Original Article

Comparing Three Models of Community-Based Diabetic Retinopathy Screening, Treatment, and Awareness Creation Services in Southern India / South Kerala

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Abstract

Background: The aim of the study was to evaluate the effectiveness of three models of diabetic retinopathy (DR) screening from an economic perspective and their effectiveness in awareness creation, screening, and ability to deliver treatment. **Materials and Methods:** Analysis of a prospective screening program for diabetes mellitus and DR in South Kerala was done. Three models were created: Model 1: blood screening camp, Model 2: comprehensive eye camp, and Model 3: institution-based screening camp. **Results:** Forty-seven camps were conducted in Model 1, 438 in Model 2, and 18 in Model 3. Of 94,993 people screened, the percentage of diabetes was 17.4. Of the diabetics screened, the percentage of retinopathy was 22.8. Model 1 was most economically viable to detect a large number of new diabetics. Model 2 was more economically challenging but had the best overall pickup rate for new DR patients. Model 3 had a lesser pickup of new DR patients. **Conclusion:** Model 1 is effective in picking up new diabetics but poor for DR screening. Model 3 is cost-efficient with very high DR detection rates. Cost-effective screening activities and service delivery are best achieved through a well-planned Model 2 camp which has the best overall detection rate for DR.

Keywords: Diabetic retinopathy, diabetic screening, screening models

Introduction

It is estimated that 57 million people in India may be diabetic by 2025.[1] When compared to the west, diabetes appears at a younger age,[2] is less associated with obesity,[3] and genetic factors appear to be stronger in our population.[4] The rising prevalence of diabetes in India[5] warrants well-conducted epidemiologic studies on diabetes-related complications, including eye problems. Although there are a few related studies in our country, there exists a difference in the reported prevalence of diabetic retinopathy (DR) – 20.8%–34.1%[6-9] because of various factors, including screening methods used. The state of Kerala, though boasts of a high life expectancy and literacy rate, has a high prevalence (16.3%) of diabetes[10,11] and, therefore, possibly DR.

In a country such as India, where resources are limited, a judicious and practical approach to distribute services is of utmost importance. In this study, we seek to compare the effectiveness of three models of DR screening from an economic perspective and their effectiveness in awareness creation, screening, and ability to deliver treatment.

Materials and Methods

The study area included five districts in South Kerala. A nonprofit organization supported by Chaithanya Eye Hospital, Trivandrum, conducted these initiatives during the period 2018–2020. The Institutional Ethical Committee approved the research project. These activities were in continuation of the TRINETRA project, a joint

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venture initiated originally with the World Diabetes Foundation.

Three models were created in this screening program:

Model 1: Blood screening camp

In this model, precamp publicity was done through local radio channels. Places with a large movement of the population such as railway stations and bus terminals were selected for screening. Large Banners were placed at strategic locations to attract attention to the camp activities. Information kiosk was set up in a van and pamphlets were distributed at the campsite. After a quick history, a spot glucometer was used to evaluate glycemic levels. Recorded blood sugar levels were informed to the patient and noted in the master record. Newly detected patients were advised to consult a physician and an ophthalmologist, and the hospital route map was given to all diabetics. The staff requirement for this model was four: 1driver, 1nurse, 1lab technician, and 1counselor.

Model 2: Comprehensive eye camp

This included precamp publicity for 2–4 weeks that involved PA system announcements at various public places such as schools, churches, temples, and markets. The involvement of local non-government organizations, arts clubs, and religious organizations also assisted in the publicity. Pamphlet distribution was done a week before the camp. The services in the camp included glucometer screening of all the attendees and ophthalmological evaluation of known diabetics and patients with high blood sugar levels. The staff requirement was 8–10: 1 driver, 2 nurses, 2 counselors, 2 optometrists, and 1–2 ophthalmologists.

Model 3: Institution-based screening camp

This included selection of a public or private service provider with an employee strength of at least 500. Awareness creation about DR was followed by screening activities. The institution's human resource department was involved in informing their employees through internal notifications and awareness posters placed in the institution before the camp.

