

# Role of Early Screening for Diabetic Retinopathy in Patients with Diabetes Mellitus: An Overview

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## ABSTRACT

Diabetes has emerged as a major public health problem in India. It is estimated that there were 40 million persons with diabetes in India in 2007 and this number is predicted to rise to almost 70 million by 2025. The impact of rapid urbanization, industrialization and lifestyle changes has led to an increasing trend in prevalence of diabetes and its associated complications such as neuropathy, nephropathy, vascular diseases (cardiac, cerebral and peripheral) and retinopathy. Diabetic retinopathy is an important cause of avoidable blindness in India. Treatment interventions at early stages of diabetic retinopathy can reduce burden of blindness due to diabetic retinopathy. With the available cost-effective methods of early screening, appropriate strategies/models need to be developed. Such models need to have a well-developed mode for screening, diagnosis and referral at each hierarchical level beginning from primary health centers to specialized institutes for eye care. The National Program for Control of Blindness of India recommends opportunistic screening for identification of diabetic retinopathy. Every opportunity of contact with high-risk cases for diabetes and/or diabetic retinopathy should be utilized for screening, diagnosis and referral. All the stakeholders including the private sector will need to play a role. Along with this, awareness generation and behavior change amongst the diabetics and care support systems should also be part of the overall model. A major role can be played by community participation and improving the health seeking behavior among diabetics in order to reach a larger population and increasing the compliance for continued care.

**Keywords:** Community participation, diabetic retinopathy, public health problem, screening

## Introduction

Worldwide, the prevalence of diabetic retinopathy (DR) is increasing at an alarming rate. World Health Organization (WHO) has predicted that in India, the number of adults with diabetes will be the highest in the world: From 19 million in 1995 to 80 million in 2030.<sup>(1)</sup> Due to lack of proper screening and treatment facilities mainly at primary and secondary care level, many of the undiagnosed and uncontrolled diabetic patients become blind. The major risk factors for developing DR are

duration of diabetes<sup>(2,3)</sup> and severity of hyperglycemia.<sup>(3,4)</sup> The diagnostic and treatment facilities are limited to urban tertiary care centers which are unable to meet the needs of entire population. Over the last 20 years, DR has emerged as a common cause of ocular morbidity and blindness in India, moving up from number 17 (1986–1989 WHO-NPCB Survey, Government of India) to number 6 (2001–2002 NPCB national survey)<sup>(5)</sup> in the list of causes of blindness. Half of the people with diabetes are unaware that they have the disease and a third of diabetics never undergo eye examination.<sup>(6)</sup> About one-fifth of known diabetics are projected to have DR.<sup>(7)</sup> It is estimated that in a population of 1 million, there are 30,000–50,000 cases of diabetes, of which 5000–10,000 have DR and around 200–1000 of these patients require laser photocoagulation.

Timely intervention by laser photocoagulation can reduce severe visual loss by 90% according to early

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treatment diabetic retinopathy study (ETDRS)<sup>(8)</sup> and diabetic retinopathy study (DRS).<sup>(9)</sup> Early detection of DR and timely treatment of these patients remains a challenge for health care providers in the country.

### Importance of Screening in DR

Screening is a process by which unrecognized diseases or defects are identified by means of rapidly applied tests in apparently healthy individuals.

The four cardinal principles for screening recommended by the WHO<sup>(10)</sup> are as follows:

1. The condition should be an important health problem with a recognizable presymptomatic state.
2. An appropriate screening procedure which is acceptable both to the public and health care professionals should be available.
3. Treatment for patients with recognizable disease should be safe, effective and universally agreeable.
4. The economic cost of early diagnosis and treatment should be considered in relation to total expenditure on health care, including the consequences for leaving the disease untreated.

DR conforms well to these principles. In DR, early detection and treatment is of vital importance as it may prevent vision loss and blindness.

