

Findings of diabetes eye screening in Brunei Darussalam: REPAS diabetic retinopathy grading scale

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ABSTRACT

Introduction: Diabetes mellitus is very common and increasing globally. Diabetic retinopathy is a common complication and regular eye check is recommended. The aim of this study is to present our findings with diabetes eye screening using our newly designed REPAS diabetic retinopathy grading scale, and the improvement it brought to the documentation, management, statistical analysis, supervision and monitoring of diabetic eye screening activities in Brunei Darussalam. **Materials and Methods:** REPAS grading scale for diabetic retinopathy is a result of intra- and inter-departmental discussions involving the National Programme for Prevention of Blindness (Brunei Darussalam), Community Ophthalmology, secondary and tertiary eye care units nationwide. Attendees of the preliminary discussion groups held agreed on the need for a standardised, easy to analyse scoring system for diabetic retinopathy. The system was launched in February 2013, and gradually migrated to BruHIMS. A pilot cross-sectional study was conducted in the month of September 2014 to assess the integrity and the usefulness of the system from the user point-of view as well as from administrative perspective. Diabetic patients seen for eye screening in all health facilities of Brunei were included. PubMed literature review and study of other countries experience was discussed. **Results:** A total of 1,184 diabetic patients were screened for diabetic retinopathy across the country in the month of September 2014. Of those, 698 (59%) were females and 782 (66%) were Malay. The highest number of attendances for diabetic retinopathy screening was seen in RIPAS hospital (18%), followed by Suri Seri Begawan Hospital (15.7%) and PAPHMWHB Health Centre (12.4%). In terms of retinopathy, Majority of patients seen did not have diabetic retinopathy (81.5%), while only 3.7% of the patients had severe non-proliferative diabetic retinopathy or worse. **Conclusion:** REPAS diabetic retinopathy grading scale is a feasible diabetic eye screening module in the consensus of Brunei's health system. It showed great potential for quality improvement of diabetic eye screening in the country.

Keywords: Diabetic retinopathy, macular oedema, grading scale, screening

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INTRODUCTION

Diabetes mellitus is one of the major causes of mortality and morbidity, with more than 220 million people affected worldwide. ¹ The

prevalence of diabetes is increasing all over the world irrespective of the region and population. Diabetes mellitus and cardiovascular disease are the commonest causes of mortality in Brunei Darussalam. ²

The Asia-Pacific region has the largest diabetes burden in the world. ³ In Singapore's National Survey (2004) reported a crude prevalence of diabetes of 8.2% among adults, with the highest prevalence among the Indian population (15.3%) followed by the Malay (11.0%) and least in the Chinese population (7.1%). ⁴ In Malaysia, the prevalence of diabetes in the population aged 30 years or older was 15.3% with a similar ethnic variation to that of Singapore. ⁵ In Brunei Darussalam, diabetes is the leading cause of blindness and the third leading cause of death. ⁶ A study done by Joshi *et al.* ⁷ in 2003 reported a prevalence of 19% for diabetic retinopathy among newly registered diabetic patients attending the eye clinic in RIPAS hospital, a tertiary referral centre in the period between 1997 and 2000. ⁷

Early identification of diabetic patients with active disease and timely delivery of appropriate treatment are the cornerstone of successful prevention of blindness in diabetic retinopathy. Since health systems, economic, demographic and geographic factors differ greatly from one country to another, finding one diabetic retinopathy screening systems that suites all countries worldwide is not feasible.

The aim of this article is to present an update on the findings of patients with diabetes mellitus referred to the eye clinic using our newly designed grading scale for diabetic

retinopathy screening. This scoring system is the result of nationwide discussions among diabetic retinopathy caregivers. It was designed to suit our health system, and to help create and agreement among personnel involved in diabetic eye screening with regards to grading of the disease and appropriate management plans and referral decision. The advantage of this scale over other available systems is that it incorporates previously. We hope our experience will inspire colleagues in other countries to follow the same concept to optimise the standards of diabetic eye screening in their own countries based on their own realism.

MATERIALS AND METHODS

Brunei Darussalam is a developing nation in the Southeast Asia region with an estimated population of 400,000. ² The country has one tertiary Eye Centre in Raja Isteri Pengiran Anak Saleha (RIPAS) hospital located in the capital, three secondary care eye departments in the district hospitals and several community-based primary eye care units located in health centres in the Brunei/Muara district. The Vitreo-retinal unit, community Ophthalmology department and National Programme for Prevention of Diabetic Blindness – Brunei Darussalam (NPPDB) are the main authorities in charge of diabetic eye care in the country. This grading scale was the product of intra- and inter-departmental discussions that involved all diabetic eye care providers in Brunei Darussalam.

