

Diabetic retinopathy screening in the public sector in India: What is needed?

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India has been witnessing an epidemic of diabetes for several years now. A large proportion of patients with undiagnosed and poorly controlled diabetes are at great risk of developing diabetic retinopathy (DR) and irreversible blindness. The goal of DR screening is to identify people with sight-threatening DR early so that prompt treatment can be initiated, and blindness can be prevented. Systematic DR screening is essential to identify disease early, and a national effort for the same is required. We adopt a health system approach to outline the actions that need to take place for effective DR screening in the public sector in India. We discuss the role of national leadership, needs assessment, finalization of DR screening and referral pathway, trainings, strategies to improve the uptake, allocation of roles and responsibilities, public-private partnerships, quality control, and financing.

Key words: Diabetic retinopathy, health systems, National program, public health, screening

India has a high burden of type 2 diabetes mellitus (T2DM). As per the International Diabetes Atlas 2019, there were 77 million people afflicted with T2DM in the country, and it is expected to increase to 101 million by 2030 and 134.2 million by 2045.^[1] With a national prevalence of 8.9% across the 20–79-year age group, roughly 1 in 11 adults in India is affected by T2DM. The issue is compounded by the high proportion of persons with undiagnosed T2DM (57%, 43.9 million in 2019). Additionally, among those who are diagnosed, one-third to half may have a poorly controlled disease. All these lay a fertile ground for the development of diabetic complications including microangiopathies such as diabetic retinopathy (DR).^[2,3] Unlike a cataract, refractive errors, or corneal blindness, patients suffering from DR often retain normal visual acuity, even with advanced DR changes. This means that by the time a patient develops symptoms, extensive DR changes have already occurred, and the patient may require laser or anti-vascular endothelial growth factor (anti-VEGF) treatment to halt vision loss. DR develops gradually and we have years and years to detect the disease early. But that can only happen if we start screening for DR. The goal of DR screening is to identify people with a sight-threatening DR early so that prompt treatment can be initiated, and blindness be prevented.

In recent years, a large body of evidence has accumulated on the requirements for DR screening, the gaps in knowledge, various models of screening for DR, as well as innovations in the screening methods. Recently, the All India Ophthalmological Society (AIOS) and the Vitreo Retinal Society of India (VRSI) came out with the consensus guidelines for DR screening in

India.^[4] One of the major points emphasized in those guidelines was the need for population-level screening for diabetes and its complications. Strategies at different levels of the public health system for the control of visual loss from DR in India have also been developed under the Queen Elizabeth Diamond Jubilee Trust program.^[5,6] The World Health Organization (WHO) has also recently published DR screening guidelines.^[7] One of the key recommendations of these guidelines is to take an integrated approach for people with diabetes to minimize blindness due to DR. The purpose of this review is to build on this knowledge and adopt a health system approach that can guide the actions for effective DR screening in the public health sector in India.

From Opportunistic to Systematic Screening

Opportunistic screening refers to DR screening when a patient attends the ophthalmology clinic for other complaints or investigations. It is considered relatively easier to establish and offers high quality, with a major shortcoming being able to target only the local population. Systematic screening aims to include the whole population at risk in its target group.^[8] The majority of the DR screening efforts start as opportunistic screening in select health facilities. Scaling up to systematic screening is complex but is necessary given the growing burden of diabetes in India. Planning a systematic DR screening program requires a health systems approach. Based on their

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Cite this article as: Gupta V, Azad SV, Vashist P, Senjam SS, Kumar A. Diabetic retinopathy screening in the public sector in India: What is needed?. Indian J Ophthalmol 2022;70:759-67.

