Diabetic retinopathy screening – Widen the net, tighten the mesh

"In public health, we can't do anything without surveillance. That's where public health begins." - David Satcher

Diabetes mellitus (DM) is a rapidly evolving public health problem in India. There were an estimated 77 million people in India with DM in 2019, set to increase to 101 million by 2030, and 134 million by 2045.[1] The National Survey 2015–2019 reported that 16.9% of those with DM had diabetic retinopathy (DR) in India, and 3.6% had sight-threatening DR (STDR).[2] The sheer numbers and the understanding that blindness due to DR is preventable if detected early, and managed appropriately, make a strong case for an efficient and effective DR screening net.

DR screening in India has been traditionally population-based and opportunistic. The United Kingdom model provides compelling evidence that systematic screening integrated with timely treatment can provide wider coverage and effectively reduce vision impairment and blindness.[3] A few pilot studies have demonstrated the feasibility of this approach in our country.[4] Selective (targeting diagnosed DM), systematic (screening of the selected population at a pre-determined periodicity), and integrated screening (screening integrated with a structured vertical referral for confirmation of diagnosis and appropriate management) is the way forward.[5]

Who to Screen

It is recommended that all people with known DM on treatment, not a known diabetic but with random blood sugar of ≥200 mg/dL or glycated hemoglobin (HbA1c) >6.5%, and women with gestational diabetes should be screened for DR.[6] It entails the establishment of a comprehensive National Diabetes Registry. While it may be simpler to register the newly diagnosed diabetics prospectively at the first point of diagnosis, the existing diabetics could be included at follow-up visits to treatment centers, medical laboratories at the point of hematological investigations, and pharmacies at the point of dispensing insulin and oral anti-diabetic agents, and by opening a portal for self-registration by the patient. The opportunistic screening of high-risk populations (age ≥50 years) for undiagnosed DM will further widen the base. The National Diabetes Registry can help geo-tag patients, assign screening, diagnosis, and treatment centers, provide recall reminders at fixed periodicity, track dropouts, monitor the progress, and measure the outcomes.

How to Screen

The gold standard for DR screening is mydriatic 30° stereoscopic color fundus photography in seven standard fields.[7] The pupil dilatation warrants prior assessment of the anterior chamber depth by an ophthalmologist or an optometrist for potential angle closure and is time-intensive. The nonmydriatic 45° digital fundus photography is rapid and comfortable and can be performed by non-ophthalmic health professionals but with sensitivity and specificity as trade-offs. [28] While mydriatic 3-field 45° color fundus photography has the highest sensitivity and specificity, and importantly, the lowest rate of ungradable images, nonmydriatic single-field 45° color fundus photography may be acceptable with targeted/staged mydriasis. The images are best graded by trained, certified/accredited ophthalmic technicians, or optometrists, or ophthalmologists. The Comparison Among Methods of Retinopathy Assessment (CAMRA) study showed 50 and 59% sensitivity and 94 and 100% specificity of smartphones to detect DR and STDR, respectively.[8] The detection rate improves using artificial intelligence (AI)-based automated software integrated with smartphone-based photography—96 and 99% sensitivity for DR and STDR, respectively, and 80% specificity for both.[9] Selfie fundus imaging (SFI) was 98% gradable with 88% sensitivity, and 86% (0.77 kappa) agreement with standard fundus photograph for the detection of DR.[10] SFI using kiosks with AI-based automated software may help resolve the issue of accessibility for DR screening. The miniaturization of nonmydriatic retinal imaging systems with auto-centration, wider field of imaging, and improved resolution, with capability for SFI, integrated with AI-based grading and geo-tag-determined referral to the nearest diagnosis and treatment center will help make DR screening universally accessible.

When to Refer

It is recommended that patients with no DR or mild non-proliferative DR are referred to an ophthalmologist within a year; moderate non-proliferative DR is referred within 3–6 months, while severe non-proliferative DR, proliferative DR, and macular edema are triaged for immediate referral.[6] The imminent need is to identify and map DR diagnostic and treatment centers with fellowship-trained medical and surgical retina specialists or trained and certified comprehensive ophthalmologists across the country and integrate these with existing facilities within the National Health Mission so that patient referral is systematically channelized. The optimal public-private partnership will minimize duplication of the resources and ensure wider coverage.

Is Structured National DR Screening and Treatment Program Feasible?

It appears that time the is ripe to integrate the resources under the National Program for Control of Blindness and the National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke with the vast public and private ophthalmology and optometry clinical care networks and set up an integrated National Diabetic Retinopathy Screening and Treatment Program. It should have training, clinical care (screening, diagnosis, treatment), and research as integral components. Table 1 shows the suggested levels of care, functions at each level, and the potential referral chain, blending the available public health facilities with the components of the LVPEI pyramidal eye care delivery model.[11]

Table 1: Proposed levels of care for diabetic retinopathy screening, diagnosis, and management

