SCREENING FOR DIABETIC RETINOPATHY

A Planning and Resource Guide

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## INTRODUCTION

### ACRONYMS

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<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AusDiab</td>
<td>National Diabetes, Obesity and Lifestyle Study</td>
</tr>
<tr>
<td>CALD</td>
<td>Culturally and linguistically diverse</td>
</tr>
<tr>
<td>CERA</td>
<td>Centre for Eye Research Australia</td>
</tr>
<tr>
<td>CSME</td>
<td>Clinically significant macular oedema</td>
</tr>
<tr>
<td>CWS</td>
<td>Cotton wool spot</td>
</tr>
<tr>
<td>DR</td>
<td>Diabetic retinopathy</td>
</tr>
<tr>
<td>ETDRS</td>
<td>Early Treatment of Diabetic Retinopathy Study</td>
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<tr>
<td>IDDM</td>
<td>Insulin dependent diabetes mellitus</td>
</tr>
<tr>
<td>LIDRS</td>
<td>Local Initiatives in Diabetic Retinopathy Screening Project</td>
</tr>
<tr>
<td>NDSIP</td>
<td>National Diabetes Strategy and Implementation Plan</td>
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<tr>
<td>NHMRC</td>
<td>National Health and Medical Research Council</td>
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<tr>
<td>NIDDM</td>
<td>Non-insulin dependent diabetes mellitus</td>
</tr>
<tr>
<td>NPDR</td>
<td>Non-proliferative diabetic retinopathy</td>
</tr>
<tr>
<td>NVD</td>
<td>New vessels on the (optic) disc</td>
</tr>
<tr>
<td>NVE</td>
<td>New vessels elsewhere</td>
</tr>
<tr>
<td>PCP</td>
<td>Primary Care Partnership</td>
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<tr>
<td>PDR</td>
<td>Proliferative diabetic retinopathy</td>
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<tr>
<td>PRP</td>
<td>Panretinal photocoagulation</td>
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<tr>
<td>VB</td>
<td>Venous beading</td>
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<tr>
<td>VRSDP</td>
<td>Victorian Retinopathy Screening Development Project</td>
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INTRODUCTION

PLANNING AND RESOURCE GUIDE

The aim of this Planning and Resource Guide is to outline the steps to implement a community-based diabetic retinopathy screening program. The expected audience is health workers such as general practitioners, community health nurses, diabetes educators, ophthalmologists, optometrists, and allied health professionals involved in diabetes management.

The first section of this Planning and Resource Guide provides background on diabetic retinopathy, the need for and methods of screening. Section two contains the steps to plan a diabetic retinopathy screening program. These steps include estimating the need for screening, methods of screening, the health professionals involved and their training, recruiting people with diabetes for screening, promoting community awareness, barriers to screening, reminder and recall systems, and evaluation.

The sources of material for this Planning and Resource Guide included the National Health and Medical Research Council (NHMRC) Guidelines, National Diabetes Strategy and Implementation Plan (NDSIP), the Victorian Retinopathy Screening Development Project (VRSDP, Appendix 2), Centre for Eye Research Australia’s (CERA) research and that of others. Details of publications are contained in the section on Additional Reading (Appendix 6).

The Appendices contain an article on management of diabetic retinopathy to prevent vision loss, a list of resources and samples of materials that have been used in previous screening projects that may be useful in the implementation of new retinopathy screening programs. Definitions of commonly used terms are given in Appendix 5.
SECTION 1  BACKGROUND

DIABETIC RETINOPATHY

Diabetic retinopathy, a microvascular complication of diabetes, is an important cause of vision loss in adults. All people with diabetes are at risk of developing retinopathy so thus at risk of vision loss or blindness. Screening for diabetic retinopathy to detect retinopathy and monitor progression has been shown to be effective in the prevention of vision loss, and to be cost effective (NHMRC, 1997). Screening involves an examination of the retina at the back of the eye and a test of visual acuity. This can be done by medical practitioners or optometrists who dilate the eye’s pupil to examine the retina. Special cameras can also be used to capture an image or photograph of the retina.

Diabetic retinopathy is asymptomatic in its early stages and vision might not be affected until the disease becomes severe and much less amenable to treatment. Laser treatment is very effective for prevention of vision loss due to diabetic retinopathy, however, laser treatment cannot restore vision that has already been lost. Therefore it is essential to detect and treat diabetic retinopathy before any vision loss occurs.

The National Health and Medical Research Council (NHMRC, 1997) guidelines on the management of diabetic retinopathy recommend an eye examination at diagnosis of diabetes and then at least every two years for all people with diabetes.

In ideal circumstances, people with diabetes will have their disease under good control and will have biennial eye examinations as recommended. Blood glucose control is the major modifiable risk factor influencing the development and progression of retinopathy (NDSIP, 1998). However, Australian data indicate that almost half of people with diabetes are not receiving adequate screening or follow-up for diabetic retinopathy (McCarty, 1998).

Diabetes affects about 7.2% of the Australian population aged 25 years and older (estimated to be 940,000) (Dunstan, 2002). One in five Australians over the age of
65 years has diabetes. In Australia, diabetic retinopathy is present in nearly one third of people with diabetes, and threatens vision in 10 per cent (Mitchell and Moffitt, 1990). Among those with no retinopathy, 10 per cent will develop it each year. Compared to the general population, people with diabetes have a 25-fold risk of vision loss. However, with early detection of retinopathy, vision loss can be prevented in almost all cases. People with diabetes have a higher risk of developing cataract. Vision loss from cataract can be detected with the visual acuity testing that is part of the screening for diabetic retinopathy.

**NATIONAL HEALTH AND MEDICAL RESEARCH COUNCIL GUIDELINES**

The National Health and Medical Research Council released guidelines for the management of diabetic retinopathy in an attempt to reduce the prevalence of preventable blindness associated with diabetes and to improve patient management (NHMRC, 1997). The management of diabetic retinopathy was chosen as one of the first areas for guideline development. This was an appropriate choice given the fact that diabetic retinopathy is one of the most easily preventable eye diseases with appropriate identification and treatment. The guidelines are designed to assist practitioners to make decisions about appropriate eye care for specific clinical circumstances, as well as to assist consumers by providing them with comprehensive information about choices available for treatment.

**Clinical Practice Guidelines for the Management of Diabetic Retinopathy**

These guidelines aimed to be useful to both health professionals and consumers to educate all involved in the care of people with diabetes about diabetic retinopathy. They were designed to assist professionals in making management decisions about diabetic retinopathy, thus improving the quality of care. Key information contained within the document includes:

- Diabetic Retinopathy – definitions, pathogenesis, prevalence and incidence, risk factors, grading, cataracts
- Screening for Diabetic Retinopathy – timing and frequency of eye examinations, screening methods, pupil dilation, fluorescein angiography, co-ordinated care
- Treatment of Diabetic Retinopathy – laser treatment, fluorescein angiography, vitrectomy surgery, other therapies, cataract surgery
Management of Diabetic Retinopathy in Aboriginal and Torres Strait Islander People

Community Impact of Diabetic Retinopathy.


*Diabetes and Your Eyes: a Consumer Guide for the Management of Diabetic Retinopathy*

This booklet is for people with diabetes and their families. Its purpose is to help people to become involved in making decisions about their treatment by giving them information regarding eye checks and treatment of diabetes related eye disease.


*Preserving Vision in Diabetes: a Quick Reference Guide for Optometrists, Nurses and other Health Practitioners*

This booklet is designed to help optometrists, nurses and other health practitioners prevent and screen for diabetic retinopathy in all patients with diabetes; to identify when patients should be referred for specialist ophthalmic management; and to understand and support specialist treatment and follow-up for patients with diabetic retinopathy.


*Management of Diabetic Retinopathy: a Guide for General Practitioners*

Due to the prevalence of diabetes in the Australian population and the fact that almost all people with diabetes will develop some form of retinopathy during their
lives, general practitioners need to be able to screen, manage and treat their patients with diabetes effectively. Whilst much of the management and treatment of patients with diabetic retinopathy must take place in a specialist context, it is hoped that screening and some follow-up can be undertaken at the primary care level. This can only be achieved, however, if primary care givers feel comfortable interpreting the relevant signs and symptoms and coordinating the subsequent management. It is within this context that this guide has been prepared.


**COMPONENTS OF A DIABETIC RETINOPATHY SCREENING PROGRAM**

Recommendations for diabetic retinopathy screening programs were made based on the NHMRC Guidelines, the results from the Victorian Retinopathy Screening Development Project (VRSDP) and other research. The recommendations outline the components of a diabetic retinopathy screening program and serve as a summary of the health professionals involved, the methods and materials needed.

1. The integral components of a screening model include screening by ophthalmologists, optometrists, GPs and those trained in the use of a non-mydriatic camera.

2. Diabetic screening should be a part of comprehensive care for people with diabetes and embedded in the health service system. Special programs such as those in Divisions of General Practice and special events such as World Diabetes Day should be fully utilised.

3. Optometrists are currently under-utilised in providing diabetic retinopathy screening. Further support and promotion of optometrists as screeners for diabetic retinopathy is needed.

4. The non-mydriatic photography offers an effective alternative to people with diabetes who do not attend ophthalmologists or optometrists. Further promotion of its use is needed.

5. The central role of the GP in diabetes care should be maintained and linkages with other health services enhanced. GPs should be kept informed about diabetic retinopathy issues.
6. Wherever possible existing nationally produced materials should be used to ensure that people with diabetes receive consistent messages regarding the timing and importance of regular eye examinations.

7. Materials developed for people of culturally and linguistically diverse (CALD) backgrounds should be evaluated for cultural appropriateness and effectiveness (i.e. reach and impact), and be consistent with national messages.

