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# **National Multi-Stakeholder Expert Summit on Diabetes and Vision Loss**

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A Report Based on the Summit  
Convened in Washington, D.C., June 2015

The Angiogenesis Foundation

# Acknowledgements

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# KEY POINTS

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1. Diabetic retinopathy, including diabetic macular edema (DME), is a significant - and growing - public health problem, both globally and in the United States. It is the leading cause of blindness among working Americans aged 20 to 74 years.
2. The U.S. Centers for Disease Control and Prevention predicts that if current trends continue, as many as one in three American adults will have diabetes by 2050. As a result, diabetes-related eye diseases - and the blindness caused by them - will exact a severe and ever-increasing socioeconomic burden on individuals, families, communities, and the nation's health system.
3. During the past decade, the development of VEGF-targeted drugs has produced a true paradigm shift in the treatment of diabetic retinopathy (DR), particularly a form of the eye disease known as diabetic macular edema (DME). Patients now have an effective treatment option that not only stabilizes vision loss, but also, in many cases, helps to reverse it.
4. The rapid development of advances in the treatment of DME has led to new questions about how the prevention, diagnosis, and long-term management of the disease is currently being addressed, both globally and in individual countries - and how those care pathways can be improved.
5. There is a persistent concern that the majority of patients with DME - or those who are at risk of developing it - are not receiving the optimal patient-centered and evidence-based care that they need to maintain vision and prevent progressive vision loss. This concern exists even in developed countries that offer advanced medical care, such as the United States.
6. All diabetes stakeholders in the United States - patients, families, patient-advocates, clinicians, researchers, and government policymakers - need to work together to overcome current prevention, diagnostic, and treatment gaps in the care pathway for diabetic eye disease. Action is urgently needed to create a continuum of patient-centered care that will efficiently, effectively, and compassionately save the vision of millions of Americans in the coming years.

# CALLS TO ACTION

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## Public Health and Prevention

- Develop mobile apps to help people assess and modify their risk factors for developing diabetes and diabetic vision complications.
- Launch a large and effective public-health campaign to encourage people with diabetes to get yearly eye exams.
- Greatly increase the number of sites throughout the country that offer screening for diabetes-related eye diseases.

## Care Delivery and Technology

- Initiate government-supported low-cost eye-screening programs, including in non-traditional settings.
- Institute a national program for the development of healthcare "coaches" to help patients manage diabetes and other chronic diseases.
- Create a personal cloud-based "dashboard" for each patient with diabetes to enhance communication between the patient and all of his/her clinicians and to more quickly identify any gaps in care.

## Patient-centered Care

- Design and conduct a clinical trial to identify successful behavioral strategies for reducing the risk of vision loss in patients with diabetes.
- Create an online platform that would leverage already existing diabetes communities to provide feedback on all aspects of their care; use what is learned from that feedback to test new strategies in the clinical setting for improving patient experiences and outcomes.
- Develop new and effective strategies for individualizing the care and treatment of patients with diabetes-related vision loss.

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# Introduction

## The Diabetes Epidemic

Diabetes is a metabolic disease that occurs when the body either lacks insulin (type 1 diabetes), or it makes too little insulin, or uses the insulin ineffectively (type 2 diabetes). As a result, levels of blood sugar (glucose) become too high, which, over time, can lead to serious complications, including cardiovascular disease, nerve disease (neuropathy), kidney disease (nephropathy), eye damage (retinopathy), and foot damage. Diabetes was the 7th leading cause of death in the United States in 2010.<sup>1</sup>

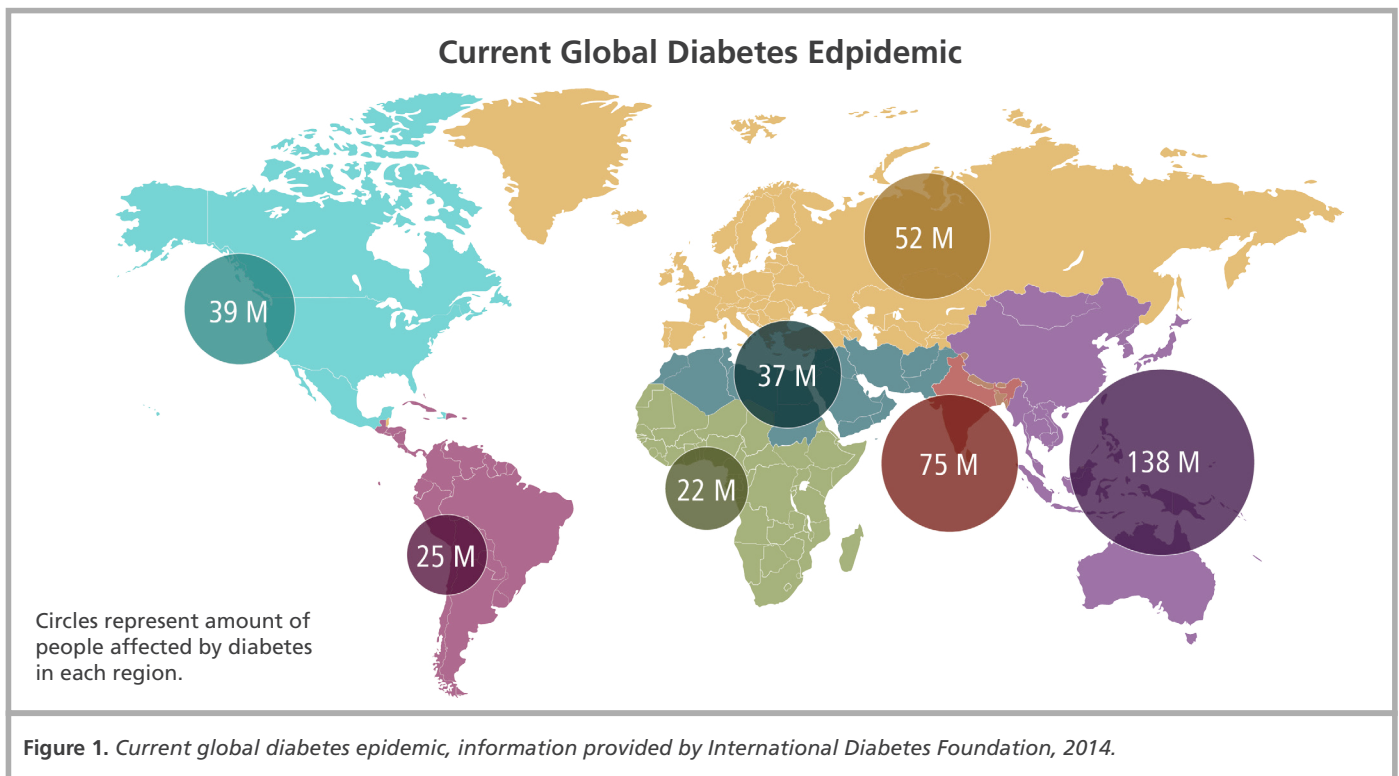
Two decades ago, in 1994, officials at the Centers for Disease Control and Prevention (CDC) declared that diabetes had reached epidemic proportions in the United States. Since then, the percentage of American adults with the disease has almost doubled, driven in part by a concurrent rise in the incidence of obesity, which is a major risk factor for type 2 diabetes. In 2012, the CDC estimated that 29 million people aged 20 and older - or 9.3% of the U.S. adult population - had been diagnosed with diabetes, up from the previous estimate of 26 million only two years earlier.<sup>1</sup> The agency also estimated that another 8.1 million Americans, or almost a quarter of all people with diabetes, remained undiagnosed in 2012.<sup>1</sup>

In addition, 86 million American adults are believed to have prediabetes, a condition in which blood glucose

levels are higher than normal, but not high enough to be considered full-fledged diabetes. Without intervention - especially dietary changes and weight loss - 15% to 30% of people with pre-diabetes go on to develop diabetes within 5 years.<sup>1</sup>

Although diabetes affects all racial, ethnic, and age groups, certain populations are at higher risk. Non-Hispanic black, Hispanic, and American Indian/Alaska Native adults are two times more likely to be diagnosed with the disease than non-Hispanic white adults.<sup>1</sup> The prevalence of diabetes also varies by age group. More than 25 percent of people aged 65 and older were diagnosed with diabetes in 2012, compared with 16 percent of those aged 45 to 64 and 4 percent of those aged 20 to 44.<sup>1</sup> The number of young adults with the disease is on the rise. However, one study found that the number of U.S. children and young adults with type 1 diabetes rose 21 percent and the number with type 2 diabetes rose 30 percent between 2001 and 2009.<sup>2</sup>

Diabetes is treated and managed with behavioral interventions and medications. People with type 1 diabetes must receive insulin by injection to survive. Type 2 diabetes can usually be managed with oral medications that lower blood glucose levels and/or by maintaining a healthy weight through diet and regular exercise. Control of blood glucose levels significantly reduces the risk of developing complications of the nerves, kidneys, and eyes.