The ophthalmological evaluation included comprehensive patient history with demographic details, diabetic history, and treatment details along with vision testing, intraocular pressure measurement, and dilated fundus examination. A trained ophthalmologist performed retinal examination with direct and indirect ophthalmoscopy. DR was categorized using the modified ETDRS classification as mild, moderate, and severe nonproliferative DR (NPDR), proliferative DR (PDR), advanced diabetic eye disease. The presence of clinically significant macular edema (CSME) was also assessed. Eyes, where posterior segment examination was not possible, were defined as ungradable. All the above information was noted into a pro forma at the campsite, which was later recorded into a computerized database created at the project office at the base hospital.

Subjects with severe NPDR, CSME, and PDR were referred for further investigations and management to the base hospital. Subjects with no or minimal retinopathy were advised to schedule an annual follow-up with their regular ophthalmologists. An expert counselor focused on awareness creation, giving patients information about the disease, treatment facilities, dietary advice, etc.

Results

A total of 24,848 people were screened in 47 camps in Model 1, 66,472 in 438 camps in Model 2, and 3673 in 18 camps in Model 3 [Table 1]. Of 94,993 people screened, the percentage of diabetes noted was 17.4. Of the diabetics screened (16,538), the percentage of retinopathy was 22.8. Average cost calculation per each camp model is shown in Table 2. Camp expenses would include publicity, transportation, hall arrangement, food for staff and volunteers, blood sugar testing, and staff salary expenses. Model 1 was most economically viable to detect new diabetics. Model 2 was more economically challenging but had the best overall pickup rate for DR patients. Model 3 had a lesser pickup of new DR patients.

One-way ANOVA statistical analysis of the mean differences in cost involved to screen one patient to detect one diabetic and to diagnose one DR was significantly different. Nonparametric Kruskal–Wallis test was applied, and this rejected the null hypothesis that all camp models incurred similar cost to detect diabetes mellitus (DM) and DR. Publicity has a positive correlation which has a statistically significant impact on the number of total Out Patients (OP) attending the camp, DM and DR detected. There was a statistically significant R^2 value of 0.48 with an unstandardized coefficient of regression of + 0.025. This meant that an increase in expenditure outlay of 1% would be associated with a 2.5% increase in total attendance and DM and DR detection rates.

Discussion

Table 1: Camp attendance and percentages of detection of diabetes mellitus and diabetic retinopathy in each camp model

Camp model	Number of camps	Total screened	DM detected	DR detected
Model 1	47	24,848	3488 (14.0)	40 (1.1)
Model 2	438	66,472	12,364 (18.6)	1972 (15.9)
Model 3	18	3673	805 (21.9)	180 (22.4)

Figures in parenthesis indicate percent values. DM: Diabetes mellitus, DR: Diabetic retinopathy

Table 2: Average cost calculation per model (Rs.)

	Model 1	Model 2	Model 3
Cost per outpatient	41.6±6.32	67.2±9.58	75.5±11.62
Cost per DM patient	360.6±20.13	440.0±29.86	660.5±37.52
Cost per DR patient	14,938.5±350.72	3716.0±70.25	3532.1±61.33

DM: Diabetes mellitus, DR: Diabetic retinopathy

Although recent studies indicate that there has been an increase in the prevalence of diabetes, only a few studies have attempted to assess the prevalence of diabetic eye complications in India.[7,8] In this study, we report the prevalence of DM and DR in a mixed urban–rural population in South India based on an epidemiologic survey. The prevalence of diabetes in this study was 17.4% which is much higher than other population-based reports[8] in the country. Considering the fact that this estimation was based on a single random blood sample value of >180 mg%, the significance of this high prevalence cannot be underestimated. Many borderline diabetics who may have abnormal *glucose tolerance tes*t were not assessed in this study, and this would have increased the prevalence further. General incidence of DR in our study was 2.2% and the prevalence of DR among the diabetics was 16.34%. This confirms the findings of earlier studies from India. A study where subjects were examined by ophthalmoscopy reported a 22.4% prevalence,[8] whereas a similar study on self-reported diabetics revealed a prevalence of 26.8%.[7] Another clinic-based photographic evaluation study revealed a prevalence of 34.1%,[12] while a cross-sectional study based on a structured protocol found a prevalence of 21.7%.[13] The guidelines issued by vision 2020 had estimated prevalence for DM as 4% and DR 11%.[14] The wide variation in the prevalence in various studies is due to the method of screening and the heterogeneous population studied. While some studies are community based,[5] others are clinic based[6] or among self-reported diabetics.[7] Moreover, some are based on direct ophthalmoscopy[8] or indirect ophthalmoscopy,[8,9] while few are based on photography.[6] Therefore, one needs to read these prevalence figures and interpret the prevalence or susceptibility of the population carefully.