8. “Block bookings” could be made for people who speak languages other than English to enable interpreter services to be utilised.

9. Recall methods are integral to the continued success of regular screening. A much higher number of people with diabetes continue to have their eyes examined when reminded to do so.

10. An assessment of a program’s effectiveness in reaching the target population should be conducted periodically to evaluate a screening program. Other issues that warrant the collection of data from screening participants include the identification of barriers to screening and information to monitor screening outcomes.

11. A Planning and Resource Guide that provides practical advice and guidelines to relevant stakeholders (such as health services and Divisions of General Practice) to set up diabetic retinopathy screening should be developed and disseminated.
SECTION 2  PROGRAM PLANNING

THE NEED FOR SCREENING

Screening should be part of the routine care of all people with diabetes.

Screening for diabetic retinopathy is justified, as it is a major health problem, its natural history is known, and cost-effective treatment is available.

Australian data indicate that a significant proportion of people with diabetes are not receiving adequate screening or follow-up for diabetic retinopathy.

NHMRC, 1997

A project has three main components - an initial planning phase, an implementation phase, and an evaluation phase. The main steps in planning for a project are:

1. Establishing a need – this can be done by using results of prevalence surveys and census data. This determines the magnitude of the problem that needs to be addressed.
2. Situation analysis – once a need has been established, the next step is to conduct a situation analysis to determine availability of existing infrastructure, human resources, equipment and technology and opportunities.
3. The third step is to review the information available and then to set priorities, define goals and establish clear, specific and realistic objectives.
4. Once the objectives have been specified, an action or implementation plan needs to be developed that charts out the course of action with clear targets and milestones.
5. Each activity in the action plan needs to be budgeted.
6. Monitoring and evaluation take place during and at the end of the project.

Estimating the target for screening

In ideal circumstances, people with diabetes will have their disease under good control and will have biennial eye examinations as recommended. However, Australian data indicate that a significant proportion of people with diabetes are not receiving adequate screening or follow-up for diabetic retinopathy. In Victoria approximately 45% of people with diabetes reported that they have not had a recent
eye examination; this includes the one-third of people with diabetes who have never had an examination to detect retinopathy (McCarty, 1998). This Victorian figure comes within the range found in other countries where a high of 60% have not had regular examinations to a low of 30%. Experience in screening programs in Victoria has confirmed that the figure of 45% can be used to estimate the number of people not being regularly screened. The figure will vary depending on the linguistic and cultural diversity in a region and also the eye care resources available for eye examinations or screening.

The size of the target group within a community or region can be estimated by applying the following simple formula:

\[
\text{Prevalence of diabetes (Dunstan, 2002)} \times \text{population aged over 25 years.}
\]

Australian Bureau of Statistics figures give an age breakdown of populations in defined areas. [www.abs.gov.au](http://www.abs.gov.au). Local councils are a good source of data also.

The example of the City of Whitehorse, a large metropolitan local government area is used:

- Total population 134,870
- Population over 25 years = 92,066
- People with diabetes (7.2%) = 6,628
- Estimated number not screened regularly (45%) = 2,982.

The National Diabetes Strategy and Implementation Plan has set the target of screening at least 80% of all people with diabetes. This would mean in the City of Whitehorse the target would be to screen an additional 2,400 people, that is the people not currently being screened, for diabetic retinopathy.

**Community Resources**

Find out who is conducting screening and discuss any proposed program with them. Useful contacts are listed in Appendix 2 and include:

- General Practice Division – Victoria. Ph: 03 9241 5200 or your local Division of General Practice
Community Profile

Determine the demographic profile of your area. In rural areas most people speak English or have been resident in Australia for some time but sometimes there are small communities of people for whom English is not the appropriate language to communicate health care messages.

Many urban areas have significant culturally and linguistically diverse populations. Census data from the Australian Bureau of Statistics or local council figures can document the diversity and size of the different groups within an area. Knowledge of the cultural diversity is important as the prevalence of diabetes differs and the utilisation of health services also vary among CALD groups, for the need to ascertain the appropriate language for health promotion messages.
**SCREENING METHODS**

Where feasible, general practitioners, optometrists and physicians should actively screen their patients for diabetic retinopathy using a dilated fundus examination, combined with visual acuity assessment.

A satisfactory level of sensitivity of at least 60% can be achieved by appropriately trained personnel using dilated ophthalmoscopy or retinal photography, or non-mydriatic retinal photography.

NHMRC, 1997

Many screening modalities are currently used. However, no single modality is superior. Screening can be performed by ophthalmologists, optometrists, general practitioners, diabetologists or other physicians with a dilated fundus examination or by photography using the non-mydriatic camera operated by appropriately trained health workers. Any screening method must be accompanied by a visual acuity assessment.

The optimum model to prevent vision loss from diabetes is a combination of screening methods. The most appropriate mix of methods and service providers are dependent on the resources available and the circumstances in an area (Figure 1).

**Dilated fundus examination**

A medically trained professional (GP, physician or ophthalmologist) or optometrist can examine the fundus (retina) to detect diabetic retinopathy. An adequate view of the retina to detect retinopathy cannot be obtained if the pupils are not dilated. Visual acuity (with a pinhole) must also be tested to establish best corrected vision. The reason for this is that macular oedema (clinically significant macular oedema - CSME) can be difficult to detect. If macular oedema is present, vision will be affected and testing visual acuity will alert the eye specialist to the possible presence of CSME.

Ophthalmologists work in either public or private practice in urban and rural areas. The Royal Victorian Eye and Ear Hospital provides services to metropolitan and country patients. Major public hospitals also have eye clinics where people with diabetes can have their eyes examined.
Optometrists are under-utilised in screening for diabetic retinopathy. The role of optometrists as screeners for diabetic retinopathy needs to be supported and promoted and lines of communication between health professionals enhanced.

Findings from the VRSDP found that GPs were not well acquainted with the possible role of optometrists. GPs perceive that optometrists are retailers of glasses and so need to be made aware of the role optometrists can play in the screening of people with diabetes. Conversely optometrists need to recognise the role of GPs as the central link for people with diabetes. This includes sending reports to GPs with results of their patients’ eye examinations.
Non-mydriatic photography

Non-mydriatic retinal cameras offer a practical alternative for people with diabetes who do not or cannot attend ophthalmologists or optometrists. The cameras can provide outreach screening services to facilitate compliance with diabetic retinopathy screening recommendations.

Non-mydriatic cameras have been designed so that they can be used by people without specialist training in eye care. A short training period in the operation of the camera can provide the necessary skill to undertake screening. Cameras have been successfully used by nurses, diabetes educators, koori health workers and others with no previous experience in health care.

Non-mydriatic means that pupils of the eye are not dilated with drops. Non-mydriatic photography is conducted in a darkened room to allow the pupils to dilate sufficiently for photography of the retina. It has been found that pupils will dilate sufficiently for photography in 95% of people. The 5% whose pupils will not dilate sufficiently need to be referred to an ophthalmologist or optometrist for a dilated examination. In an additional 5% of people it is not possible to obtain a clear view of the retina due to opacities such as cataract.

Non-mydriatic photography has been shown in a number of studies to be an acceptably sensitive test to screen for the presence of any diabetic retinopathy (NHMRC, 1997). This photographic documentation allows screeners without formal eye qualifications in diabetes clinics, group general practices or remote areas not regularly visited by an ophthalmologist or optometrist, to perform adequate eye screening of their patients with diabetes. It is much easier for most general practitioners to recognise early retinopathy signs from a non-mydriatic photograph than to detect it by examination with an ophthalmoscope.

It is critical that measurement of visual acuity accompanies non-mydriatic eye photography as CSME cannot be detected from the photograph. Use an available distance visual acuity test or the CERA Vision Test is a suitable test to measure visual acuity (Appendix 2). A referral should be made to an ophthalmologist if visual
acuity is reduced, if any retinopathy is detected on photographs taken of either eye or if adequate screening photographs are not obtained.

Advantages of non-mydriatic photography include:

- Portability of the camera allowing wide geographic coverage
- Elimination of the need for dilating drops which has been reported as a barrier to eye examination by some people
- The ability of non-medically trained personnel to perform the examination.

Furthermore, follow-up results from screening with non-mydriatic photography has found that nearly 90% of participants continued to have their eyes examined according to guideline recommendations, when recommended to do so, after participation in a screening project (Lee, 2000).

**Results and referral**

When no diabetic retinopathy is present two yearly follow-up screening is recommended, or every year for Aboriginal people. These people with results within normal limits (ie with no need for referral) should be advised by letter to have another screening examination in two years time or sooner should they experience any visual symptoms. People who have abnormal results, either related to diabetic retinopathy or from some other pathology, should be sent one of two letters with the recommendation to contact their GP for possible referral to an ophthalmologist (Appendix 4). Summary of the recommendations:

- A person with minimal NPDR (isolated microaneurysms only) may not require referral to an ophthalmologist if vision is normal, but needs a review examination at least yearly by their usual screening method.

- Patient should be referred routinely to an ophthalmologist if mild NPDR is found.
• Patient should be referred to an ophthalmologist as soon as possible if moderate or severe NPDR is found, if vision is reduced or has worsened or if the fundus can not be adequately examined.

• Patient should be referred urgently to an ophthalmologist if PDR or macular oedema is found, for consideration of laser treatment.

There is a small proportion of people (approximately 10%) where photographs taken with a non-mydriatic camera cannot be graded due to small pupils, an opacity or other technical difficulties. In these situations a letter recommending that they seek referral for a dilated fundus examination by an ophthalmologist or optometrist is required. If the screening is not conducted within a general practice, copies of letters should be sent to the person’s nominated GP. See suggested sample letters in Appendix 4.