## Diabetes and Vision Loss

Diabetes is the leading cause of new cases of blindness among Americans of working age (20 to 74 years). People with diabetes are 40% more likely to develop glaucoma (an increase in fluid pressure inside the eye that damages the optic nerve) and 60% more likely to develop cataracts (a clouding of the eye lens). The most common diabetes-related eye disease, however, is diabetic retinopathy. The CDC estimates that 28.5 percent of all Americans with diabetes aged 40 years and older - or 4.2 million individuals - had diabetic retinopathy in 2005-2008.<sup>1</sup>

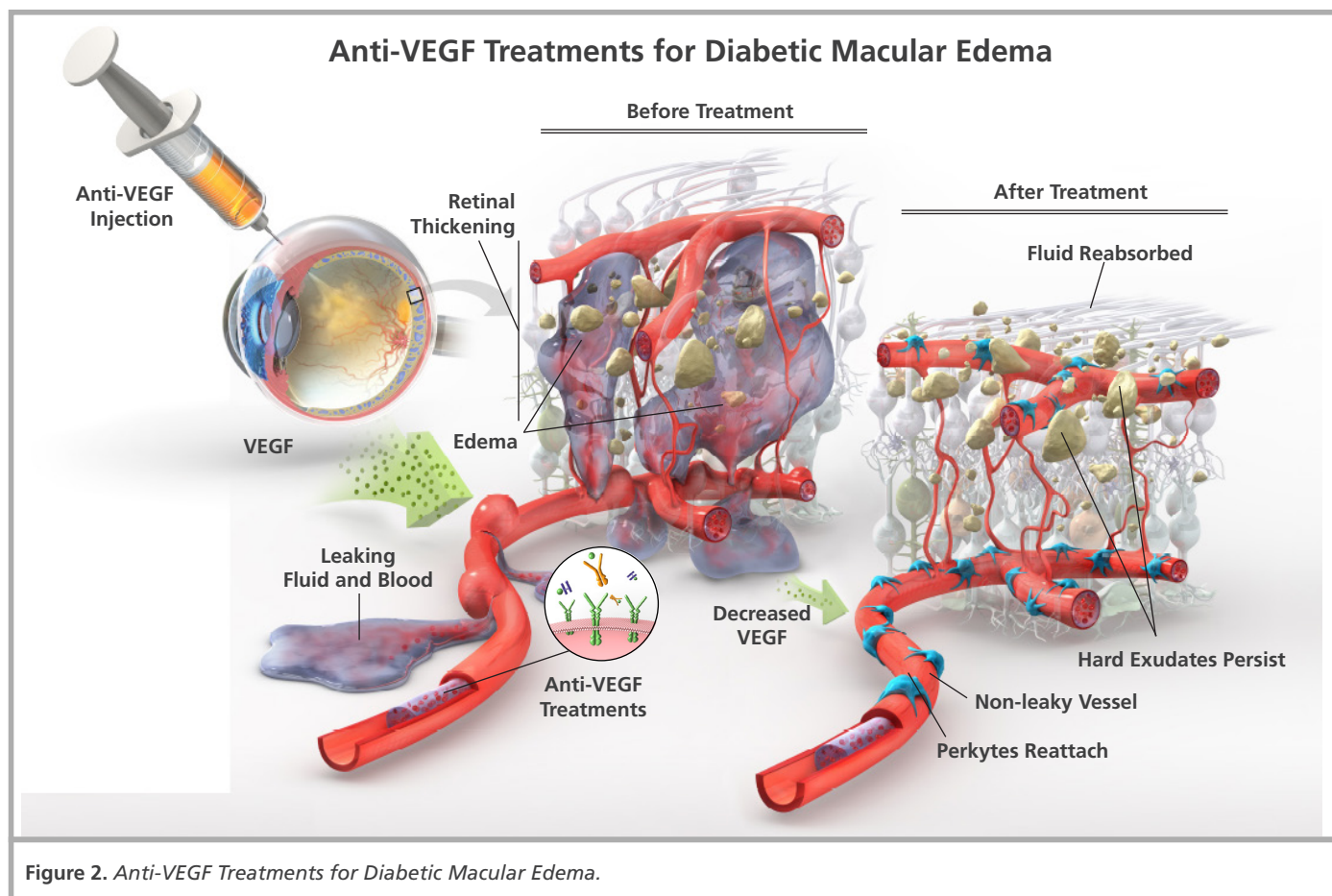
As its name suggests, diabetic retinopathy develops when chronically high levels of blood glucose damage and block the tiny blood vessels (capillaries) in the retina, the layer of nerves that lines the back of the eye. Cut off from oxygen, the hypoxic retina tissue responds by increasing, or upregulating, the expression of a small glycoprotein called vascular endothelial growth factor (VEGF). As a result of the elevated levels of VEGF, fragile, abnormal capillaries form and, eventually, leak blood into the center of the eye, blurring vision.<sup>3</sup> This advanced form of diabetic retinopathy is known as proliferative retinopathy. Fluid can also leak into the macula, the high visual acuity region at the center of the retina, causing it

to swell and thicken and leading to a loss of central vision. This form of diabetic retinopathy is called diabetic macular edema (DME). About half of individuals with proliferative retinopathy also have DME.<sup>4</sup>

Given that 1 in 10 American adults has diabetes today - and that as many as 1 in 3 may have the disease by 2050 if current trends continue<sup>5</sup> - diabetic retinopathy is a significant and growing public health issue for the nation.

## Anti-VEGF Therapies for the Management of Diabetic Retinopathy

When it became clear that VEGF performs a role in the development of diabetic retinopathy, researchers went to work identifying and then evaluating the impact of four anti-VEGF drugs - pegaptanib, ranibizumab, bevacizumab, and aflibercept - on the clinical management of the disease. All four drugs have been shown to be effective, but only two - ranibizumab and aflibercept - have received regulatory approval in the United States for the specific treatment of diabetic retinopathy.



## Ranibizumab

In 2012, ranibizumab received regulatory approval from the U.S. Food and Drug Administration (FDA) for the treatment of DME and of macular edema following retinal vein occlusion (blockage of the capillaries that carry blood away from the retina).<sup>6</sup> Early in 2015, the approval was expanded to include the treatment of diabetic retinopathy in patients with DME.<sup>7</sup> Prior to these announcements, the FDA had approved the drug for the treatment of wet (neovascular) age-related macular degeneration (AMD), a non-diabetes-related eye disease in which abnormal blood vessels grow and leak fluid into the macula.

