meeting in December 2019, to analyse the existing diabetic retinopathy guidelines, and formulate a guideline more specific to the Region.

Retina or public health specialists were pooled from Bangladesh, Bhutan, India, Indonesia, Myanmar, Maldives, Nepal, Sri Lanka, and Thailand. In addition to their deliberations, the guidelines have derived guidance and wisdom from two experts from the WHO SEA Regional Office: Dr Thaksaphon Thamarangsi, Director, Healthier Populations and Noncommunicable Diseases, and Dr Patanjali Dev Nayar, Regional Adviser, Disability & Injury Prevention and Rehabilitation. I also place on record the encouragement of Dr Poonam Khetrapal Singh, Regional Director of the WHO South-East Asia Region; she has always encouraged all efforts to reduce needless blindness in the Region and specifically, the formulation of these guidelines.

All guidelines are time-bound recommendations. Over time, technologies change and new evidence emerges. Thus, it is expected that a new group of experts from the SEA Region will meet again in five years or at longer intervals, to review the recommendations and make appropriate changes.

Taraprasad Das, MD
Regional Chair, South-East Asia,
International Agency for the Prevention of Blindness (IAPB)

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Abbreviations and acronyms

AI	artificial intelligence
CBP	complete blood picture
CNP	capillary non-perfusion
DM	diabetes mellitus
DME	diabetic macular oedema
DR	diabetic retinopathy
ETDRS	early treatment diabetic retinopathy study
FAZ	foveal avascular zone
FFA	fluorescein angiography
GNI	gross national income
HIC	high-income country
HTN	hypertension
IAPB	International Agency for the Prevention of Blindness
ICDR	international classification of diabetic retinopathy
ICO	International Council of Ophthalmology
IDF	International Diabetes Federation
IPCEC	integrated people centred eye care
IOP	intraocular pressure
IVI	intravitreal injection
LIC	low-income country
LMIC	low- and middle-income country
MA	microaneurysm
MIS	management information system
NVA	new vessels angle

NVD	new vessels disc
NVE	new vessels elsewhere (retina)
NVI	new vessels iris
NPDR	non-proliferative diabetic retinopathy
OCT	optical coherence tomography
OCTA	optical coherence tomography angiography
PDR	proliferative diabetic retinopathy
PRP	pan retinal photocoagulation
SEA	South-East Asia
UHC	universal health coverage
US$	United States dollar
VEGF	vascular endothelial growth factor
VR	vitreoretinal
WHO	World Health Organization
WRV	World Report on Vision

Executive summary

Diabetes mellitus (DM) is increasing in the world and in countries of the South-East Asia (SEA) Region.

The International Diabetes Federation (IDF) estimates that the number of people with DM in seven countries of the SEA Region, is likely to increase from 87.6 million in 2019, to 115.1 million in 2030.

Diabetic retinopathy (DR) is an important cause of vision impairment and blindness in South-East Asia.

The age-adjusted prevalence of DR in SEA countries is likely to increase from 11.3% in 2019, to 12.2% in 2030 (IDF).

There is strong evidence that good control of DM and associated systemic conditions reduces the incidence of sight-threatening retinopathy, and/or improves prognosis after standard treatment of DR.

Human resource is a constraint in most Member States of the SEA Region.

A combination of the gross national income per capita (GNI/capita) and the available human resources in the Member States of the SEA Region, reveals that there are two countries each in the high- and low-income categories, and six are in the middle-income category.

There is an acute shortage of retina specialists, and in two countries there are none. Development of infrastructure and capacity building are of paramount importance.

Screening at the primary level using non-ophthalmic, trained technicians would help in covering a larger population.

A clear demarcation of referral pathways and a national registry for diabetes mellitus / diabetic retinopathy (DM/DR) are highly recommended.

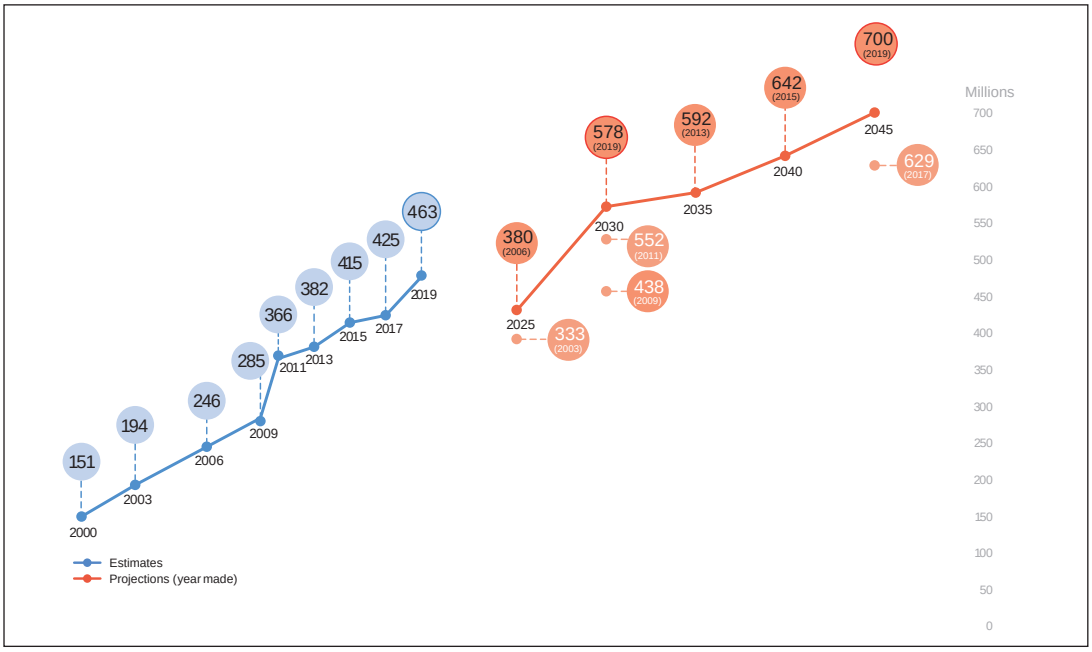
Background

Diabetic retinopathy (DR) accounted for 1.07% of blindness, and 1.25% of moderate to severe visual impairment (MSVI) in 2015 [1]. Despite two decades of global efforts to reduce visual impairment, there was a 25% increase in the prevalence of DR (Crude prevalence 0.032% and 0.04% in 1990 and 2015 respectively) [1]. This disparity is explained by the increase in absolute numbers of people with diabetic retinopathy (DR), consequent to an increase in people with diabetes mellitus (DM).

The International Diabetes Federation (IDF) estimates that the number of people with DM is likely to increase from 463 million people in 2019, to 578 million in 2030 [2] (Figure 1). Three other factors expected to impact the increase are: rises in population, longevity and ageing. The world population is estimated to rise from 7.7 billion in 2019, to 8.5 billion in 2030. People are likely to live longer; the life expectancy of 64.2 years in 2019 is likely to increase to 72.6 years in 2030. The change in the demography of the world population also means that the proportion of ageing people (65 years and above) is estimated to increase from 9.1% in 2019, to 11.7% in 2030 [3].

These changes will also impact the global cost of diabetes care; the combined direct and indirect cost is estimated to increase from US$ 1.3 trillion in 2015, to US$ 2.1–2.5 trillion in 2030 [4]. However, it is anticipated that the planned expenditure on diabetes and its complications, will be higher in high-income countries (HIC) than in low- and middle-income countries (LMIC).

Figure 1: *Estimates and projections of the global prevalence of diabetes in the 20–79 year age group (millions)*



(Source: IDF Atlas 2019)

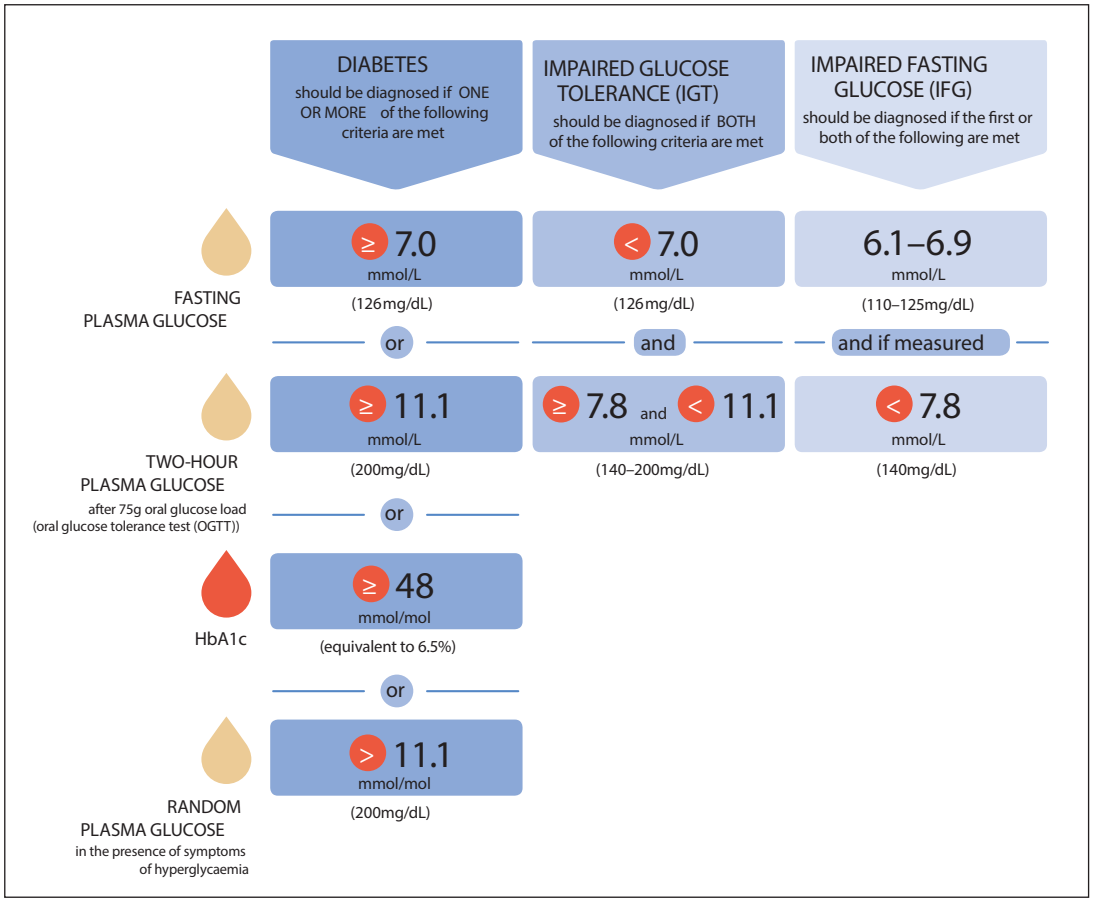
1. Diabetes mellitus

Diabetes mellitus (DM) is a chronic, metabolic disease characterized by elevated levels of blood glucose, which, over time, lead to serious damage to the heart, blood vessels, eyes, kidneys and nerves [5]. DM occurs because the body cannot produce any or enough of the hormone insulin, or, cannot effectively use the insulin it produces. Insulin, an essential hormone produced in the pancreas, allows glucose from the bloodstream to enter the body's cells, where glucose is converted into energy. There are 3 main categories of DM: type 1 (T1DM), type 2 (T2DM) and gestational diabetes mellitus (GDM).