Photographs from the polaroid non-mydriatic camera can be filed in patients’ medical histories held by GPs. The polaroid photographs maintain good quality and definition for many years.

Grading of photographs
Images or photographs from non-mydriatic cameras can be graded by ophthalmologists or optometrists. GPs can be trained to grade photographs.

Results of the grading of photographs is useful feedback to the camera operator. A sample form to record results of visual acuity testing and to attach photographs is in Appendix 3. A suggested grading is:

1. Excellent. Well-centred photograph with resolution adequate to detect retinal microaneurysms (diameter 75-125 microns) throughout the 45º field
2. Adequate. Disc and macular region must be visible with resolution adequate to detect small retinal haemorrhages (diameter >125 microns)
3. Non-diagnostic. Criteria of 1 and 2 not met due to small pupil, media opacity (cataract), poor fixation or other unknown cause.
Each readable photograph can then be graded to determine the need for future screening or referral. The classification suggested is:

1. **NAD**  
   No abnormality detected.  
   No retinopathy (and no other pathology) detected on a gradable (excellent or adequate) photograph.

2. **NPDR**  
   Non-Proliferative Diabetic Retinopathy.  
   Presence of one or more of the following: microaneurysms, retinal haemorrhage, lipid exudates, cotton wool spots, venous changes (beading), or IRMAs (intraretinal microvascular abnormalities). Includes mild NPDR (at least one microaneurysm or haemorrhage), moderate NPDR and severe NPDR.

3. **PDR**  
   Proliferative Diabetic Retinopathy.  
   Any evidence of neovascularisation on the optic disc or elsewhere; any pre-retinal or vitreous haemorrhage.

4. **Not Gradable**  
   Non-diagnostic or no photograph due to small pupil, media opacity such as cataract, poor fixation, or other unknown cause.

5. **Other pathology**  
   Evidence of other fundus pathology other than NPDR or PDR eg. retinal vein occlusion, glaucoma, age-related macular degeneration.

**Non-mydriatic cameras**

Both Polaroid or digital cameras are available. A polaroid camera with all accessories costs approximately $28,000 - $30,000. A digital camera costs approximately $40,000 but with an additional cost for a laptop computer and software. The polaroid film used is readily available from photography shops. The cost of film per eye is approximately $1.50. Check with Divisions of General Practice or other health agencies if there are cameras available for loan.

Both cameras need to be placed on an adjustable table (approximate cost $2,000) to enable ease of operation with people of different sizes. To protect the camera during transport for outreach services, a sturdy carrying case is needed. All accessories can be ordered from the supplier of the camera.
The advantage of the digital camera is that images are captured on a computer attached to the camera so there are no ongoing running costs associated with the purchase of film. The disadvantage is the higher cost of the purchase of the camera. The decision between polaroid and digital will depend on the users and specific circumstances.

Both are easy to use. A training manual for the operation of the camera has been written by CERA (Appendix 2).

The cost to establish screening with a non-mydriatic camera needs to take into account:

- Person(s) to organise and conduct screening with camera
- Travel (a station wagon needed for transport of the camera)
- Health promotion on diabetic retinopathy in general and specifically for the local project.

The role of a screening program co-ordinator would include:

- Assessment of local needs
- Health promotion – community awareness and social marketing activities
- Organise screening locations with suitable room for screening*
- Conduct screening or arrange for training of local camera operators
- Liaise with GP or eye specialist to “read” images or photos
- Send screening result letters to patients and GPs
- Ensure that follow-up screening is conducted on a regular basis.

* The non-mydriatic camera needs a room that can be darkened either with curtains or blinds. It might be necessary to block out some light sources with a covering such as black plastic.
THE DIABETIC RETINOPATHY SCREENING TEAM

Retinopathy screening needs to be part of the systematic care of all people with diabetes and can be facilitated by many different professionals.

General practitioners have the responsibility to ensure that all their patients with diabetes have regular eye examinations, either by performing it or by referring patients to an appropriately trained examiner.

NHMRC, 1997

Education campaigns targeting all practitioners who care for people with diabetes are needed to highlight the need for regular eye screening and its benefits. Strategies are also needed to increase the involvement of general practitioners and diabetes physicians in eye screening. These practitioners can perform the screening themselves (dilated ophthalmoscopy or non-mydriatic photography) and subsequently arrange referral to an ophthalmologist once any retinopathy is detected. Alternatively they can refer all diabetic patients in their care either to an ophthalmologist or optometrist. Optometrists currently perform retinopathy screening of their clients with diabetes. The Optometrists Association of Australia recommends compliance with the NHMRC Guidelines in referring patients to an ophthalmologist once any retinopathy greater than “minimal” (isolated microaneurysms only) is detected.

General Practitioners

As general practitioners (GP) have a central role in the management of people with diabetes, effective diabetic retinopathy screening must first enrol the support of the GP. In fact, GPs are reported to be the sole carer for over 50% of the population with diabetes (Colagiuri, 1998). One of the barriers to regular contact to conduct or refer for regular screening is that many patients see many different practitioners making continuity of care more difficult.

In their capacity to incorporate screening for diabetic retinopathy, GPs have identified the issues of capacity, costs and communication with consumers and other professionals. The adoption of computers to manage information such as the need for referrals and recall of patients will facilitate an increase in regular screening and
examination of patients with diabetes. Medical software programs are introducing information on diabetes management. The barriers to adoption of information technology are both the cost and the training needed to fully utilise its capabilities.

It is essential that those conducting screening keep GPs informed of the results of the screening and any referrals made for their patients.

Each Division of General Practice has a nominated ophthalmologist for the Division who could advise on diabetic retinopathy screening. For details contact Dr Deb Colville at CERA colville@unimelb.edu.au or the Royal Australian and New Zealand College of Ophthalmologists at www.ranzco.edu.

**Diabetes Educators**
Diabetes educators should be part of the referral network for diabetic retinopathy screening. They play an important role in education of people with diabetes and their families. This includes complications of diabetes such as vision loss. The educator can reinforce the need for and timing of screening and explanation of laser treatment. A diabetes educator can refer a patient to an optometrist or to a GP for possible referral to an ophthalmologist. In some programs diabetes educators have been trained in the use of non-mydriatic cameras.

**Ophthalmologists**
All ophthalmologists can screen people for signs of diabetic retinopathy. Some ophthalmologists specialise in treatment of diseases of the retina, including diabetic retinopathy, and have the laser equipment needed to treat vision threatening retinopathy.

Ophthalmologists work in private practices and in public hospitals with eye departments and at the specialist eye hospitals, such as the Royal Victorian Eye and Ear Hospital in East Melbourne and the Sydney Eye Hospital. A referral from a GP or optometrist is needed for a patient to make a Medicare claim for a visit to an ophthalmologist.
**Optometrists**

Optometrists are under-utilised as members of the eye and health care team who can be involved in screening of people with diabetes for signs of retinopathy. Optometrists are part of the primary health care team. Appointments with optometrists do not need a referral. Most optometrists bulk bill for eye examinations. A frequent incorrect perception of optometrists is that their role is to only sell glasses.

GPs usually refer people needing eye care to ophthalmologists however links need to be made between GPs and other health care providers with optometrists to enable optometrists to be included as screeners for diabetic retinopathy. Optometrists can perform dilated eye examinations and continue to screen people with diabetes until examination or treatment is needed by an ophthalmologist.

**Training**

Possible members of a screening program team are likely to need training specific to provision of diabetic retinopathy screening. Possible trainers can be contacted through:

- Royal Australian and New Zealand College of Ophthalmologists. Ph: 02 9690 1001 [www.ranzco.edu](http://www.ranzco.edu)

Eye and health care professionals and the topics content of training is outlined in Table 1 on the next page.
Table 1. Health professionals and possible topics for training for diabetic retinopathy screening programs.

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**Non-mydriatic Photography**

An outcome of the VRSDP was the development of an accredited training program for allied health professionals in the use of the non-mydriatic camera. The content of the course is:

- Purpose of screening and assessment of risk for diabetic retinopathy
- Cause and natural history of diabetic retinopathy
- Identification of people at risk of diabetic retinopathy
- How diabetic retinopathy causes blindness
- How diabetic retinopathy is detected
• Treatment for diabetic retinopathy
• The keys to preservation of vision for people with diabetes
• Examination procedures for screening for diabetic retinopathy with a non-mydriatic retinal camera
• Post examination procedures for diabetic retinopathy screening
• Program promotion and recruitment
• Room requirements for diabetic retinopathy screening
• Safe handling and transportation of the non-mydriatic camera.

Details about this accredited course are available from the Director of Training, Vision Australia Foundation, 454 Glenferrie Road, Kooyong, phone 03 9864 9222.
HEALTH PROMOTION AND COMMUNITY AWARENESS

The effectiveness of a diabetic retinopathy screening program depends largely on the proportion of the target population screened. The target population to recruit is those people who do not have their eyes examined every two years or have not been examined ever.

Recruitment

One of the barriers to regular eye examinations by people with diabetes is lack of knowledge of the need for examinations. Recruitment campaigns need to firstly convey information on the necessity for examinations to people with diabetes and their families. Recruitment should specifically target people with diabetes but particularly those who have not been screened at all or not within the previous two years with a message such as, "Have you had your eyes examined in the last two years?"

Planning recruitment and including a budget item for a publicity campaign is an essential component of a diabetic retinopathy screening program. Recruitment can be through a broad social marketing campaign to raise awareness of the link between diabetes and vision loss or local publicity in a targeted local area to encourage attendance for eye examinations.