Ranibizumab's efficacy and safety for the treatment of diabetic retinopathy were first established in the RISE and RIDE studies, two randomized clinical trials involving 759 patients who were treated and followed for three years.<sup>8</sup> The studies found that between 34% and 45% of patients treated with monthly ranibizumab intravitreal injections of 0.3 or 0.5 milligrams (mg) gained at least three lines of vision on a standardized vision chart compared with 12% to 18% of patients who received sham (placebo) injections. The most common side effects observed were intraocular pressure, bleeding in the membrane (conjunctiva) that lines the inside of the eyelids, eye pain, and vitreous floaters (shadowy specks or strings of material that float across the field of vision). Based on these clinical trials, the FDA approved a monthly ranibizumab dose of 0.3 mg for the treatment of DME because the studies found no additional benefit for the higher dose of 0.5 mg. The results of those two studies were supported by later data from the Diabetic Retinopathy Clinical Research Network, which followed 854 patients for two years.<sup>9</sup>

## Aflibercept

In 2014, the FDA approved aflibercept for the treatment of DME.<sup>10</sup> The agency expanded this approval to include the treatment of diabetic retinopathy in patients with diabetic macular edema in 2015.<sup>11</sup> Aflibercept had been

previously approved by the FDA for the treatment of AMD and for macular edema following central retina vein occlusion.<sup>12</sup> Late in 2015, European regulators added to its approvals for the drug, the treatment of visual impairment due to myopic choroidal neovascularization, an eye disease characterized by high degrees of myopia (near-sightedness).<sup>13</sup> The FDA's approval of aflibercept for the treatment of diabetes-related eye diseases was based on the results of the VIVID and VISTA studies, two clinical trials involving 872 patients.<sup>14</sup> These studies found that, after 52 weeks,

patients treated monthly with 2.0 mg of aflibercept for five months and then every two months afterwards gained, on average, two additional lines on a

## Normal Vision

## Vision with DME



**Figure 3.** Comparison of normal vision to vision with DME.

standardized vision chart compared to patients treated with laser therapy. The most common side effects observed in the studies were conjunctival bleeding, cataracts, eye pain, and vitreous floaters.

With the advent of anti-VEGF drugs, clinicians could offer their patients with diabetic retinopathy the opportunity to not only stop vision loss, but, in many cases, to reverse that loss. These drugs have several drawbacks, however, most notably the burden that receiving multiple injections over many months places on patients and caregivers.

## U.S. Expert Summit: Identifying and Meeting a Need

By early 2014, it had become clear that rapid advances in anti-VEGF therapies were revolutionizing the treatment of diabetic retinopathy - and the field of ophthalmology. Recognizing the clinically transformative nature of these remarkable therapies, the Angiogenesis Foundation decided that it was an opportune time to bring together the diabetes stakeholder community to review the impact that the new drugs are having on the



treatment of diabetes-related eye diseases; the challenges that such treatments present to patients, clinicians, advocates, and policymakers; and the questions that still need to be answered to ensure the very best outcomes for patients with the disease. As a scientific nonprofit organization with expertise in how anti-VEGF therapies are used across many different indications, the Angiogenesis Foundation recognized that it was well positioned to play the role of the neutral facilitator for such a review. In summer 2014, the Foundation hosted a global summit comprised of a group of international leaders in DME treatment and translational science - a summit similar to successful ones the Foundation has hosted on other angiogenesis-related diseases, including wet AMD and metastatic colorectal cancer (mCRC). That event, the International Expert Summit on Advocating for Improved Treatment and Outcomes for Diabetic Macular Edema was convened in Paris on June 22, 2014. It included experts from Latin America, Europe, and the Asia-Pacific region, as well as from North America.

It was clear from that global summit that different countries and regions of the world face their own specific challenges regarding the prevention, diagnosis, and treatment of diabetic retinopathy. To assist in identifying regional and country-specific solutions for these challenges, the Angiogenesis Foundation has begun to work in collaboration with stakeholders across the globe to organize a series of regional summits. The first of these, the Canadian National Multi-Stakeholder Expert Summit for Diabetic Macular Edema, was convened in Toronto on January 17, 2015. The second, the National Multi-Stakeholder Expert Summit for Diabetes and Vision Loss, was held in Washington, D.C. on July 29, 2015. Dr. William Li, President, Medical Director, and Co-Founder of the Angiogenesis Foundation served as Chair of these events. The Washington, D.C. summit, like the previous ones in Paris and Toronto, was not a traditional scientific meeting, but rather an interactive, professionally moderated set of short presentations and roundtable discussions that aimed to establish a dialog and agreement among the participants. The summit opened with four short presentations. The first presentation provided an overview of diabetes-related vision loss and its implications for science and society; the second summarized what the research and clinical practice has revealed about reducing the risk of diabetic retinopathy; and the third outlined the latest findings regarding the comparative effectiveness of various treatments for diabetic retinopathy. The final presentation told the compelling personal story, from the perspective of a person with diabetes, of how the disease affects the vision - and lives - of the people who are diagnosed with it. Under the direction of a moderator, the 17 assembled experts then engaged in a discussion that defined and prioritized the greatest concerns that different diabetes

stakeholders - people living with the disease, patient-advocates, physicians and other clinicians, researchers, and government policymakers - have regarding the potential for vision loss both before and after the patient is diagnosed with diabetes. A graphic recorder captured key points of this and all other discussions during the meeting, enabling the participants to visually review the content of their conversations as they worked through the tasks at hand.

The meeting began with the experts reviewing the current care pathway for the diagnosis and treatment of diabetic eye disease in the United States, starting with awareness and screening and moving through diagnosis, referral, treatment, and follow-up. This included a discussion of the key issues regarding the prevention, screening, treatment, and management of diabetes-related vision loss. Next, the participants turned their focus to identifying the key gaps that impede the prevention of vision loss in the diabetes care pathway. They then prioritized those gaps and identified the ones that, if addressed, would make the greatest near-term improvement in reducing diabetes-related vision loss, as well as the ones that would be the easiest to address through joint action. The meeting ended with the experts compiling a list of recommended "action steps" for diabetes stakeholders to undertake. This white paper is a result of the open, comprehensive, and lively discussions that took place during the summit. It offers detailed summaries of the key points raised during the meeting.

## The Role of The Angiogenesis Foundation

Founded in 1994 and headquartered in Cambridge, Massachusetts, The Angiogenesis Foundation is the world's first 501(c)(3) nonprofit organization dedicated to conquering disease with approaches based on angiogenesis, the growth of new blood vessels in the body. Its global mission is to help people benefit from the full promise of angiogenesis-based medicine, and to make life-, limb-, and vision-saving treatments available to everyone in need.

As a scientific organization, The Angiogenesis Foundation is independent of any individual, institution, or commercial entity, and, as such, it takes a unique approach to achieving its mission to help people lead longer, better, and healthier lives. It has helped propel innovative research involving both angiogenesis inhibitors and stimulators. Although much of this research has been pharmacological, promising studies involving nutrition and biomarkers are also being actively pursued. In addition, The Angiogenesis Foundation is constantly looking for ways to innovate new and more

effective prevention and care pathways, including the use of innovative mobile devices and software that engage patients as well as physicians in managing both health and disease.

Angiogenesis-related research is being conducted across a remarkably wide variety of disease states. In recent years, for example, profound angiogenesis-treatment breakthroughs have been discovered in oncology, wound care, and cardiovascular disease, as well as in ophthalmology. The Angiogenesis Foundation recognizes the challenges of optimizing patient care and outcomes with such paradigm-shifting discoveries as anti-VEGF treatments for diabetes retinopathy. It also deeply understands that to meet the goal of improving global health through angiogenesis-based medicine, the complex needs of all of the stakeholder groups involved, including patients, caregivers, patient-support organizations, physicians, researchers, scientists, industry leaders, regulators, policymakers, and funders, must be aligned and met. The Angiogenesis Foundation is committed to helping these groups work together to ensure that all people benefit from current and future advances in angiogenesis-based medicine.



**Figure 4.** *National Diabetes and Vision Loss Expert Summit participants, Washington D.C., June 2015.*

# Situation Analysis

The National Multi-Stakeholder Expert Summit for Diabetes and Vision Loss opened with welcoming remarks from Dr. William Li. He explained the origins and purpose of the current summit. Dr. Li's remarks were followed by brief presentations by four diabetes experts. Emily Y. Chew, MD, a retina specialist and the deputy director of the Division of Epidemiology and Clinical Applications and the deputy clinical director at the National Eye Institute (NEI), National Institutes of Health (NIH), described the scope of the health burden from diabetes-related vision loss and its implications for science and society. Richard E. Pratley, MD, an endocrinologist and the medical director of the Florida Hospital Diabetes Institute, provided an overview of how current treatments can help reduce the risk of diabetes-related vision loss and other chronic complications of the disease. Jennifer K. Sun, MD, MPH, an ophthalmologist at the Joslin Diabetes Center and an assistant professor at Harvard Medical School, presented the latest comparative effectiveness research regarding treatments for diabetes-related vision loss. Quinn Nystrom, director of Dateline Diabetes, a nonprofit organization that provides support to young people with diabetes, ended the presentations with stories of how the disease affects the vision - and the lives - of individual patients.

