REVIEW ARTICLE

Critical Review of Public Health Interventions in Diabetic Retinopathy: Challenges for Karnataka

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ABSTRACT

Diabetic retinopathy (DR) is a chronic complication of diabetes mellitus (DM), and its prevention is related to the duration as well as control of DM. The prevalence of diabetes has reached a pandemic proportion which is mostly attributed to rapid lifestyle transitions and by a narrowing in the urban-rural divide in living conditions. In another 15 years, nearly one-fifth of the world's diabetic population will be in India. This will increase the prevalence of DR-related eye disease that can potentially cause blindness in younger people. Since DM and DR is a public health problem, its management requires public health approaches. This article reviews the various challenges in implementing public health interventions in preventing DR-related blindness.

KEY WORDS: Diabetic retinopathy, public health approaches

INTRODUCTION

Diabetic retinopathy (DR) is a chronic complication of diabetes mellitus (DM), and its prevention is related to the duration as well as control of DM. Diabetes has now become a major health problem in India with an estimated 40 million people (2007) having diabetes, accounting for about 20% of the world's diabetics. Current projections are that without active intervention, these numbers will rise by another 29 million, reaching 69.9 million by 2025.[1,2] India is predominantly a rural nation, and the recent available reports indicate a rising prevalence of the disease in the rural areas.[3,4]

Diabetes and its complications affect predominantly people of productive age group, and its poor control leads to US$ 2.2 billion in annual health-care costs in India alone.[5] There is an increase in disability and mortality rates that lead to high direct, indirect, and intangible costs which can threaten India's emerging economy if immediate action is not taken.

Because diabetes is a public health problem, it warrants public health approaches complementary to those done in clinical care.[5-7] DR is ideally suited for control using various public health interventions as DM affects a large proportion of the population and early diagnosis and treatment could prevent sight-threatening sequelae and premature death. Most evidence available regarding evidence-based public health interventions for DR are from developed countries.[8-10] Indian scenario needs a modified approach due to various factors.

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PUBLIC HEALTH INTERVENTIONS IN DR

Primordial prevention

A relatively new concept aims at prevention of occurrence of diabetes in the first place involving a population-based campaign to build awareness and bring about a positive change in dietary-lifestyle habits. This ideally begins in early childhood, the time when lifestyles are formed. A multi-pronged and comprehensive approach involving all sections of society is needed.

Applicability of this approach (feasibility)	Transferability of this approach (generalizability)
Ideal approach Very challenging in any country as it involves a paradigm shift in local socioeconomic/ cultural norms	Results take decades to be noticed This approach cannot be relied on in a scenario of a public health problem More urgent measures are needed to tackle the problem

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Primary preventive measures

This involves tighter glycemic control and control of risk factors such as hypertension, hyperlipidemia, and improved physical activity in known diabetics to at least prevent or delay DR. Outcome measures is the incidence of new DR cases.

Applicability of this approach (feasibility)	Transferability of this approach (generalizability)
Important in the Indian setting Where there are a large number of newly diagnosed diabetics who require appropriate and timely medical care and health education to effectively control their disease	Yes, this approach is applicable in the Indian setting as India has the potential to build up a large health-care manpower and health systems that need to be strengthened to detect, manage, and treat chronic diseases Recently the Indian Government launched the National Program for Prevention and Control of Diabetes/Cardiovascular Disease and Stroke (2008).[11,12]

Primary preventive approaches are the best in the long run but needs a big sustained campaign which is lacking in the present.

Secondary prevention/early identification and treatment

This approach is an enormous challenge considering the huge burden of DM.

Due to this life-long evaluation for retinopathy by retinal screening of diabetic individuals is a valuable and necessary strategy. Screening is vital to preventing visual loss from diabetes because retinopathy is often asymptomatic early in the course of the disease.[13] While no RCTs have demonstrated that screening directly reduces rates of blindness, simulation models (Markov) predict a reduction in the visual loss with retinal screening.[14,15]

Screening would ideally involve complete ophthalmologic examination of all known diabetics by ophthalmologists and includes detailed fundus examination to detect and grade retinopathy and maculopathy, so as to make correct treatment decisions and give appropriate advice. This is difficult considering the enormous time it would consume to see every potential case. This method needs specialists who can perform comprehensive eye examination quickly consistently to detect proliferative DR (PDR)/diabetic macular edema (DME) and institute treatment. Trained fundus photographers are needed to take images for monitoring and follow-up of the disease among the cases over time.

There is strong evidence that pan-retinal photocoagulation (PRP) significantly reduces the risk of severe vision loss from PDR by at least 50%.[16-19] Newer therapies, however, require further evaluation and cannot be recommended as standard interventions for PDR/DME.

