

Screening for diabetic retinopathy – a need for consensus and standards

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Diabetic retinopathy: What is it?

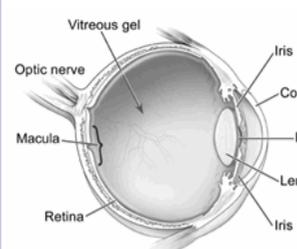


Figure 1 - Cross section of the eye

Diabetes leads to several complications, one of which is retinopathy. Diabetic retinopathy (DR) is a result of high blood sugar levels causing damage to the blood vessels that serve the retina (see Figure 1). The retina is the membrane lining the inner eyeball where images are projected, like the film in a camera. In the United States, DR is the leading cause of new-onset blindness among adults 20 to 74 years of age.

The incidence of DR increases with the duration of diabetes. After 20 years, more than 90% of patients with Type 1 diabetes and more than 60% of patients with Type 2 diabetes will develop DR. In Singapore, among 13,296 patients with diabetes screened at six polyclinics in 1995, 21.8% were found to have DR [1]. This trend is expected to increase. In patients with DR, almost half have sight-threatening retinopathy.

DR can be divided into three stages:

1. Non-proliferative (background / pre-proliferative)
2. Proliferative
3. Macular oedema

The non-proliferative stage is characterized by microaneurysms, retinal hemorrhages, dots, blots, cotton wool spots and venous dilation, venous beading and intra-retinal microvascular alterations (see Figure 2).

Proliferative DR is characterized by the formation of new (and abnormal) blood vessels, either on the optic disc or on

the surface of the retina. These new vessels have thin and fragile walls. Blood leakage from these vessels results in severe vision loss and blindness.

Macular oedema, causing blurring of vision, results when fluid leaks out of the blood vessels and accumulates near or in the macula. The macula is a spot near the center of the retina responsible for central vision.

[1] Lau HC VY, Yeo KT, Ling SL, & Jap A. Mass screening for diabetic retinopathy - a report on diabetic retinal screening in primary care clinics in Singapore. Singapore Medical Journal. 1995;36:510-3.

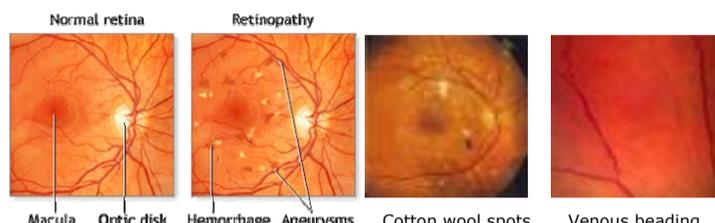


Figure 2 - Retinal changes seen in the non-proliferative phase

Screening for diabetic retinopathy

Why the need?

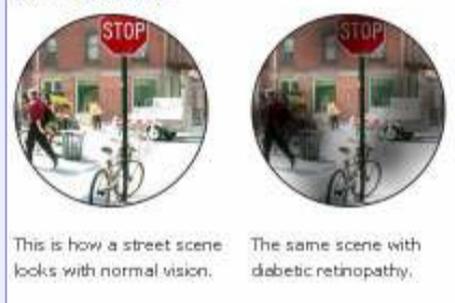
In both the non-proliferative and proliferative stages, individuals with DR may not experience any visual symptoms. Hence, regular eye examinations are important for its early detection and treatment before they develop blindness. Laser treatment is effective in slowing the progression of DR, although it does not restore lost vision.

Current screening practices worldwide

DR screening is achieved by ophthalmoscopy, retinal photography and variations of both.

1) Ophthalmoscopy is an examination of the back part of the eyeball using the ophthalmoscope. There are two types of ophthalmoscopes, the direct and

What It's Like



This is how a street scene looks with normal vision.

indirect.

2) Retinal photography presents an added advantage to ophthalmoscopy in tracking the patient's disease progression. Retinal photography can be used with Polaroid colour prints, 35 mm transparencies or digital imaging. Digital imaging technology is more expensive but allows for easier and cheaper storage than Polaroids and transparencies. Some practices dilate the pupil prior to photography so as to produce an image of better quality.

The gold standard for screening involves retinal photography of seven visual fields. In practice however, one, two or three fields are used. Though this reduces screening cost and time, no study has examined the optimal screening method.

What is the optimal number of fields for accurate and reliable screening?

- What does the evidence say?

We carried out a "Systematic review of the diagnostic accuracy of the single, two and three field digital retinal photography for screening diabetic retinopathy".

1) An exhaustive search of the literature was carried out to synthesize the evidence. 22 studies which met the inclusion criteria were reviewed.

- 15 studies applied the single field followed by two fields (5 studies) or three fields (7 studies).
- 5 studies compared more than one field type with the reference standard.
- The heterogeneity of studies precluded a quantitative synthesis, due to differences in patient characteristics, sample selection, methods of screening, grading scales,

inclusion of ungradeable images and units of analysis.

• There was a large overlap in the sensitivity and specificity across the number of fields, but with a trend for higher sensitivity and lower specificity with increasing number of fields. Table 1 presents the range of results across the studies, stratified by application of dilation and reference standard.

2) The above evidence is insufficient to make any recommendations on the optimal number of screening fields. *Until further research is available, clinicians may choose to use a single field for screening given that it would require less time and have lower costs.*

3) Dilation of pupils is useful in reducing the proportion of ungradeable images. A targeted approach for dilation is recommended, as opposed to dilating all patients.

- Older age, smaller pupil size and presence of cataract have been associated with having an ungradeable image.

No. of fields	Undilated		Dilated		All	
	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)	Sensitivity (%)	Specificity (%)
Reference Standard: 7SF						
1	66-87	45-86	75	96	66-87	45-96
2	86-98	78-95	-	-	86-98	78-95
3	98	72	85-87	81-86	85-98	72-86
Reference Standard: Indirect ophthalmoscopy						
1	38-100	47-100	80-90	79-98	38-100	47-100
2	92	96	83-97	79-100	83-97	79-100
3	92	98	90-97	90-98	90-97	90-98

Table 1 - Sensitivity and specificity for single, two and three field screening

Recommendations

1. Field specialists need to achieve consensus on the methods involved in the use of digital photography for screening diabetic retinopathy on:
 - the extent and area of retinal coverage for photography
 - minimum resolution for image viewing
 - a standard scale for grading retinopathy
 - referral criteria
2. Future studies should also follow the reporting standards for studies of diagnostic accuracy to allow generalizability of results to other settings. Studies lacked in reporting sample characteristics such as age, gender, diabetes type, duration of diabetes, personnel performing the screening and reference standard as well as their training and handling of indeterminate results.
3. A prospective study comparing the single, two and three fields, with and without dilation will provide the required evidence for the selection of optimal number of fields for screening. Thus far, no such studies on this have been carried out anywhere in the world.

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This systematic review was carried out in collaboration with the Eye Institute, NHG in answer to an important health services practice in Singapore. The review constitutes the work of HSOR as a Centre for Evidence-based Health Services Management, an international collaboration with the Joanna Briggs Institute, University of Adelaide for evidence-based healthcare.

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