Access this article online

Website:
www.ijo.in

DOI:
10.4103/ijo.IJO_1298_21

Quick Response Code:



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Received: 19-May-2021

Revision: 31-Jul-2021

Accepted: 24-Sep-2021

Published: 25-Feb-2022

experience in Sub-Saharan Africa, Poole and colleagues have described a five-step approach for transition to systematic screening services. These include gradual expansion of the scope of the screening target from the eye clinic to the hospital diabetes clinic, actively calling patients with diabetes enrolled with the hospital, identifying and calling patients in the community, and finally to a nationwide DR program.^[9]

Experiences with DR Screening in Public Sector

One of the leading global examples in the public sector is the DR screening program in England. This program started as an opportunistic screening program till 2003 when the national systematic screening program was recommended. Under this program, all individuals with diabetes aged 12 years or older are eligible. The program is based on screening by qualified screeners who do two-field retinal photography which is graded at the central locations by qualified graders. The program also includes a comprehensive quality assurance system including regular auditing of screenings carried out by the central creators. One of the major achievements of the program has been high coverage.^[10-12] Nationwide or regional population-based systematic diabetic eye screening programs have also been implemented in many European countries (Iceland, Ireland, Norway, Denmark, Sweden, the Netherlands, Czech Republic, Italy, Poland, Serbia, Hungary, Turkey). Substantial progress has also been made in Botswana, China, Singapore, Indonesia, and Bangladesh.^[8] A review of these programs has identified key factors for success and challenges [Table 1].

Public sector DR screening in India

There have been many efforts for facility-based DR screening in India. Dr RP Centre, AIIMS, New Delhi, had initiated a screening program for DR initially based on camps approach in various

public locations and subsequently in public health facilities run by the Delhi Government. The screening strategy under this program was based on the utilization of non-mydiatic fundus cameras by trained optometrists who would conduct fundus photography as well as grading in the public healthcare setting. The patients who were already diagnosed as suffering from diabetes were referred by the medical officer, nurses, Accredited Social Health Activist (ASHA) workers, health workers, and self-referrals. The screening at each center was organized at an interval of 10–15 days and the schedule of the screening program was shared in advance with the medical officers and health workers. The program was run as much as possible as a part of the routine activities of the public health system. A simple one-page form was filled for each screening activity recording the patient's age, gender, duration of diabetes, presence of comorbidities, glycemic control status, and the outcome of the retinopathy assessment. The participants who were screened positive were assisted in referrals to the base hospital where free management of DR was insured through the retina services of the hospitals. It was observed that the program was successful in screening a large number of patients with diabetes but challenges were observed in ensuring follow-up of the patients who were identified as having DR and were referred to the base hospital.^[13]

A major program for screening of DR was initiated under the Aegis of Queen Elizabeth Diamond Jubilee trust in 10 states of India.^[14-18] The program relied on the identification of the patients with diabetes through clinics for non-communicable diseases (NCD) in various government facilities or through line-listing followed by community service. Once identified, the persons with diabetes were screened by the paramedical ophthalmic assistant (PMOA) or optometrists primarily, or by trained nurses (Maharashtra and Tamil Nadu). Under this program, over 6,000 government personnel were trained including 41 ophthalmologists, 183 ophthalmic technicians, and 6,000 plus frontline workers. Over 55,000 patients of diabetes were screened for DR, and among them, nearly 6,200 had changes in their fundus images and 2,361 were finally treated. This program also included the development of Information Education Communication (IEC) material for awareness about vision loss due to DR and strengthening of the health system. It identified the follow-up of the patients screened with DR as a major challenge. In one of the implementations in Tukur, Karnataka, 85% of the registered patients with diabetes in the government non-communicable disease clinics were screened for DR and the treatment could be provided to 95% of those needing laser therapy.^[19] An Electronic Medical Record (EMR) was used which helped increase the uptake of treatment by tracking defaulters. It was observed that poor awareness of DR was associated with poor uptake of screening. Poor communication was observed between the physicians treating people with diabetes and ophthalmologists. There was an absence of structured follow-up mechanisms. Lack of dedicated personnel and clinic space were additional challenges in some states. Another challenge was tracking people with diabetes through the care pathway, from non-communicable disease clinics to eye-care providers. The project software was not used optimally in some states. In some districts, the eye-care personnel, such as ophthalmic assistants, who could be trained to screen for DR, were not available.^[20]

The Samvedna Eye Care project was initiated by the Ahmedabad Municipal Corporation (AMC) in collaboration

