Diabetic Retinopathy in the Developing World: How to Approach Identifying and Treating Underserved Populations

DAVID S. FRIEDMAN, FERHINA ALI, AND NICKOLAS KOURGIALIS

BLINDNESS FROM DIABETIC RETINOPATHY (DR) IS ALMOST COMPLETELY PREVENTABLE WITH APPROPRIATE SCREENING AND TREATMENT.1 Furthermore, better management of blood sugar, blood lipids, and blood pressure dramatically reduces the rate of developing DR, as has been demonstrated in large randomized clinical trials.2,3 Nevertheless, widespread systematic screening of persons with diabetes mellitus (DM) is not uniformly available in developed countries and is virtually unheard of in developing nations.

Exacerbating this health system failure is the rapid increase in the prevalence of diabetes worldwide. There currently are 285 million people with DM and this will increase to 439 million in 2030 as the age-specific prevalence increases and the global population ages. The largest increases will occur in regions with developing economies.5 At present, 70% of these cases are in low- and middle-income countries, where average annual per capita healthcare expenditures are as low as $20 per year. Surveys of persons with diabetes indicate that in settings where DM treatment is widely available, about 10% have vision-threatening DR and about 5% require treatment at the time of screening.6 Rates are likely higher in regions where blood sugar and blood pressure are not as well managed.

What is to be done to prevent needless blindness in developing countries with limited resources and rapidly growing diabetic populations?

The process of screening for DR is complex and attention to detail is required if screening efforts are to succeed. First, the cost of screening itself must be kept to a minimum since so many must be screened to identify just one case of treatable disease. For example, Bangladesh has a per capita GDP of about $1300 and total annual healthcare expenditure per capita is about $70.6 An efficient and accurate system must be in place if there is any hope of screening in such a resource-poor setting. The most efficient approach is to use nonmydriatic cameras and centralized grading of the images. The use of general medical doctors without extensive education and training will not work,9 and relying on individuals to directly assess the retina does not perform as well as photographic screening.10 Camera costs remain high (about $20,000), but several low-cost prototypes are being developed. Given the high capital cost of placing cameras, identifying locations that see many diabetic patients per day is a key component to keeping down expenses. In Bangladesh, we are working with the Diabetic Association of Bangladesh, which has affiliated hospitals that specialize in providing care to diabetic patients.

While photographic evaluation for DR sounds straightforward, it is in fact difficult to do well.12,13 Maintaining photographic quality can be difficult, and ensuring that the grading center is consistent and accurate requires ongoing training and quality control. Turnover of staff is a major concern. In order to perform at an acceptable level, software is needed to monitor each grader as well as the numbers screened. Identifying failures in the system early is essential, and this can only be done through close monitoring of performance. As noted above, cost must be kept low, so grading should be performed by trained and certified personnel, not ophthalmologists. Ophthalmologists should confirm treatment referrals in order to reduce the rate of unnecessary examinations.12 From a practical standpoint, programs will have to aim to keep screening costs in the range of one or two dollars per patient screened if they are to succeed.

One emerging technology is the automated grading of retinal images for DR.14,15 Recent publications indicate that these software programs can perform very well at identifying images that are definitely normal, thereby greatly reducing the workload of a grading center. Integrating automated grading using software into the grading center could streamline the process and allow for immediate report of results to patients who screen normal. However, the cost must be low enough to use the software to justify the added benefit.

The most difficult work begins after screening. If real-time analysis of the images is not performed, then patients need to be contacted at a later date with the results, a process that can be challenging. Every effort should therefore be made to establish real-time grading to remove this obstacle to care. Patients with normal examinations need to be recalled annually, once again pointing to the need for proper data management. All of these processes are part of the “screening” arm of the program. This is not the case for treatment, as patients may go to one of several locations for treatment; however, information systems in those locations may not integrate with the ones being used for
the screening program. Some mechanism must be established to monitor whether or not patients who need treatment have received it, and to identify when the treatment phase is over and the patient should return for ongoing photographic screening. There is presently no system-wide solution for dealing with this key part of the process and each program must address this locally.

The logistics and outcomes of DR treatment pose substantial obstacles. First, patients with proliferative DR rarely experience an improvement in vision and can lose some peripheral field, color vision, and night vision after laser treatment. Treatment itself can be painful. Patients are unlikely to be grateful for the tremendous job you have done saving their sight. This is also the case for diabetic macular edema, where conventional laser treatment results in an average increase of only five letters at one year and 20% of those treated go on to lose five or more letters. With laser therapy, only 15% of those treated have an increase of 15 or more letters at one year. Convincing individuals to pay for these outcomes can be daunting and educating patients about the treatment process is critical. Furthermore, repeat laser treatments are required in a substantial proportion of cases. Charging for each laser treatment is a standard model, but one that may not work in developing world settings. Charging one price for all treatments might be more effective and promote greater trust, but may be limited by loss to follow-up; research into how best to structure the payment system is sorely needed.

Training personnel to perform laser treatment can be challenging. While many excellent ophthalmology programs exist in developing countries, not all ophthalmologists receive adequate training in diagnosing diseases of the retina and many ophthalmologists have no experience providing laser treatments. In the programs that Helen Keller International is supporting, we have elected to provide laser treatment at a central location in order to ensure that properly trained clinicians are providing care. Over time, additional personnel can be trained to provide the service closer to the population being served. Expanding programs to provide services locally requires additional capital investments in the laser device as well as laser maintenance and lenses that are required.

Identifying and treating patients with DR is difficult, but possible. The key is thinking through the logistics and the potential points of failure. With the development of low-cost cameras, less expensive lasers, automated grading algorithms, and proper pricing, it will be possible to face the ensuing challenge of the massive increase in diabetes and its complications that is going to occur in the coming decades.

DAVID S. FRIEDMAN DISCLOSURES A CONSULTING RELATIONSHIP WITH BAUSCH & LOMB, LECTURE FEES FROM MSC AND PFIZER, and an instrument loan from Zeiss Meditech. Involved in concept and design (N.K., D.S.F.); writing the article (D.S.F., F.A., N.K.); critical revision of the article (D.S.F.); final approval of the article (D.S.F., F.A., N.K.); data collection (F.A.); literature search (D.F.); and administrative, logistic, or technical support (F.A.).

REFERENCES

13. Jyothi S, Elahi B, Srivastava A, Poole M, Nagi D, Sivaprasad S. Compliance with the quality standards of...


Biosketch

David S. Friedman, MD, MPH, PhD, is the Alfred Sommer Professor of Ophthalmology at the Wilmer Eye Institute of Johns Hopkins University, Baltimore, Maryland. He is also the Senior Ophthalmologist for Helen Keller International, a large non-profit organization dedicated to alleviating blindness worldwide. Dr. Friedman has been leading efforts to implement diabetic retinopathy screening and treatment programs in Bangladesh and Indonesia.