Increasing Eye Care Screening & Referral for People with Diabetes via Telehealth Programs

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Introduction

Twenty-four million Americans are affected by the complications and premature morbidity and mortality rates associated with diabetes mellitus (DM)(Centers for Disease Control and Prevention, 2007). In this report, we focus on two of those complications, visual impairment and blindness. (We will use the term visual impairment to encompass both complications). This is important because many individuals with diabetes do not receive recommended vision care. In particular, we explore one strategy that can be used as a preliminary screen for diabetic retinal disease, the leading cause of blindness among working-aged adults(Centers for Disease Control and Prevention, 2009b). The strategy, known as digital teleretinal imaging, can reduce visual impairment by 1) increasing referrals for comprehensive eye exams, 2) improving patient awareness and compliance, and 3) facilitating timely treatment. We explore advantages and limitations of this

strategy and discuss the role that state public health agencies can play in facilitating further research and implementation.

The Burden of Diabetic Eye Diseases

Diabetes is the leading cause of blindness among adults aged 20-74 years(Centers for Disease Control and Prevention, 2007). In 2008, 3.6 million adults with diabetes (aged 18 years or older) reported visual impairment, defined as "difficulty seeing even with vision corrected by eyeglasses or contact lenses."(Centers for Disease Control and Prevention, 2009a) In a recent prevalence report, 32.8% of people with diabetes (self-reported) had diabetic retinopathy and 5.2% had vision-threatening diabetic retinopathy (Xinzhi Zhang et al., 2010). People with diabetes are more likely to suffer from glaucoma (40% increase) and more likely to develop cataracts (60% increase) than those without diabetes(American Diabetes Association, 2010a). Cataracts in people with diabetes also occur at a younger age and progress more rapidly in people with diabetes (Prevention, 1991).

The number of individuals affected (diagnosed and undiagnosed) by diabetic eye diseases is rising(Saaddine et al., 2008). Between 2005 and 2050, the number of Americans 40 years or older with diabetic retinopathy is predicted to triple from 5.5 million to 16 million people and vision-threatening diabetic retinopathy will rise from 1.2 million in 2005 to 3.4 million in 2050 (Centers for Disease Control and Prevention, 2009; Saaddine et al., 2008).

Visual impairment imposes a significant burden on patients, providers, and the health

care system. It can significantly interfere with a person's ability to conduct such activities of daily living as reading or watching television, walking, driving, shopping and preparing meals. Visual impairment also limits an individual's ability to attend to personal affairs and socialize(Crews, Jones, & Kim, 2006; Ellwein, Friedlin, McBean, & Lee, 1996). In older adults, vision impairment has been shown to be associated with a variety of co-morbidities such as depression, hearing loss, and stroke(Crews et al., 2006). In 2005, the National Eye Institute (NEI) in collaboration with the Lions Club conducted a telephone survey of more than 3000 adults over the age of 18. When asked to rate a list of conditions on a scale of 1 to 10 according to their impact on daily living (with 1 connoting the lowest impact and 10 the highest), 71% of those surveyed gave eyesight a 10 (National Eye Institute, 2007a). In addition to its negative impact on quality of life, vision loss costs an estimated $51 billion each year in the U.S.(Prevention, 2009a) Diabetic retinopathy alone, independent of related impairments such as cataracts and glaucoma, costs the nation more than 1 billion annually in direct medical expenditures for people 40 years and older(Prevent Blindness America, 2007).

Prevention and Detection

Although retinal disease is common in people with diabetes, many people with retinal disease do not seek eye care because diabetic retinopathy is often symptom free until vision is significantly compromised. At this late stage, visual impairment is more difficult and more expensive to manage and often the damage is irreversible. The most important approach to preventing sight-threatening diabetic retinopathy (DR) is early detection. When pathology is identified early, control of hyperglycemia, lipid levels, and blood

pressure can delay the progress of DR. In addition, success of treatment for DR with laser photocoagulation can be optimized when implemented early, before symptoms are manifest(Brechner et al., 1993; Porta & Bandello, 2002).