## Vision Loss in Diabetes: Implications for Science and Society

Diabetes is an immense and growing public health challenge, both in the United States and worldwide. The prevalence of the disease will increase dramatically in the coming years. In 2011, diabetes affected an estimated 366 million people worldwide, a number that is predicted to increase to 522 million by 2030.<sup>15</sup> The upsurge in new cases is going to be especially strong in Africa, the Middle East, and Southeast Asia, although it will also occur in the United States. It's estimated that one-third of the babies born in the United States in 2000 will be diagnosed with diabetes during their lifetime. There are several reasons why increasing numbers of Americans are developing the disease. Diabetes is associated with obesity, which, like diabetes, has reached epidemic levels in the United States. In addition, Americans are developing diabetes at earlier ages - and living longer with the disease, which increases the pool of patients who need care.<sup>15</sup>

Diabetes exacts a huge economic burden on the U.S. economy. A study commissioned by the American Diabetes Association (ADA) estimated that the costs associated with diabetes was \$245 billion in 2012, including \$176 billion in direct medical costs and \$69

billion in reduced productivity.<sup>16</sup> The U.S. Centers for Disease Control and Prevention (CDC) has estimated that people with diabetes spend twice as much as those without the disease on medical care.<sup>17</sup>

Vision loss is a major complication of diabetes, with many implications for both individuals and society. The main cause of diabetes-related vision loss is diabetic retinopathy, which has two advanced forms: proliferative diabetic retinopathy and diabetic macular edema (DME). The U.S. Centers for Disease Control and Prevention estimates that more than 1 in 4 adults with diabetes aged 40 and older has one of these forms of vision loss.<sup>18</sup> Early detection is very important for preventing vision loss from diabetic retinopathy. Timely treatment and careful disease management can reduce the risk of blindness by 95 percent.<sup>4</sup>

It's estimated that 4.1 million Americans had diabetic retinopathy in 2000, a number that is expected to grow to 7.2 million by 2020.<sup>19</sup> Although all racial and ethnic groups will be affected by this increase, the highest proportion of new cases will occur within the Hispanic population. The 10-year incidence rate of visual loss from diabetic retinopathy varies by age.<sup>20</sup> An estimated 1.8% of younger-onset patients, who are more likely to have type 1 diabetes, become blind within 10 years of diagnosis; that compares with 4.8% of older-onset patients with type 2 diabetes. In addition, 9.2% of younger onset patients and 21.4% of older-onset patients develop moderate vision impairment (the equivalent of losing 3 lines of vision on the Early Treatment of Diabetic Retinopathy Study [ETDRS] chart) within 10 years of diagnosis. The longer someone has diabetes, the greater the risk of vision loss.

In a 2014 survey, many Americans rated losing eyesight as the disability that would potentially have the greatest impact on their daily life, including 57% of African Americans, 49% of Caucasian, 43% of Asian-Americans, and 38% of Hispanics.<sup>21</sup> The survey also revealed that Americans are as concerned about losing their vision as they are about developing Alzheimer's disease. Other research has shown that patients with severe vision loss equate it to having severe angina or losing a kidney. Losing vision is very important among people with diabetes; in one survey, 41 percent of patients with diabetes said they were very or extremely worried about going blind - more so than losing a limb to the disease or developing diabetes-related heart or kidney problems.<sup>22</sup> Those concerns are well founded, for diabetic retinopathy has a major impact on activities of daily living, such as reading, cooking, the management of personal finances, self care (including administering insulin), personal mobility, and social participation. The disease thus leads to a dependence on others and



feelings of isolation and vulnerability. One study found that decreasing visual acuity is the most important factor associated with changes in vision-related quality of life among people with type 1 diabetes.<sup>23</sup>

Diabetes-related vision loss imposes a devastating burden on individuals and on society. The challenge facing all of us is to develop less invasive, less time-consuming, and lower-cost treatments, and even more urgently, to find more effective methods of prevention.

## Reducing Risk: A Focus on Retinopathy and Other Chronic Complications of Diabetes

The United States is in the midst of a major diabetes epidemic, which has become a huge public health problem. The challenges posed by the epidemic are numerous, but include several of particular urgency:

### 1. Who will care for all the new diabetes patients?

The U.S. does not have enough endocrinologists to take on the growing numbers of patients with diabetes, so the burden of caring for those patients is going to fall largely on primary care physicians and, increasingly, on mid-level practitioners. In addition, how will cost-effective care be delivered to this expanding pool of patients when the annual cost of diabetes to the United States is already approaching \$300 billion?

### 2. How can we best manage the pre-diabetes epidemic?

The number of Americans with pre-diabetes is significant and growing. The CDC estimates that 86 million people in the United States have pre-diabetes, and that as many as 30% of them will develop diabetes within five years.<sup>1</sup> The consensus recommendations of the American Diabetes Association (ADA) for managing pre-diabetes include weight loss (at least 7% of total weight), moderate exercise (at least 150 minutes per week), and, for certain patients (those who are obese



Figure 5. Moderated discussion at the Expert Summit.

and/or younger than age 60), the drug metformin.<sup>24</sup> Yet, although these lifestyle changes can be effective, they are not often implemented in primary care. Furthermore, a 2015 study found that metformin is being prescribed to only 3.7% of eligible patients with pre-diabetes.<sup>2</sup>

### 3. **How can we reduce diabetes-related complications?**

Diabetes is the leading cause in the United States of new cases of blindness among working-age adults, new cases of end-stage renal disease, and non-traumatic lower-extremity amputations. The disease is also associated with a two- to four-fold increase in the risk of cardiovascular disease, and two out of three people with diabetes die as a result of a cardiovascular complication.

Research has demonstrated a quantitative relationship between tight glycemic control and a reduction in the risk of microvascular complications in patients with diabetes,<sup>26</sup> including retinopathy and nephropathy.<sup>27,28</sup> The risk of such complications appears to be lowest among patients with A1C levels below 6%, but any decrease in A1C levels is likely to reduce the risk. No strong cardiovascular benefit has been found for glycemic control, however. Research suggests that if there is such a benefit, it accrues only after 20 years of follow-up.<sup>26,27</sup> One study found an increase in mortality with glycemic control,<sup>29</sup> suggesting that we still have much to learn about how to manage the overall spectrum of risk factors.

Another diabetes-related complication is dementia, including Alzheimer's disease. The risk of dementia is up to two times higher among people with diabetes.<sup>30</sup> The reasons for the association are not well understood, but the current epidemics of diabetes and obesity could foreshadow a future explosion in the prevalence of Alzheimer's disease. Researchers are exploring several diabetes-related therapies, such as nasal insulin and thiazolidinedione, to see if they decrease the risk of dementia. This research into the possible link between diabetes and dementia has applications for retinopathy because the retina is a neural tissue.

### 4. **How can we make the treatment of diabetes less complicated?**

Keeping up with current research and standards of care for the treatment of diabetes and its complications is challenging. The ADA sets glycemic goals at or below 7%, primarily because of the

associated reduction in microvascular complications.<sup>24</sup> The goals should be individualized, however, based on such factors as how long the patient has had diabetes, the patient's age and life expectancy, comorbid conditions, and any known cardiovascular disease or advanced microvascular complications. Twelve classes of drugs have been approved for the treatment of diabetes, and most patients take more than one drug. Thus, physicians and their patients are presented with what can seem at times an overwhelming array of possibilities for lowering blood glucose. This factor is one of many that make the lives of people living with diabetes very complicated.