The diabetic eye care screening setup in Brunei involves follow-up of diabetic patients with no evidence of diabetic retinopathy (NDR), and those with stable (inactive) mild to moderate non-proliferative diabetic

retinopathy (NPDR) at the primary eye care facility covering their residential capture area, while patients with moderate to severe diabetic retinopathy and/or macular oedema requiring active management are followed up at the secondary and tertiary eye care units.

The Ministry of Health, Brunei Darussalam has adopted a paper-less computer-based electronic Health Information System, the Brunei Health Integrated Management System (Bru-HIMS) which provides a unified Electronic Medical Record (EMR) for each patient throughout all the health and medical facilities in the country. To maximise the use of this new health system for monitoring of performance reporting, digitalisation of the grading system for diabetic retinopathy has become a necessity. Furthermore, in view of the expected software inevitable flaws that are associated with any computer system, it is important to find a practical method to provide accessible summary of previous clinical events related to diabetic retinopathy. The proposed grading scale helps with this regard, as it provides information about previous management as well as severity of the disease in form of simple numbers, that can be compiled into one practical card that provide a glimpse-fast overview of the past history of the patient. This not only provides data back-up in cases of system break-down, but it also saves significant time during the patient consultation, increasing the efficiency of the system.

The new protocol of diabetic eye screening in Brunei was soft-launched in February 2013, before the kick-off of BruHIMS, as a paper-based system, but with vision of the upcoming BruHIMS system in mind. Once

the paperless system started, the screening programme was gradually in stages until complete incorporation was achieved by early 2014.

A detailed analysis of the data gathered is produced every month to review the system as a whole. We have included the statistical data gathered from all diabetic eye screening units in the country in the month of September 2014 as an example to illustrate the integrity and the usefulness of this scale, not only for quality improvement but also for planning of manpower, monitoring and supervision at higher administrative levels.

Brunei National Programme for Prevention of Diabetic Blindness (BNPPDB) – Management protocol for diabetic retinopathy:

The national protocol for management of diabetic retinopathy was launched by the BNPPDB in 2011 including a follow-up plan for diabetic patients attending diabetic eye care units in Brunei Darussalam (Table 1). This plan was set based on clinical load against our set-up and manpower capacity. The widely accepted International clinical diabetic retinopathy and diabetic macular oedema disease severity scales were also adopted by the BNPPDB as the standard classification to be used in the country for the management of diabetic retinopathy patients. These severity scales are modifications from the classical Early Treatment Diabetic Retinopathy Study (ETDRS) classification system. It was proposed by an international committee initiated by the American Academy of Ophthalmology in 2008.⁸

REPAS grading system: Although the classification of diabetic retinopathy should be

Table 1: Eye examination schedule recommended by the National Programme for Prevention of Diabetic Blindness (Brunei Darussalam) for patients with diabetes mellitus.

Diabetes Type	Recommended Time of First Examination	Recommended Follow-up
Type 1	3-5 years after diagnosis	Yearly
Type 2	At time of diagnosis	Yearly
Prior to pregnancy (type 1 or type 2)	Prior to conception and early in the first trimester	No retinopathy to mild or moderate NPDR: every 3-12 months Severe NPDR or worse: every 1-3 months

standardised worldwide to gain grounds for comparison, the application of such classification in reality may entail operational difficulties, as different countries and societies have different infrastructures, social, demographic and geographical composition that requires strategic improvisation without affecting the overall reference measures. Thus, grading/screening systems used may be modified to suit individual communities (based on their unique circumstances) following the internationally accepted classification criteria.

This new scale involves five elements; each has a separate scoring system. The elements included are – **R**etinopathy, **M**acular **O**edema, **L**aser **P**hotocoagulation, **A**nti-VEGF injections, and **S**urgery. The acronym 'REPAS' was used to remind the caregiver about these five elements. It is easy for doctors working in Brunei to memorise the acronym as it mimics the name of the national reference tertiary hospital (RIPAS Hospital). The scoring of the retinopathy 'R' and the macular oedema 'E' is based respectively on the International Severity Scale for Diabetic Retinopathy and Diabetic Macular oedema⁸ (Table 2).