Table 1: Factors promoting success, and challenges and barriers observed in large-scale systematic DR screening programs. Adapted from^[8]

Factors promoting success	Challenges and barriers
Equitable and widespread access to laser treatment and trained staff (including administrative staff)	Decentralized healthcare, or mainly private insurance-based healthcare have shown low success
Initiation as local screening programs that are scaled up	Eligible population for screening increases each year putting strain on the budget
Screening offered at times and locations that meet the needs of the patient	Majority of patients do not show any DR on annual examination and are likely to progress slowly
Centralized registers of eligible people are essential and need constant updates	Less than 85% uptake of the annual eye screening invitations observed consistently in England
Buy-in from healthcare professionals, patients, and their families is crucial	Non-attendance at screening substantially increases the risk of the subsequent detection of vision-threatening retinal features
Accurate data collection, review, and reporting	Isolated DR screening without management of diabetes, specialist ophthalmic services, and patient engagement is almost certainly bound to fail

with World Diabetes Foundation (WDF) during 2008–2012.^[21,22] It included the components of training of ophthalmic and para-ophthalmic personnel, screening, referral, and awareness generation activities. Under the project, the intern doctors, family physicians, optometry students, and community and social workers were trained with the purpose of motivating them to educate the patients on the need for ophthalmological examination and awareness creation. The screening for DR was done through two approaches: (a) screening patients with known diabetes in municipal corporation hospitals, and (b) screening camps for the public throughout the city, conducted fortnightly. All screened patients were also given information about diabetes, its complications, and other relevant issues, and mass media was used for awareness generation in the community.^[21]

The Sankara Nethralaya Diabetic Retinopathy Program (SNDRP) was initiated in 2003 with the support of the Lions Club International Foundation.^[23] The program focused on awareness creation, and training physicians and ophthalmologists in DR diagnosis and nearly 350 doctors were trained. Subsequently, tele-DR screening initiatives supported by WDF, Denmark and Lions Clubs International Foundation (LCIF), USA, have been initiated through a teleophthalmology mobile van equipped with tools for retinal screening.^[24,25] Two such pilot projects have been done in Tamil Nadu (two districts) and Karnataka (six districts). Newer strategies like artificial intelligence-assisted DR screening at physician clinics and anterior segment ophthalmologist out-patient departments (OPDs) have also been implemented.^[26,27]

The Aravind Eye Care System has also implemented multiple models for DR screening in the public health system. It has been involved with the use of teleophthalmology and teleconsultation for DR for many years.^[28] A nurse-led screening model was implemented with the support of the Queen Elizabeth Diamond Jubilee Trust in five blocks in the Tirunelveli District covering five common health centers (CHCs) and 13 (out of 99 total) primary health centres (PHCs).^[15] This model also included components of capacity strengthening at all levels, followed by the implementation of the care pathway. PMOAs and staff nurses were trained in fundus photography. The PMOAs at the CHC were also trained in optical coherence tomography (OCT) and fundus fluorescein angiography (FFA). The ophthalmologists at the Tirunelveli Medical College were trained in laser management as well as in reading and grading the fundus images using a software. The DRROP software developed by Public Health Foundation of India (PHFI) for Trust program was used for data management. The DR screening, counseling, referral, and follow-up tasks were assigned to the NCD nurses at the respective community health centers and primary health centers using the telemedicine platform. The project was successful with 75.4% of the people with diabetes being screened and the state government agreeing to scale up the services in three more districts.

The Ornate India project and the related Nayanamritham study include collaborations between researchers from the UK and India, and the Government of Kerala.^[29-32] The Ornate study aimed to build research capacity and capability in India to tackle diabetes-related visual impairment. The Nayanamritham study aimed to pilot a DR care pathway in the Thiruvananthapuram district, spanning primary, secondary, and tertiary care. This included components of (a) training nurses and doctors in the

family health centers on DR management (b) training nurses to take retinal images using handheld smartphone-based cameras (c) collection of research data through data entry operators (d) setting up a centralized grading center at the Regional Institute of Ophthalmology, and (e) referral linkage with the district hospitals for the management of patients identified with DR. The patients with diabetes attending the health centers for routine clinical care were invited for DR screening. An important finding of the study was the observed necessity to dilate to increase the gradeability of the retinal images. Of the 5,307 patients screened for DR, 31.3% needed a referral for treatment of sight-threatening DR, or because of ungradable images. Based on the study results, the Government of Kerala has implemented a policy to screen all the people with diabetes registered in the primary care clinics for DR.