Any campaign should use evidence-based messages, that is using information based on research summarised in the NHMRC Guidelines (1997). The key messages are:

- Have an eye examination as soon as diabetes is diagnosed
- Continue to have regular eye examinations, at least every two years
- Good control of diabetes will reduce the risk of complications.

Videos, posters and brochures are readily available from the Lions Eye Health Program and Diabetes Australia (Appendix 2). These can be incorporated into campaigns or the messages they contain used.

Effective methods for large scale or regional social marketing campaigns in English and other languages are:

- Videos, posters and brochures
Use ‘special’ days or weeks that occur annually to link into national publicity campaigns:

- National Diabetes Week (2\textsuperscript{nd} week in July)
- World Sight Day (2\textsuperscript{nd} Thursday in October)
- World Diabetes Day (14 November)

Effective strategies to convey information in a local area about the need for screening of people with diabetes have been:

- Information distributed by general practitioners or diabetes educators
- Community networks and newsletters
- Mail out either targeted to people with diabetes or a “householder mailing”
- Newspaper stories or advertisements
- Radio or television
- Project launch utilising media or other local “personality”
- Posters in local community settings
- Presentations to community groups

Television has been found to be the most effective of these methods of communication. Community TV stations will broadcast health promotion messages in many languages.

**Recruitment of Culturally and Linguistically Diverse Populations**

Australia’s migrants come from over 230 countries and speak over 190 languages. In total approximately 15% of Australians speak a language other than English at home. In some urban areas this proportion can be as high as 50%.
People who are not fluent in speaking or reading English experience disadvantages in accessing information for effective self-management and in access to eye and health care services. Translating videos, brochures, posters or other information can assist people to gain information. It is important to use both written and spoken formats of health promotion materials. Having material in multiple languages does not ensure that the expected message is conveyed. In some languages there are no direct translations for some key words such as ‘screening’.

Another issue is that beliefs about health and use of health care services differ. These beliefs can discourage people from seeking preventive care from health services when they perceive that they are ‘well’. Health professionals need to be aware of cultural reactions to information such as encouragement to participate in screening. Discussion with leaders or key informants in cultural groups will enable understanding of cultural health beliefs. If available, linking people with health care providers who speak the same language is important.

Translating materials
All languages have different styles – academic, everyday and colloquial. When having materials translated it is important to use everyday language, to avoid use of jargon and have the information understandable.

After the English is translated to another language, it is essential to have the material “back translated” by an independent translator. The translated material can then be checked against the original to ensure that the correct messages will be communicated.

Before undertaking translation of material, check the availability of existing retinopathy materials. A good source with links to other websites is www.eyesondiabetes.org.au.

Community Awareness
Many sources of information about the need for screening exist for health care practitioners and their patients. The Diabetes Eye Health Project created materials in
English and 10 languages. The Diabetes and Your Eyes brochures are available in the following languages:

- Arabic
- Chinese
- Greek
- Hindi
- Indonesian
- Italian
- Thai
- Turkish
- Ukrainian
- Vietnamese

These materials can be accessed through the Diabetes Australia website www.diabetesaustralia.com.au or phone 1300 136 588 (Appendix 2).

The Lions Eye Health Program - Australia (LEHP) has a video, poster and brochures about the need for eye examinations for people with diabetes. Translations in some languages are also available. Contact your local Lions Club or LEHP, 1800 010 234 or email LEHP@cera.unimelb.edu.au for information or brochures (Appendix 2).
RECALL AND REMINDER SYSTEMS

Patient Recall
A recall system is one where people receive a message that the time is due for their next examination for screening. Recall notices for re-screening that are sent by post or some other direct contact have been demonstrated to be effective in maintaining regular screening (Lee, 2000). An example is the Breastscreen program where people in the target group receive letters when their next examinations are due. The direct mail method needs to be supplemented by community health promotion activities such as campaigns using radio, television or newspaper.

On a local basis this requires that practitioners or others involved in screening keep records of those screened and the dates so that recall can be organised.

Many optometrists have efficient annual recall systems that usually include sending letters to their patients. Recall letters for two-year follow examinations with non-mydriatic cameras have been demonstrated to have good “return rates” (Lee, 2000).

Many general practices are now becoming “computerised” giving them the ability to “flag” the time for screening of their patients, such as for eye examinations, and notify them either by letter or on the next visit of the need for an examination. However, barriers of funding and support exist for GPs in their move to computerisation to manage and monitor patient records.

A computerised database is not essential to organise a recall system as a paper-based system can work just as well. All that is needed is to construct a table or database and record the dates and names of people examined and arrange for follow-up contact.

Reminders
Reminders to people with diabetes can be through continued reminders from health care practitioners such as GPs and diabetes educators or reminder cards given to them at previous examinations. Examples of simple reminder cards or the write-on fridge magnets are shown on the next page.
Another method is a ‘self-monitoring’ system. People with diabetes can keep record books for monitoring of their diabetes and the need for the regular checks for all of the complications of diabetes. This could be used in conjunction with any of the recall or reminder systems.

Use reminders about the next or regular examinations to prevent vision loss to also reinforce the messages about control of diabetes.
BARRIERS TO SCREENING

Despite well-conducted health promotion campaigns and existing eye and health care services to conduct screening, many people with diabetes do not have regular screening. Increased knowledge and awareness raising of eye screening may by itself prompt people with diabetes to have eyes examined. Addressing barriers, however, is a complex issue. While knowledge and awareness raising can be effective, it has been shown that simply knowing about the importance of regular screening is often not enough to prompt a person with diabetes into action.

Knowledge of barriers to screening is needed to plan the content, target groups and methods for health promotion. Understanding of the barriers is necessary for the health care system to be responsive to plan for better utilisation of existing services. The barriers to screening can be examined in three areas, those that relate to people with diabetes, the professionals that could be involved in screening and the services themselves.

People with Diabetes

The most commonly reported barrier to screening by people with diabetes is that they did not know of the need for eye examinations. Since diabetic retinopathy remains asymptomatic in its early stages, another major barrier to achieving the first and regular eye examinations is the belief that “nothing is wrong with my eyes”. Other barriers are:

- Poor access and transport to services
- Cost of the service
- Knowledge of who can screen for retinopathy
- Perception that diabetes is ‘only a touch of sugar’
- Other health priorities
- Don’t want drops in eyes
- Differing health beliefs
- Language and modes of communication.
Some groups in the community are less likely to have eye examinations; these are males, people from culturally and linguistically diverse backgrounds (CALD), Kooris and older people. They encounter barriers related to their linguistic or cultural backgrounds. The availability of interpreters is important; the gender of the interpreter can be critical for effective, open communication and to gain information. Offering “block bookings” to specific groups, such as when an interpreter has been arranged can encourage participation.

Health Care Professionals
Barriers have been identified as to why some health care professionals, especially GPs, are not involved in screening or unaware of the potential networks. Knowledge or attitudes of providers also present access barriers. These include:

- Limited time and heavy case loads
- Limited knowledge of recommended frequency for screening
- Lack of awareness of cultural views of health, prevention and treatment
- Referral networks, and particularly the inclusion of optometrists.

Health Services
It is often the case that people who have been referred for eye examinations do not make or attend the appointments. People can make appointments with GPs or optometrists for consultations that are covered by Medicare or they can visit public hospitals. Even though there might be no direct patient costs for the consultation, there are associated costs of attending appointments. These costs include taking a day off work, costs of travel and parking. Other barriers identified by people with diabetes have been:

- Long waiting lists
- Availability of providers in rural areas
- Lack of recall or reminders for appointments
- Linkages between services or providers.
SCREENING FOR DIABETIC RETINOPATHY IN ABORIGINAL AND TORRES STRAIT ISLANDER COMMUNITIES

Aboriginal and Torres Strait Islander people have a higher prevalence and earlier onset of non-insulin dependent diabetes than non-indigenous populations

Poor access and low utilisation of services may contribute to the higher rate of diabetic complications (including retinopathy) in Aboriginal and Torres Strait Islander populations

Involvement of Aboriginal health workers in community-based screening for diabetic retinopathy is desirable

NHMRC, 1997

Some Aboriginal and Torres Strait Islander people attend existing eye care services for examination for diabetic retinopathy and other eye care. However, experience in Victoria and other states showed that most Aboriginal people with diabetes had not ever had their eyes examined. It was felt that screening for diabetic retinopathy should become part of the health care offered in Aboriginal Medical Services or other community-based health care. In most cases the screening programs use non-mydriatic cameras as few centres have medical or optometric personnel who can perform a dilated eye examination.

A successful program was initiated at the Rumbalara Aboriginal Co-operative in the Goulburn Valley in Victoria. A Koori health worker was trained in the operation of a non-mydriatic camera and to test visual acuity. Approximately 90% of people could have adequate photographs taken to examine for presence of retinopathy. This figure is similar to that in other screening programs.

The training also included health promotion activities, methods to recruit people for screening, record keeping, referral procedures and links with eye care providers, setting up a database for annual recall of those screened, monitoring and evaluation. The success of that program lead to the recommendations in “Eye Health in Aboriginal and Torres Strait Islander Communities”. These recommendations included:

- Regionally based equipment such as non-mydriatic cameras and lasers
- Patient management and recall systems
- Training for primary health care workers.

The Koori Eye Care program was implemented by the Victorian Aboriginal Community-Controlled Health Organisations (VACCHO) in collaboration with a multi-disciplinary and representative committee. Regional program co-ordinators administer the program in Victoria. For location of current diabetic retinopathy screening activities, contact VACCHO (03 9419 3350, Appendix 2).