DR is a chronic disease with a long latent phase. Among the diabetics, 10–15% constitute type 1 diabetics and the remainder are type 2 diabetics. In about 10 years, DR develops in 71–90% patients with type I diabetes and this incidence rises to 95% in 20–30 years.<sup>(3)</sup> Out of these, 30–50% patients have proliferative DR.<sup>(11)</sup> In type II diabetes, 67% patients develop DR after 10 years,<sup>(12)</sup> with 10% patients showing features of proliferative DR. Up to a fifth of newly diagnosed diabetics have some form of retinopathy. Therefore, screening will prove to be beneficial at any stage of this long latent phase of the disease and will also be helpful in avoiding blindness among 90% patients.<sup>(13)</sup>

Screening for DR is cost-effective when compared with disability loss for people going blind in the absence of a screening program. The compliance for the screening program should be more than 80% for more gains.<sup>(14)</sup> The funds invested to increase compliance are small but a vital component of the costs of a screening program.

At a primary level, emphasis should be on early identification of diabetic patients from the community and an efficient referral system so that all the diagnosed cases of diabetes may be referred for further diagnoses and treatment of DR at secondary or tertiary level. It is suggested that patients with type I diabetes should

be screened annually for retinopathy, 5 years after the onset of diabetes. Patients with type II diabetes should have initial examination for retinopathy shortly after the diagnosis and the examination should be repeated annually or earlier, as per the severity of the retinopathy. Pregnant women with diabetes should have a comprehensive eye examination in first trimester and close follow-up throughout pregnancy.

At the secondary level, more emphasis is required to provide diagnostic facilities for DR. This involves availability of sufficient equipment for retinal examination and trained ophthalmologists for interpretation of findings to identify cases of DR requiring referral. These patients requiring further management for DR should be referred to tertiary level retina unit.

At tertiary level, one retina unit should be identified for every 5 million population where facilities of fundus photography, fluorescein angiography along with laser photocoagulation should be available for diagnosis and effective management of DR. The unit should also provide training facilities for secondary level service providers for diagnosis and referral of DR cases.

The program requires networking of the government and private hospitals, general physicians and non-governmental organizations (NGOs) with the secondary and tertiary level centers providing screening and diagnostic facilities for DR. At all points of interaction with the health professionals, the patient should be stressed about the need for good control of blood sugar and regular follow-up.

### Criteria for Review and Referral

1. Annual review but referral is not appropriate:
  - a. Normal fundus
  - b. Mild background diabetic retinopathy (BDR) with small hemorrhages and/or small hard exudes more than one disc diameter from fovea
2. Routine referral to ophthalmologists:
  - a. BDR with large circinate exudates within the major temporal arcades but not threatening the fovea
  - b. BDR without maculopathy but with reduced visual acuity to determine causes of visual impairment
3. Early referral to ophthalmologist:
  - a. BDR with hard exudates and/or hemorrhages within one diameter from the fovea
  - b. Maculopathy
  - c. Pre-proliferative DR
4. Urgent referral to ophthalmologist:
  - a. Proliferative DR
  - b. Pre-retinal or vitreous hemorrhage
  - c. Rubeosis iridis
  - d. Retinal detachment

## Screening Tests for DR

Many different modalities of screening are in use depending on the availability of local facilities. These include number of available ophthalmologists, other trained healthcare professionals, and equipment and resources available for screening. However, whichever method is used, it should have sufficient sensitivity (>80%) and specificity (>80%) for a single modality screening process. The minimum sensitivity for any method to be effective if it is repeated at the recommended interval is 60%. This level of sensitivity can be achieved with ophthalmoscopy through dilated pupils (Sensitivity = 65.7% and Specificity = 93.8%)<sup>(15)</sup> by suitably trained observers (principally ophthalmologists, optometrists, general practitioners, or physicians) or with non-mydriatic photography (Sensitivity = 87.3% and Specificity = 84.8%).<sup>(15-17)</sup> The sensitivity of detecting diabetic retinopathy by retinal photography has been reported to be higher than that of direct ophthalmoscopy (64% versus 41%; 95% confidence interval of difference, 1.2%- 44.3%).<sup>(18)</sup> Specificities of retinal photography and direct ophthalmoscopy have been reported to be 90% (95% confidence interval, 84%-96%) and 93% (95% confidence interval, 88%-97%), respectively.<sup>(18)</sup> Single field fundus photography with interpretation by trained readers could serve as a screening tool to identify patients of DR. Combining two modalities of screening (e.g. direct ophthalmoscopy in conjunction with retinal photography) provides excellent sensitivity (87.3%),<sup>(17)</sup> but increases the cost per case screened and is often only possible in a hospital-based setting. Screening involves measurement of visual acuity for both distance and near vision using ETDRS chart.