Almost two-third of all Type 2 and almost all Type 1 diabetics are expected to develop DR over a period of time. This highlights the need to plan and implement screening models for diabetes and related blindness. Handling of the increasing problem of diabetes and its danger to sight includes effective education and communication with the patients on the one hand and with health professionals on the other hand. As part of this initiative, all the participants in our study received health education, including materials related to DR.

Three camp models were conceptually different and hence had different attributes. These attributes lead to different nature of usefulness, economic implications, and detection rates.

Model 1 camps were based on the principles of mass screening with minimal precamp publicity. Brief counseling was done at the time of DM detection. However, due to a large number of participants and nature of location chosen (public places), detailed counseling could not be given. This led to very few percentages of diabetics attending the hospital for DR screening. Only 244 people of 3488 came to the base hospital and only 40 were detected to have DR. This concluded that this method is economically viable for detection of diabetes but was ineffective in screening perspective for DR. The advantage is an easy organization of the camp and capability to screen large numbers. However, an attempt to increase the number of counselors was not fruitful because of the floating nature of the population involved.

Advantage of Model 2 camps was reasonably high pickup rate of DM and DR. Adequate counseling and dietary advice could be given to the attendees. Disadvantage was labor intensive and costly. The cost to pick up new diabetic patients and DR patients was Rs. 440 and 3716, respectively. The camp had a greater impact of awareness creation and had a very high rate of patients attending the base hospital for continuing medical care. The model also probably reflected the incidence rates of DM and DR in the community more accurately than other methods.

In Model 3 camps organized in institutions, attendance was generally better than other models and detection rates for both DM and DR were also high. This was probably because the population screened had more of a sedentary lifestyle with high rates of obesity compared to the general population. The advantage of such a model is its economic viability if attendance at the camp is atleast 200. Disadvantage is the limited reach of these camps and the concentration of these in urban and semi-urban areas.

Statistical analysis showed that per capita costs involved to pick up DM and DR were significantly different. This meant that it was unviable to use Model 1 camp to screen diabetics for retinopathy, but it was by far the most economical for diabetes screening. It was also the least efficient to give advice for the participants. In Model 3, the cost to detect DM was significantly higher than in Model 2 camps, but the per capita cost to detect DR was lower. Model 2 has thus the best overall pickup rate of DM and good rates of DR detection and is most suited for our country. In Urban areas, however, institution-based DR screening is an extremely cost-efficient and successful model with very high pick-up rates.

One of the major criticisms regarding screening in India is that retinal screening is done by a clinician and photographic documentation is not practiced. In contrast, photographic screening is the standard practice in the national DR screening program in the UK and the Joslin network in the USA. Retinal fundus photography allows better standardization, permanent documentation, and accurate reporting, although the costs of image acquisition and transmission are a deterrent in a country like ours. Furthermore, the concept of a reading centre where reading, grading, reporting and making recommendations for Diabetic Retinopathy screening is still non-existent in India. Considering these limitations, community-based screening strategies by ophthalmic personnel continue to be the viable solution to tackle diabetic blindness in our country. However, the recent COVID pandemic has curtailed these routine screening activities and the spotlight is now on exploring photography-based screening even in our country, which is advocated to be safer and more relevant in these times.

Conclusion

Blood screening camps are effective in screening a large

population and identifying new diabetics, but poor for DR screening. Institutional screening camps are cost-effective with very high DR detection rates, but have a limited reach across the general population. So in a developing country like India, cost effective screening activities and service delivery are best achieved through a well planned comprehensive eye camp which has the best overall detection rate for DR.

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Conflicts of interest

There are no conflicts of interest.

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