The proposed 'REPAS' grading score summarises previous clinical and management data into five numbers for each visit. Using this to design a follow-up card kept by

the patient would overcome the obstacles of obtaining the previous clinical notes at the time of consultation even if system breakdown happens and, at the same time, provide concise, yet informative, data that can be easily abstracted and processed. A follow-up diabetic retinopathy eye card was designed by our discussion groups to be kept by each patient (Table 1).

Table 2: REPAS grading system for diabetic retinopathy.

Category	Grades	Descriptions
Retinopathy (R)*	0	No diabetic retinopathy
	1	Mild NPDR
	2	Moderate NPDR
	3	Severe NPDR
	4	PDR
	9	No view
Macular oEdema (E)**	0	No apparent macular edema
	1	Mild macular edema (defined as hard exudates or retinal thickening within the macula, but outside the yellow and red zones)
	2	Moderate macular edema (defined as hard exudates or retinal thickening within the Yellow Zone "A two-disc-diameter circle centred at the fovea excluding the Red zone")
	3	Severe macular edema (defined as hard exudates or retinal thickening within the Red Zone "A one-disc-diameter circle centred at the fovea")
Photocoagulation (P)	0	No retinal laser treatment done
	1	Focal laser done
	2	Grid laser done
	3	Pan-retinal photocoagulation done
Intravitreal Anti-VEGF (A)	0	No previous anti-VEGF treatment
	1-10	Number of anti-VEGF injections given
Vitreoretinal Surgery (S)	0	No previous vitreoretinal surgery done
	1	Vitreoretinal surgery done

NPDR = Nonproliferative diabetic retinopathy, PDR = Proliferative diabetic retinopathy, Anti-VEGF = Anti-vascular endothelial growth factor.

* Based on International clinical diabetic retinopathy disease severity scale

** Based on International clinical diabetic macular edema disease severity scale

A poster (Figure 2) that summarizes the scoring system and the management plan for each score was designed and distributed as a quick reference that can be used by both Ophthalmologist and non-Ophthalmologist doctors (*Refer to Supplementary Text*).

RESULTS

A total of 1,184 diabetic patients were screened for diabetic retinopathy across the country in the month of September 2014. Of these, 698 (59%) were females and 782 (66%) were Malay. Figure 1 shows the total number of attendances per centre during the period of the study. The highest number of attendances for diabetic retinopathy screening was in RIPAS hospital (18%), followed by Suri Seri Begawan Hospital (15.7%) and PAPHMWHB Health Centre, Gadong (12.4%).

In terms of retinopathy, majority of patients did not have any diabetic retinopathy 'R₀' (81.5%), followed by 'R₂' (8.0%) (Figure 2). Cicatricial retinopathy, which is the end-stage disease in diabetic retinopathy, was only seen in three patients (0.3%). A break-

down of retinopathy grading per centre is illustrated in figure 3.

Likewise, 93.6% of patients screened did not have macular oedema, and severe diabetic macular oedema was only seen in three patients (Figure 4).

An illustration of overall REPAS grading among diabetic patients attending the diabetic eye screening clinic in RIPAS hospital is shown in Figure 5. The same is done in every centre, and gives an overview of the patients seen in the whole system every month.

Although the number of patients with no diabetic retinopathy (NDR) seen at primary care level is collectively higher than the same in RIPAS hospital, the number of patients with NDR is still highest in RIPAS than any other screening unit. Our strategy aims to gradually transfer all patient with NDR to be followed up at the primary eye care level, saving more of RIPAS time to provide Tertiary care management for diabetic patients.