T1DM is the major cause of DM in childhood; it is caused by an autoimmune reaction, whereby the body's immune system affects the insulin-producing beta cells of the pancreas. As a result, the body produces very little or no insulin. In T2DM, there is inadequate production of insulin; it is most commonly seen in older adults. Hyperglycaemia in pregnancy, can be either gestational diabetes mellitus (GDM) or, diabetes in pregnancy (DIP). GDM is diagnosed for the first time during pregnancy, and may occur anytime during pregnancy (most likely after 24 weeks).

Measurement of the plasma glucose level is the cornerstone for the diagnosis of DM. Depending on the level of fasting plasma glucose or glycated haemoglobin, the International Diabetes Federation (IDF) classifies the DM diagnostic criteria into three levels (Figure 2).

Figure 2: *Current diagnostic criteria of diabetes mellitus (Source: IDF Atlas 2019)*



Over the next quarter century, there will be a population rise in nearly all countries in the South-East Asia Region, and a disproportionate increase in the number of people with diabetes (Table 1)

Table 1: *Current and anticipated diabetes mellitus burden in SEA Region Member States [2]**

Country	Adult population in millions (20–79 years)			DM disease burden (20–79 years)		
	estimated in 2019	projected in 2045	% increase	estimated in 2019	projected in 2045	% increase
Bangladesh	104.0	144.5	39	8.4 million	14.9 million	79
Bhutan	0.5	0.72	36	46 000	88 000	91
India	859.9	1159.2	35	77.0 million	134.2 million	74
Indonesia	172.2	223.9	30	10.7 million	16.6 million	56
Maldives	0.31	0.43	39	22 800	48 500	113
Myanmar	34.7	44.2	37	1.28 million	2.00 million	56
Nepal	17.5	25.8	47	0.69 million	1.59 million	129
Sri Lanka	14.1	14.8	5	1.23 million	1.54 million	25
Thailand	51.4	49.3	-4	4.28 million	5.07 million	18
Timor-Leste	0.6	1.19	97	32 000	645 000	102

*Data on DPR Korea is not available

*Adopted from IDF Atlas 9th edition, 2019. (https://www.diabetesatlas.org/data/en/)

2. Diabetic retinopathy

Diabetic retinopathy (DR) is an important microvascular complication of both type 1 and type 2 diabetes mellitus (DM), that usually occurs after 5–7 years of T2DM, and around puberty in T1DM. Diabetic retinopathy progresses from a mild, non-proliferative state to moderate and severe non-proliferative diabetic retinopathy (NPDR) and to proliferative diabetic retinopathy (PDR). Diabetic macular oedema (DME) can develop at any stage of retinopathy. Sight-threatening diabetic retinopathy (STDR) results from several mechanisms: macular oedema, macular ischemia, bleeding from new vessels, and contraction of the accompanying fibrous tissue, leading to tractional retinal detachment.

2.1 Prevalence of DR

A meta-analysis of the data published in the IDF Atlas suggested that the global prevalence of DR and DME, for the period 2015–2018, was 27.0% for any DR, 25.2% for NPDR, 1.4% for PDR and 4.6% for DME. The prevalence of DR was 12.5% for South-East Asia [6]. The mostly hospital-based studies from South-East Asian countries which were published between 2006 and 2020, are shown in table 2.

Table 2: *South-East Asia published prevalence of diabetic retinopathy [7-15]*

Country	Publication year	Study Type	Cohort	Any DR %	NPDR %	PDR %	DME %	STDR
Bangladesh[7]	2019	hospital-based	49 264	33.0	3.9	7.8	19,2	12.2
Bhutan[8]	2020	hospital-based	2913	12.4	NA	9.8	10.9	NA
India[9]	2020	hospital-based	11 182	32.3	21.6	10.7	9.1	19.1
Indonesia[10]	2017	cross-sectional	1184	43.1	9.4–11.1	12.1	NA	26.3
Maldives	NA	NA	NA	NA	NA	NA	NA	NA
Myanmar[11]	2017	hospital-based	97	34.0	10.0–13.5	13.5	NA	23.5
Nepal[12]	2020	hospital-based	8855	19.4	14.7	4.6	6.9	NA
Sri Lanka[13]	2014	cross-sectional	50 000	27.4%	25.6	1.8	5.3%	NA
Thailand[14]	2006	cross-sectional	7119	31.4	22.0	9.14	NA	-
Timor-Leste[15]	2015	hospital-based	283	18.6	NA	NA	NA	NA

NA- not available

2.2 Clinical features and classification

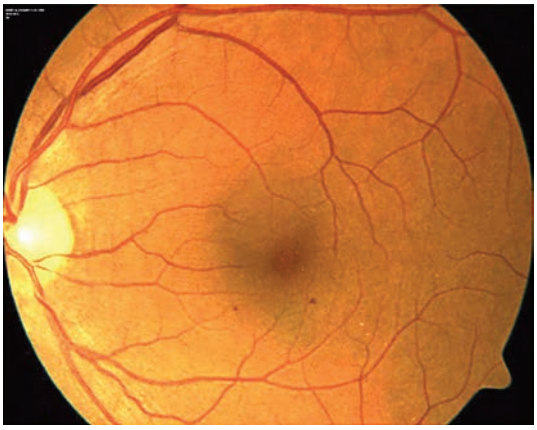
The International Classification of Diabetic Retinopathy (ICDR) is the most commonly used classification of DR [16]. It classifies DR into 3 broad categories of NPDR, PDR and DME; and further divides NPDR and DME into 3 levels (mild, moderate and severe). Table 3:

Table 3: *International Classification of Diabetic Retinopathy and disease severity [16]*

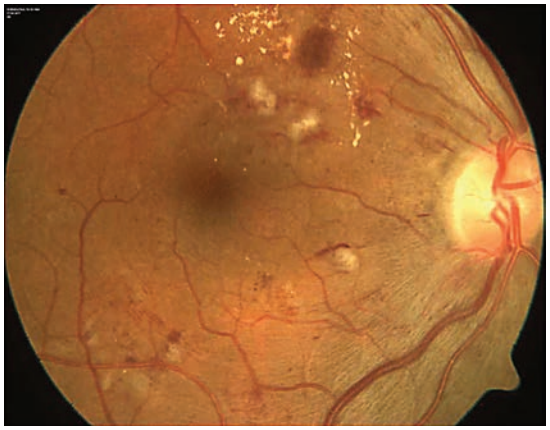
Disease severity	Findings observable upon dilated ophthalmoscopy
Diabetic retinopathy (DR)	
No Apparent DR	No abnormalities
Mild NPDR	Microaneurysms only
Moderate NPDR	More than just microaneurysms, but less than severe NPDR, (microaneurysms with other signs like intraretinal haemorrhages, hard exudates, cotton wool spots)
Severe NPDR	Any of the following: (4:2:1) 1. More than 20 intraretinal haemorrhages in each of 4 quadrants 2. Definite venous beading in 2+ quadrants 3. Prominent intraretinal microvascular abnormalities IRMA in 1+ quadrant (And no signs of PDR)
PDR	One or more of the following: 1. Neovascularization 2. Vitreous/preretinal haemorrhage
Diabetic macular oedema (DME) by clinical appearance	
No apparent DME	No retinal thickening or hard exudates at the macula
Mild DME	Some retinal thickening or hard exudates in posterior pole but distant from the centre of the macula
Moderate DME	Retinal thickening or hard exudates approaching the centre of the macula but not involving the centre
Severe DME	Retinal thickening or hard exudates involving the centre of the macula
DME classification by centre of macula involvement using optical coherence tomography (OCT)	
Non-central involving DME	Retinal thickening in the macula that does not involve central sub- field zone in OCT (1 mm diameter)
Centre involving DME	Retina thickening in the macula that involves the central subfield zone in OCT (1 mm diameter)

Figure 3: *Clinical features of DR*

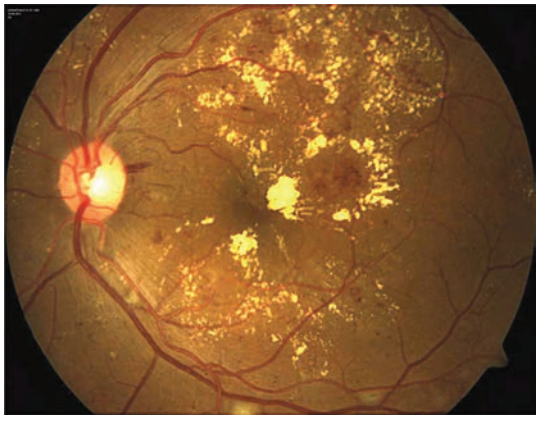
3.1. NPDR- Mild



3.2. NPDR- Moderate



3.3. NPDR- Severe

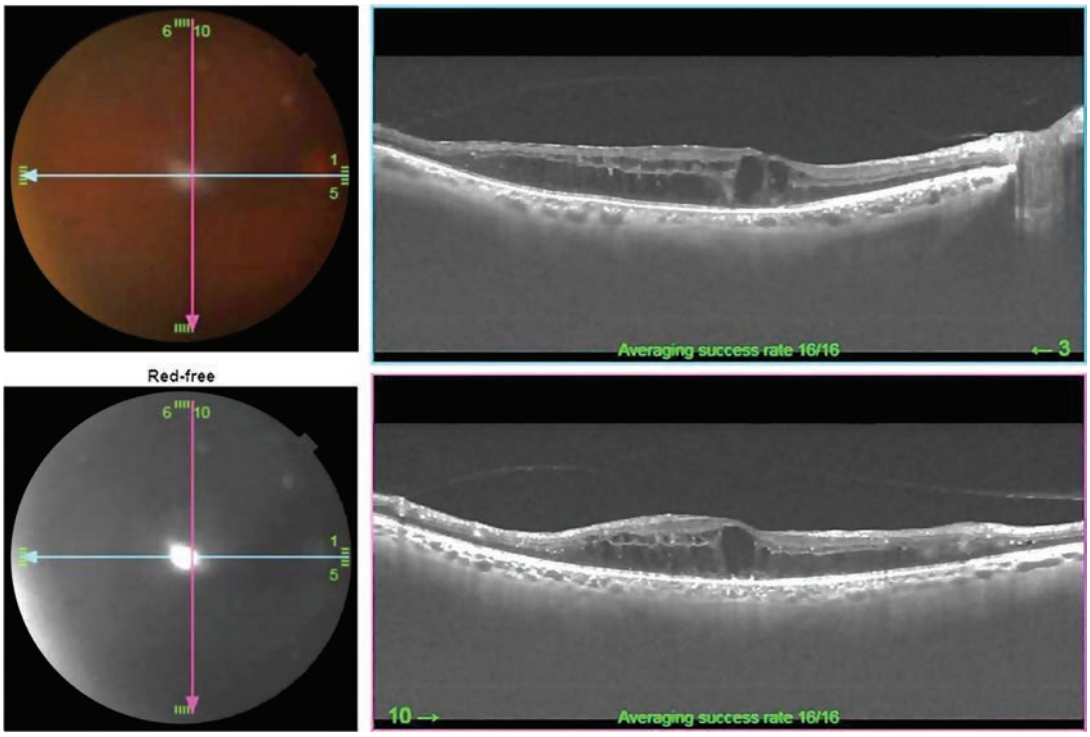


Mild non-proliferative diabetic retinopathy (NPDR) of left eye shows few dot haemorrhages and microaneurysms

Moderate non-proliferative diabetic retinopathy (NPDR) of right eye shows blot and dot haemorrhages, and soft and hard exudates.