Applicability of this approach (feasibility)	Transferability of this approach (generalizability)
Costly if applied to all diabetics with "any retinopathy."	The need of the hour It is imperative that this is started quickly

For secondary interventions, measures that need to be monitored would include progression of DR, changes in visual acuity and macular thickness, and rates of legal blindness and therapeutic adverse effects.

SCREENING STRATEGIES AVAILABLE FOR PUBLIC HEALTH INTERVENTIONS FOR DR

Health screening is defined as "the application of a test on people who are not exhibiting symptoms and the classification of those people based on their likelihood of having a particular disease."[20] Screening cannot be a substitute for a good clinical examination and should be performed as part of a multidisciplinary approach to diabetes care. The challenge in dealing with a diabetic with non-PDR (NPDR) is to bring the diabetic patient for routine eye screening during the asymptomatic stage. This can help both patients and caregivers focus on primary prevention and control of risk factors. This proactive approach will result in regression of early DR changes and even delay the progression of the sight-threatening stages of DR (STDR).[21,22]

Screening aims at detecting PDR/DME that requires laser, and second, detecting "any retinopathy" that is a risk marker that aids more effectively targeting individuals at high risk of PDR/DME. Applying PRP to treat STDR and a focal laser to treat the leaking vessels, in addition to the pharmacotherapy to treat DME, will delay blindness and serious morbidities such as vitreous hemorrhage and tractional retinal

detachment.[23,24] If STDR is detected during screening, laser treatment, medications, and surgeries could be offered in a timely fashion in addition to the primary prevention measures. In addition, the cost of advanced treatment and surgeries could be reduced.[25,26]

Four key data variables are necessary to determine the overall effectiveness in any screening program: Disease prevalence, compliance, sensitivity and specificity of the screening method, and cost.[25] Since the prevalence of diabetes in India is high enough to be a public health problem, the population is considered ideal for screening on a large scale. To justify initiation of DR screening, the results of the proposed screening test should be valid, reliable, and reproducible. Validity is the ability of screening to correctly categorize cases with STDR (usually symptomatic) or those without symptoms (includes "No DR" and NPDR).[26] Direct and indirect ophthalmoscopy performed by an ophthalmologist is the cheapest and most reliable method for screening.[26] Effective control of hyperglycemia, hyperlipidemia, and hypertension in the preclinical stage of NPDR can mitigate the effects of the early stages of NPDR and even halt the rapid progression of DR from NPDR into STDR.[26] Comprehensive eye exams are best performed by ophthalmologists trained in examining the peripheral retina rather than other health staff.[26]

The World Health Organization has, therefore, recommended that member countries should adopt the public health approach to address DR, and one of the strategies is the early detection of DR.[27]

Opportunistic screening targeting high-risk patients

Essentially involves screening all diabetics who had DM for a certain period 3-5 years are screened for diabetes at 3-year intervals as a part of their routine medical care. Uniform recommendations for yearly screening of all Type-2 diabetics produce inefficient outcomes.[14] Targeting younger more poorly controlled high-risk patients are likely to provide most of the achievable benefit while at the same time limiting the number of patients who need to be followed up closely.[14,28] However, optimal screening intervals have not been adequately evaluated especially for Indians, particularly with regard to variability in eye disease risk in those at low risk. This has potential implications in deploying scarce ophthalmic resources in DR screening, especially in the context when there are other major diseases that still need to be tackled.

Studies in South India revealed poor awareness about "diabetes" and its manifestations and what they could do to minimize the risk of morbidity.[29-31] This underscores the urgent need to complement clinical management with public awareness through risk reduction media campaigns, health services research, and community-based participatory research.[32] PACE Diabetes Project[33] and SN-DREAMS,[34] in Chennai, were notable projects using such approaches.

Optometrist screening

Involves use of suitably trained optometrists to screen for DR and refer all cases of retinopathy to specialists. There is a shortage of fully trained optometrists, and this approach is just not feasible in the Indian context.

Mobile teleophthalmology screening

Aims to efficiently lower the barriers to screening and created new screening opportunities for a large number of known diabetics who are lost in the general health-care system and do not usually seek eye care.[30] Regular screening of people in a well-defined geographic area that is far from the fixed screening clinics. Fundus photographs by technicians are relayed to reading centers, and PDR/DME cases are referred to specialists.

Applicability (feasibility)	Transferability (generalizability)
Has good potential to provide better outreach Identifies individuals truly in need of the services of an ophthalmologist; at the same time, it maximizes the use of limited ophthalmologic resources while favoring multidisciplinary collaborations.[35]	Generalizable in most parts of India Cannot be the sole approach In spite of improved communication facilities, this method is constrained by high overall costs

Tertiary prevention (disability limitation and rehabilitation)

Visual disabilities due to DR are likely to increase in the coming years. An organized public health approach must be adopted, and all stakeholders must

work together to control severe visual disabilities due to DR. Protocols to promote tertiary preventive interventions ideally should be a part of "disease management." STDR causing non-clearing vitreous hemorrhage, widespread, or diffuse DME that is non-responsive to the laser may benefit from vitrectomy.[18,19] Retinal detachment surgeries are very difficult and yield poor results. Blindness registry-rehabilitation to people with low vision needs to be linked to the program.