Strategies were formulated at a Diabetic Retinopathy Screening Forum about developing partnerships to initiate screening of people with diabetes in Koori communities (www.dhs.vic.gov.au/phd/nhpa). A summary of the strategies to engage Koori communities were:

**Community Consultation**
- It is most important to use health workers and liaison officers who are leaders in Koori communities. The aim is the empowering of people with diabetes to seek ongoing care
- Koori communities are diverse and cultural understanding is complicated by the diversity of the communities – differences exist between Melbourne and rural communities
- Allow adequate time for consultation with the community and its leaders, the health workers and others involved
- The screening projects require a community development approach.

**Training**
- When conducting training, provide hands-on learning materials and experiences so that health workers develop an understanding of diabetic retinopathy
- Be open to learn from health workers
- Arrange for a cultural awareness program for your staff to appreciate more about Koori issues – contact your local Aboriginal Co-operative, Health Service or VACCHO for details
• Keep health–related language simple and free from jargon (eg use ‘diabetic eye disease’ rather than ‘retinopathy’).

**Screening**

• Koori health care programs employ a holistic approach to health
• Try to integrate screening for retinopathy in people with diabetes into other health care programs such as the “Well Person’s Health Check”
• Use incentives to encourage people to attend such as show bags with healthy items and information or have food available
• Activities need to be child-friendly – look after or entertain children
• Co-ordinate screening with eye and health care in the local community – consult GPs, ophthalmologists, local optometrists, hospitals or diabetes educators. VACCHO or CERA could help with contacts
• Be creative and have realistic expectations.

**Barriers**

• Lack of resources in communities; health workers are involved in many different health projects
• Duplicating existing or related services
• Unrealistic goals and time-lines.

Screening for diabetic retinopathy is being conducted in some Koori communities in Victoria. An example is the partnership between the Central Gippsland Aboriginal Health and Housing Co-operative and the Latrobe Community Health Service. Check with VACCHO for details of other projects (Appendix 2).

Partnerships between Koori medical centres and local optometrists have lead to optometrists conducting regular sessions in medical centres. Examples of such long term partnerships are in the Rumbalara Aboriginal Co-operative in Mooroopna and at the Victorian Aboriginal Health Service in Fitzroy. These partnerships are either with optometrists in private practice or through the Victorian College of Optometry (VCO). For further details, contact the Clinic Co-ordinator at VCO, phone 03 9349 7441.
The NHMRC Guidelines (pages 50-51) contain a section on the special considerations for screening for diabetic retinopathy in indigenous people.  

Due to higher prevalence and earlier onset of diabetes, poor access and low utilisation of services among Aboriginal and Torres Strait Islander people, retinopathy screening is recommended on diagnosis of diabetes and then at yearly intervals.

Another publication is Specialist Eye Health Guidelines for use in Aboriginal and Torres Strait Islander Populations. It contains sections on cataract, diabetic retinopathy and trachoma. It was produced by the Office for Aboriginal and Torres Strait Islander Health, Commonwealth Department of Health and Aged Care. Phone 02 6289 5280. Copies are also available from CERA (03 9929 8360).
EVALUATION STRATEGIES

Evaluation makes judgements about the value of a program. It is a process that determines whether a program has achieved its goals and objectives.

Evaluation needs to be incorporated into the initial project planning and take place throughout the program. Evaluation can assess if the program is doing what was planned comparing progress against objectives for the attainment of the goal of preventing vision loss from diabetic retinopathy. The results from evaluation can identify what is working (and what is not) to guide future decision making and planning. The program planning should include a strategy as to how the results will be disseminated, how they can be used and by whom.

An evaluation plan should:

- Identify what will be evaluated and the purpose of doing it
- Clarify what needs to be learnt to ask clear and simple questions
- Establish the criteria for success of the program
- Identify all stakeholders, especially those with diabetes
- Identify sources, methods and resources available and those needed
- Identify the tasks and develop timelines.

Evaluation takes place on three levels:

- Process or formative evaluation: monitoring of activities and strategies
- Impact evaluation: identifying achievement of the project objectives
- Outcome or summative evaluation: identifying achievement of the project goal.

**Process Evaluation**

Process evaluation is about all aspects of the delivery of the program. It involves the documentation of activities, its reach and scope, and the quality and satisfaction with the program. Questions that address these are “are we doing what we said we would?”, “is it working and reaching all who should have access?” and “are people satisfied with the program?”
Possible areas of a diabetic retinopathy screening program that need to be evaluated are increases in knowledge and awareness, training of health professionals participating in screening, and screening conducted. Examples of indicators for process evaluation of activities and strategies are:

- **Documenting Activities**
  - list health promotion activities undertaken: one article in local newspaper, broadcast of community service announcements, public launch of project, publicity in the media on World Sight Day and International Diabetes Day, brochures or videos distributed to target groups
  - translation of health promotion or project materials into other languages
  - utilisation of materials
  - collaborative partnerships with existing eye care resources and practitioners that can be involved in screening
  - training sessions conducted, eg for diabetes educators, GPs, health professionals to use non-mydriatic camera
  - linkages and referral networks established
  - referral protocols developed using NHMRC Guidelines
  - number of screening sessions conducted

- **Reach and Scope**
  - estimate of local needs
  - identify and make contact with specific CALD groups, leaders or professionals such as GPs

- **Quality and Satisfaction with Program**
  - accuracy and quality of materials
  - participant satisfaction with program
  - staff and participant reaction to how the program is going.

**Impact Evaluation**

Impact evaluation measures the achievement of program objectives. The impact of a diabetic retinopathy screening program could be measured across three areas – awareness and knowledge resulting from the health promotion campaign, active involvement of health professionals in referral and screening, and the proportion of
the target group(s) screened. The evaluation questions focus on what has changed. The important change in a diabetic retinopathy screening program is the number of people with diabetes who had not previously been screened who participated in screening conducted during the program; the effectiveness is measured as the proportion of the target group who accessed screening.

The effectiveness of social marketing or a local awareness campaign can be evaluated informally by asking people who attend screening how they heard about diabetic eye disease or the need for screening. Written or telephone surveys can also be used to evaluate the awareness of a health promotion campaign to evaluate not only knowledge of the messages but the relative effectiveness of different methods of publicity, such as use of media versus direct mail. Use of interpreters or translated survey forms are critical to ensure that people from CALD backgrounds have obtained knowledge and are aware of the need for screening and how to access services.

If the objective is to increase the number of people with diabetes being regularly screened, it is important to look not only at the numbers of people but the proportion of the target population screened. Sub-groups within the total population also need to be addressed, that is, are people with diabetes in all CALD groups being screened? In the longer term, the effectiveness of reminder or recall systems can be evaluated by measuring the proportions of people returning for two-yearly screening.

The numbers of health professionals who attend training or conduct screening can be used to investigate the impact of the introduction of a screening program. Within a region such as a GP Division, the location of optometrists, GP practices and other health professionals and agencies involved is important so that screening is readily available across an area or region.

An important issue during impact evaluation is to gain an understanding of the barriers to adoption of, or participation in the program. This could involve identifying the range of health professionals participating in the screening team, the compliance with referrals and utilisation of the screening program by the specific CALD groups or Aboriginal people. Interviews, documentation of case studies and focus groups are
means to obtain information on barriers and how programs can be improved to minimise barriers.

Ongoing audit of the effectiveness of training in the use of the non-mydriatic camera can be easily conducted. Camera operators can self-monitor the quality of photographs that they take. The CERA Manual for the non-mydriatic camera contains sample photographs so that quality can be monitored against sample photos and the reason for poor quality or unreadable photographs diagnosed (Appendix 2). In addition, the monitoring of the quality of photographs can be done by the reader of the photographs. The suggested form (Appendix 3) grades the quality of photographs taken. Feedback is then available to the camera operators and program co-ordinators.

**Outcome Evaluation**

The long-term goal of screening for diabetic retinopathy in people with diabetes is the prevention of vision loss. This can only be achieved by regular screening for early detection of retinopathy before vision is lost and timely laser treatment when necessary.

The reduction of vision loss in the population is not able to be determined over a short time period or in a local project. This can only be demonstrated through a population-based survey to measure change from baseline data. This type of evaluation will take place through The Vision Initiative, a project commencing in Victoria, that has been planned by Vision 2020 partners, a consortium of eye care and professional groups.

Cases where vision loss has been avoided can be documented through case studies. It would be valuable to collect stories of people newly diagnosed who have commenced screening as soon as they were diagnosed with diabetes. Other cases could be adolescents or adults who have had diabetes for 10-20 years who have retained good vision as they have attended for screening at least every two years. These stories can be contrasted with stories recounted by ophthalmologists who have had people referred with severe retinopathy with vision loss where vision can not be restored.
In summary, program planning will include what should be evaluated, identify methods to collect data for process and impact evaluation, allow time for interpretation of data so that conclusions and recommendations can be made to plan for sustainable change to prevent vision loss from diabetic retinopathy.
APPENDICES

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Optimum Management of Diabetic Retinopathy

Retinopathy is a microvascular complication of diabetes and it remains the leading cause of blindness in adults 20–65 years of age in Australia. However, almost all cases of blindness due to retinopathy could have been prevented with proper implementation of existing technology. Optimising systemic factors (glycaemic control, blood pressure and serum lipids), regular eye checks and timely retinal laser treatment are the keys to maintaining good vision. GPs can play a crucial role in all stages of this disease.

Pathophysiology of Diabetic Retinopathy

Chronic hyperglycaemia in diabetes damages retinal capillaries. The biochemical mechanisms for this damage are complex and the subject of intensive research. The histological changes are well documented, with loss of pericytes (the supporting cells of the retinal capillaries) and thickening of the capillary basement membrane.