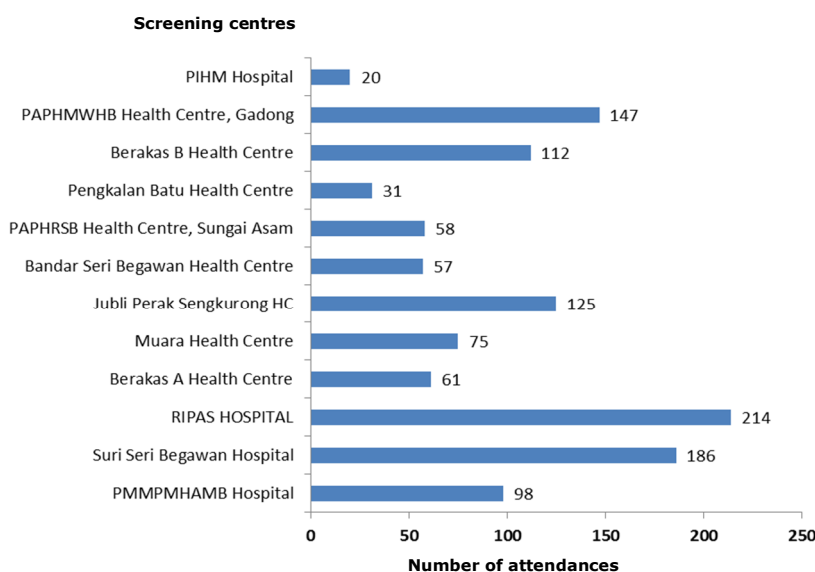


Fig. 1: Total attendances per diabetic eye screening units in the month of September, 2014. A total number of 1,184 diabetic patients were seen in all diabetic eye screening units in the country (Data was extracted from BruHIMS).

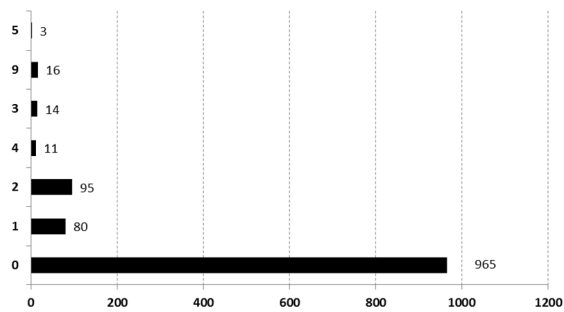


Fig. 2: Retinopathy grading 'R' among the total number of patients seen for diabetic eye screening in September 2014.

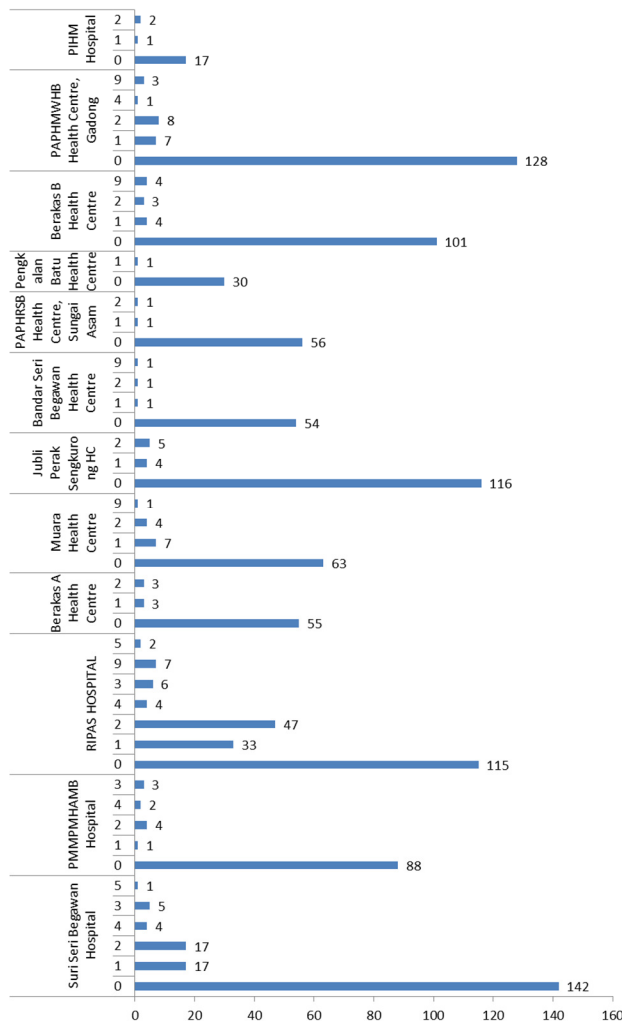


Fig. 3: REPAS Retinopathy grading 'R' of the right eye per centre among diabetic patient attending all diabetic eye screening units in the month of September, 2014. (Data was extracted from BruHIMS).