### 5. **What is the best approach to treating diabetes in older adults?**

As the U.S. population continues to age, an increasing number of older adults will be living with diabetes and pre-diabetes. Yet we really don't understand the appropriate treatment targets in older adults or even what the best treatments are for this population. Nor do we fully understand how diabetes affects cardiovascular risk and other comorbidities in older individuals. Older adults with diabetes are currently understudied; less than 10% of people in diabetes-related clinical trials are aged 65 or older. That is one of many factors that need to be addressed by the health and research community in the coming years as we try to prevent diabetes and its complications from affecting growing numbers of people in the United States and around the world.

## **Diabetic Vision Loss: From Cause to Treatment, and the Emergence of Comparative Effectiveness Research**

Diabetic macular edema (DME), the most common cause of moderate vision loss in diabetic patients, is the result of abnormal leaking of blood vessels in the retina. DME is a multifactorial disease, involving more than one molecular pathway. A number of different mechanisms have been implicated, including the formation of reactive oxygen species, inflammation, and the overexpression of vascular endothelial growth factor (VEGF).<sup>31</sup> These mechanisms all lead to the loss of tight junctions between the endothelial cells that line the capillaries in the retina, thus increasing their permeability. Fluid then exits the capillaries and causes the retina to swell. Vision becomes blurred and, if untreated, blindness may occur.



For many years, the mainstay of treatment for DME was laser photocoagulation. It was shown to be very effective in reducing the risk of moderate vision loss, and was also shown to result occasionally in moderate visual gain. In addition, it was highly effective in reducing retinal thickening. In 2010, the Diabetic Retinopathy Clinical Research Network (DRCRN), a large collaborative network of research sites, published a study called Protocol I, which changed the standard of care for DME from laser therapy to newer anti-VEGF agents.<sup>32</sup> In the study, laser-treated patients gained, on average, 3 letters of vision after one year, while patients treated with an anti-VEGF drug (ranibizumab) gained, on average, 8 or 9 letters. This finding represented a clear shift in understanding within the medical community. We now had new and effective treatments that substantially improved vision beyond what could be gained with laser. The efficacy of anti-VEGF treatments over laser therapy has been confirmed by other studies, including those that involved a second anti-VEGF agent, aflibercept.<sup>33,34</sup>

By early 2015, three anti-VEGF drugs were available for the treatment of DME. Two drugs had received FDA approval (ranibizumab and aflibercept) for treatment of this disease, and a third (bevacizumab) had been shown in large case series and through the experience of physicians to be probably beneficial. Physicians were using all three of the drugs commonly, yet information was lacking on the relative efficacy of the agents. A comparison study was needed because of the important public-health implications, particularly in terms of the varying cost of these drugs.

In February 2015, the DRCRN Network published the results of the first head-to-head study involving aflibercept, bevacizumab, and ranibizumab, called Protocol T. The study was conducted at 89 clinical sites and involved 660 adults with DME.<sup>35</sup> The patients were randomized to intravenously receive one of the three anti-VEGF agents. All were treated on an as-needed basis as often as every 4 weeks, and were followed for 12 months. On average, the patients received 9 to 10 injections during the course of the year. (The study continued for a second year, and those results will be available in 2016.) The 1-year results demonstrated that aflibercept produced greater improvements than the other two drugs; however, a further analysis of the data revealed this difference was driven by improvements in eyes that had worse vision at baseline (20/50 or worse). No differences were found among the three drugs in patients with mild vision loss. The retinal thickness results echoed the visual acuity ones, with aflibercept appearing to produce a more beneficial effect in terms of drying the retina. Importantly, the drugs did not differ with regard to adverse events.

Anti-VEGF treatment is clearly a good first-line therapy for most patients with DME. Additional comparative effectiveness studies will provide us with better data on the relative efficacy of the different anti-VEGF agents. The decision about how to treat an individual patient will be driven, however, not just by a drug's efficacy, but also by its cost and availability. Laser photocoagulation still has a role in the treatment of DME, particularly in eyes that do not respond to anti-VEGF therapy. Still, we need to continue to pursue the development of additional non-anti-VEGF therapies for DME. Many eyes do not respond to existing therapies. More work also needs to be done to identify biomarkers to predict visual outcomes in patients with DME - and to hasten the development of new therapies.

## **Diabetes and My Vision: Perspectives from the Eyes of a Patient-Advocate**

In 1996, the presenter Quinn Nystrom's younger brother, Will, was diagnosed with type 1 diabetes at the age of 5. The family had no history of diabetes. The boy's grandmother, a registered nurse, had recognized the classic signs of the disease and recommended that the child see a doctor. Ms. Nystrom's parents described for her and her other sibling, a sister, what this diagnosis would mean for the family in terms of dietary and other lifestyle changes. Her parents also asked the family pediatrician about the chances their other two children would develop diabetes. He dismissed the idea. "If another one of your children is diagnosed with diabetes," he said, "your family will be on the cover of the New England Journal of Medicine."

Two years later, Ms. Nystrom was diagnosed with type 1 diabetes at age 13. The diagnosis was a shock to her; it also made her angry. All she wanted to do was to look and act like her friends, but now she felt she "suddenly stuck out like a sore thumb." She wanted nothing to do with disease. A year later she was forced by her parents to go to a 7-day diabetes camp. That camp changed her life because she saw other young people living successfully with diabetes. When she returned from the camp, she decided to start speaking out publicly on what it's like to have diabetes. Ms. Nystrom has been an active diabetes patient-advocate ever since.

Ms. Nystrom then described the experiences of three other young people with diabetes:

- Emily is a 25-year-old Minnesotan who works with disabled adults. She's had type 1 diabetes since age 2, but did not have her eyes checked until recently, when she noticed her vision was worsening. She has health insurance, but owes \$2,000 in back medical bills and can't cover her monthly insurance premiums. In fact, she can barely afford the cost of her insulin.
- Zach, 27, is a practicing attorney in Florida who has lived with type 1 diabetes since the age of 14. He has been very proactive about managing his diabetes, but recently his doctor lectured him for 20 minutes about how his blood sugar levels were not sufficiently in control and that retinopathy was in his future. Zach left that appointment feeling very defeated, and doesn't want to return for his next appointment.
- Siri, 22, is a registered nurse with type 1 diabetes. During a recent eye appointment, the medical assistant administering her eye drops described