The functional results are capillary leakage (leading to retinal oedema), and capillary blockage (leading to retinal ischaemia). In diabetic retinopathy, one or both of these processes may occur in either fundus ocular.

In an eye with extensive retinal ischaemia, growth factors are released from damaged retinal tissue, resulting in the proliferation of new blood vessels and fibrous tissue from the surface of the retina into the vitreous. New blood vessels are fragile and prone to bleeding (vitreous haemorrhage). Contraction of fibrous proliferation in the vitreous will cause traction on the retina, which leads to retinal detachment.

Epidemiology

Many patients with diabetes will have no retinopathy at their initial examination (a normal fundus is shown in Figure 1). However, these patients need regular review because almost all will eventually develop retinopathy. The major risk factors for developing retinopathy are:

- Long duration of diabetes
- Poor glycaemic control.

Other risk factors include hypertension, nephropathy, hyperlipidaemia and pregnancy.

![Image of a normal fundus.](image)

Salient Points

- Most cases of blindness due to retinopathy could be prevented
- All patients with diabetes are at risk of developing retinopathy
- Tight glycaemic control reduces the risk of development and progression of retinopathy
- Tight blood pressure control reduces the risk of retinopathy progression and visual loss in type 2 diabetes
- All people with diabetes require a fundus examination at the time of diagnosis, with regular screening
- Timely retinal laser treatment can prevent up to 95% of blindness from diabetic retinopathy
Clinical Features

Non-Proliferative (Background) Diabetic Retinopathy (NPDR)
- Microaneurysms (Figure 2) are the earliest sign of NPDR
- Retinal haemorrhages (Figure 3) and hard exudates (Figure 4) are easily visible on ophthalmoscopy
- Gradual loss of vision with NPDR may be due to macular oedema (Figure 5).

Proliferative Diabetic Retinopathy (PDR)
- New vessels grow from the optic disc and retina (Figure 6)
- In addition to these new vessels, NPDR changes (including microaneurysms and retinal haemorrhages) are always present
- Rapid loss of vision with PDR may be due to vitreous haemorrhage and retinal detachment.

Other Diabetic Eye Changes

Refractive Changes
Patients will report fluctuating blur in vision during periods of poor glycaemic control; this is due to osmotic shifts of glucose within the lens of the eye. In particular, distance vision may be blurred, but reading vision remains clear due to induced myopia (short-sightedness) when blood glucose is high. These changes are completely reversible, and will stabilise with improved glycaemic control.

Cataract
Cataract is more common in patients with diabetes. Undiagnosed diabetes should be considered as a cause of cataracts, particularly in patients younger than 65 years of age.

Cranial Nerve Palsies
Isolated microvascular nerve palsies may involve any of the cranial nerves and cause ocular symptoms such as diplopia (third, fourth or sixth nerve) or ptosis (third nerve). If the palsy is due to microvascular disease, it will usually recover completely over 3 months.

Prevention of Diabetic Retinopathy

Glycaemic Control
Results from huge clinical trials with long-term follow-up (8–10 years) have proven that tight glycaemic control reduces the risk of development and progression of retinopathy in type 1 diabetes (DCCT – Diabetes Control and Complications Trial, 1993) and type 2 diabetes (UKPDS, the United Kingdom prospective diabetes study, 1998). Even modest improvements in glycosylated haemoglobin (HbA1c) levels will significantly slow retinopathy progression.

Treatment of Hypertension

The UKPDS demonstrated a dramatic benefit from tight control of blood pressure in hypertensive patients with type 2 diabetes. 1148 patients were randomised to tight BP control (mean 144/82 mmHg) or less tight control (mean 154/87 mmHg) and followed for 8 years. In the group allocated to tight control, there was a 32% reduction in deaths related to diabetes, a 44% decrease in the incidence of strokes, 34% reduction in risk of significant deterioration of retinopathy, and a 47% reduction in risk of visual deterioration by three lines. The

Figure 2. Minimal non-proliferative diabetic retinopathy showing a solitary microaneurysm.

Figure 3. Mild non-proliferative diabetic retinopathy showing retinal haemorrhages. This patient has a pale complexion and a pale fundus, with easily visible (normal) choroidal blood vessels.

Figure 4. Moderate non-proliferative diabetic retinopathy showing microaneurysms, retinal haemorrhages and some hard exudate. Vision remains 6/6 because the centre of the macula is unaffected.

Figure 5. Moderate non-proliferative diabetic retinopathy with severe macular oedema. The oedema and hard exudate involving the centre of the macula has caused gradual loss of central vision.

Figure 6. Proliferative diabetic retinopathy showing new vessels on the optic disc and elsewhere that are starting to bleed inferiorly.
beneficial effect was not specific to use of ACE inhibitors. These results proved that treatment of hypertension is at least as important as glycaemic control in type 2 diabetes.

**Treatment of Serum Lipids**

Patients with elevated serum cholesterol are twice as likely to develop retinal hard (lipid) exudates. Increasing hard exudate deposition in the macula damages vision. Interventional studies are being conducted to evaluate whether treating elevated cholesterol improves the visual outcome.

**Treatment**

**Retinal Laser (Photocoagulation)**

Randomised clinical trials have proven that retinal laser treatment can prevent up to 95% of blindness (legal blindness defined as vision less than 6/60 in both eyes) from diabetic retinopathy. The timing of laser treatment and regular follow-up after treatment are both crucial in achieving good results. Retinal laser treatment cannot restore sight that is already lost, and therefore regular screening examinations are required to detect early (asymptomatic) vision-threatening retinopathy.

‘Focal’ laser treatment (Figure 7) is used to directly treat leaking areas in the macular region in patients with macular oedema. This treatment is painless, but may need to be repeated if oedema recurs. Patients should be informed that these treatments are aimed to maintain rather than improve their vision, although there may be dramatic improvement in the fundus appearance (Figures 8a and 8b). Some patients with severe progressive disease will continue to lose some vision despite appropriate treatment, and should be counselled accordingly.

‘Scatter’ laser treatment, which is otherwise known as panretinal photocoagulation or PRP, is used to treat areas of widespread inchaemia in the peripheral retina of eyes with proliferative diabetic retinopathy (Figures 9a and 9b). PRP may result in dramatic regression of new vessels and is a very effective treatment to prevent blindness. It does, however, have significant side effects, including pain during treatment, and some blurring of vision that may persist. Most (but not all) patients will maintain vision that is adequate to drive a car. PRP will usually require two or more treatment sessions on each eye, but once the new vessels have regressed, the treatment effect is lifelong and it will not need to be repeated.

**Screening for Diabetic Retinopathy**

**When Should Screening be Considered?**

- All people with diabetes require a fundus examination at the time of diagnosis. This is particularly important for patients with type 2 diabetes who may have a long duration of undiagnosed diabetes. The only exception to this rule is for children, who do not require examination prior to puberty.

- If there is no retinopathy at the initial examination, repeat screening examinations are required at least every 2 years.

**Who Should Undertake the Screening?**

Screening should be undertaken by any suitably trained personnel, including GPs, physicians, optometrists and ophthalmologists. The GP’s role is central – either to perform the screening or to check that it is
occurring regularly. Adequate communication between providers is essential, and some form of computerized database or reminder system is optimal.

**How Should Screening be Done?**
1. Measure visual acuity of each eye
2. Dilate the pupils
3. Assess the fundus with an ophthalmoscope.

Pupil dilatation using tropicamide 0.5 or 1% is safe and essential for an adequate examination with any sort of ophthalmoscope. Patients should be warned that their vision may be blurry for a few hours, particularly for reading, and that they may experience difficulty with glare in a sunny environment. They could be warned of these potential problems prior to driving a car, although most patients can drive without difficulty while the pupils are dilated.

Inducing angle closure glaucoma is an exceedingly rare adverse event and should not deter GPs from using tropicamide drops.

An acceptable alternative method of screening is retinal photography, and using a modern non-mydriatic retinal camera will obviate the need for dilating drops.

**Referral**
Referral should be arranged if:
- Any unexplained loss of vision occurs
- Any retinopathy is detected
- You are unable to perform regular screening examinations

**References**
4. Ferris FL. How effective are treatments for diabetic retinopathy? JAMA 1993; 270(2): 120–1
* Telephone the Diabetes Australia on 02 62501155 to order a copy (limited copies still available) or visit the NHMRC website to download free of charge.

http://www.healthe.gov.au/00/00/00/00/00/publications/policy/ctf55cover.htm

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The full text of this article is available on the Current Therapeutics website http://www.ctonline.com.au

**Appendix 1. Commonly asked questions**

What percentage of patients with diabetes develop retinopathy?
Everyone with diabetes is at risk. After 15 years, about three out of four people with diabetes will have some retinopathy, and about one in four have vision threatening retinopathy (proliferative retinopathy, macular oedema or both). With type 2 diabetes, 15% will have some degree of retinopathy at the time of diagnosis of diabetes, indicating that there may have been a long duration of asymptomatic undiagnosed diabetes.

Although it is reassuring to know the risk of acute angle closure glaucoma is rare after use of dilating drops, should GPs routinely warn all patients of this risk prior to instilling drops? In the unlikely event that this complication occurs, how soon does it happen, and what should the GP do to manage it?

Inducing acute-angle closure glaucoma by instilling dilating drops is exceedingly rare. The risk is approximately 1 in 2000 or less. Ophthalmologists would not routinely warn patients of this complication and I do not think it is necessary for GPs to do so. However, it is appropriate to warn patients of the expected side effects of dilation (blurred near vision and glare, losing a few hours). If angle closure does occur, the patient will develop a severe pain in one or both eyes some hours after dilation. Angle closure glaucomas is a very unstable condition, initially with acute angle closure 500% IV or oral to lower the intraocular pressure) and miotics (pilocarpine), and definitively with a laser iridotomy. Prompt treatment leads to better outcomes. For completeness in a busy environment, patients could be advised to seek medical attention if they develop severe pain in the eye following testing.