DISCUSSION

The concept of digitalisation of the grading of diabetic retinopathy is not new. A similar grading system was designed by 'Diabetic Retinopathy Screening Programme' in the United Kingdom in 2008.⁹ This grading system involved three parameters – Retinopathy 'R', Maculopathy 'M', and Laser Photocoagulation 'P'. This grading depended on the Early Treatment Diabetic Retinopathy Study (ETDRS) classification criteria, and photocoagulation was included as one of the important parameters that should be considered when screening and managing diabetic eye patients. Another simplified retinopathy digital scale was proposed by Knudsen *et al.*¹¹ in 2006, where the severity of retinopathy was graded from 'Level 0' to 'Level 4b' based on the international clinical diabetic retinopathy and diabetic macular oedema disease severity scales.⁸

In all previously published systems, the only included management parameter was laser photocoagulation. Since then, the role of Anti-VEGF intra-vitreous injections and early vitreoretinal surgery were extensively studied and proved to affect the course of the disease as well as management prognosis.

Our grading scale takes into consideration the other modalities of treatment which were either not available or not considered at the time RMP system was designed (i.e. Anti-VEGF agents and vitreo-retinal surgery). Anti-VEGF agents were proven effective in the management of both proliferative diabetic retinopathy and diabetic macular oedema.¹² Though

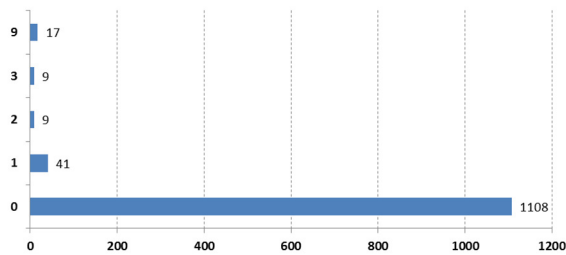
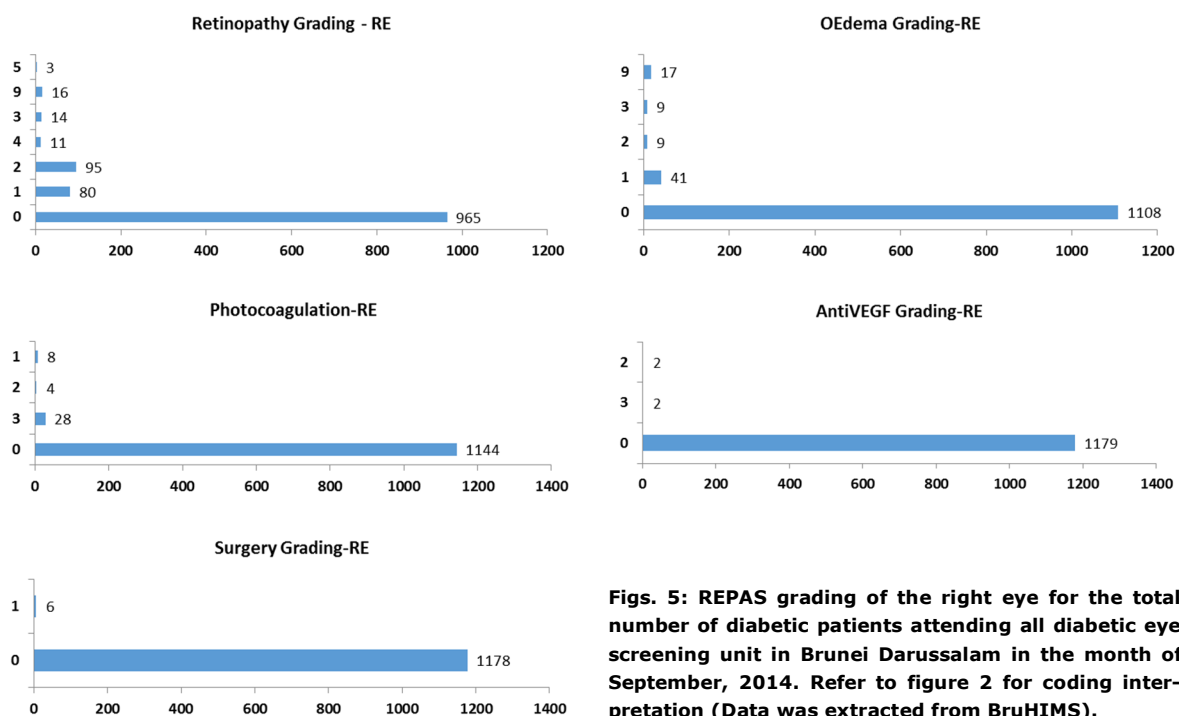


Fig. 4: Macular oedema grading 'E' among the total number of patients seen for diabetic eye screening in September 2014.

effective, the intra-vitreous injection of anti-VEGF changes the usual natural history of the disease, requiring a different plan of follow-up and management. The documentation of previous anti-VEGF treatment is thus of crucial importance when deciding the follow-up and management protocol for each individual patient. Vitrectomy removes both chemical and mechanical aggravating factors of retinal neovascular proliferation and macular edema in diabetic patients;^{13, 14} Hence, previous history of vitreo-retinal surgery is also vital.