Another notable state government-led initiative is the Mukhyamantri e-Eye Kendram by the Government of Andhra Pradesh in the public-private partnership (PPP) mode for eye care in 115 CHCs across 13 districts of the state. These centers are equipped with fundus camera,^[33,34] and cloud-based teleophthalmology software that enable DR screening. Over 1,55,013 fundus checks have been completed under the program.^[35]

The Way Forward for Systematic DR Screening in Public Sector in India

We base our recommendations on the current structure and activities of the National Program, the challenges unique to India and the WHO's recent guidance on the implementation of systematic DR screening programs. Based on our experience, and current global recommendations, we can list some of the key strategies for DR screening in India:

1. The DR screening program must be systematic.^[7] In the absence of systematic DR screening in many countries in Europe, the opportunities to prevent people from developing vision impairment and blindness get missed while systematic programs have yielded success.^[36,37] Systematic tele-screening programs for DR have been shown to be cost-effective in India, Singapore, and in meta-analyses.^[38-40] Systematic DR screening program contributed to DR no longer being the leading cause of certifiable blindness among the working-age adults in England and Wales.^[36] Systematic screening would require the presence of a list of cases eligible for screening. This list is likely to be available through the NPCDCS.
2. While the ideal, systematic screening program will take time to build up, we need to minimize the missed opportunities. This can be achieved through targeted screening in the NCD clinics. The targeted screening in private diabetes clinics through the telemedicine approach has been shown to yield a higher yield in terms of hospital attendance at the referral center when compared with universal referral and counseling of all the persons with diabetes.^[41] Additionally, opportunistic screening can be implemented in the ophthalmology outpatient departments to screen patients coming for other related eye diseases. Targeted screening is likely to yield more sight-threatening DR. Both targeted and opportunistic screening programs would require a screen-pathway approach.
3. Given the lack of ophthalmologists in the rural areas and in public health facilities below the district level, a

“task-shifting” approach for DR screening is required. This would require using tele-screening approaches or using non-physician graders for the initial screening. Under the National Program for Control of Blindness and Visual Impairment (NPCB and VI), the PMOAs and under the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular diseases and Stroke (NPCDCS), the NCD nurses should be trained in the screening methods and allocated this responsibility. The strategy may vary from state to state based on the availability of the personnel. There is an extensive body of global evidence which shows that when properly trained, their results are accurate.^[7,42-50]

4. Establishing screening pathways is recognized as an essential component for the effectiveness of screening programs. It starts right from identifying the population eligible for screening till treatment, follow-up, and monitoring outcomes.^[51] The people who are screened positive would require confirmation and clinical management. The screening must not happen unless a robust system for clinical management of the patients is identified with DR in place. Thus, there is a need to institute “DR screening pathways” within the public health system to increase screening effectiveness.^[7]
5. Given the large volume of persons who need screening, adequate internal quality assurance and external quality-control mechanisms must be an integral part of the system. Monitoring indicators for the program need to be identified. Such indicators have been reported in the UK DR screening program. The AIOS task force has recommended that screening programs for DR should achieve at least 80% sensitivity, 95% specificity, and <5% technical failure rates, based on the globally recognized standards.^[4] The task force has also recommended that the ophthalmologists, optometrists, ophthalmic assistants, and eye technicians must be certified graders. The UK Diabetic Eye Screening Program has developed key performance indicators quality standards for internal quality assurance as well as external quality assurance at regular intervals.^[36]
6. Since the screening would need to be repeated annually, a robust system for tracking all persons with diabetes and their screening status is warranted. The involvement of ASHAs through monetary incentives and health education has been shown to be effective in increasing the uptake of DR screening in rural communities.^[18]
7. Monitoring and evaluation of the DR screening pathway would be vital to improving the efficiency of the program. Operational research such as the Nayanamritham study can supplement monitoring and evaluation to yield insights into the effectiveness of programmatic interventions such as the use of automated grading, centralized grading centers, different personnel for screening, attrition at different steps of screening, screening interval, etc.^[32]