Severe non-proliferative diabetic retinopathy (NPDR) of left eye shows blot and dot haemorrhages, and hard exudates in the posterior pole and close to the fovea.

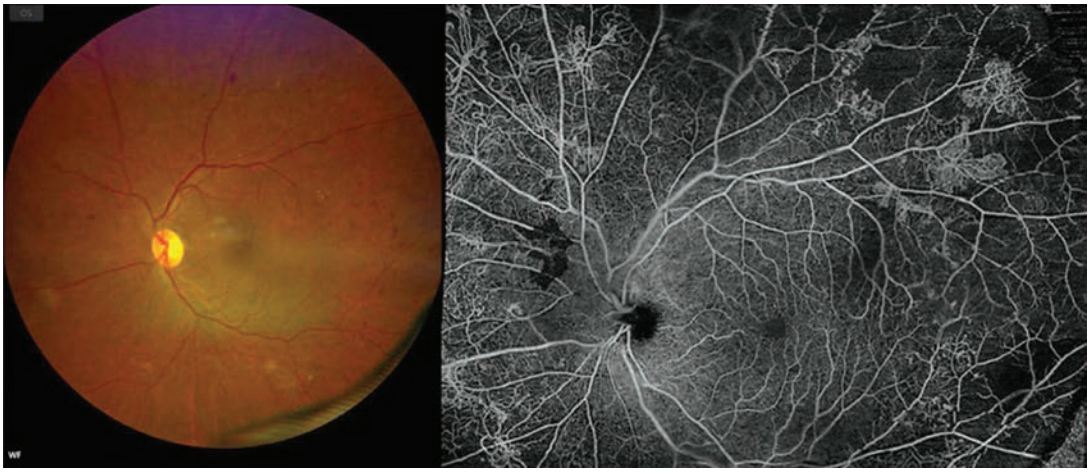
3.4. DME-OCT



Optical coherence tomography (OCT) of centre-involved diabetic macular oedema

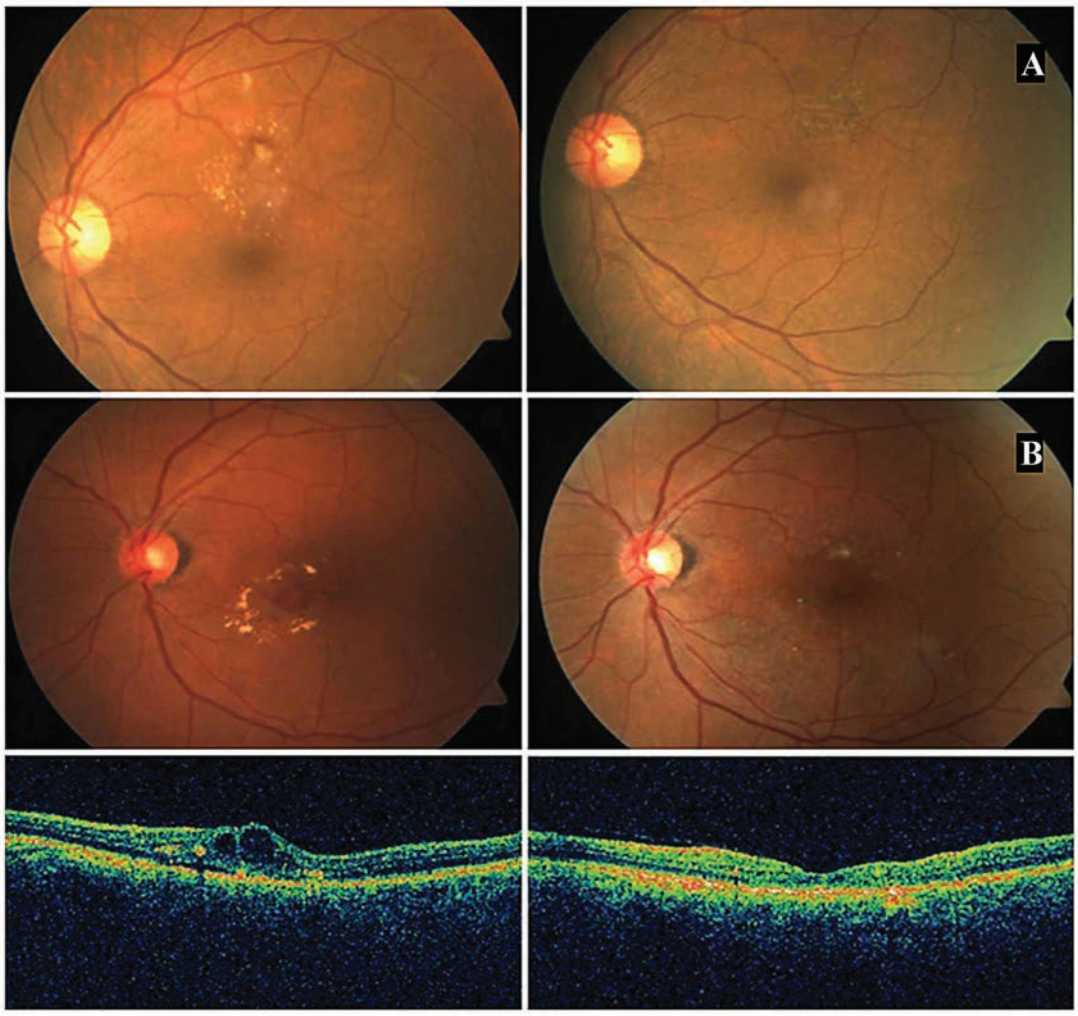
(DME) with multiple (upper), and single (lower) cystoid spaces and intraretinal oedema in both images.

3.5. Left eye colour fundus photo (left) and corresponding OCTA (right).



Colour fundus and corresponding optical coherence tomography angiography (OCTA) of left eye; OCTA shows several areas of retinal new vessels and areas of capillary non-perfusion.

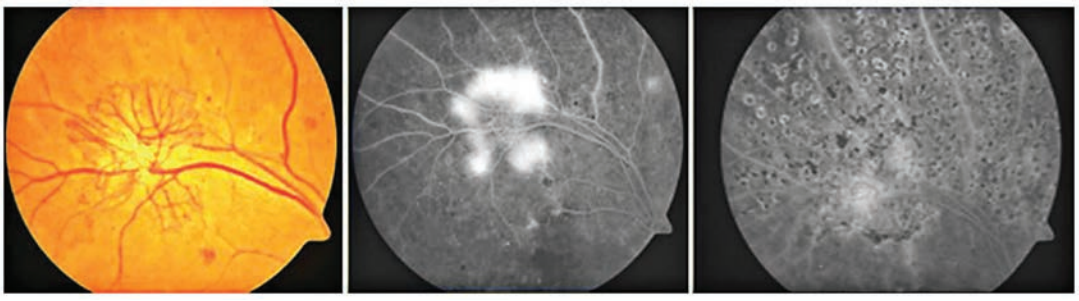
3.6. DME treatment with laser and anti VEGF



3.6.A. Non centre-involved diabetic macular oedema left eye (left) resolved after laser treatment (right).

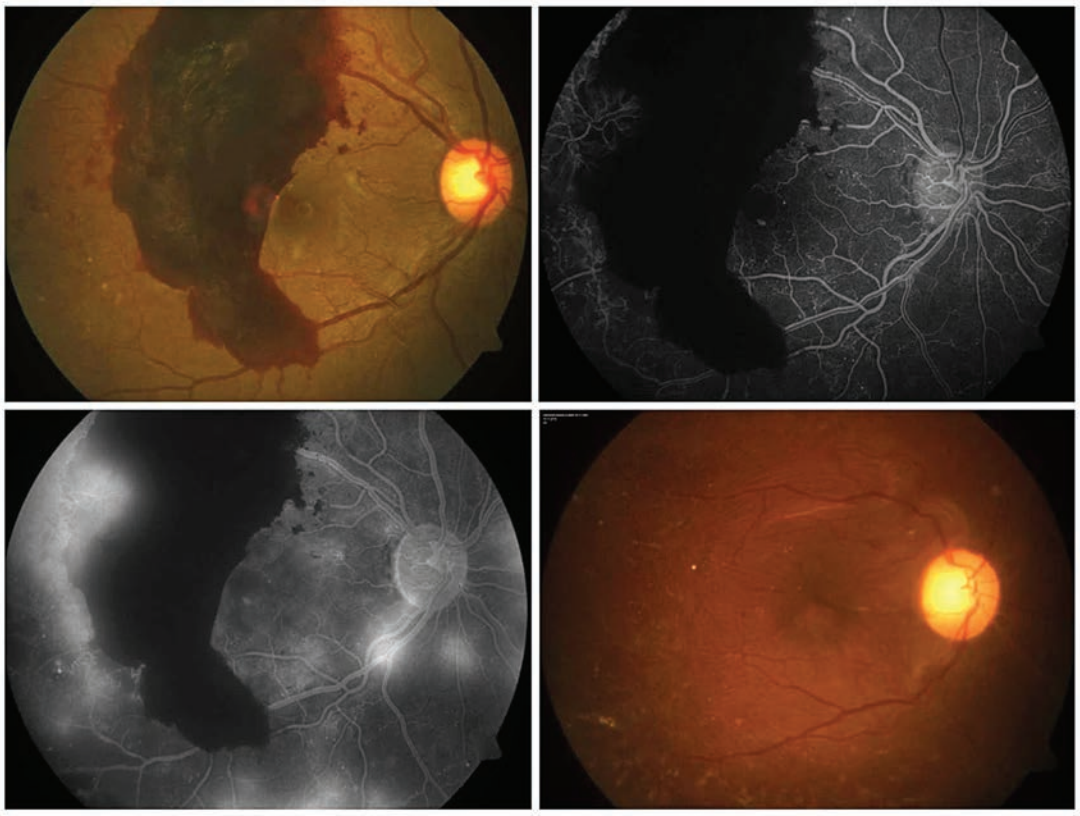
3.6.B. Centre-involved diabetic macular oedema left eye (left upper and lower), resolved after three intravitreal, anti-vascular endothelial growth factor (VEGF) injections. (right upper and lower)

3.7. Laser-treated PDR



Proliferative diabetic retinopathy (PDR) right eye. Left:colour fundus image shows retinal new vessel; middle: fluorescein angiography shows leaking retinal new vessel; right: shows regressed retinal new vessels and laser photocoagulation marks on fluorescein angiogram.