The benefits of early detection of diabetic retinopathy and other diabetic eye changes (including iris neovascularization, diabetic macular edema, cataract and glaucoma) provide strong incentives for professionals and public organizations to advocate for regular, comprehensive eye exams. A comprehensive exam is conducted by an eye care specialist (an ophthalmologist or optometrist) who assesses the entire health and function of the eye both before and after the pupil is dilated. Pupil dilation allows the provider enhanced viewing of the structures of the eye, and greatly increases detection and evaluation of diabetic retinopathy. (Pupil dilation is a component of a comprehensive eye exam, but is not a necessary procedure for a screening.) The American Diabetes Association (ADA) recommends that adults and children aged 10 years or older with type 1 diabetes have a comprehensive eye examination with dilation within 5 years after the onset of diabetes(American Diabetes Association, 2010b). For people with type 2 diabetes, the ADA recommends a dilated and comprehensive eye examination shortly after the diagnosis of diabetes, and annually thereafter. Finally, women with diabetes who are planning pregnancy or who have already become pregnant, should have a comprehensive eye examination, according to the ADA, and should be counseled on the risk of development and/or progression of diabetic retinopathy. The ADA recommends an eye examination in the first trimester with close follow-up throughout pregnancy and for 1 year postpartum. Comprehensive eye exams for people with diabetes is also

recommended by other professional organizations (i.e. American Academy of Family Physicians, American Academy of Ophthalmology, American Association of Clinical Endocrinologists, American College of Physicians, American Optometric Association, Centers for Disease Control and Prevention, the National Eye Institute, and others.)

Barriers and Challenges

Despite the availability of evidence-based prevention and treatment protocols for DR many adults with diabetes are not screened for the presence of diabetic retinopathy(Lee, Feldman, Ostermann, Brown, & Sloan, 2003; Prevention, 2009b). The National Committee for Quality Assurance, Health Plan Employer Data and Information Set (HEDIS®[1]) of 2009, reported that for adults between the ages of 18 and 75 who were diagnosed with diabetes, only 56.5% of those covered by commercial health plans, 63.5% covered by Medicare, and 52.7% covered by Medicaid had a retinal exam in the prior year(National Center for Quality Assurance, 2009). Similarly, Healthy People 2010, set an objective of annual dilated eye exams for 75% of adults with diabetes; to date (2008) only 53% of people of this age group with diabetes (>18) had actually received dilated eye exams(Prevention, 1991).

Confusion among definitions

Screening as a means of detecting diabetic eye diseases early is well supported in the literature. However, the definition of the term “vision screening” is inconsistent thus confounding the implication of research results. Some researchers and authors use the term “vision screening” to refer to a medical procedure that identifies those at risk for eye

[1] HEDIS is a registered trademark of the National Committee for Quality Assurance (NCQA).

disease; some use the term to refer to a diagnostic procedure, and still others use the terms “vision screening” and “diagnosis” interchangeably. In this paper, we define “screening” to denote a preliminary assessment of risk. A vision screening, therefore, is like a mammography or colonoscopy in that it assesses an individual’s likelihood of having disease. While a mammography or colonoscopy may be followed by a biopsy to confirm a diagnosis, a vision screening is followed by a diagnostic procedure, the comprehensive, dilated eye exam.

Digital Teleretinal Imaging – Description

In 2004, the American Telemedicine Association (ATA) published the “Telehealth Practice Recommendations for Diabetic Retinopathy,” representing a comprehensive review of existing evidence on ocular telehealth for diabetic retinopathy(American Telemedicine Association, 2004). It summarized clinical, ethical and technological recommendations for effective implementation of a teleretinal imaging program. Other research demonstrates the effectiveness of teleretinal imaging as an effective means to screen people with diabetes for diabetic retinopathy(Cavallerano & Conlin, 2008; Gómez-Ulla et al., 2002) and as a means of improving adherence to screening guidelines and eye care(Fonda et al., 2007; Taylor et al., 2007).

With teleretinal imaging, technicians at primary care offices or other local or mobile imaging centers capture stereo images of the retina using a digital camera. The images can be electronically transmitted to and interpreted by trained interpreters, optometrists, or ophthalmologists, who may be offsite. The readers evaluate the image for evidence of

diabetic retinopathy (or other pathology) and make a referral recommendation to the primary healthcare providers based on established protocol.