Applicability (feasibility)	Transferability (generalizability)
Costly but necessary approach that needs to be in place to manage the small minority of cases that need these services	Costly but also necessary due to the huge load of untreated complicated DR in India

DR: Diabetic retinopathy

CHALLENGES TO DR SCREENING AND THE PUBLIC HEALTH APPROACH

The challenges of Public Health Interventions in DR in the Indian context are huge and multiple approaches are needed to tackle the challenge. If control measures are not established DR can overwhelm eye care programs and become a major cause for vision impairment and blindness. Such control measures will have to additionally tackle the possible barriers that prevent optimal eye care service uptake in the Indian context.[36]

Public health campaigns against DR, based on outreach camp approach like in cataract would not be sustainable due to the low yield of DR from the general population.[27] Community screening of known diabetic individuals who are high-risk for DR may help to increase the yield of DR cases without compromising sustainability. In spite of providing eye care, much will depend on individuals with diabetes as they have to alter health behavior for the rest of their life.[26] The palliative nature of DR treatment, the need of frequent intervention sessions and possibility of progression of DR despite standard treatment are issues worth noting.[26]

Public health programs and actions must be not only effective but applicable and transferrable for local communities. If an intervention scores well on applicability and transferability,[37] then local policy makers should be able to readily adapt it to their local setting.

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ANNEXURE

Challenges for Karnataka

The challenges faced by Karnataka are described in the annexure. The tables describe the human resource and workload challenges that we would face in trying to give diabetic retinopathy screening and treatment facilities across Karnataka. This data could be used to plan diabetic retinopathy services in any geographical area if we have the population data.

Table 1: The diabetic retinopathy prevalence using assumptions based on population data

Diabetic retinopathy disease prevalence estimation (Karnataka)			
	Denominator	**Rate (%)**	**Affected**
Service area population Population above age of 30 years*			31500000
Prevalence of DM		20	
Number of persons living with DM	31500000		6300000
Prevalence of DR (15-25%)		15	
DR among diabetics	6,300,000		945,000
Prevalence of sight threatening DR (20%)	945,000	10	94,500
Laser/anti-VEGF treatment among those with DR	945,000		94,500
Proportion of DR becoming blind (2%)	94,500	2	1890#

*Proportion of population over the age of 30 is assumed to be approximately 50%. #These patients require low vision and rehabilitation services.
DM: Diabetes mellitus, DR: Diabetic retinopathy, VEGF: Vascular Endothelial growth factor

Table 2: Describes annual and daily workload estimates for eye care system in Karnataka

Annual and daily workload estimation			
Number of working days a year			300
	Frequency	**Total patients**	**Daily load**
Routine hospital examination of diabetics for DR	Once a year	6300000	21000
Routine hospital examination of diabetics for DR (not sight threatening)	Twice a year	1890000	6300
Total out-patient examinations		8190000	27300
	Rate		**Number of eyes**
Laser procedures (eyes) incidence estimated as a % of the backlog of DR laser patients	20%		141750
Number of treatment sessions	3	3	425250

DR: Diabetic retinopathy

Table 3: Describes the human resource challenge in addressing diabetic retinopathy for the eye care system in Karnataka

Human resource challenge in addressing diabetic retinopathy	
Number of ophthalmologists in Karnataka (assumption based on total KOS membership)	1900
Number of ophthalmologists in Karnataka who can do or routinely perform indirect ophthalmoscopy (assumption 50%)	950
Number of ophthalmologists in Karnataka who routinely perform indirect ophthalmoscopy and see DR cases (assumption 35%)	665
Approximate number of ophthalmologists who can perform LASER or are trained in medical/surgical retina procedures	200
Workload if all the doctors are evenly distributed as the prevalence of diabetic retinopathy and all diabetics are routinely examined by indirect ophthalmoscopy	
Examinations per year per ophthalmologist	8621
Examinations per day per ophthalmologist	29
Number of ophthalmologists working with all facilities to manage DR complications	150
Yearly workload for medical retina specialists if 50% of DR cases that require examination seek care	27300
Yearly workload of laser procedures per medical retina specialist (approximately)	2835 eyes
Daily workload of laser procedures per medical retina specialist (approximately)	10 eyes

There is a huge backlog of diabetic retinopathy patients to receive even one eye examination. Even if 50% of those who are affected by diabetes seek care the eye care systems resources in Karnataka will be stretched. DR: Diabetic retinopathy