Tele-medical screening may be undertaken to screen patients with DR. A major advantage of digital technologies is the ability to transmit images to a centralized reading center for grading. This involves a remote imaging system, a centralized grading center and a data storage system. A significant increase in rate of DR surveillance and in the rate of laser treatment for DR may be achieved by implementing retinal image technology in the primary care setting.

Anterior segment examination is conducted using slit lamp to rule out complications of DR like rubeosis iridis and neovascular glaucoma. Posterior segment should be examined following pupillary dilatation with 1% tropicamide by indirect ophthalmoscope and +20 D lens by a trained ophthalmologist. For evaluation of macula, indirect biomicroscopy on a slit lamp with +90 D lens is the standard. The direct ophthalmoscope is limited in this respect as it offers a two-dimensional view. Other tests like fundus photography by a retina specialist to assess the severity of DR are required to determine the site of

leakage in macular edema and neovascularization. This helps in planning for the treatment of cases.

Based on an assessment of available cohort studies, the most effective strategy for testing is the use of mydriatic retinal photography with the additional use of ophthalmoscopy for cases where photographs are upgradeable.<sup>(14,17)</sup> This does not exclude the use of ophthalmoscopy alone for opportunistic case finding but there is evidence of considerable variation in effectiveness of this test. Screening for DR needs to be community based in addition to clinic-based services and can include a range of examination modalities. The use of the non-mydriatic camera (Sensitivity = 97.7% and Specificity = 84.0%)<sup>(19)</sup> empowers an additional cadre of health professionals who can participate in screening programs. Screening of diabetics by ophthalmic technicians increases the outreach to the periphery with sufficient sensitivity and specificity and is cost-effective.<sup>(20)</sup>

## Screening Models for DR

### Diabetes screening camps

The screening camps are for screening diabetes with a focus to enhance awareness of diabetes and DR at a primary level. Screening camps for diabetes can be organized by general hospitals, endocrinologists and local NGOs. All patients above 30 years of age should undergo screening of diabetes by finger prick method for random blood sugar estimation using a glucometer. High-risk screening should be promoted to examine patients with positive family history of diabetes mellitus. Any person with random blood sugar more than 200 mg/dl is considered as newly diagnosed case of diabetes and should be referred for further diagnosis of diabetes and screening for DR. Community participation is the key to success for screening. Local village groups like women's self-help groups and volunteers play an important role in motivating diabetics to attend screening camps.

### DR screening camps

In these camps, all diabetic patients referred through a network from government and private hospitals, general physicians and diabetologists, laboratories and through diabetic screening camps are screened for DR. The eye examination includes visual acuity using EDTRS chart, anterior segment evaluation by slit lamp, dilated fundus evaluation with indirect ophthalmoscope and +20 D lens. Patients with sight-threatening DR are referred to base hospital for further management and treatment.

### Comprehensive eye screening camps

Screening for DR is done along with screening for other blinding ocular conditions. Dilated fundus examination using indirect ophthalmoscope and +20 D lens is done

by a trained ophthalmologist. The cases of DR like severe non-proliferative DR and proliferative DR are referred for further management.