Teleretinal imaging can be performed with mydriatic or non-mydriatic cameras (those requiring pupil dilation versus those that don't). In a 2001 randomized clinical trial, non-mydriatic cameras were shown to be comparable in their accuracy in detecting retinopathy to the established gold standard established in the Early Treatment Diabetic Retinopathy Study (ETDRS), which required pupillary dilation(Bursell et al., 2001). Other studies have corroborated those results(Cavallerano & Conlin, 2008), with one study concluding that non-mydriatic digital imaging improves the rate of identification of diabetic retinopathy(Conlin et al., 2006). While researchers do not all agree on the greater efficacy of the non-mydriatic camera, the non-mydriatic camera has important advantages. Dilating the patients' eye requires administration of controlled substance drops and thus requires a licensed provider. Dilation is disruptive to vision and visual function typically for many hours, and it is time consuming. These disadvantages increase barriers to screening and early detection.

A Potential Approach to Reduce Barriers to Screening and Early Detection

The following are some of the attributes of the non-mydriatic teleretinal imaging technology.

Patient Awareness

Lack of patient awareness of the importance of an eye care visit has been cited as an obstacle to eye health(Dervan, Lillis, Flynn, Staines, & O'Shea, 2008; National Eye

Institute, 2005). Interventions to increase patient awareness alone have proven effective at increasing screening rates(Xuanping Zhang et al., 2007). This was demonstrated in two Veterans Affairs clinical studies utilizing the Joslin Vision Network Eye Health Care Model telemedicine program for diabetic retinopathy. In one project in Boston(Conlin et al., 2006), and another in Maine(Cavallerano et al., 2005), the digital image resulting from the process, using non-mydriatic technology, was found to increase the ability of the imaging specialist to educate the patient about the disease. The American Telemedicine Association recommends that provider-patient communication be a component of a telehealth program(American Telemedicine Association, 2004).

Primary Care Provider Knowledge

Limited eye health knowledge by primary care doctors has also been raised as an impediment to adherence to eye care guidelines. In a national web-based study of primary care physicians conducted in 2007, only half of physicians believed they had adequate knowledge to advise their patients on vision health, and only 58% believed they could identify patients at higher risk for eye disease(National Eye Institute, 2007b). With an on-site teleretinal imaging system, identifying patients is done by the trained imager, the off-site reader, and the technology, thereby addressing this knowledge gap.

Physician Communication/Recommendation

Several studies have validated patient reliance on the advice of their primary care physician. It follows that when there is no personal physician recommendation for an eye exam, patients do not know that such an exam is important. Unfortunately, referral for

comprehensive eye exams by primary care providers are far from universal or automatic(Xinzh Zhang, Andersen, Saaddine, Beckles, & Duenas, 2008). In a qualitative study conducted by the National Eye Institute in 2005, a majority of participants over the age of 40 said they do not visit an eye doctor because such a visit was not recommended by their doctor(National Eye Institute, 2005). A majority of study respondents also said that their primary care doctor does not look into their eyes or talk to them about their vision health during their physical exam. Locating the camera equipment in the primary care office has been shown to circumvent that barrier and increase referrals to eye care providers(O'Hare et al., 1996). A clinical trial conducted at three primary care clinics of the Indian Health Service in Arizona over five years, resulted in a 50% increase of annual retinal examinations followed by a 51% increase in laser surgery treatment rate(Wilson, Horton, Cavallerano, & Aiello, 2005).

Transportation Barriers

Screening with teleretinal imaging equipment can also help reduce transportation barriers. In a primary care office, patients can get their screening in a familiar setting, on the same day they visit their doctor, limiting the need for multiple trips, reducing time off from work and its related income loss, and limiting transportation costs. Teleretinal imaging is now being conducted in mobile eye clinics that can travel to communities to provide service, thereby addressing patient transportation challenges. The success of these efforts will need to be evaluated.