3.8. Vitrectomy-treated PDR

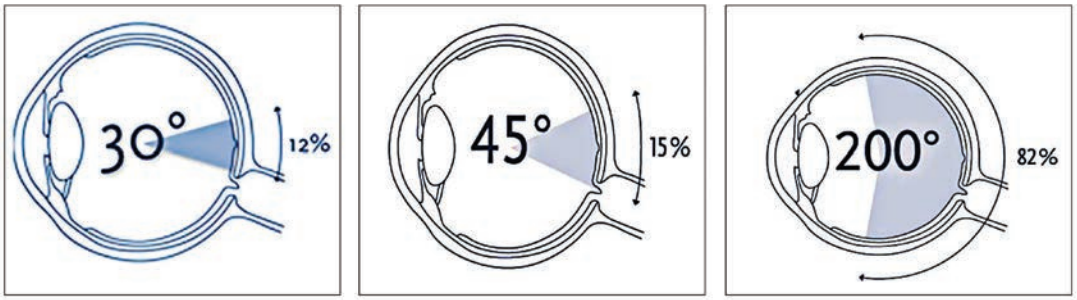


Proliferative diabetic retinopathy (PDR) right eye. Upper-left: massive pre-retinal haemorrhage in the posterior pole; upper-right and lower-left: fluorescein angiogram at different phases show leaking retinal new vessels; lower-right: post vitrectomy and retinal laser shows a clear posterior pole and occluded retinal vessels.

2.3 Fundus photography-based diagnosis

Fundus photographs have been used for diagnosis and grading of DR, since the Diabetic Retinopathy Study (DRS) first commenced in the early 1970s. The DRS recommended a 7-field stereo photograph of 30^0 field of view each, arranged in a particular fashion around the disc and macula [17]. Today, most investigators would recommend one or two wide-field (45^0–50^0) monoscopic digital fundus photographs, or one 200^0 ultrawide-field photograph for DR grading [18,19]. The area of retina covered, increases from 12% in a traditional retinal camera to 15% with a wide-field retinal camera, to 82% with an ultrawide-field retinal camera (Figure 4).

Figure 4: *Area of the retina covered with different retinal cameras. Left: traditional; middle: wide-field; right: ultrawide-field retinal camera (Source: www.optos.com with permission].*



Ultrawide retinal cameras are expensive. Currently two 45^0-field fundus photos, one centred on the disc, and the other centred on the macula; 60^0 horizontal and 45^0 vertical respectively, are considered good enough for grading DR [20]. One drawback of digital retinal imaging is its inability to accurately identify and grade macular oedema. There are advanced to less bulky and hand-held cameras, mobile phone-based cameras and non-mydriatic fundus cameras with good sensitivity and specificity [21,22]. A good quality fundus image captures both disc and macula in the same frame, with good focus and illumination.

2.4 Diagnosis of DR

The diagnosis of DR is made from fundus examination, often aided by fundus fluorescein angiography (FFA), optical coherence tomography (OCT) and of late, optical coherence tomography-angiography (OCTA). The FFA is useful to qualify and quantify areas of capillary non-perfusion; the OCT is particularly useful to qualify and quantify macular oedema. The guidelines of the American Academy of Ophthalmology for FFA and OCT are shown in Table 4 [23]. The South-East Asia diabetic retinopathy expert group agreed upon these criteria.

Table 4: *American Academy of Ophthalmology Guidelines for fluorescein angiography and optical coherence tomography [23].*

Investigation	Situation	Usually	Occasionally	Never
FFA	Investigate unexplained vision loss	X	-	-
	Guide laser treatment for DME	X	-	-
	Identify clinically suspect NVE/NVD	X	-	-
	Identify area of capillary non-perfusion	–	X	-
	Screen for DR	–	–	X
OCT	Investigate unexplained vision loss	X	–	–
	Identify areas of vitreo-macular traction	X	–	–
	Monitor response to treatment	X	–	–
	Evaluate patients difficult to examine	X	–	–
	Investigate other possible causes of macular oedema	–	X	–
	Screen for DR	–	–	X

2.5 Management of systemic risk factors in DR care

From the pathophysiology of DR, it is but natural to reach the conclusion that reducing the number of people with DM, would lead to a reduction in the number of people with DR. Thus, the foremost strategy to reduce DR would be to reduce the prevalence and severity of DM in the population, and effective control of plasma glucose levels in individuals with DM. This would necessarily entail the control of DM and many associated co-morbidities. There are both modifiable and non-modifiable risk factors, that need focus and management. (Table 5) Modifiable risk factors are those amenable to interventions. Proven factors are those that carry level 1 evidence (obtained from a systematic review of all relevant randomized controlled trials), and variable evidence from large observational studies (level 3 evidence).

Table 5: *Non-modifiable and modifiable risk factors in DR and DME*

Non-modifiable	Modifiable-proven	Modifiable-variable evidence
Duration of diabetes	Hyperglycaemia	Dyslipidaemia
Diabetes type	Hypertension	Diabetic kidney disease
Pregnancy	–	Anaemia
Puberty (Type 1 diabetes)	–	Smoking
Age	–	High salt intake
Genetic factors	–	Glitazone drugs

(Modified from: Guidelines for the prevention and management of diabetic retinopathy and diabetic eye disease in India 2019; Indian Institute of Public Health, Hyderabad) [24].

Glycaemia and blood pressure are two risk factors that are proven to be modifiable. There is evidence to suggest that intensive glycaemic control and tight blood pressure control, help reduce DR progression [25,26]. Other important systemic factors are kidney disease (greater association with T1DM), microalbuminuria, anaemia (for retinopathy progression and DME) and obesity (strong relationship with insulin resistance) [27–30].

2.6 Screening for diabetic retinopathy

The vast majority of patients who develop DR have no symptoms until the late stages, due to DME and complications of PDR. It is a global phenomenon, and is more likely to happen in countries/regions with inadequate resources, suboptimal infrastructure and difficult accessibility to diagnostic / treatment modalities. In these situations, DR screening is more important, and fits to all criteria of chronic diseases screening [31].

Traditionally, ophthalmologists and physicians perform DR screening. With the shift from ophthalmoscopy to digital retinal photography, technically trained and certified screeners such as optometrists, and allied ophthalmic personnel, including trained retinal photographers, would be more cost-effective. In many countries, the existing law does not allow optometrists to dilate pupils without supervision by an ophthalmologist. This barrier could be overcome, if optometrists were given the ability to read and grade the retinal images obtained with the currently available, non-mydriatic retinal cameras. Screening methods and validity are shown in table 6 [32].

Table 6: *Screening methods and validity [32].*

Method	Personnel	Outcome measure	Sensitivity %	Specificity %
Clinical Examination				
Directophthalmoscopy	general physician	any DR	63	75
	optometrist	any DR	74	80
Dilated slit lamp exam	ophthalmologist	referable DR	87	95
	optometrist	referable DR	73	90

Method	Personnel	Outcome measure	Sensitivity %	Specificity %
Retinal Imaging – mydriatic				
1 Field 35^0-colour	general physician	any DR	79	73
	optometrist	any DR	88	68
	diabetologist	any DR	73	93
2 Fields 50^0-colour	retinal photographer	referable DR	93	87
3 Fields 30^0- colour	ophthalmologist	any DR	95	99

The current recommendation is that the first screening for DR for people with T2DM, is done at the time of diagnosis of DM, and during puberty (usually 12–15 years), or, at five years after the diagnosis, for people with T1DM. The follow-up care depends on the severity of the disease. Examination during pregnancy is usually undertaken during every trimester. These examinations are ideally performed in a fixed facility, and compliance is better when this is done closer to people's residences or, when combined with a definitive treatment such as retinal laser [33–35] [Table 7].

Table 7: *The recommended timing of the first ophthalmic (and retinal) examination and subsequent follow-up examinations for people with diabetes.*

Type of diabetes	Recommended initial retinal assessment	Recommended follow-up
Type 1 DM	Within 5 years of diagnosis of diabetes.	Annually.
Type 2 DM	At the time of diagnosis of diabetes.	Annually.
Pregnancy(T1DM/ T2DM) *	Prior to conception and early in the first trimester.	1.No DR to mild NPD: every 3–6 months; 2.Severe NPDR or worse- every 1–3 months.

*Women with gestational diabetes do not have an increased risk of DR during pregnancy.

The minimum screening requirements are a record of presenting vision (and spectacles correction, if any) and fundus photography, in addition to the history and status of diabetes [36]. A comprehensive eye examination in an ophthalmologist's office would also include slit-lamp examination, intraocular pressure (a gonioscopy, when pressure is high), and dilated eye examination [36] [Table 8].

Table 8: *Screening, follow-up in people with DM with and without DR [36]*

Status of retinopathy	Referral to ophthalmologist	Follow-up
No DR	within 1 year	every year
Mild NPDR	within 1 year	every year
Moderate NPDR	within 3–6 months	every 6 months
Severe NPDR	immediate	every 3 months
PDR	immediate	every 3 months
No DME	within 1 year	every 2 year
Non-centre involving DME	within 3–6 months	every 3 months
Centre involving DME	immediate	every 1–2 months

The key indicators of the success of DR screening are the robustness of the referral system, and compliance to referrals. An annual check-up is necessary when retinopathy is not detected, and this interval is reduced, depending on the degree of retinopathy. A referral of all people with STDR and those with symptoms of reduced vision, is mandatory.