National and state-level leadership

A task force for DR exists under the National Program for Blindness and Visual Impairment for several years. It is required that the task force be revitalized. The team should include clinical leaders such as ophthalmologists, endocrinologists/diabetologists, public health experts, family doctors, optometrists, and representatives of their professional associations. This task force should have subgroups to address issues such as screening and management guidelines,

quality standards, center-state coordination, and program management. Perhaps the most important task for the central group would be to finalize the goals and objectives of the program and make a decision on the strategy that will be adopted for DR screening. In addition, non-governmental and professional organizations have a key role to play. The AIOS Diabetic Retinopathy Task Force and the VRSI have developed consensus guidelines for DR screening in India. The AIOS DR task force, formed in 2019, has worked toward the creation of awareness in society about diabetic blindness and its prevention. It has also implemented DR screening through outreach camps, and diabetes centers.^[52,53] The leadership has also been displayed by research institutions in India in developing artificial intelligence-based software solutions for the automated grading of fundus images.^[54,55] Given the size of the country and the federal nature of the governance wherein health is a state subject, there is a need to establish state-level task committees which support implementation, as well as innovation at the state level.

Needs assessment

Once the strategies and standard operating procedures (SOPs) have been identified, there will be a need to identify which are the resources and infrastructure available within each district and the gaps therein which need to be addressed. The needs assessment includes equipment used to screen DR, equipment for diagnosis and treatment of DR, staff availability, skill levels, etc. The geographical and public-private distribution needs to be mapped as well. This also gives an indication of the current capacity of the system to screen and manage DR, as well as the implication of these on the proposed DR screening strategy. In India, mapping of human resources has already been initiated at Dr RP Centre in partnership with the Ministry of Health and Family Welfare (MoH and FW) and Orbis. The recent National Diabetic Retinopathy Survey that has been completed in 21 districts of India also provides excellent up-to-date information about the geographical distribution of the burden of the DR in India.

Finalization of DR screening and referral pathway

Once the needs assessment has been done and the broad strategies are in place, the subsequent task would be to develop the Standard Operating Procedures (SOPs) for DR screening under the national program. The key steps that need to be finalized include the following:

1. Identifying the eligible population—list everyone who has a diagnosis of diabetes
2. Guidelines, protocols, and SOPs for screening; handling missed screening
3. Classification and grading systems
4. Referral threshold and process for screen-positive patients
5. Follow-up/surveillance and re-screening for screen-negative patients
6. Methods for capturing data flows, including processes to track patients through the pathway
7. Process for ensuring that information on results is transmitted and reported to the stakeholders (such as people with diabetes, family doctors, ophthalmologists, leaders, and coordination and management teams).

We have already alluded to the guidelines for DR screening that have recently been released by the AIOS and VRSI. These provide guidance for identifying individuals eligible for

DR screening, process of DR screening, screening intervals, screening models, referral pathways, and clinical standards required for DR screening and treatment of DR. These also include suggestions on the governance, standards for DR screening, training, infrastructure, use of artificial intelligence, public awareness, and the need to work with diabetologists.^[4] These form an excellent starting point for the final SOPs to be adopted under the national program. As per the InDiab Study, the prevalence of diabetes is 7.7% in the population aged 20 years or more. With 60% of the population in this age bracket, for every million individuals, nearly 46,000 persons with diabetes/per million population, nearly half would not be aware of their diabetic status.^[2,5,56] The DR screening of these patients must be made available close to their homes across the district. There is a need for a National Registry of Persons with Diabetes to keep a record of all diagnosed individuals. This needs to be linked with the DR screening program to identify the individuals requiring initial screening as well as re-screening, and the outcomes of screening.