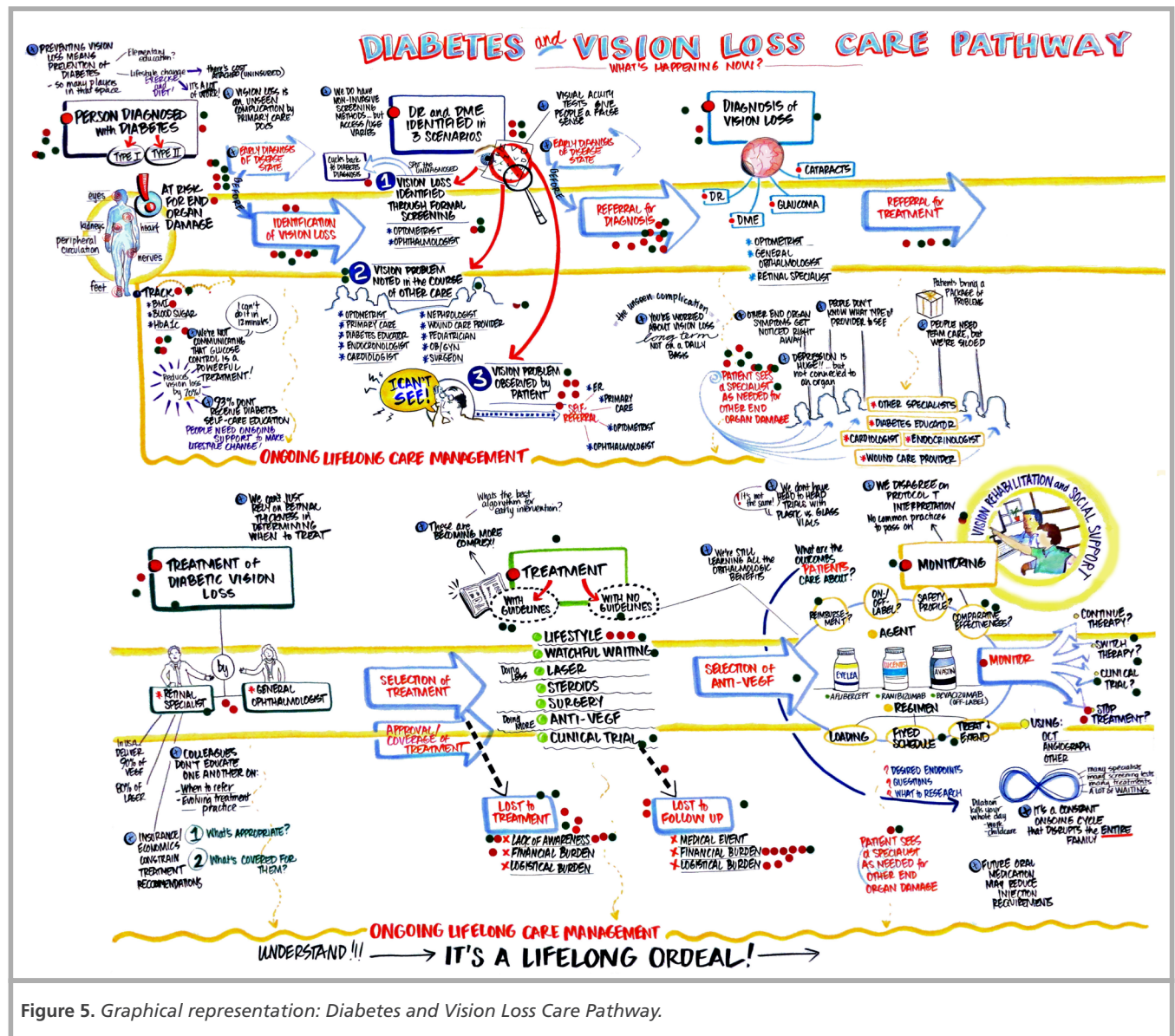
diabetes in the direst terms. The assistant said all her patients with diabetes - even the ones with "perfect" control of their blood glucose - had developed retinopathy. Siri left that appointment feeling discouraged and wondering if anything she could do would save her vision. Like Zach, she doesn't want to return for her next appointment.

These stories illustrate how important it is for patients with diabetes to have access to regular, inexpensive diabetes care - and how important it is for clinicians to offer advice to their diabetes patients that is encouraging rather than discouraging. The high cost of diabetes care often keeps patients from keeping regular medical appointments, including with their eye doctors. Messages from clinicians that instill fear and anxiety also keep patients from seeking care. The most effective clinicians view themselves as health coaches, not strict taskmasters. Clinicians need to work closely and empathetically with patients to help them be proactive with the management of their disease.

# The Patient-Centric Pathway of Diabetic Eye Disease - Global Perspective

As the summit's opening presentations made clear, diabetic retinopathy is a leading cause of vision loss in the United States and around the world. Recent advances in anti-VEGF therapies promise to dramatically improve how diabetic retinopathy is treated and managed, but these disease's social and economic burdens are predicted to remain high and, in fact, to significantly grow in the coming years as populations age and the incidence of diabetes increases. Still, diabetic retinopathy is just one of many serious health complications, including heart disease, kidney disease, and nerve damage, for which people with diabetes are at risk. The question then arises: What can be done by diabetes stakeholders - patients, patient-advocates, clinicians, researchers, policymakers, and others - to improve the diabetes care pathway and reduce the burden of this disease, particularly as it relates to vision loss?

During a group dinner on the night before the summit, the experts had been introduced to a large map of the care pathway for diabetic eye disease. The pathway had been compiled from earlier summits and expanded to include new key points that pertain specifically to the U.S. experience. The experts were asked to indicate on the map (with colored dots) the points along the pathway that presented the greatest problems for patients, clinicians, and other diabetes stakeholders and those that presented the greatest opportunities. The moderator used that exercise from the previous evening to open discussion in this segment of the summit. He asked the meeting's participants for their general impressions of the current care pathway as well as for their answers to some specific questions regarding it. Key points raised during that discussion are summarized below.



**Figure 5. Graphical representation: Diabetes and Vision Loss Care Pathway.**

## **What are some of the more problematic points along the U.S. care pathway for diabetes-related eye disease?**

### ***Retinopathy screening:***

The diabetes care pathway has several different but parallel “tracks.” One involves vision loss, but, as the experts emphasized throughout the summit, patients are simultaneously navigating additional pathways having to do with other areas of the body affected by diabetes, such as the kidneys, cardiovascular system, and nervous system. Coordinating patient care along all these pathways is one of the major challenges clinicians face when caring for people with diabetes. Managing the journey along these pathways is also a huge challenge for patients.

From the patient’s point of view, one of the most frustrating aspects of the vision-related diabetes care pathway is the constant monitoring and screening that’s required. The exam for retinopathy screening takes up a large segment of the patient’s day, and because it involves pupil dilation, the patient is unable to engage in other tasks, such as reading or answering e-mail, while waiting. Often, a family member must also go to the screening in order to drive the patient home.

Furthermore, retinopathy screening is just one of the many medical appointments that patients with diabetes must undergo each year. One expert at the summit, a patient-advocate, said she had gone to 63 appointments with 13 different diabetes specialists during 2013.

For ophthalmologists, one of the barriers to getting patients to come in for regular retinopathy screening is that they are likely to notice other diabetes-related complications sooner. The patients therefore postpone their retinopathy screening to deal with those other health issues. Primary care health providers also tend to focus less on retinopathy screening than on screening for other diabetes-related health issues - again, because the symptoms related to the other issues are more immediate and thus are given precedence. Part of the reason primary care providers do not regard retinopathy screening with the urgency it requires is because many do not receive adequate training about the progression of the disease.

One aspect often overlooked when discussing diabetes care pathways is the high rate of depression and other psychological co-morbidities associated with the disease. Depression can have a significant negative effect on how often people go to medical appointments and how proactive they are with managing their disease.

### ***Interaction between physician and patient:***

Diabetes should be a “team disease,” but the various generalists and specialists who care for patients with diabetes tend to work in professional siloes. The Affordable Care Act (ACA) supports federally qualified

healthcare centers, but currently less than 18% of those centers offer on-site eye care. Caring for people with diabetes at health centers that offer all the constituents of care that they need - including eye care - is important, yet few such centers currently exist.

Currently, too many physicians lecture their patients about the dangers of not controlling their “numbers,” whether those numbers are measures of their A1C levels, their blood pressure, or their cholesterol levels. Patients would be better served - and more likely to comply with their treatment plan - if physicians took an approach that involved less lecturing and more listening. Patients need their physicians to understand that they are often doing the best they can to manage their disease. Sometimes, even doing everything “right” is not going to be sufficient to get a patient’s numbers where they need to be for optimal outcomes. To keep from getting discouraged, patients want reassurance and support from their physicians rather than stern warnings. From the clinician’s perspective, interactions with patients would be much more effective if the clinician had more time to spend with each patient and/or if they knew where to send patients for education and support, such as to a diabetes educator.

### ***Patient education:***

A 2014 study conducted by the Centers for Disease Control and Prevention (CDC) found that less than 7% of people receive diabetes self-management education and training within 1 year of diagnosis.<sup>36</sup> Even when patients do go through diabetes-education programs, they are often inundated with a quantity of information that can leave them feeling overwhelmed and confused. Patients would be better served if the information were more equally meted out over the course of the disease, not just “dumped” on the patients at one time. Also, people with diabetes are not a heterogeneous group. Education and training about diabetes treatment and management should be individualized to meet the needs of each patient.