Previous management data is important to decide on future management plan. A rapidly progressive retinopathy may justify early treatment with laser treatment before the development of proliferative disease. On the other hand, a patient with a slowly progressive disease may be observed for a longer period before deciding on any intervention. Our follow-up card provides a single-glance review of the progress of diabetic retinopathy over the past visits (up to 30 visits in one card). This is of great practical use in busy clinics, and should significantly cut down on



Figs. 5: REPAS grading of the right eye for the total number of diabetic patients attending all diabetic eye screening unit in Brunei Darussalam in the month of September, 2014. Refer to figure 2 for coding interpretation (Data was extracted from BruHIMS).

consultation time as well as reducing the severe need for previous clinical notes.

In our grading scale, we have included a more quantitative elaboration of laser photocoagulation treatment; A patient with proliferative disease who received laser treatment previously, or underwent surgery previously, is requires less urgent intervention compared to a fresh patient, who will follow a more aggressive clinical course and is more prone to have vitreous haemorrhage and tractional retinal detachment. This is of prognostic importance. The amount and nature of laser given can be of clinical importance. Focal laser is used to treat a specific leaking point (e.g. microaneurysm), indicating a mild to moderate disease. Grid laser indicates a previously diagnosed significant sight-threatening macular edema. A previously given pan-retinal photocoagulation indicates a previous episode of proliferative disease. In our grading scale. This adds a significant prognostic value to its proved diagnostic benefits.

Since its implementation, REPAS grading scale for diabetic retinopathy has holistically improved the quality of service we provide to our diabetic patients. This report helps introducing the new system to other (non-Ophthalmic) diabetic caregivers, and sharing our experience with peers in the international community.

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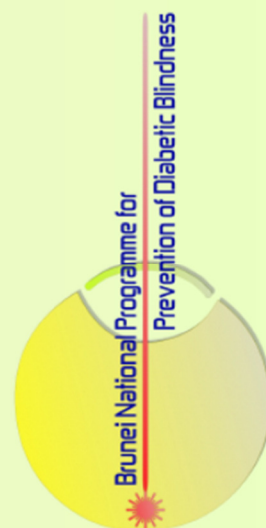
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REPAS GRADING SCALE FOR DIABETIC RETINOPATHY



R Diabetic Retinopathy "DR"	0 No apparent DR	1 Mild NPDR Microaneurysms only	2 Moderate NPDR More than R ₁ but less than R ₂	3 Severe NPDR Any of the following: 10 or more retinal haemorrhages in 4 quadrants; Venous beading in 2 or more quadrants; IRMA in 1 or more quadrants AND no neovascularisation	4 PDR 1 or more of the following: Definite neovascularisation Proliferative or vitreous haemorrhage	5 Cicatrical DR Regressed PDR with tractional Retinal / Macular Detachment	9 No view
	Yearly to 9 monthly follow-up	6 monthly follow-up	Urgent referral to retinal unit				
E Diabetic Macular Edema "DME"	0 DME Absent No retinal thickening or Hard Exudates in the macula	1 Mild DME Retinal thickening or Hard Exudates within the macula but away from Fovea (Green zone on the photo to the right)	2 Moderate DME Retinal thickening or Hard Exudates near but not within the Fovea (Yellow zone on the photo to the right)	3 Severe DME Retinal thickening or Hard Exudates within the Fovea (Red zone on the photo to the right)	Urgent referral to retinal unit		
	Yearly to 9 monthly follow-up	3-6 monthly follow-up					
P Laser Photocoagulation	0 No laser done previously	1 Focal Laser	2 Grid laser	3 Panretinal			
A Anti-VEGF injections	0 No Hx of Anti-VEGF injections	1 — 10 + Number of Anti-VEGF injections given					
S Vitreoretinal Surgery	0 No previous Vitreoretinal surgeries	1 Vitreoretinal surgery done previously					

Figure 2: A poster showing REPAS Diabetic retinopathy grading scale and the corresponding management protocol for each score. This poster was distributed to all Eye care facilities, as well as general practice and Endocrine clinics.