To start with, the DR screening should be made available at all district hospitals and block/sub-divisional/taluka hospitals and community health centers. This can be integrated with a tele-screening approach—medical colleges and ophthalmology training centers are involved in a program wherein the residents provide diagnostic and clinical support to the allied ophthalmic personnel who are conducting tele-screening. Opportunistic screening is the approach currently recommended by the Government of India. The same can also be continued and systematic screening should be initiated in a phased manner in the districts where the NPCDCS program is able to screen for diabetes. A key decision that needs to be taken for India would be whether digital fundus photography is a feasible option. Globally, digital retinal photography is considered to be the most cost-effective DR screening method. But it requires a significant investment in terms of procuring and maintaining the fundus cameras. In India, this is further amplified due to the large population. However, to ensure the quality of screening, as well as for long-term tracking of progression, digital fundus photography is a key consideration. These also become amenable to teleophthalmology, central grading centers as well as AI-based grading. The current guidelines on the Health and Wellness Centers by the Government of India already include DR screening using non-mydratic fundus cameras and referral as a key activity.^[57,58]

The program management must rely on electronic data capture and electronic reporting mechanisms. Additionally, the digital images that are captured will pose additional requirements on the system for secure and confidential data storage and transport. The recently proposed National Digital Health Mission provides a good framework for ensuring long-term tracking of eligible patients and ensuring data portability as the patient moves from one health facility to another.

Additional aspects that would require attention include making adequate provision of maintenance of equipment. In the authors' personal experience with non-mydratic fundus cameras, wear and tear are common as the cameras are removed from the cradle for capturing images and placed back into the cradle for data transfer limiting the useful life of

the camera. Program managers need to ensure that provisions of equipment maintenance and servicing are available in each district.

Training/capacity enhancement

The finalization of the screening pathway will inform about the training needs under the DR program so that a plan for those can be prepared. These would include not just training in the DR screening, but also in the DR management, and the program management activities such as record keeping, referral support, etc. The training must be done systematically to ensure a rapid scale up to the entire country. A notable example at the national level is the Certificate Course in Evidence-Based Management of Diabetic Retinopathy targeted at physicians across India. This is an on-the-job training course, with four modules, a once-a-month contact session, hands-on skill training, and an exit examination, targeting graduates with a medical degree (MBBS) and 3 years or more clinical experience. Under the program, 578 physicians were trained over four program cycles and nearly 50% of them had government affiliation. The course is being adopted by the Government of Tripura and Madhya Pradesh.^[59] Trainings have been conducted in other programs for PMOAs, nurses, etc., and those training modules could form the basis for a standard set of training modules that can be implemented under the national program. The training guides need to be developed for ophthalmologists, optometrists, and program managers. A central-level team of committed trainers should then go to each state and conduct trainings. Online learning modules with accreditation can also be introduced and popularized for trainee ophthalmologists and optometrists, though many of those would need to be supplemented in-person hands-on training to ensure high-quality skills transfer. The Government of India has also started the Integrated Government Online Training (IGOT) platform under the department of personnel and training, accompanied by the DIKSHA app that may be leveraged for rapid upscaling of DR capacity orientation programs in regional languages.

Improving uptake in DR screening program

Lack of knowledge, attitude, awareness, and motivation of persons for DR screening will need to be addressed through health education interventions. Improved awareness of DR and complications of diabetes are critical to ensuring good uptake of screening. Additionally, patients need to be informed about what to expect during DR screening and the process after the screening is completed. In urban areas, especially the lack of uptake may not be due to physical distance but due to poor functional access. Improved awareness helps build trust in the system, which initiates a cascade and increases the uptake of DR screening. For this purpose, health education material needs to be developed in regional languages and disseminated widely. The most important outcome of health education would be enabling patients with diabetes to adopt health behaviors voluntarily, as well as to generate demand for DR screening. The health information and resources will need to be kept simple so that they are accessible to the majority of the population. Patient information leaflets should be developed and provided to eligible patients who are being invited for screening to overcome hesitancy.