2.7 Treatment of diabetic retinopathy

The main management of DR is four-pronged: systemic control, laser photocoagulation, intravitreal drug injections (IVI) and vitreoretinal surgery. Therapeutic approaches in people with DR, or at risk of developing DR, include lifestyle modification and drug therapy to alter/ reduce modifiable risk factors. Lifestyle modifications include regular exercise, and a healthy diet (reduced calorie intake, high fibre intake) [37–39]. Control of all co-morbidities are required for optimal treatment effect of DR.

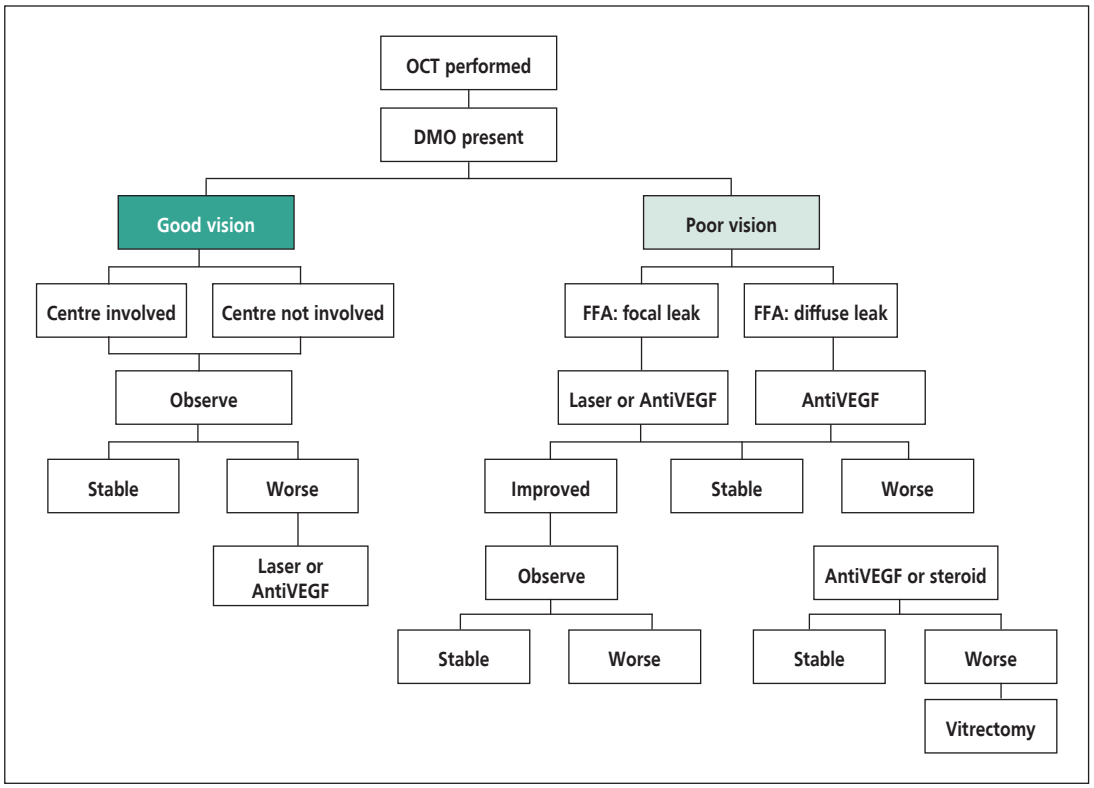
Retinal laser is effective in PDR and severe NPDR; intravitreal injection of anti-vascular endothelial growth factor (VEGF) is effective in macular oedema, and in certain stages of PDR; vitrectomy is good in sequalae of PDR, and occasionally, in non-resolving macular oedema [40–42] [Table 9]. Treatment of macular oedema combines all modalities of retinal imaging, (fundus photo, FFA and OCT) and all modalities of therapy (laser, anti VEGF injection and vitrectomy); the choice depends on the vision and macular status [43] (Figure 5).

Table 9: *Management of Diabetic Retinopathy*

DR status	Observe	PRP laser	Maculalaser	Anti VEGF	VR surgery
Mild NPDR	X	–		–	–
NPDR-DME, centre not involved	–	–	X	–	–
NPDR-DME, centre involved	–	–	–	X	–
Severe NPDR- large areas of CNP*	–	X	–	X	–
PDR- flat NVE	–	X	–	X	–
PDR- NVD	–	X	–	–	–
PDR- elevated NVE	–	X	–	–	–
PDR WITH DME **		X		X	
Vitreo-macular traction	–	–	–	–	X
Traction retinal detachment	–	–	–	–	X

*Option of PRP and anti VEGF; ** Anti VEGF followed by PRP

Figure 5: *Treatment recommendations for DME [43]*



2.8 Special Situations

Two common special situations, DR in pregnancy and cataract with DR, need further elaboration.

Pregnancy: Assessment of DR before conception and during pregnancy, is important in people with pre-existing diabetes. Pregnant women with pre-existing DM should have their screening and retinal assessment, at six weeks of pregnancy. The frequency of further retinal assessments is made on an ophthalmologist's advice. While laser photocoagulation for PDR or DME can be done during pregnancy, the anti-VEGF intravitreal injection is normally avoided. One examination at three months postpartum, and further review depending on the retinal condition, are recommended.

Cataract Surgery: DR and DME can progress faster after cataract surgery. In people with moderate cataract, where the assessment of DR status is possible, treatment for DR prior to cataract surgery must be attempted (PDR and severe NPDR with PRP; any DME with focal laser, or anti-VEGF intravitreal injection). Cataract surgery is done after PDR/ DME is stable. If DME is present, anti-VEGF therapy before surgery, or at the time of surgery, can be planned. For dense cataract with poor fundus view wherein the DR status cannot be assessed, cataract surgery followed by assessment and treatment of DR/ DME, must be instituted as necessary.

3. Public health perspective of diabetic retinopathy care, with specific reference to South-East Asia

From a public health perspective, vision loss resulting from DR can be significantly reduced by a systematic approach that includes advocacy (increase public awareness and targeted health education), national level screening (all people with DM), timely referrals (people with treatable lesions, and people with reduced vision), and finally, appropriate management. This needs sound health infrastructure, trained health personnel and financial resources, which may not be possible in all countries in the world. The International Council of Ophthalmology (ICO) has proposed a two-way strategy to manage this heterogeneity, one for a high resource setting (invariably high-income countries), and the other for a low resource setting (invariably middle- and low-income countries). The basic differences are in screening (shorter screening intervals in high resource settings), in referrals (longer interval in mild to moderate DR, in low resource settings), and in laser treatment strategy (preferred over anti VEGF therapy, in low resource settings) [36].

3.1 World Bank categorization of SEA Region countries

Based on the gross national income per capita (GNI/capita: gross national income divided by the midyear population), the World Bank divides countries into two broad categories and four sub- categories. Currently no country of the SEA Region is categorized as a low-income country (LIC) category, and one country is categorized as a high-income country (HIC) category [44] (Table 10).

Table 10: *World Bank categorization of countries [44]*

Threshold level	GNI/capita (US$)	SEA Region Member countries
Low-income country	< 1020	–
Lower middle-income country	1020–3995	Bangladesh, Bhutan, India,Myanmar, Nepal, Sri Lanka, Timor-Leste
Upper middle-income country	3996–12 375	Indonesia, Thailand
High-income country	> 12 375	Maldives

3.2 SEA Region country categorization by GNI and health resources

The WHO South-East Asia DR expert group categorized the SEA Region Member States among themselves and by their GNI and resource settings, into high, medium and low. Resource settings were based on the CSR (cataract surgical rate per million population, in one year) and, the availability of ophthalmologists per population. By this categorization, two countries were placed at low level, six countries were placed at middle level and two countries were placed at high level (Table 11) [45].

Table 11: *SEA Region Member countries by GNI and resource setting; Expected DR care system based on* GNI and resource setting [44,45]

Country	GNI/capita US$ [44]	Resource setting		Level based on GNI & resources
		CSR/m [45]	ophthalmologist one/ people*	
Bangladesh	1906	1475	135 883	middle
Bhutan	3423	1550	75 000	middle
India	2044	5050	56 689	high
Indonesia	4193	1079	98 672	middle
Maldives	15 563	1287	20 384	middle
Myanmar	1723	2038	138 461	low
Nepal	1034	4513	86 865	middle
Sri Lanka	3946	5030	163 000	middle
Thailand	8170	2400	40 941	high
Timor-Leste	2262	720	325 000	low

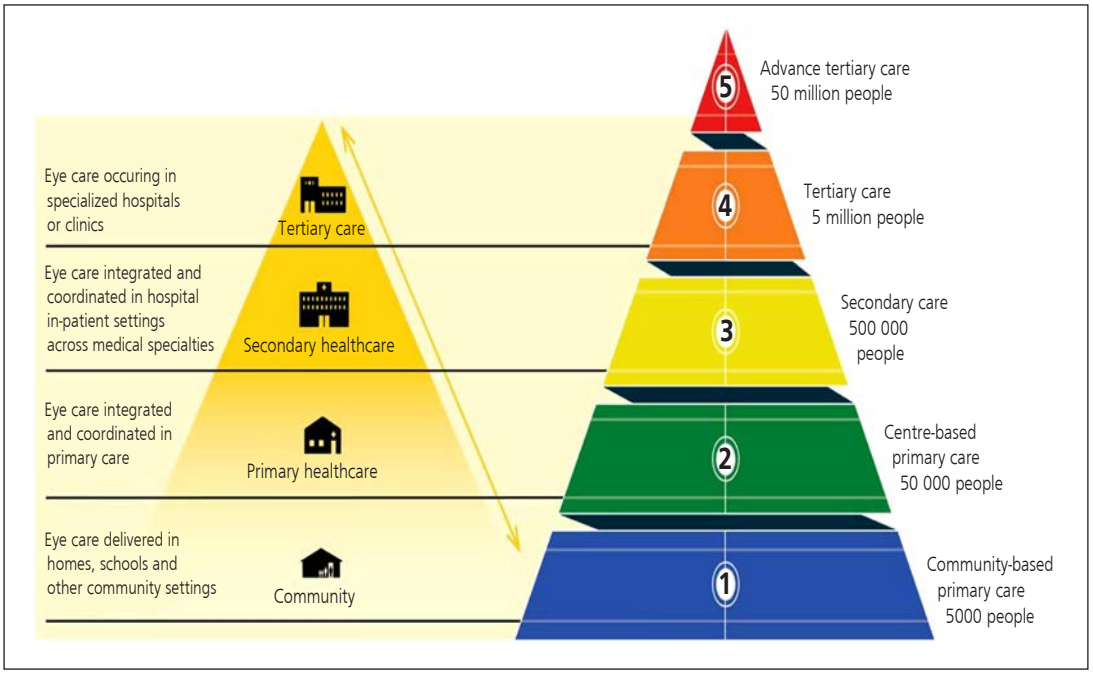
* 2019 data collected from respective Member States

3.3 Categorization of the diabetic care system

The DR care system can be divided into three categories: desirable, recommended, and essential for South-East Asia Region countries. Integrated people-centred eye care (IPCEC) detailed in the World Report on Vision (WRV) published by WHO in 2019, would be an ideal delivery system from community to tertiary care, to manage DR appropriately [46]. To reduce inequities, eye care must be an integral part of universal health coverage (UHC) [47]. To achieve integrated people-centred eye care, countries need to adopt four key strategies:

1) empowering and engaging people and communities, 2) re-orienting the model towards strengthening eye care in primary health care, 3) coordinating services within and across sectors, and 4) creating an enabling environment. The four-tier system suggested by the World Report on Vision (WRV) would be ideal for countries of the SEA Region with relatively low populations (Bhutan, Maldives, Nepal, Sri Lanka and Timor-Leste). Those with larger populations (Bangladesh, India, Indonesia, Myanmar, and Thailand) might need a five-tier structure, which is already in practice in India [48] [Figure 6].