Eye Care Provider Availability

Studies in rural areas(Boucher, Nguyen, & Angioi, 2005; Cavallerano & Conlin, 2008; Cummings, Morrissey, Barondes, Rogers, & Gustke, 2001) indicate the advantage of the use of digital retinal imaging in primary care and community settings to increase screening of diabetic eye diseases in areas where availability of eye care providers is low and transportation to eye care is difficult. The advantage of non-mydriatic imaging – it does not require pupil dilation -- enables the establishment of the equipment in settings other than the eye care professional office, and opens the door for use by those who are not eye care doctors. Technicians can be rapidly trained to use the non-mydriatic imaging equipment(Cavallerano & Conlin, 2008). In addition, non-mydriatic cameras have been well received by patients(Cavallerano & Conlin, 2008; Cummings et al., 2001). The digital imaging system helps providers screen for evidence of diabetic eye disease and refer to the eye care provider only those people identified as at risk of diabetic eye complications. This system of triage has the potential of reducing long waits for appointments and follow-up with eye care providers. The potential for teleretinal imaging to increase referral for comprehensive eye exams in areas of low eye care provider availability and transportation challenges is promising and would benefit from further research.

Cost/Economic Barriers

Researchers have begun to investigate the economic feasibility and cost-benefit ratio of teleretinal imaging. In a 2009 review article on the economic evidence for diabetic retinopathy screening, the authors conclude, “Digital photography with telemedicine links has the potential to deliver cost effective, accessible screening to rural, remote and

hard-to-reach populations(Jones & Edwards, 2010)." Additional research suggests this method has potential for cost savings. An analysis of the Joslin Vision Network (JVN) teleretinal imaging system versus conventional clinic-based ophthalmoscopy concluded that the JVN "has the potential to be more effective than clinic based ophthalmoscopy for detecting proliferative diabetic retinopathy and averting cases of severe vision loss, and may do so at lower cost." (Whited et al., 2005).

At the University of California, Berkeley, a license-free, web-based "store and forward" system (images are stored, and sent to trained readers) was designed to reduce barriers to access to retinal exams for diabetes patients. It has been used in over 120 primary care sites throughout California and elsewhere. Two articles describing the system and the research suggest potential economic savings and improved access to eye health care from the use of this system(Newman, 2009; Whited et al., 2005). In one article, the authors project that "for each patient examined for retinopathy with store and forward telemedicine, the cost savings to the state will total nearly $2,500 over the patient's lifetime(Newman, 2009)." Further research on financial benefit of implementing a teleretinal imaging systems in a primary care setting is necessary.

Public Health Roles

State and local public health agencies can play important roles in the prevention of diabetes-related vision loss by supporting and implementing interventions that increase the rate of comprehensive, dilated retinal exams via a variety of strategies and by promoting evolving technologies such as teleretinal imaging. The following tasks foster

those goals:

Assess Numbers of People at Risk and Barriers to Screening and Early Detection

- Assess the impact of diabetes and identify populations at greatest risk for diabetes-related eye diseases, where these people are located, and their barriers to getting regular, comprehensive eye exams. Use data sources such as the Behavior Risk Factor Surveillance System (BRFSS) vision module, and state-level Medicaid and Medicare data (and private provider data if available) to define state and local diabetes-related vision problems.

Educate People with Diabetes

- Educate people with diabetes about the importance of screening and comprehensive eye exams, even when they do not have symptoms.
- Encourage people with diabetes to ask for an eye screening when visiting their primary care provider.

Educate Providers

- Encourage primary care providers to 1) implement tracking systems to identify people with diabetes 2) to recommend annual eye exams for those patients with diabetes, and 3) to implement tracking systems to identify people with diabetes.
- Inform primary care providers about teleretinal imaging and how it can help reduce access barriers, improve clinical efficiency and help high risk populations receive vision and eye care in a timely and appropriate manner.

- Inform providers about partnerships and services that can reduce barriers to eye care, so that when pathology is identified, patients have knowledge of and access to such services as transportation to appointments, mobile eye exam vans, and language interpreters.