### Opportunistic screening model

As opposed to population-based screening, opportunistic screening relies on detection of disease in patients who present to health care providers for various complaints. Most elderly patients, those with a family history of diabetes (all at risk for diabetes and diabetic eye disease), visit the ophthalmologists and optometrists for other eye care need. They also visit physicians for medical needs. These high-risk patients visiting the health care providers for other problems may be screened for DR. To be effective, ophthalmologists, optometrists, diabetologists, physicians and other health care personnel, must all be involved in such case detection. The National Program for Control of Blindness of India also recommends opportunistic screening for identification of DR.

### Tele-DR screening approach

In this approach, a mobile van with satellite connection goes to remote areas and trained ophthalmic technicians take digitized fundus images which are viewed in real time by retinal specialist at base hospital. The patients with DR are identified at primary level and are referred to the base hospital where further treatment and diagnosis can be done. This method reduces the cost of transporting all cases to the base hospital.

## Detection of DR at Various Levels of Service Delivery

Personnel involved in the detection of diabetes and DR at each level of service delivery in the health care system are as follows:

### PHC medical officers and general physicians

The medical officer should check the capillary blood sugar of each patient over 30 years the first time they are seen, or earlier if they have symptoms or a positive family history, and then every 2 years after that. If the result is more than 140 mg/dl, they should be entered into a diabetic register and the patient should be referred to a physician at the secondary center. They should do a dilated fundus examination if possible; if not, they should refer the patients to an ophthalmologist for an eye check-up.

### Ophthalmic assistants and optometrists

Any patient they see, who is more than 30 years or has a family history of diabetes, should be asked to get their blood sugar checked. For existing and newly detected diabetics, they should do a visual acuity check-up, refraction and a dilated fundus examination with a direct ophthalmoscope. If there is any abnormality, they are

referred to an ophthalmologist; if not, they are asked to come for an annual check-up.

### Laboratory technicians

Those patients with a high blood sugar (>140 mg/dl) or positive urine sugar should be advised to see a physician for the control of diabetes and to have his/her eyes checked by an eye care provider.

### Opticians

All presbyopic patients are advised to get their blood sugar examined. All patients not improving to 6/9 in either eye or those who are known diabetics should be asked to get a detailed examination from an ophthalmologist/optometrist.

### Pharmacist

Every patient who comes to buy any anti-diabetic medicine should be asked to get his/her blood sugar examined, visit a physician and an ophthalmologist once every year.

### Diabetologists/Endocrinologists

All newly diagnosed diabetics should be referred to an ophthalmologist for bilateral ocular examination and counseled about annual fundus examination.

### Ophthalmologist (sub-district/district and private)

The ophthalmologists during the first contact should do a detailed evaluation and undertake comprehensive eye examination. They should grade DR and refer for treatment, if required. They should also counsel the patient for regular follow-up.

## Community Participation in DR Screening

WHO defines community participation as "an educational and empowering process, in which people work in partnership with those who are able to assist them, identify the problems and needs, increasingly assume responsibility themselves to plan, manage, control and assess the collective actions that are proved necessary".

The stress on community participation is, in effect, recognition of the fact that the people are the most important and valuable resources of the country and often this resource remains untapped. Capacity of the communities shall be developed to identify their own problems and find possible solutions or support from within them. An approach of community need assessment should be adopted to assess the status of diabetic care and any disparities in the community. Communities and health care systems should first assess the prevalence of DR and associated blindness in the community. Then, the level of awareness in the community and level of care and education provided to persons with diabetes should be



assessed at the community level. Community approaches can then be developed to address the health disparities and improve care and quality of life.

### Role of community

Awareness generation in target groups for DR, namely, persons with diabetes and their families and high-risk general population, by health care providers and volunteers (NGOs/self-help groups). The following key messages should be given:

- about the disease and its complications;
- about the available treatment opportunities;
- social, economic and health-based repercussions of blindness on not only the patient but also the entire family; and
- about preventive care – all people with diabetes need dilated eye examination once a year.