Given that the only 100% effective way of preventing diabetes-related vision loss is to keep people from developing diabetes, greater effort must be placed on educating the public about preventing the disease. If we could incentivize Americans to lead more healthful lifestyles, we would have fewer people needing to learn how to traverse the care pathway for diabetes-related vision loss. Greater efforts are also needed to identify individuals at risk for diabetes - including those with pre-diabetes - so that interventions can be initiated that would keep them off the pathway as well. As the federally funded Diabetes Prevention Program (DPP) study has shown, losing just 7% of total body weight through healthier eating and 30 minutes of daily exercise five times per week can greatly delay or even prevent the disease in high-risk people.<sup>37</sup> As some of the summit



experts pointed out, however, the patients in that study had meals prepared for them and had an exercise coach. Whether that kind of program is practical for the broader population remains unclear. Research is currently underway to figure out how to deliver effective and cost-efficient early interventions.

### **In regards to discovering the early signs of diabetic retinopathy, where does that typically occur on the care pathway for diabetic eye disease?**

Two decades ago, the American Diabetes Association (ADA) changed their guidelines to say that patients could see either an optometrist or an ophthalmologist for their diabetic eye exams. (Only ophthalmologists should treat proliferative retinopathy and DME, however.) Today, 60%-70% of optometrists in the United States have OCT - Ocular Coherence Tomography - screening technology in their offices. This makes it easier for patients to find a clinician who can check their eyes, but many people with diabetes do not go to any type of eye clinician for regular screenings.

In some cases, a patient's diabetes is discovered during an eye exam. The optometrist or ophthalmologist will then advise the patient to see to his or her general practitioner for a full physical exam and diagnosis. Communication between eye clinicians and general practitioners is generally poor, however, whether the patient has already been diagnosed with diabetes or not. One of the major weaknesses of the care pathway for diabetic eye disease (and other diabetes-related care pathways) is the lack of full and timely feedback among the patient's various physicians.

### **When clinicians and patients come to the treatment point on the pathway for diabetic eye disease, how is the selection of treatment made, and who delivers the treatment?**

In the United States, many more patients are being treated with state-of-the-art anti-VEGF therapies than with laser photocoagulation. General ophthalmologists remain less likely to recommend anti-VEGF therapies for their diabetic retinopathy patients than retina specialists. Optometrists do not treat patients with diabetic retinopathy, but they do refer patients with suspected cases to ophthalmologists for diagnosis and treatment. Many optometrists do not give referrals early enough in the course of the disease, partly because central retinal thickness may or may not be accompanied by poor vision early in the disease.

The treatment algorithms for diabetic retinopathy are much more complicated now than in the past. That factor has led to retina specialists taking the lead in the delivery of the therapies. In the United States, retina specialists administer more than 90% of anti-VEGF

therapy and perhaps 80% of laser therapy to patients with diabetic retinopathy. In rural areas, however, general ophthalmologists are often more likely to deliver these treatments.

Patients must receive approval from their health insurance company before therapies for diabetic retinopathy can begin. It would be extremely beneficial in terms of ensuring the patient receives timely treatment if this approval could be received on the day the diagnosis was made. Approval usually takes much longer, however. Another constraint on starting treatment are the large deductibles and co-pays that many patients must pay out-of-pocket for the therapies.

### **To what extent has the Protocol T study affected treatment decisions on the diabetic eye pathway?**

Retina specialists disagree about how to interpret Protocol T, the first direct head-to-head comparison study of the anti-VEGF agents aflibercept, bevacizumab, and ranibizumab.<sup>33</sup> The study's findings indicate that aflibercept may be a better choice for patients with vision that is 20/50 or worse, but for patients with mild vision loss, the findings suggest that all three agents are similarly effective. Affordability may therefore become an important factor in treatment decisions.

The summit experts pointed out that the bevacizumab used in Protocol T was not in a form that is readily available to clinicians. Thus, the findings may not reflect a true head-to-head comparison of the three drugs.

### **How does patient preference affect treatment decisions on the diabetic eye care pathway?**

Too often patients are not asked about the quality-of-life outcomes they want from their treatments. New patient-centered research is trying to change that situation by investigating the treatment outcomes - as determined by quality-of-life measurements - patients say are most important to them. This research may eventually change the endpoints that are looked at in studies evaluating the effectiveness of various treatments.

One aspect of the diabetic eye disease care pathway that the summit experts repeatedly underscored during this segment of their discussion, was the fact that diabetes requires ongoing care management. Clinicians see patients only at certain points along the pathway. But for patients living with diabetes, the threat or reality of vision loss is a constant, lifelong journey.

# Analyzing Gaps in the Diabetic Eye Care Pathway

Based on their discussion of the challenges and opportunities in the current care pathway for diabetes-related eye disease, the experts turned their attention to identifying the key gaps, or places of inefficiency and lack of continuity along that pathway. They focused their discussion on the following gaps that, if closed, would lead to significant improvements in those pathways.

- Gaps in making the prevention of diabetes-related eye disease a public health priority.**

Although diabetes has been declared an epidemic and a public health emergency in the United States, diabetes-related resources have tended to focus on treating other complications of the disease, such as those involving the heart and kidney. There has also been a failure to use public health measures to identify people at risk for diabetes-related eye disease, and preventive interventions are often unfunded by both government and private insurers.

- Gaps in patient understanding of the importance of regular eye exams.**

People with diabetes often lack awareness of how regular eye exams are essential to reducing their risk of vision loss. Everybody knows, whether they have diabetes or not, that annual preventative dental check-ups are valuable. But people with diabetes often fail to understand the importance of annual eye check-ups - until their vision falters. Primary care providers sometimes contribute to this gap by failing

to follow through with their patients with diabetes to make sure they visit a qualified eye clinician annually.

- Gaps in the referral process.**

Current treatment guidelines say people with diabetes should receive a comprehensive eye exam within "a short period of time" after diagnosis. The vagueness of that wording, however, often means that people delay getting the exam. Many patients do not know how to find an appropriate clinician to examine their eyes for retinopathy, and general practitioners do not always provide sufficient assistance with connecting their patients with a general ophthalmologist or retina specialist. Nor is there much follow-up to ensure that the patient has actually carried through on the referral. Insurance and cost issues also aggravate gaps in the referral process.

- Gaps in the delivery of care.**

The current system for delivering care to patients with diabetic retinopathy is fragmented. In addition to having a primary care provider and an eye doctor (either an ophthalmologist or retina specialist), patients with diabetes often see other clinicians, such as a cardiologist and/or a nephrologist. Communication among all these clinicians is often weak, which means that important points along a patient's care pathway - such as annual retinopathy exams - can get overlooked.