Figure 6: *Eye health delivery structure: World Report on Vision (left) and LV Prasad Eye Institute, Hyderabad, India (WHO Collaborating Centre in prevention of blindness) (Right) [48].*



3.4 Collaboration throughout the health system

Provision of integrated people-centred eye care (IPCEC) and universal health coverage (UHC) requires a higher level of collaboration between various branches, as well as various levels of the health system. Strengthening the primary level for diagnosis and management of DM, is required as much as the availability of instrumentation / equipment to manage DR at the secondary and tertiary level, to reduce the prevalence of DM and DR. All six building blocks of the health system (WHO) [49], i.e., (1) service delivery, (2) workforce, (3) information system, (4) access to essential medicine, (5) financing and (6) leadership/governance, must be strengthened to have a meaningful impact on DR care. Community involvement and sustained health education are equally important. The ophthalmic community will need to collaborate with, and in turn, support a variety of disciplines to make a real impact in reducing the incidence/ prevalence of DR, and visual impairment/blindness caused by DR.

The expected level of care at three care-levels (desirable, recommended, essential) and three service categories (primary, secondary, tertiary) in reference to DR care, is shown in tables 12 and 13. In general, countries with better GNI/capita and good human resources, which are currently better equipped to handle DR, should focus on research and assist lower-resource countries in capacity-building and infrastructural development. Countries with lower resources should continue to strive to improve their health systems. Research should be advocated at all levels, to formulate indigenous solutions for each Member State.

Table 12: *System for the management of risk factors for DR in the SEA Region*

Care Level	Countries	Primary health	Secondary health	Tertiary health
Desirable	India, Thailand	manage HTN-DM lifestyle changes	manage all risk factors	manage all risk factors
Recommended	Bangladesh, Bhutan, Indonesia, Maldives, Nepal, Sri Lanka	manage HTN-DM lifestyle changes	manage all risk factors	manage all risk factors
Essential	Myanmar, Timor-Leste	manage HTN-DM lifestyle changes	manage "most" risk factors	manage all risk factors

Table 13: *DR screening pathway*

Care level	Primary health care	Secondary health care	Tertiary health care
Desirable	Fundus photography, visual acuity and IOP	Fundus photography, ophthalmologist available	Fundus photography, retinal surgeon available
Recommended	Ophthalmoscopy/ fundus photography, visual acuity and IOP	Fundus photography, ophthalmologist available	Fundus photography, retinal surgeon available
Essential	Visual acuity	Ophthalmoscopy/ fundus photography, visual acuity and IOP	Fundus photography, retinal surgeon available

3.5. Referral mechanism

The success of DR screening is measured by the robustness of referrals of people with STDR, people with reduced vision and people with ungradable fundus images. The ICO has recommended a simple referral mechanism and timeline, depending on the stage of DR. The same can be applied to the SEA Region. However, each Member State needs to identify and map the referral pathway, and linkages to the nearest secondary health centre for every primary health centre, and, to the nearest tertiary health centre for every secondary health centre. A feedback system to track compliance and completion helps. Table 14 outlines the process.

Table 14: *Referral system for DR Management in the SEA Region*

	Primary health care	Secondary health care	Tertiary health care
Desirable	Systemic assessment, referral.	Systemic assessment, referral for surgery, lasers available, IVI available.	Complete care, systemic assessment and treatment of all co-morbidities. Comprehensive ophthalmic examination. Care for DR- laser, IVI, surgery, care for all other ophthalmic disorders.
Recommended	Systemic assessment, referral.	Systemic assessment, referral for surgery, lasers preferably available, IVI available	
Essential	Systemic assessment,referral.	Systemic assessment,referral for surgery and laser, IVI preferably available.	

3.6 Health workforce and capacity building

A shortage of trained human resources in low- and middle-income countries is one of the greatest challenges to increasing the availability of eye care services, and reducing the prevalence of avoidable vision impairment and blindness.

Capacity building forms the core of a successful health program for future and long-term outcomes. Training is required for health workers, allied eye health personnel including ophthalmic nurses, ophthalmic technicians/photographers, optometrists, ophthalmologists and retina specialists (Table 15). The current status of the essential eye health workforce in the Member States, is shown in table 16.

Table 15: *System for manpower allocation for managing DR in the SEA Region*

Attributes	Primary health care	Secondary health care	Tertiary health care
Desirable	health worker,photographer	health worker, photographer, ophthalmologist, nursing personnel	all personnel
Recommended	health worker, photographer	health worker, photographer, nursing personnel	all personnel
Essential	health worker	health worker photographer nursing personnel	all personnel

Table 16: *Essential eye health workforce in SEA Region Member States (2019 data)*

Country	Professional body		Country population 2019	Registered eye health workforce(includes expatriates)			
	Ophthal	Retina		Ophthal-mologist	Retina specialist	Opto-metrist	AOP
Bangladesh	Yes	Yes	163.0 m	1200	80	1485	500
	eye health workforce distribution			1/135 883	1/2.0 m	1/109 764	1/326 000
Bhutan	No	No	0.75 m	10	1	9	56
	eye health workforce distribution			1/75 000	1/0.75 m	83 333	13 393
India	Yes	Yes	1366.0 m	23 567	1059	12 000	30 000
	eye health workforce distribution			1/56 689	1/1.26m	1/113 833	1/44 433
Indonesia	Yes	Yes	267.6 m	2712	66	2470*	6250
	eye health workforce distribution			1/98 672	1/4.0 m	1/108 340	1/42 816
Maldives	Yes	No	0.53 m	26	1	13	0
	eye health workforce distribution			1/20 384	1/0.53 m	1/40 769	-
Myanmar	Yes	No	54.0 m	390	15	95	0
	eye health workforce distribution			1/138 461	1/3.6 m	1/568 421	-
Nepal	Yes	Yes	29.1 m	335	45	857	1246
	eye health workforce distribution			1/86 865	1/646 666	1/33 955	1/23 354

Country	Professional body		Country population 2019	Registered eye health workforce(includes expatriates)			
	Ophthal	Retina		Ophthal-mologist	Retina specialist	Opto-metrist	AOP
Sri Lanka	Yes	Yes	21.3 m	130	9	670	1355
	eye health workforce distribution			1/163 000	1/2.3 m	1/31 800	1/15 700
Thailand	Yes	Yes	69.6 m	1700	250	320	1200
	eye health workforce distribution			1/40 941	1/625 582	1/217 500	1/55 500
Timor-Leste	Yes	No	1.3 m	4	0	2	24
	eye health workforce distribution			1/325 000	-	1/650 000	1/52 0000

Six recognized intervention strategies are : (1) Internet-based instruction, (2) training and workshops, (3) technical assistance, (4) education using self-directed learning, (5) communities of practice, and (6) multi-stage interventions. These learning and professional development plans could be made within public and nongovernmental health-care systems and facilities, including WHO collaborating centres in the prevention of blindness. The outcomes at individual, organizational and system levels are measured by the changes in knowledge, skills or confidence (self-efficacy), changes in practice (application or intent), and supportive environments (system building) [50].

4. Recommendations

The WHO SEA Region DR expert group agreed that the current financial and human resources and infrastructure, may not allow countries to reach the highest level of care in one go. The expert group recommended incrementally increasing care, as per the resource setting outlined earlier in Table 11. The recommendations are outlined in Table 17. At the same time, countries are encouraged to design country-specific eye health infrastructure, as per the recommendation of the WRV and as outlined in Figure 6 [46,48].

Table 17: *WHO SEA Region DR expert group recommendations.*

Strategy	Low resource	Middle resource	High resource
Screening	Mild NPDR- 1 year; moderate NPDR- 1 year; DME- 6 months;PDR- 6 months once stabilized.	Mild NPDR- 1 year; moderate NPDR- 1 year; DME- 6 months;PDR-6 months once stabilized.	Mild NPDR- 1 year; Moderate NPDR- 1 year; DME- 3 months;PDR- 6 months once stabilized.
Specific eye examination	VA, refraction, S/L exam, IOP, fundus photo.	VA, refraction, S/L exam, IOP, fundus photo, FFA, OCT..	VA, refraction, S/L exam, IOP, gonioscopy, fundus photo, FFA, OCT/ OCT-A.
Referral	Recalcitrant DME.	VR Surgery.	–
DR diagnosis by fundus photo	300 camera:4 fields.	Wide-field camera: 2 fields fluorescein angiography.	Wide-field camera:2 fundus.
DR diagnostic equipment	300 fundus camera.	Wide-field fundus camera, fluorescein angiography OCT.	Wide-field -2 fundus camera; 2 fields, ultrawide-field fundus camera- 1 field fluorescein angiography OCT and OCT-A.
Blood/urine parameters	CBP, diabetes, HTN.	CBP, diabetes, HTN, lipid.	CBP, diabetes, HTN, lipid, urine microalbumin.
Treatment	Laser.	Laser, IVI, low vision.	Laser, IVI, VR surgery Low vision.
Eye health technical workforce	AOP, general ophthalmologist.	Internist, AOP,general ophthalmologist.	Internist, optometrist, ophthalmic scrub nurse, specialist ophthalmologist.
Health system	Physical register.	Electronic database, MIS tracking and recall. system.	Electronic database, MIS tracking and recall system.
National DM & DR registry	–	+	+
Advocacy with government	+	+	+

The WHO SEA Region expert group agreed that the current guideline may require a revision in three to five years, and the incorporation of the new data and technology. The expert group

urged and expected the WHO SEA Region Office to play a pivotal role in helping individual Member States with the right advocacy with governments. The Office was also urged to help in capacity building through the WHO collaborating centres in the prevention of blindness, and in holding periodic Regional meetings, for the exchange of ideas and information.