### Support to diabetics for self-management

Community settings are the key potential sites for diabetes self-management education interventions. They help to inculcate positive health seeking behavioral change and teach lifestyle changes, including diet. Home-based training might be easier and helpful for persons with disabilities or with socio-cultural barriers. The aim of such support programs is to provide individuals and community with the means to promote their own well-being, and in this case, to participate in their own health care.

### Support to other social institutions

- Family support: People with early symptoms are encouraged by their family members to attend eye care services. Also, families are motivated to adopt changes in lifestyle to prevent and/control diabetes and eye diseases. The families can also provide support and motivation for continued care in such chronic diseases.
- Other social institutions and help groups: Industrial groups in urban areas, old age homes, community support systems for rehabilitation can also be a motivating and educational center for screening patients and adopting healthy practices to prevent or control DR.

Any model of community capacity building/community partnerships should be comprehensive, need-based and community-oriented, acceptable to all stake holders/partners, effective in fostering and sustaining change, adaptable to other communities, and sustainable after the funding ceases.

### Screening of DR in relevance to the national programmes

The National Diabetes Control Programme aims to decrease the burden of diabetes by improving the

health care delivery system. The pattern of diabetes treatment and management can be improved through a multi-pronged approach involving healthcare professional training, awareness campaign, patient education and training of other medical personnel involved in the management of diabetes and referral for its complications like retinopathy. A systematic approach to improve awareness about diabetes, its complications and its control both among patients and the medical fraternity is the need of the hour in India today.

Through the programme, awareness needs to be created at all levels of health care delivery. The general practitioners should refer all diabetic patients to an ophthalmologist for an eye check-up. The Diabetologists or Endocrinologists should refer all newly diagnosed diabetics to an ophthalmologist for bilateral ocular examination and counseled about annual fundus examination. Diabetes and DR can be brought under control by organizing public awareness campaigns and events and diabetes health awareness programmes to address the general public and policy and decision makers. Training of medical staff and community nurses in screening patients of diabetes and referral to ophthalmology centres, registration of diabetes societies and helping poor diabetes patients, conducting or facilitating training or continuing medical education to community workers and other paramedical staff, organizing awareness training programmes among various target groups (patients and their families, high risk groups, policy makers, programme managers and the general public), education of the public and patients on diabetic retinopathy and its importance can be mobilized through the programme to decrease diabetes associated morbidity and blindness.

The National Blindness Control Programme lays stress on the prevention, screening and management of DR. The Eleventh plan of NPCB (2007-12) clearly emphasizes the need to screen for DR, in known diabetic patients and at risk population. Opportunistic screening by ophthalmologists of all diabetic patients attending diabetic clinics and hospitals need to be stressed. The operational guidelines for this are by screening all known diabetics for DR and providing laser treatment to those who may require it. All diabetic patients referred through a network from government and private hospitals, general physicians and diabetologists, laboratories and through diabetic screening camps, are screened for diabetic retinopathy. Proper emphasis on Information, Education and Communication and early diagnosis in relatives having DM could go a long way in capturing hidden cases of DM in the community.

### Conclusion

India needs DR screening programs for early identification of the condition, supported by hierarchical referral

structure to provide appropriate timely treatment to reduce the burden of blindness due to diabetes. This shall be done by incorporating and streamlining such models in the existing health infrastructure with public private partnerships and community involvement. Every opportunity of contact with the high-risk cases for DR at any health service facility shall be utilized to identify patients of DR.