What factors might affect a patient’s compliance with follow up of laser treatment? Loss of follow-up during laser treatment is an important and preventable cause of poor outcomes. Most patients will experience pain during PRP, although individual pain tolerance varies considerably between patients. Most patients will also detect some worsening of vision during treatment. Patients must be warned about these side effects, and informed about the progressive nature of the disease and the goals of treatment. If the patients are not given this information, it is hardly surprising that some will fail to attend. Some patients understandably lose faith in their ophthalmologist when things are not going well, and if that is happening then judicious support from the GP or a prompt second opinion can be valuable. The worst outcome is to have irreversible vision loss from inadequate or delayed laser treatment.

What are some of the techniques that have been shown to improve early detection of retinopathy in the general practice setting? Computerised patient recall systems and diabetes care plans (incorporating retinopathy screening) are extremely valuable tools to remind both doctors and patients about the need for regular eye review. Diabetes educators may also play a major role in coordinating diabetes care in some general practices.

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APPENDIX 2 RESOURCES

1. The Australian Diabetes, Obesity and Lifestyle Study (AusDiab) was the first national study on the prevalence and impact of Diabetes mellitus. It is a major component of the National Diabetes Strategy designed to document the increasing problem of diabetes in Australia. Australian Diabetes, Obesity and Lifestyle Study (AusDiab) was conducted by the International Diabetes Institute, http://www.diabetes.com.au/research/ausdiab.htm.

2. Testing visual acuity. A test of visual acuity should be carried out during an examination of a person with diabetes to determine if the person has normal vision (acuity of 6/6). The CERA Vision Test is suitable for this. It can be obtained from CERA: Phone 03 9929 8391 or email to cera-ehp@unimelb.edu.au. The cost of $25.00 includes postage.

3. Non-Mydriatic Camera Training Manual. Manuals for the operation of the digital or polaroid cameras are available from CERA. Either manual can be obtained at a cost of $12.00 including postage. Contact the Eye Health Promotion Unit on 03 9929 8391 or email to cera-ehp@unimelb.edu.au.

4. The Department of Human Services (DHS) funded the Victorian Retinopathy Screening Development Project (VRSDP) as part of the National Visual Impairment Prevention Project of the National Diabetes Strategy (NDS). Summary reports of that project and the DHS funded Local Initiatives in Diabetic Retinopathy Screening (LIDRS) are on the DHS website, www.dhs.vic.gov.au/phd/nhpa/diabetes.

5. The National Health and Medical Research Council Guidelines are available on the NHMRC website:


7. Diabetes Australia. Diabetes Australia has material on diabetes and its complications in English and other languages. These can be accessed though its website, www.diabetesaustralia.com.au or a toll free number 1300 136 588.

8. Lions Eye Health Program (LEHP-Australia). This health promotion program has produced posters, brochures and videos on diabetic retinopathy and glaucoma. Materials are available from Lions Clubs or LEHP@cera.unimelb.edu.au, toll free number 1800 010 234.

9. Victorian Aboriginal Community Controlled Health Organisation (VACCHO). For information and contacts regarding the Koori Eye Care Project, phone 03 9419 3350.
10. Professional organisations and services can provide information or give links to its members:

Royal Australian and New Zealand College of Ophthalmologists, www.ranzco.edu, phone 02 9690 1001

Optometrists Association of Australia – Victorian branch, www.vioptom.asn.au, phone 03 9486 1700

General Practice Division – Victoria, www.gpdv.com.au phone 03 9341 5200

Royal Victorian Eye and Ear Hospital, www.rveeh.vic.gov.au, phone 03 9929 8666

Centre for Eye Research Australia (CERA), http://cera.unimelb.edu.au, phone 03 9929 8360

Victorian College of Optometry, www.optometry.unimelb.edu.au, phone 03 9349 7400
### APPENDIX 3

#### RECORD FORM

<table>
<thead>
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<th>Name ____________________________</th>
<th>DOB _________</th>
</tr>
</thead>
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**Visual acuity**  
R _________  
L ___________

**Tested with spectacles**  
Yes / no

**Visual acuity with pinhole**  
R _________  
L ___________

- Attach right eye photograph
- Attach left eye photograph

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<th>Left</th>
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<td>_____</td>
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<td>_____</td>
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<td>_____</td>
<td>_____</td>
<td>Other pathology</td>
<td>_____</td>
<td>_____</td>
</tr>
</tbody>
</table>

**Follow up letter (circle one)**  
1  2  3  4  (Appendix 4)
Patient Result Letter 1

Date

<patient name and address>

Dear <patient name>

Thank you very much for attending the recent diabetes eye examination. As you will recall, we checked your vision and took photographs of the back of your eyes. We are checking for changes in the small blood vessels of the back of the eye (diabetic eye disease). This is a common and <i>treatable</i> complication of diabetes. If left untreated, these changes may cause loss of vision.

The photographs that were taken of your eyes showed no evidence of any significant diabetic eye disease, and you do not need to take any further action at this stage. However, we would like to stress the importance of having regular eye examinations to detect the first signs of change. With early detection and treatment, loss of vision can be prevented. You should have your eyes checked again in two years time or sooner if you notice any blurring of vision. Good control of diabetes will help to prevent eye problems.

Thank you once again for attending.

Yours sincerely

<Sender name>
Date

<patient name and address>

Dear <patient name>

Thank you very much for attending the recent diabetes eye examination. As you will recall, we checked your vision and took photographs of the back of your eyes. We are checking for changes in the small blood vessels of the back of the eye (diabetic eye disease). This is a common and treatable complication of diabetes. If left untreated, these changes may cause loss of vision.

The photographs that were taken of your eyes showed some evidence of diabetic eye disease. We would like you to visit your doctor within the next month. Your doctor may wish to refer you to an eye specialist.

Thank you once again for attending.

Yours sincerely

<Sender name>
Patient Result Letter 3

Date

<patient name and address>

Dear <patient name>

Thank you very much for attending the recent diabetes eye examination. As you will recall, we checked your vision and took photographs of the back of your eyes. We are checking for changes in the small blood vessels of the back of the eye (diabetic eye disease). This is a common and treatable complication of diabetes. If left untreated, these changes may cause loss of vision.

We were not able to obtain clear quality photographs of your eyes. We would like you to visit your doctor within the next month. Your doctor may need to arrange another eye test.

Thank you once again for attending.

Yours sincerely

<Sender name>

cc <doctor name>
Dear <patient name>,

Thank you very much for attending the recent diabetes eye examination. As you will recall, we checked your vision and took photographs of the back of your eyes. We are checking for changes in the small blood vessels of the back of the eye (diabetic eye disease). This is a common and treatable complication of diabetes. If left untreated, these changes may cause loss of vision.

The photographs that were taken of your eyes showed no evidence of any significant diabetic eye disease. However, the results indicate that your eyes were not completely normal. We would like you to visit your doctor within the next month. Your doctor may need to arrange another eye test.

Thank you once again for attending.

Yours sincerely

<Sender name>

cc  <doctor name>
APPENDIX 5  GLOSSARY OF TERMS

Argon laser
A medical instrument that delivers green or blue-green laser energy for treatment of diabetic retinopathy.

Cataract
An opacity of the crystalline lens of the eye, associated with age and many other risk factors. The most frequent age-related cataract types are nuclear, cortical and posterior subcapsular (PSC). Early-onset of cortical and PSC cataract occurs in people with diabetes.

Clinically-significant macular edema (CSME)
Leak from capillaries in the macular or perimacular region causes retinal thickening. When present within 2 disc diameters of the centre of the macula, it is termed macular oedema. When present within or close to the central macula, it is termed clinically-significant macular oedema (CSME). CSME is best assessed using stereo slit lamp biomicroscopy (with or without a fundus contact lens) or from stereo photographs of the macula.

Clinical practice guidelines
Systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances.

Cotton-wool spot
An ill-defined white patch due to a micro-infarct within the retinal nerve fibre layer, also termed 'soft exudate' .

Cranial nerves
Twelve pairs of nerves that transmit information to and from the brain. Only six nerves are involved with the eye (1st ophthalmic, 2nd optic, 3rd oculomotor, 4th trochlear, 5th trigeminal, 6th abducens).

Diabetes mellitus
Diabetes mellitus is a collection of closely related chronic systemic diseases, with a common feature of elevated blood glucose. Diabetes is classified from differences in aetiology, clinical presentation and natural history. Insulin-dependent diabetes mellitus (IDDM) is characterised by insulin deficiency, while the more frequent non insulindependent diabetes mellitus (NIDDM) is characterised by insulin resistance.

Diabetic retinopathy (DR)
Diabetic retinopathy may be defined as the presence of typical retinal microvascular lesions in an individual with diabetes. Microneurysms (Ma), haemorrhages (H), hard exudates (HEx), cotton wool spots (CWS), intraretinal microvascular abnormalities (IRMA), venous beading (VB), new vessels (NV) and fibrous tissue comprise the clinical features of diabetic retinopathy. However, none of these individual lesions are specific for diabetes, as they may occur in other disease processes such as hypertension, hyperviscosity, inflammation or radiation. It is the pattern, symmetry and evolution of the lesions that characterises the appearance as diabetic retinopathy.
Effectiveness
The extent to which an intervention (treatment) does more good than harm for the patient when applied under usual circumstances and that achieves the intended goals.