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Country Profiles

Bangladesh [1-5]

Area in sq.km in 2018	130 170.0
Population in 2018 in millions	161.3
Total expenditure on health as % of GDP (2016)	2.37
Life expectancy at birth (women) in 2016	74.4 years
Crude death rate (per 1000 population) in 2013	5.7
Under-five mortality rate male/female (per 1000 live births) in 2014	51.8/55.7
Maternal mortality ratio (per 100 000 live births) in 2017	173
Prevalence of blindness in 2015	0.82%

Prevalence of DR in rural areas	5%
Prevalence of DR in urban areas	33%
KAP of DR	4%
National guidelines on DR	No
DR screening at PHC level	No
DR screening at SHC level	Yes
Management of DM at PHC level	Yes
Funding sources for DR screening programs	Yes (Hellen Keller, Fred Hallows and Orbis International)
Government support for DR screening	Yes, through National Eye Care (NEC), which is the operational plan of 4th Health, Population and Nutrition Sector Programme under the Ministry of Health & Family Welfare.
DR screening as a part of national program	Yes
Mode of screening	Fundus camera, direct and indirect ophthalmoscopy and smart phone
Screener for DR	Vision technician, optometrist, ophthalmologist and retina specialist
Screening system for DR	Targeted / opportunistic and as a part of cataract screening
Fundus photography for screening	Yes
Data maintenance	paper type
Availability of ophthalmologists trained in DR	Yes, medical and surgical
Laser facility	Yes, at tertiary level
Injection facility	Yes, at tertiary level
Country-based registry for DR	No

Recommendations:

- KAP needs to be enhanced in the country.
- DR screening should be initiated at the PHC level.
- Nationwide registry for people with DR would be very helpful.

Bhutan [6]

Area in sq.km in 2018	38 144.0
Population in 2018 in millions	0.75
Total expenditure on health as % of GDP (2016)	3.45
Life expectancy at birth (women) in 2016	70.8 years
Crude death rate (per 1000 population) in 2013	6.5
Under-five mortality rate male/female (per 1000 live births)	43.33/ 36.78
Maternal mortality ratio (per 100 000 live births) in 2017	183
Prevalence of blindness in 2015	0.69%

Prevalence of DR in rural areas	Not known
Prevalence of DR in urban areas	Not known
KAP of DR in Region	No study available
National guidelines on DR	Not available
DR screening at PHC level	Limited
DR screening at SHC level	Present
Management of DM at PHC level	Yes, but not all primary centres
Funding sources for DR screening programmes	Himalayan cataract project may be used
Government support for DR screening	Yes
DR screening as a part of national programme	Yes, but lack of human resources
Mode of screening	Ophthalmoscopy
Screener for DR	Ophthalmologist, optometrist, vision technician
Screening system for DR	Opportunist screening
Fundus photography for screening	Not done
Data maintenance	Paper type
Availability of ophthalmologists trained in DR	Severe deficiency
Laser facility	Only at THC
Injection facility	Only at THC
Country-based registry for DR	Available

Recommendations:

There is urgent need for:

- evaluating DR prevalence and KAP related to it. National guidelines should be based on this data;
- establishing a DR screening system at PHC level, and ensuring that basic management of DM is available concurrently;
- developing fundus photography and human resources to enhance and propel the DR screening system;
- improving facilities at the SHC level for the medical management of DR and for trained retina specialists.

India [7-11]

Area in sq. km in 2018	2 973 190.0
Population in 2018 in millions	1352.6
Total expenditure on health as % of GDP (2016)	3.66
Life expectancy at birth (women) in 2016	70.3 years
Crude death rate (per 1000 population) in 2013	7.9
Under-five mortality rate male/female (per 1000 live births) in 2016	33.9
Maternal mortality ratio (per 100 000 live births) in 2017	145
Prevalence of blindness in 2015–19	0.36%

Prevalence of DR in rural areas	10.4%
Prevalence of DR in urban areas	18%
KAP of DR	37.1%
National guidelines on DR	Yes
DR screening at PHC level	No
DR screening at SHC level	Yes
Management of DM at PHC level	Yes
Funding sources for DR screening programmes	Yes (World Diabetic Foundation, RD TATA trust), Queen Elizabeth Diamond Jubilee trust, LCIF)
Government support for DR screening	Yes – through the All India Ophthalmological Society
DR screening as a part of national programme	Yes
Mode of screening	Fundus camera, direct and indirect ophthalmoscopy and smartphone
Screener for DR	Vision technician, optometrist, ophthalmologist and retina specialist
Screening system for DR	Targeted / opportunistic and as a part of cataract screening
Fundus photography for screening	Yes
Data maintenance	Electronic and paper type
Availability of ophthalmologists trained in DR	Yes, medical and surgical
Laser facility	Yes, at secondary (limited places) and tertiary levels
Injection facility	Yes, at tertiary level
Country-based registry for DR	No

Recommendations:

- KAP needs to be enhanced in the country;
- DR screening should be initiated at the PHC level;
- Nationwide registry for people with DR would be very helpful.

In India a vision technician (a school graduate trained for two years in basic ophthalmic techniques) uses a less expensive, non-mydriatic fundus camera, developed in India for retinal imaging in rural India.

Location: Prakasham district, India.

Narration and photo credit: Dr Padmaja K. Rani.

Indonesia [12.13]

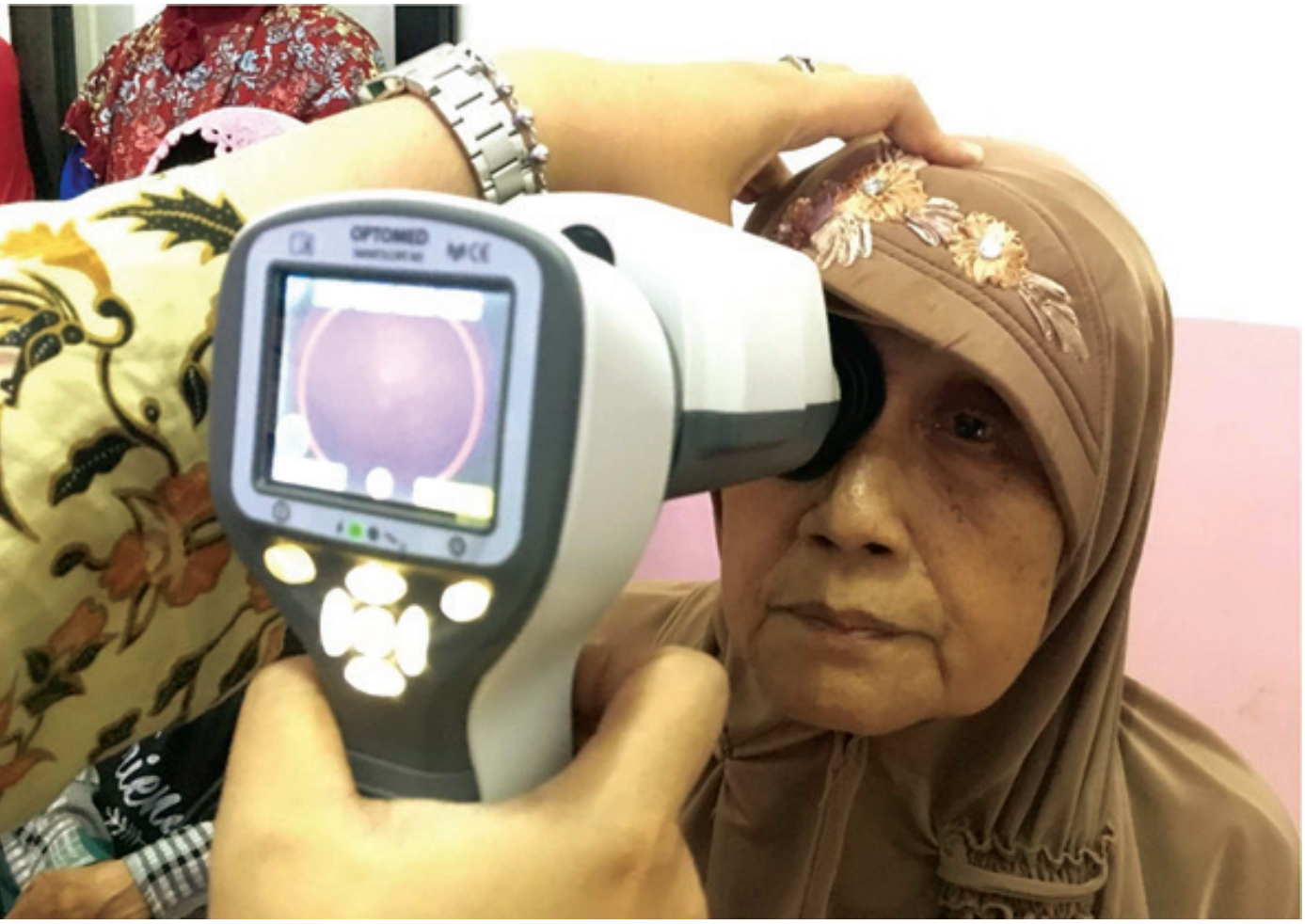
Area in sq.km in 2018	1 811 570.0
Population in 2018 in million	267.6
Total expenditure on health as % of GDP (2016)	3.12
Life expectancy at birth (women) in 2016	71.4 years
Crude death rate (per 1000 population) in 2013	6.2
Under-five mortality rate male/female (per 1000 live births) in 2012	47.9/36.7
Maternal mortality ratio (per 100 000 live births) in 2017	177
Prevalence of blindness in 2015	0.67%

Prevalence of DR in rural areas	Not known
Prevalence of DR in urban areas	43.1%*
KAP of DR in Region	Available (done in 2010)
National guidelines on DR	Yes (reference not available)
DR screening at PHC level	Yes by handheld fundus camera
DR screening at SHC level	Yes
Management of DM at PHC level	Yes
Funding sources for DR screening programmes	NGO- Hellen Keller International
Government support for DR screening	Yes
DR screening as a part of national programme	Yes (integrated with NCD programme)
Mode of screening	Fundus photography
Screener for DR	Vision technician, ophthalmologist, physician
Screening system for DR	Targeted screening
Fundus photography for screening	Yes
Data maintenance	Electronic and paper-based
Availability of ophthalmologists trained in DR	Yes
Laser facility	Yes
Injection facility	Yes
Country-based registry for DR	Yes

Recommendations.

There is urgent need for:

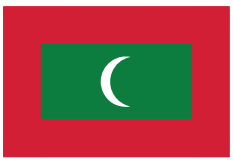
- evaluating DR prevalence in rural areas, as DR prevalence is high in Indonesia;
- improving the DR screening system, as well as the management of diabetes and hypertension (risk factors) at PHC level;
- increasing the availability of surgical retina specialists in tertiary care centres, as VTDR is high in Indonesia.