People from disadvantaged and ethnic minority communities are likely to have lower uptake rates for DR screening. Distance is also an important factor. In large, sparsely populated districts, difficult terrains (hilly areas, forest areas), and tribal areas, mobile-based DR screening strategies can help improve acceptance. These must be actively considered in the districts of northeastern states, Himachal Pradesh, Uttarakhand, Leh, Jammu and Kashmir, and districts of Rajasthan, Gujarat, and other states where physical access barriers are likely. Another important strategy to increase the uptake would involve grass-roots level workers such as ASHAs in the identification and referral of persons with diabetes.^[60]

Allocation of roles and responsibilities

The program management aspect of the program will need to be clearly defined. Activities for identifying and managing persons with diabetes are in the domain of the NPCDCS in India. The results of DR screening should be conveyed to the physicians managing diabetes. Persons having DR also require closer monitoring for blood sugar control and other microvascular and macrovascular complications. This calls for close interactions between the NPCDCS and NPCB and VI. All district-level DR screening programs should be led by the district ophthalmologist who has the overall responsibility for the program at the district level. The role of the ophthalmologist is to ensure the quality and coverage of the service by making sure that everyone working in the screening program adheres to the correct guidelines and protocols. The DPM (NPCB and VI) can help the district ophthalmologist in collating data and generating reports. The administrative staff is required to enable successful entry of data into the health management information system (HMIS), for managing logistics, communication between stakeholders, preparation of reports, etc.

Public-private partnerships

The National Sample Survey Organization (NSSO) data on household consumption over the last 15 years has consistently shown that more than two-thirds of the Indians availed themselves outpatient care in the private sector.^[61] In the most recent survey, only 32% of the rural and 26% of the urban respondents had sought care in the public sector.^[62] Thus, it is imperative that from day 1, the national DR screening program involves the private sector in a big way. In the districts, NGOs running vision centers and having an existing DR screening set-up must be engaged through contractual arrangements. This will minimize the lead time to initiation of DR screening. Under the PM-JAY/Ayushman Bharat scheme, the provision of inpatient treatment of DR has been made. The providers who can treat DR under such insurance schemes must be identified and engaged for referral management. Under the NPCB and VI, Rs. 2,000 is provided as a grant-in-aid for laser treatment of DR and Rs. 10,000 for vitreoretinal surgery to the registered NGOs and private practitioners. Additionally, Rs. 25 lakhs per district is available for the initiation of a teleophthalmology network (four to five vision centers linked to a base hospital). The DR screening is also a listed activity to be undertaken by the Multipurpose District Mobile Ophthalmic Units (MDMOU). A DR Register has also been developed under the management information system of the program.^[63] As already mentioned, PPP schemes have also been initiated by the state governments of Andhra Pradesh and Kerala.

Quality control and assurance

Quality control would be essential in the DR screening program. There would be a need to develop indicators and standards to measure the performance of the program. A good example to follow would be the UK standards that relate to the coverage of the program, uptake at various steps of the DR screening program, quality of DR screening tests, referral, diagnosis, and treatment.^[11] For each standard, thresholds need to be identified that signal whether the standard is met or not. The indicators must then be measured and published regularly. An example of such a standard is that all newly diagnosed people with diabetes must be offered the first screening appointment within 3 months of the program being notified of their diagnosis and the thresholds have been set as $\geq 90.0\%$ acceptable and $\geq 95.0\%$ achievable. For digital fundus images, it will be essential to have a systematic quality-control system in which a proportion of the images are double-read (by highly trained retina specialists and/or reading software) and the discrepancies are picked up to improve quality. The fail-safe processes must be in place to check that the persons with diabetes are on the list of people to be screened. All those invited get screened, those who are screened reach the ophthalmologist, etc. Ideally, all these indicators and fail-safe systems must be integrated with the health information system, but they can be put in place in paper-based systems using index cards and bring-forward systems. Monitoring should occur regularly, at least annually, using the key outcome indicators which indicate whether the DR screening program is successful or not. The indicators that might be considered include timely screening, adequate coverage, uptake of screening, and the proportion of patients with sight-threatening retinopathy receiving laser treatment timely. The long-term-impact indicator would be the proportion of people with diabetes developing vision impairment because of DR.