Levels of Care	Population Unit	Key Professionals	Facilities for Diabetic Retinopathy (DR) Screening, Diagnosis and Management, and Functions at each level
Level 1: Population-based Health Surveillance	1000	Accredited Social Health Activist (ASHA)	Community-based screening for DM, Sensitization and Public education, Referral of diabetics to Level 2 for DR Screening
Level 2: Sub-health Center	5000	Vision Guardian	Smartphone Fundus Camera with grading at a Reading Center, Referral of screening positive to Level 5 as per DR referral guidelines
Level 3: Primary Eye Care Center, Primary Health Center Coopted Practicing Ophthalmologists and Existing Vision Centers	30000-50000	Vision Technician	Hand-held Fundus Camera with grading at a Reading Center, Referral of screening positive to Level 5 as per DR referral guidelines
Level 4: Community Eye Care Center, Community Health Center Coopted Practicing Ophthalmologists and Private Eye Hospitals	120000-150000	Optometrist	Hand-held Fundus Camera with grading at a Reading Center, Referral of screening positive to Level 5 as per DR referral guidelines
Level 5: Secondary Eye Care Center, Sub-divisional Hospital Coopted Practicing Ophthalmologists, Private Eye Hospitals, and Existing Secondary Centers	0.5-0.6 million	Ophthalmologist trained in the medical retina with telementoring by a Tertiary Eye Care Center	Fundus Camera, Fluorescein Angiography, Optical Coherence Tomography, Laser, Intravitreal Injection, Training of Levels 1-4, Reading Center, Referral of DR needing surgery to Levels 6-8
Level 6: Tertiary Eye Care Center, District Hospital Coopted Practicing Specialists, Private Eye Hospitals, and Existing Tertiary Care Center	3-5 million	Specialist Ophthalmologists	Complete Vitreoretinal Medical and Surgical Unit, Training of Level 5, Referral of DR needing complex surgery to Levels 7-8
Level 7: Apex Center, Medical College Ophthalmology Department Coopted Practicing Specialists, Private Eye Hospitals, and Existing Apex Center	30-50 million	Specialist Ophthalmology Units	Complete Vitreoretinal Medical and Surgical Unit equipped for complex surgeries, Training of Levels 5 and 6, Rehabilitation, Clinical Research
Level 8: Center of Excellence Coopted Existing Centers of Excellence	300-500 million	Specialist Ophthalmology Units, Disease-based experts	Complete Vitreoretinal Medical and Surgical Unit equipped for complex surgeries, Training of Levels 5-7, Basic, Clinical, and Operational Research
National Diabetic Retinopathy Screening and Treatment Program Command Center	National	Public Health Professionals, Domain Experts	Policy, Planning, Implementation, Data Management, Quality Control, Research, Reports, Operational Training

We Missed the Goalpost 2020—Let us Catch up with 2030

With the epidemic of DM-related visual impairment and blindness looming on us, it is imperative that India plans and implements the National Diabetic Retinopathy Screening and Treatment Program in a mission mode. Selective, systematic, structured DR screening program, seamlessly integrated with the National Diabetes Registry as the broad information and reporting base and vertically with stratified diagnosis and treatment centers should enable us to minimize the incidence of DR-related avoidable blindness by 2030. A robust public health approach is the key to success.

"There is no human endeavor that is outside the realm of public health." - William Foege

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References

1. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, *et al.* Global and regional diabetes prevalence estimates for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. Diab Res Clin Pract 2019;157:107843.

2. Vashist P, Senjam SS, Gupta V, Manna S, Gupta N, Shamanna BR, *et al.* Prevalence of diabetic retinopahty in India: Results from the National Survey 2015-19. Indian J Ophthalmol 2021;69:3087-94.

3. Liew G, Michaelides M, Bunce C. A comparison of the causes of blindness certifications in England and Wales in working-age

adults (16–64 years), 1999–2000 with 2009–2010. BMJ Open 2014;4:1-6.

4. Murthy GV. Situational analysis of diabetic retinopathy screening in India: How has it changed in the last three years? Indian J Ophthalmol 2021;69:2944-50.

5. Diabetic retinopathy screening: A short guide: Increase effectiveness, maximize benefits and minimize harm 2020. World Health Organization. Regional Office for Europe. Available from: https://apps.who.int/iris/handle/10665/336660.

6. Raman R, Ramasamy K, Rajalakshmi R, Sivaprasad S, Natarajan S. Diabetic retinopathy screening guidelines in India: All India Ophthalmological Society diabetic retinopathy task force and Vitreoretinal Society of India Consensus Statement. Indian J Ophthalmol 2021;69:678-88.

7. Early Treatment Diabetic Retinopathy Study Research Group. Grading diabetic retinopathy from stereoscopic color fundus photographs -an extension of the modified Airlie House classification. ETDRS report number 10. Ophthalmology. 1991;98(5 Suppl):786–806.

8. Ryan ME, Rajalakshmi R, Prathiba V, Anjana RM, Ranjani H, Narayan KM, *et al*. Comparison Among Methods of Retinopathy Assessment (CAMRA) Study: Smartphone, nonmydriatic, and mydriatic photography. Ophthalmology 2015;122:2038–43.

9. Toslak D, Liu C, Alam MN, Yao X. Near-infrared light-guided miniaturized indirect ophthalmoscopy for nonmydriatic wide-field fundus photography. Opt Lett 2018;43:2551–4.

10. Kumari S, Venkatesh P, Tandon N, Chawla R, Takkar B, Kumar A. Selfie fundus imaging for diabetic retinopathy screening. Eye 2021. doi: 10.1038/s41433-021-01804-7.

11. Rao G. The Barrie Jones Lecture-Eyecare for the neglected population: Challenges and solutions. Eye 2015;29:30–45.