In Indonesia, diabetic retinopathy screening to identify referable cases, begins at the primary level of eye care. All diabetic persons are registered in the diabetic database of primary health care, and have regular eye checks every six months. This includes fundus photographs with a non-mydriatic fundus camera. People with vision-threatening diabetic retinopathy are referred to the district hospital.

Narration and photo credit: Dr Aldiana Halim.

Maldives [14]



Area in sq.km in 2018	300.0
Population in 2018 in millions	0.51
Total expenditure on health as % of GDP (2016)	10.61
Life expectancy at birth (women) in 2016	79.9 years
Crude death rate (per 1000 population) in 2013	3.5
Under-five mortality rate male/female (per 1000 live births) in 2009	28.7/25.0
Maternal mortality ratio (per 100 000 live births) in 2017	53
Prevalence of blindness in 2015	0.32%

Prevalence of DR in rural areas	Not known
Prevalence of DR in urban areas	Not known
KAP of DR in Region	No study available
National guidelines on DR	Not available
DR screening at PHC level	No
DR screening at SHC level	No, only in tertiary care
Management of DM at PHC level	No, mainly only in atoll hospitals of Maldives
Funding sources for DR screening programmes	Government, World Diabetes Foundation
Government support for DR screening	Government will fund if requested by service provider
DR screening as a part of national programme	No
Mode of screening	Fundus camera, direct and indirect ophthalmoscopy
Screener for DR	Ophthalmologist
Screening system for DR	Opportunistic at physician clinic
Fundus photography for screening	Yes
Data maintenance	Paper
Availability of ophthalmologists trained in DR	Medical retina alone, not surgical
Laser facility	Yes
Injection facility	Yes
Country-based registry for DR	No

Recommendations.

There is urgent need for:

- evaluating DR prevalence and KAP related to it. National guidelines should be based on this data;
- establishing a DR screening system and ensuring the concurrent availability of basic management of DM at PHC level;
- mobile DR screening vans at PHCs to provide access of care to all;
- increasing the availability of ophthalmologists in rural areas;
- improving facilities for DR screening, as well as medical management of DR at SHC level;
- creating an electronic national registry for diabetes and DR.

Narration: Dr Abdulla Junaid

Laser photocoagulation using multi-spot green retina laser in Maldives; Department of ophthalmology, Indira Gandhi Memorial Hospital, Malé, Maldives.

Myanmar [1 5,16]

Area in sq.km in 2018	653 080.0
Population in 2018 in millions	53.7
Total expenditure on health as % of GDP (2016)	5.09
Life expectancy at birth (women) in 2016	68.9 years
Crude death rate (per 1000 population) in 2013	8.4
Under-five mortality rate male/female (per 1000 live births) in 2015	77.4/65.2
Maternal mortality ratio (per 100 000 live births) in 2017	250
Prevalence of blindness in 2015	0.78%

Prevalence of DR in rural areas	Not known
Prevalence of DR in urban areas	Not known (minimal data)
KAP of DR in Region	No data
National guidelines on DR	Not available
DR screening at PHC level	No
DR screening at SHC level	Present
Management of DM at PHC level	Not integrated with national NCD programs
Funding sources for DR screening programmes	Yes, Helen Keller International, WHO and Sight for all
Government support for DR screening	No
DR screening as a part of national programmes	No
Mode of screening	Fundus camera and ophthalmoscopy
Screener for DR	Ophthalmologist, retina specialist
Screening system for DR	Targeted screening
Fundus photography for screening	Yes
Data maintenance	Electronic and paper
Availability of ophthalmologists trained in DR	Yes, at THC
Laser facility	Yes, at THC
Injection facility	Yes, at THC
Country-based registry for DR	No

Recommendations.

There is urgent need for :

- evaluating DR prevalence and KAP related to it. National guidelines should be based on this data;
- establishing a DR screening system and ensuring the concurrent availability of basic management of DM at PHC level;
- improving facilities for the medical management of DR at SHC level.

Nepal [17-21]

Area in sq.km in 2018	147 181
Population in 2018 in million	28.0
Total expenditure on health as % of GDP (2016)	6.2
Life expectancy at birth (women) in 2016	71.6 years
Crude death rate (per 1000 population) in 2013	6.6
Under-five mortality rate male/female (per 1000 live births) in 2016	49.5/42.6
Maternal mortality ratio (per 100 000 live births) in 2017	186
Prevalence of blindness in 2015	1.20%

Prevalence of DR in rural areas	18%
Prevalence of DR in urban areas	30%
KAP of DR	11.5% (general population) 50% (people with DM)
National guidelines on DR	Available (diabetic retinopathy management guidelines,Nepal)
DR screening at PHC level	Limited
DR screening at SHC level	Yes
Management of DM at PHC level	Yes
Funding sources for DR screening programmes	Yes (Fred Hallows and World Diabetic Foundation)
Government support for DR screening	Yes, but limited
DR screening as a part of national programme	Yes
Mode of screening	Eye health workers, allied medical personnel, ophthalmic assistant, optometrist, physicians, ophthalmologist and retina specialist
Screener for DR	Targeted / mass screening/ integration of DR screening in comprehensive DM management/opportunist and as a part of cataract screening
Screening system for DR	Targeted / mass screening/ opportunist and as a part of cataract screening
Fundus photography for screening	Yes
Data maintenance	Electronic and paper type
Availability of ophthalmologists trained in DR	Yes, medical and surgical
Laser facility	Yes, at tertiary level
Injection facility	Yes, at tertiary level
Country-based registry for DR	No

Recommendations:

- Strengthening of DR screening systems at PHC levels;
- Improving KAP on DR in the Region;
- Nationwide registry for patients with DR will be very helpful.

Screening of a 6-1/2-minute video in local language, which includes all the necessary information on diabetic retinopathy. Currently, every screening camp begins with this video, before the eye examination. This has improved the attendance and attention of people attending DR screening camps.

Location: Devadaha municipality, Nepal;

Narration: Mr Sailesh Mishra, Nepal Netra Jyoti Sangh;

Photo Credit: Mr Sanjeev Adhikari.

Sri Lanka [22,23]

Area in sq. km in 2018	62 710.0
Population in 2018 in million	21.6
Total expenditure on health as % of GDP (2016)	3.89
Life expectancy at birth (women) in 2016	78.5 years
Crude death rate (per 1000 population) in 2013	6.6
Under-five mortality rate male/female (per 1000 live births) in 2010	No data
Maternal mortality ratio (per 100 000 live births) in 2017	36
Prevalence of blindness in 2015	0.37%

Prevalence of DR in rural areas	Not known
Prevalence of DR in urban areas	27.4%*
KAP of DR in Region	No study done
National guidelines on DR	Recently released (yet to be circulated by ministry of health)
DR screening at PHC level	Yes
DR screening at SHC level	Yes
Management of DM at PHC level	Yes
Funding sources for DR screening programmes	Ministry of health
Government support for DR screening	Yes available
DR screening as a part of national programmes	No
Mode of screening	Fundus photography & direct ophthalmoscopy by trained medical officer
Screener for DR	Optometrist, ophthalmologist, physician
Screening system for DR	Targeted screening and opportunistic
Fundus photography for screening	Yes
Data maintenance	Paper
Availability of ophthalmologists trained in DR	Yes (medical and surgical)
Laser facility	Yes
Injection facility	Yes
Country-based registry for DR	No

Recommendations:

- Conduct an urgently needed evaluation of DR prevalence in rural areas and KAP related to it;
- Increase awareness about DR at PHC level;
- Improve the availability of laser; machines in secondary health centres and ensure the presence of more VR specialists at tertiary health centres;
- Create an electronic national diabetes and DR registry.

Fundus examination of a person with diabetes during the cross-country "Walk for Sight" event in 2015.

Narration: Dr Asela Abeydeera.

Photo credit: Mr Kasun de Silva.

Thailand [24]

Area in sq.km in 2018	510 890.0
Population estimate 2019	69.4
Total expenditure on health as % of GDP (2016)	3.71
Life expectancy at birth (women) in 2016	79.3 years.
Crude death rate (per 1000 population) in 2013	7.6
Under-five mortality rate male/female (per 1000 live births) in 2010	No data
Maternal mortality ratio (per 100 000 live births) in 2017	37
Prevalence of blindness in 2015	0.51%

Prevalence of DR in rural areas	35%
Prevalence of DR in urban areas	8.4%
KAP of DR in Region	Evaluated but KAP is low
National guidelines on DR	Yes
DR screening at PHC level	No
DR screening at SHC level	Yes
Management of DM at PHC level	Yes
Funding sources for DR screening programmes	Fundus photography and ophthalmoscopy
Government support for DR screening	Yes
DR screening as a part of national programmes	Yes
Mode of screening	Fundus photography and ophthalmoscopy
Screener for DR	Technician, ophthalmologist, retina specialist, physician
Screening system for DR	Targeted screening
Fundus photography for screening	Yes
Data maintenance	Electronic and paper-based
Availability of ophthalmologists trained in DR	Yes
Laser facility	Yes
Injection facility	Yes
Country-based registry for DR	No

Recommendations:

- improve and reevaluate KAP related to DR;
- establish a DR screening system at PHC level;
- aim for an ideal system, develop a national registry and research for DR;
- take the onus of helping other Member States in the SEA Region, by training manpower

Community diabetic retinopathy screening. Ophthalmic team brings slit lamp, fundus camera and indirect ophthalmoscope, to perform comprehensive eye examinations and DR screenings in the community. These screenings are usually held at marketplaces, schools or temples.

Location: Maha Sarakham province in north-eastern Thailand;

Narration and photo credit: Dr Prut Hanutsaha.

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Diabetic retinopathy is an increasingly significant cause of vision impairment and blindness in the WHO South-East Asia Region, where the prevalence of diabetes is rising.The International Diabetes Federation estimates that the number of people with diabetes in seven of the Region's 11 countries is likely to increase from 87.6 million in 2019 to 115.1 million by 2030. This will, in turn, increase the prevalence of diabetic retinopathy. Immediate and decisive action is required to control diabetes and, with it, diabetic retinopathy.

Diabetic retinopathy is preventable; periodic eye examinations by ophthalmologists, accompanied by standard treatment of diabetic retinopathy, can postpone serious loss of vision. The guidelines presented here are aligned with the Integrated People-centred Eye Care model as recommended by the World Report on Vision. They highlight the critical need for countries to adopt a coordinated and multisectoral approach to reduce the incidence of diabetes and the onset of diabetic retinopathy. This approach can be implemented at all levels of the health system.

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