Early Treatment Diabetic Retinopathy Study (ETDRS)
A National Eye Institute sponsored multicentre randomized controlled trial of focal and panretinal laser treatment for non-proliferative diabetic retinopathy, early proliferative diabetic retinopathy and macular oedema. The ETDRS was conducted in the United States from 1980 to 1985 and made recommendations about the timing and benefits of laser for these stages of retinopathy.

Evidence-based guidelines
Clinical practice guidelines based on a systematic review of scientific data and publications.

Extracapsular cataract extraction
Operative procedure to remove the cataractous lens, while preserving the posterior lens capsule. A technique known as phacoemulsification is sometimes employed, allowing a smaller incision and more rapid visual rehabilitation.

Exudates
see Hard Exudates

Fluorescein angiography
A valuable means of documenting the retinal capillary bed, the presence and features of macular oedema or to confirm the presence of new vessels, not otherwise seen. The test is conducted following an intravenous dye injection of sodium fluorescein solution and requires specially developed filters in a fundus camera. It is a most useful investigation in the management of macular oedema.

Fundus
Central area of the retina that includes the optic nerve and macula. The area of the retina examined for presence of retinopathy (images in Appendix 1)

Gestational diabetes mellitus
Development of diabetes or elevated blood glucose in women during pregnancy. It usually regresses spontaneously in the post-partum period.

Glaucoma
An optic neuropathy in which characteristic visual field defects occur in association with abnormal cupping of the optic disc. Glaucoma is frequently associated with elevated intraocular pressure and is frequently undetected until significant visual loss has occurred.

Glycaemic control
In diabetes this refers to the need to maintain blood glucose levels as close to normal as possible, using a combination of diet, tablets and possibly insulin.
**Glycosylated haemoglobin**
Component of blood haemoglobin to which glucose molecules become attached. It provides a useful measure of glycaemic control because of its extended half-life in the blood.

**Grading of diabetic retinopathy**
Assessment systems developed to differentiate the severity of diabetic retinopathy. Grading will allow comparison among different groups of patients, or of the same patient examined at different times.

**Hard exudate**
Well-defined irregular yellowish retinal deposits (lipid and fibrin), often at the margin of oedematous retina and derived from leaking retinal capillaries. These are also termed "hard exudates" and are differentiated from cotton wool spots, also termed "soft exudates", which are retinal nerve fibre layer infarcts.

**Hyperlipidaemia**
Elevated levels of cholesterol and/or triglycerides (fats) in the blood. This is commonly associated with type 2 diabetes, and is a risk factor for cardiovascular disease and visual loss.

**Hypertension**
A systemic disease characterised by abnormally elevated blood pressure. Associated with an increased risk of many diseases, including vascular events as well as early mortality.

**Impaired glucose tolerance (IGT)**
Elevated blood glucose levels after ingestion of an oral glucose load (glucose tolerance test), but less than levels diagnostic of diabetes mellitus. The risk of IGT progression to frank diabetes is uncertain.

**Incidence**
Refers to the number of new events or cases of disease that develop in a population of individuals at risk during a specified interval.

**Insulin dependent diabetes mellitus (IDDM)**
A form of diabetes characterised by acute onset, usually presenting before age 30, with insulin deficiency and a need for exogenous insulin to maintain life.

**Intraocular lens (IOL)**
An artificial lens made from a variety of semi-synthetic materials and designed to be placed in either the anterior or posterior chamber of the eye during cataract surgery and replace the cataractous lens.

**Intraretinal microvascular abnormalities (IRMAs)**
Visible dilated capillary vessels in the retina, which bridge arteriolar and venous tributories and indicate the presence of capillary non-perfusion.
Laser
An acronym, Light Amplification by the Stimulated Emission of Radiation. Laser is the principal instrument used in photocoagulation treatment of diabetic retinopathy. Other photocoagulators such as xenon arc are now not routinely used.

Macular oedema
Abnormal retinal thickening, defined as thickening or oedema located within 2 disc diameters of the centre of the macula, caused by leak from capillaries in the macular or perimacular region.

Media opacity
Both the lens and the cornea of the eye need to be clear for good vision. Either a cataract (lens) or cloudiness from scarring or disease of the cornea will affect vision. A cataract or cloudy cornea make it difficult or sometimes impossible to obtain a clear view of the fundus.

Microaneurysm
One of the earliest diabetic retinopathy lesions, which appears as a round small red dot within the retina, due to saccular dilations of capillary vessels.

Mydriasis
Pupil dilation from short-acting eye-drops such as tropicamide 0.5 or 1.0%. Mydriasis is essential in ophthalmoscopic screening for diabetic retinopathy, but may not be needed when using a newer non-mydriatic camera.

Neovascular glaucoma
A glaucoma often secondary to ocular ischaemia, caused by the growth of new vessels in the iris and anterior chamber angle of the eye, resulting in elevated intraocular pressure. It may occur in the late stages of diabetic retinopathy and may be accelerated by intraocular surgery.

Nephropathy
A renal complication of diabetes. Form of microangiopathy similar to diabetic retinopathy, initially manifest by micro-albuminuria which may progress to macro-proteinuria and endstage renal failure.

Non-insulin dependent diabetes mellitus (NIDDM)
A form of diabetes mellitus characterised by insidious onset, usually from age 30 or older, with insulin resistance. Management can often be achieved with diet alone or with oral agent therapy, although insulin is needed by many patients to achieve satisfactory glycaemic control.

Non-mydriatic camera
Fundus camera, on which retinal photography can be performed satisfactorily either with or without dilating the pupils with drops.

Non-proliferative diabetic retinopathy (NPDR)
Also termed ‘background’ retinopathy and includes all stages of diabetic retinopathy prior to the development of proliferative retinopathy. Features include retinal microaneurysms, haemorrhages, hard exudates, cotton wool spots, intraretinal microvascular abnormalities and venous beading. Signs of macular oedema are also classified as NPDR, if proliferative changes are absent.
New vessels on the disc (NVD)
If new vessels (neovascularisation) occur on or within one disc diameter of the disc margin, they are termed 'new vessels on the disc' (NVD).

New vessels elsewhere (NVE)
If new vessels (neovascularisation) occur in any other location, they are termed 'new vessels elsewhere' (NVE).

Ophthalmoscopy
Examination of the inside of the eye using a special instrument (ophthalmoscope).

Panretinal photocoagulation (PRP)
Application of photocoagulation burns (usually laser) to retinal areas outside the vascular arcade. PRP is the principal treatment technique for proliferative diabetic retinopathy and is usually applied in more than one treatment session. May be painful and require the use of peribulbar or retrobulbar local anaesthesia. Also termed 'scatter' photocoagulation.

Pars plana vitrectomy
An intraocular procedure through the pars plana of the eye to remove vitreous haemorrhage, excise fibrous or vitreous traction bands and to relieve retinal traction from these bands. Vitrectomy may be accompanied by an injection into the eye of an inert gas or silicone oil to provide retinal tamponade.

Photocoagulation (laser treatment)
Surgical technique in which laser light is used to treat ischaemic or oedematous retina in patients with diabetic retinopathy. Subject of large randomized clinical trails, including the DRS and ETDRS. See also 'Laser' or 'Argon Laser'.

Prevalence
The frequency of a particular disease or condition within a population at a designated point in time; a census type of measure.

Proliferative diabetic retinopathy (PDR)
An advanced stage of diabetic retinopathy which is characterised by the growth of abnormal new vessels and then fibrovascular proliferation on the retinal surface, in response to retinal ischemia. These vessels are fragile and tend to bleed causing pre-retinal or vitreous haemorrhage. Late contraction of the new vessels and fibrous bands produces retinal traction and may lead to tractional retinal detachment.

Refractive error
Optical defect of the eye which prevents light from being brought to a sharp focus on the retina.

Reliability
The reliability of a test is its capacity to give the same result, that is, positive or negative (whether correct or incorrect), on repeated testing of a person with a given level of disease.

Retinal detachment
See Rhegmatogenous retinal detachment or Traction retinal detachment.
Rhegmatogenous retinal detachment
Detachment of the neuro-sensory retina associated with the development of retinal holes or breaks.

Risk factors
Factors which indicate a higher risk of having a particular disease than in the general population. The distinction between a risk factor and a disease, however, is not always clear-cut, as illustrated by hypertension or nephropathy as risk factors for diabetic retinopathy.

Screening
Examination of a group of asymptomatic people considered at risk for a particular disease in order to detect any pre-clinical disease. People detected during screening as likely to have disease are investigated further to arrive at a final diagnosis. Screening is conducted on the basis that early detection can improve quality of life or survival rate.

Sensitivity
The ability of a test to designate people with pre-clinical disease as positive is referred to as the sensitivity of the test. The screening test sensitivity is thus the ratio of the number of people with pre-clinical disease who are positive on testing to the total number of people tested who have pre-clinical disease. Detected cases are termed 'true positives', while cases of disease with a negative test result are termed 'false negatives'.

Soft exudates
See cotton wool spot.

Specificity
The specificity of a test is its ability to designate as negative people who are not diseased. The specificity of a test also determines whether the frequency of false positives will be low enough for a screening program to be useful.

Traction retinal detachment
Disease in which the sensory retina is detached; may occur in the late stages of diabetic retinopathy due to contraction of fibro-vascular proliferation and retinal traction.

Visual acuity
A measure of the ability of the eye to see detail clearly. It is measured with standardised tests.

Vitreous
Clear jelly-like substance of the eye.

Vitrectomy
See Pars plana vitrectomy.
APPENDIX 6  ADDITIONAL READING AND REFERENCES