## References

- World Health Organization: What is diabetes? article online Available from <http://www.who.int/mediacentre/factsheets/fs312/en/index.html>. [Last accessed 2009 May 22]. Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes: Estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004;27:1047-53.
- Leske MC, Wu SY, Nemesure B, Hennis A; Barbados Eye Studies Group. Causes of visual loss and their risk factors: An incidence summary from the Barbados Eye Studies. *Rev Panam Salud Publica* 2010;27:259-67.
- Elshafei M, Gamra H, Khandekar R, Al Hashimi M, Pai A, Ahmed MF. Prevalence and determinants of diabetic retinopathy among persons  $\geq 40$  years of age with diabetes in Qatar: A community-based survey. *Eur J Ophthalmol* 2010;21:39-47.
- DCCT Research Group: The relationship of glycemic exposure (HbA1c) to the risk of development and progression of retinopathy in the diabetes control and complications trial. *Diabetes* 1995;44:968-83.
- Murthy GV, Gupta SK, Bachani D, Jose R, John N. Current estimates of blindness in India. *Br J Ophthalmol* 2005;89:257-60.
- Mohan D, Raj D, Shanthirani CS, Datta M, Unwin NC, Kapur A, *et al.* Awareness and knowledge of diabetes in Chennai—the Chennai Urban Rural Epidemiology Study [CURES-9]. *J Assoc Physicians India* 2005;53:283-7.
- Dandona L, Dandona R, Naduvilath TJ, McCarty CA, Rao GN. Population based assessment of diabetic retinopathy in an urban population in southern India. *Br J Ophthalmol* 1999;83:937-40.
- ETDRS Research Group: Early photocoagulation for diabetic retinopathy. ETDRS report number 9. Early Treatment Diabetic Retinopathy Study Research Group. *Ophthalmology* 1991;98(5 Suppl):766-85.
- Diabetic Retinopathy Study Research Group: Photocoagulation treatment of proliferative diabetic retinopathy: Clinical application of diabetic retinopathy study (DRS) findings, DRS report number 8. *Ophthalmology* 1981;88:583-600.
- World Health Organization. Principles of Screening. Geneva: World Health Organization; 2001.
- Klein R, Klein BE, Moss SE, Davis MD, DeMets DL. The Wisconsin epidemiologic study of diabetic retinopathy. II. Prevalence and risk of diabetic retinopathy when age at diagnosis is less than 30 years. *Arch Ophthalmol* 1984;102:520-26.
- Klein R, Klein BEK, Moss SE, Linton KL. The beaver Dam Eye Study. Retinopathy in adults with newly discovered and previously diagnosed diabetes mellitus. *Ophthalmology* 1991;99:58-62.
- Ferris FL. Results of 20 years or research on the treatment of diabetic retinopathy. *Preventive Medicine* 1994;23:740-42.
- Dasbach EJ, Fryback DG, Newcomb PA, Klein R, Klein BE. Cost-effectiveness of strategies for detecting diabetic retinopathy. *Med Care* 1991;29:20-39.
- Owens DR, Gibbins RL, Lewis PA, Wall S, Allen JC, Morton R. Screening for diabetic retinopathy by general practitioners: Ophthalmoscopy or retinal photography as 35 mm colour transparencies? *Diabet Med*. 1998;15:170-5.
- Moss SE, Klein R, Kessler OD, Richie KA. Comparison between ophthalmoscopy and fundus photography in determining severity of diabetic retinopathy. *Ophthalmology* 1985;92:62-7.
- Benbassat J, Polak BC. Reliability of screening methods for diabetic retinopathy. *Diabet Med*. 2009;26:783-90.
- Siu SC, Ko TC, Wong KW, Chan WN. Effectiveness of non-mydratric retinal photography and direct ophthalmoscopy in detecting diabetic retinopathy. *Hong Kong Med J*. 1998;4:367-370.
- Boucher MC, Gresset JA, Angioi K, Olivier S. Effectiveness and safety of screening for diabetic retinopathy with two nonmydratric digital images compared with the seven standard stereoscopic photographic fields. *Can J Ophthalmol*. 2003;38:557-68.
- Wilson PJ, Ellis JD, MacEwen CJ, Ellingford A, Talbot J, Leese GP. Screening for diabetic retinopathy: A comparative trial of photography and scanning laser ophthalmoscopy. *Ophthalmologica*. 2010;224:251-7.

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