Financing

Finally, the DR screening program can only take off if adequate finances have been allocated for this activity. Screening is not usually included under medical insurance schemes. Nor does India have any comprehensive national disease screening program where DR screening can be integrated. DR screening using digital fundus imaging has been shown to be highly cost-effective in the prevention of blindness. There will be a need for additional funding for set-up costs for equipment, training of personnel, information management systems, quality assurance, and management of the DR screening program. These will need to be worked out and duly earmarked as line items in the annual district action plan. NPCB and VI and NPCDCS are both included in the NCD flexipool of the National Health Mission for a funding perspective. Program Implementation Plans (PIPs) are the most crucial documents in National Health Mission (NHM) through which the states/UTs plan, prioritize, and propose strategies and activities to address the challenges in public health. Based on the plan and the budget proposed, the appraisals and discussions are carried out which culminate in the National Program Coordination Committee (NPCC) meeting and approvals are accorded through the Record of Proceedings (RoP). The DR screening-related expenditures should be included in the PIPs prepared by the districts and states so that funds can be approved against those requests.

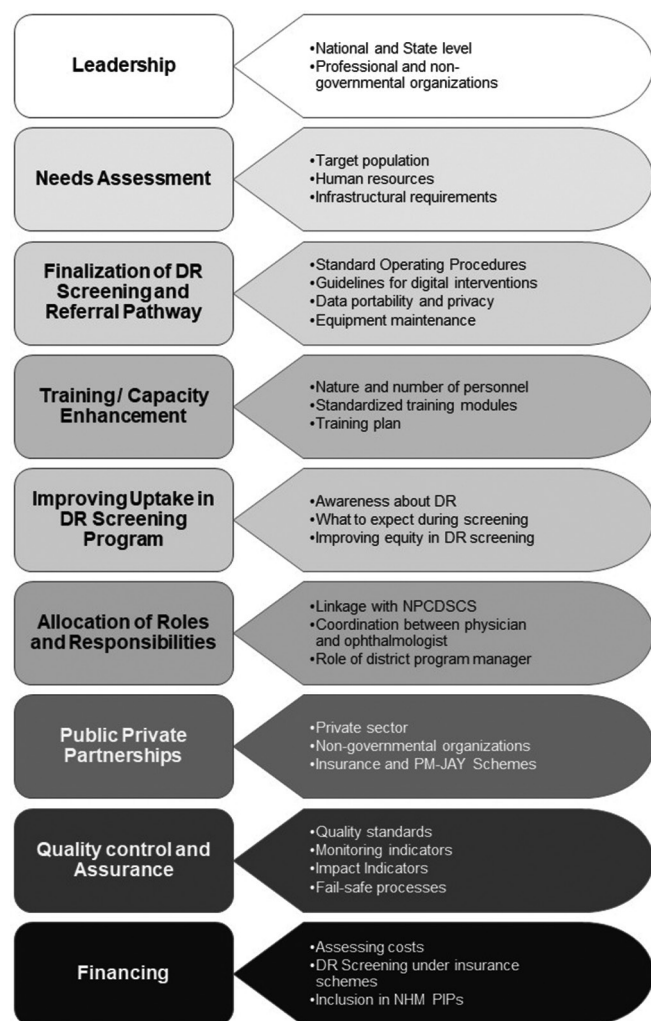


Figure 1: Framework for health systems approach for DR screening in the public sector in India

Conclusion

We have attempted to outline a list of key steps that need to be undertaken to ensure that a systematic DR screening program can be initiated at a country level in India [Fig. 1]. It is possible to build on the existing systems prevalent in NPCB and VI and NPCDCS. India has a major challenge of scale due to its large population and high prevalence of diabetes. The latter is what also makes the early initiation of systematic DR screening at a country level that much more important. There will be a major role of the private sector which needs to be factored in from the initial stages of the program. Setting up a DR screening program is not going to be cheap, primarily because India is a big country, but it will be offset by the savings that we, as a country, will have by preventing diabetes-related blindness and by identifying and managing patients with diabetes at risk of microvascular and macrovascular complications early.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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