Facilitate Partnerships

- Convene an advisory group of primary and specialty eye care providers, (and include current users of teleimaging protocals such as the Joslin Vision Network (JVN) and the University of California at Berkeley), to define the credentials and experience needed for screening in the primary care setting and whether teleretinal imaging or another system of screening and referral for diagnosis and treatment of identified diabetic eye problems is appropriate

- Collaborate with state and regional ophthalmology and optometry associations to identify and map location of eye care specialists.
- Form community partnerships to mobilize resources to implement teleretinal imaging pilot studies based in primary care offices.
- Encourage and participate in collaborative grants that pay for pilot projects, and advocate for the integration of teleretinal imaging research projects within existing clinical programs for the underinsured or uninsured.

Develop policies

- Provide information to policy makers and encourage further study on the offering of reimbursement and/or tax credit programs for eye specialists providing care for low-

income, under and uninsured and for primary care providers using teleretinal imaging as a screening methodology.

Evaluate

- Investigate state digital retinal imaging systems, their location, scope, and effectiveness. Keep in mind that an effective screening modality must be acceptable and convenient for patients, be sensitive to local needs and have built-in quality control mechanisms. In any one region, the screening program that is adopted is likely to be a compromise between efficacy of the method, the existing infrastructure and local expertise.

Limitations

The intent of this paper is to provide an overview of a technology that holds promise for increasing vision screening rates and for overcoming some barriers to recommended eye care for people with diabetes. It does not address issues of follow-up care after people have been screened and identified with pathology. This paper is also not meant to be a comprehensive discussion of access issues that prevent people from getting appropriate eye care. People with diabetes who are screened via teleretinal imaging and identified with pathology that requires follow-up care, may still face such access issues as cost, transportation, and eye care provider availability.

In this paper, we present a strong case for teleretinal imaging for those with access to primary care but with limited or no access to eye care providers. In locations with well-

developed and accessible eye care systems, there may be other issues that affect the use of teleretinal imaging.

Conclusion

The burden of diabetes-related visual impairment and blindness on individuals and society is significant. Teleretinal imaging is a strategy that can increase vision screening rates for people with diabetes and thereby detect pathology early when prevention and treatment are more likely to forestall vision loss. The technology is not intended to replace a comprehensive, dilated eye exam. It is, however an effective preliminary screening technology, used most effectively as a triage mechanism, to identify those with pathology and refer them for comprehensive, dilated eye exams. Teleretinal imaging holds promise for increasing primary care provider referrals to eye care providers, for reducing barriers related to transportation and eye care provider availability, and for facilitating patient and primary care provider education. The fulfillment of this promise will depend on continued evaluation and application of the technology. Public health agencies and practitioners play a key role in that process by exercising their abilities to assess the disease and the efficacy and cost effectiveness of the technology, by educating patients and providers about the strategies available to increase rates of comprehensive eye exams, and by facilitating partnerships that enhance their vision health activities, and that further legislative options to reduce costs.

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Appendix A

National Association of Chronic Disease Directors (NACDD)
Vision & Eye Health Council
Membership Roster

State Members
Kathy Allely, Alaska
Kathy Berman, New Hampshire
Bonnie Bradley, Arkansas
LaTonya Bynum, Arkansas
Roger Chene, California
Michelle Cook, Texas
Patricia Daly, Massachusetts
Rayleen Earney, Nevada
Marjorie Franzen-Weiss, Nevada
Michelle Hansen, Colorado
Thomas Joyce, Ohio
Kim Kelly, New York
Pamela Kovach, New Mexico
Chris Maylahn, New York
Cheryl Metheny, Illinois
Nuris Rodriguez, New Jersey
Nicole Runner, Idaho
Donald Shepherd, Iowa
Pasa Turituri, American Samoa
Gloria Vellinga, Colorado
Eric Weiskopf, New York

Partner Organizations
American Academy of Ophthalmology
American Optometric Association
Centers for Disease Control and Prevention
Lighthouse International
New England Eye Institute
National Eye Institute
New Jersey Commission for the Blind
New Mexico Health Care Takes on Diabetes
Point Park University
Prevent Blindness America
University of Houston, Optometry
VisionServe Alliance
Vision Service Plan