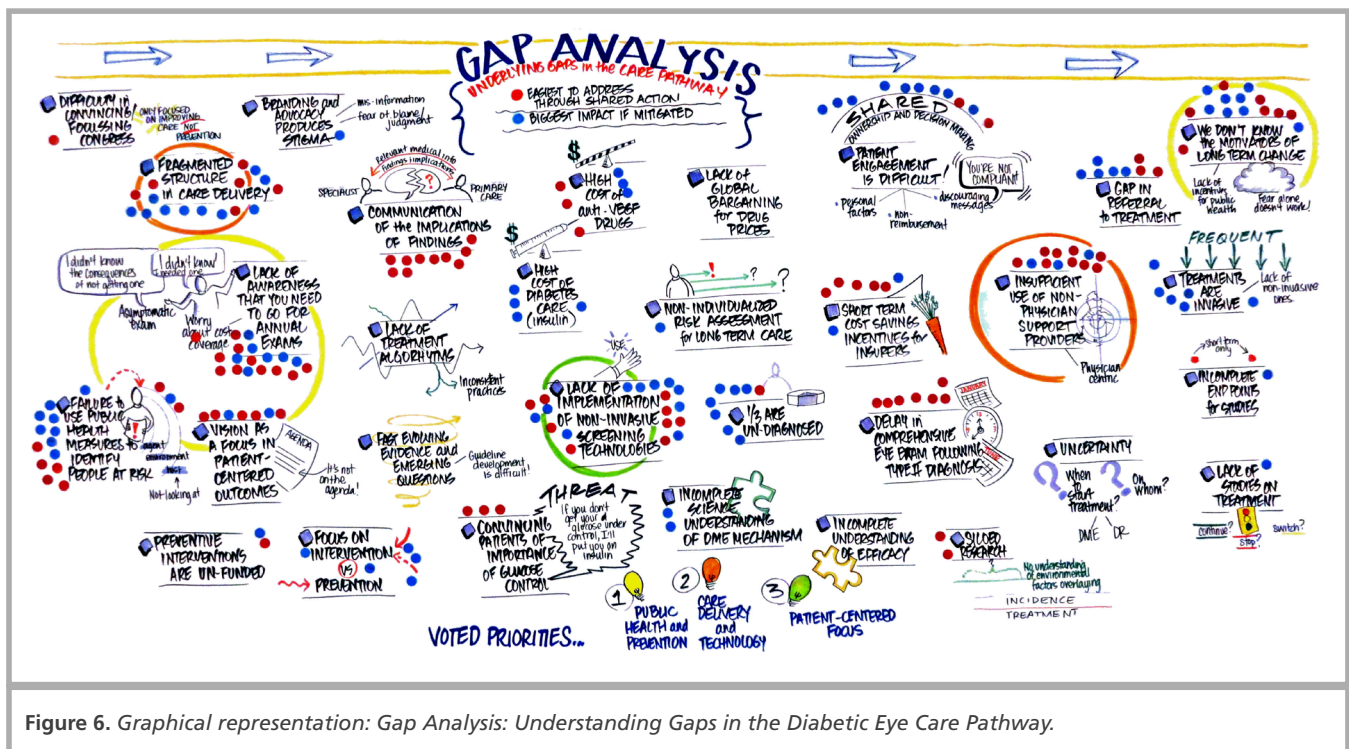


Figure 6. Graphical representation: Gap Analysis: Understanding Gaps in the Diabetic Eye Care Pathway.

- **Gaps in consistency of care.**  
Ever-changing treatment algorithms for diabetic retinopathy have led to inconsistent practices. As a result, treatment decisions are often quite complex for healthcare providers and patients alike. There has been some movement toward evidence-based treatment guidelines, but how widely such guidelines will be accepted remains unclear. In addition, any new guidelines that are developed are likely to change frequently in the coming years as researchers and clinicians gain a greater understanding of anti-VEGF and other therapies.
- **Gaps in understanding of how and who to treat with anti-VEGF therapies.**  
Not all patients with diabetes respond to anti-VEGF therapies for proliferative retinopathy or DME. Even when the initial response to the therapy is good, the disease - and the vision loss - may return. Understanding the biological mechanisms for patient non-response is crucial, for it would help with the development of alternative treatment approaches for those patients.
- **Gaps in treatment options.**  
Although anti-VEGF agents currently offer the most effective therapy for proliferative retinopathy and DME, these drugs are administered intraocularly. They must also be administered frequently, a factor that demands a major time commitment from patients and clinicians. In addition, the approved drugs are expensive. The lack of inexpensive, infrequent, non-invasive therapies for diabetic retinopathy deters some patients from initiating or continuing treatment.
- **Gaps in relevant endpoints when evaluating treatments for diabetes-related eye disease.**  
Clinical trials that assess the effectiveness of therapies for diabetic retinopathy typically have endpoints of short duration. Those endpoints also tend to focus on traditional measurements, such as the number of lines of vision gained on a standardized vision chart. Such endpoints may not reflect the treatment outcomes most important to patients. Clinical trials need to include quality-of-life endpoints that have been demonstrated to be of value to patients.
- **Gaps in the use of non-physician patient-support providers.**  
Not enough diabetes patient-educators are embedded within the offices and clinics of primary care providers - or within the offices of retinal specialists. Such services are also not covered by all health insurance policies.
- **Gaps in collaboration among advocacy groups.**  
Convincing Congress to spend more money on preventing diabetes - and particularly on preventing diabetes-related vision loss - has been a challenge. Congress has preferred to focus its funding on broad-scaled public health interventions that affect a number of chronic diseases. Better collaboration among diabetes-related advocacy groups would enhance efforts to convince Congress about the urgent need to increase funding specifically aimed at diabetes prevention and research.
- **Gaps in understanding what motivates people to change unhealthful behaviors.**  
Healthful habits - specifically those related to diet, exercise, and weight maintenance - can help prevent people from developing diabetes. They can also help reduce the risk of complications for people who have the disease. Healthcare practitioners play an important role in motivating their patients to adopt a healthier lifestyle. Too often, however, the messages that patients hear from their practitioners are ones that discourage, rather than encourage them to be proactive with the self-management of their disease.

At the end of this segment of the summit, the experts acknowledged that three key priority areas had evolved from their discussion: 1) public health and prevention, 2) care delivery and technology, and 3) patient-centered care.

# Action Agenda

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In the final session of the summit, the experts broke into three multi-stakeholder groups to develop potential “ingenious solutions” for bridging gaps in each of the priority areas previously identified - solutions that could lead to significant improvements in outcomes for Americans with diabetic retinopathy. The solutions were then presented back to the entire group for discussion. A summary follows.

## Public Health and Prevention

- Use established risk assessment tools to develop new mobile apps that allow people to assess their diabetes risk. The apps could also be used to help people modify their risk factors. The apps would be supported by groups whose constituencies have an important stake in diabetes, such as the AARP and the National Eye Health Education Program (NEHEP), and promoted by celebrity spokespeople.
- Develop a public-health marketing campaign to encourage people with diabetes to get eye exams once a year. This campaign should have a strong social media platform and deliver a lasting emotional impact. A great model for such a campaign is the highly successful 2014 “Help Us Save Brad Pitt!” campaign by the Belgium nonprofit Stop Darmkanker, which encouraged people to undergo colorectal-cancer screening.
- Turbocharge the number of sites across the country where people can undergo eye screening. Expand the distribution of retinal imaging technology, including OCT equipment. Currently, only 18% of health clinics offer any on-site eye care. Patients with diabetes would then be able to have their eyes checked regularly and with less inconvenience.

## Care Delivery and Technology

- Use the CDC to encourage and support low-cost eye-screening programs. Put these programs at locations that people can access easily, including non-traditional sites, such as pharmacy-based walk-in clinics, community health centers, and perhaps even workplaces. Encourage the development and distribution of automated eye-screening machines, much like automated blood pressure monitors that are now widely available in drugstores and elsewhere.
- Institute a national program for developing healthcare coaches to enhance communication between patients and their medical practitioners. This project could be modeled after “The Asheville Project,” a highly successful diabetes-education-and-management program launched in 1997 by the city of Asheville, North Carolina. The Asheville Project incorporates the services of both diabetes educators and pharmacists. It has not only improved the health of its participants, but also significantly reduced the city’s diabetes-related health costs. (The program has since been expanded to include city employees with other chronic diseases.)
- Create a cloud-based “dashboard” for each patient with diabetes. Both the patient and all his/her clinicians could upload information to the dashboard, which could then be seen by everybody on the patient’s healthcare team. This would provide a meaningful way to communicate the results of tests - and to identify any gaps in care.
- Enlist the efforts of nonprofits and patient-advocacy groups to lobby for reductions in the costs of therapies for diabetes-related eye disease. Advocacy is also needed to encourage increased funding for the development of less costly and less invasive treatments. One possibility is a “drug re-purposing” research program that would look at existing off-patent drugs to see if any are effective against diabetes-related eye diseases.



## Patient-centered Care

- Design and conduct a small clinical trial (informed by focus groups comprised of patients, providers, and behavioral experts) to identify successful strategies that will lead to healthful behavioral changes in patients with diabetes - changes that have a positive effect on reducing the risk of diabetes-related vision loss.
- Create an online platform that would leverage already existing diabetes communities to provide feedback on all aspects of their care. Use what is learned from that feedback to test new strategies in the clinical setting for improving patient experiences and outcomes.
- Develop new strategies for individualizing patient care. Perhaps create an annual wellness evaluation that helps the patient set diabetes-related goals based on quality-of-life indicators that have meaning for the patient. One patient may set a goal of being healthy enough to attend a daughter's wedding; another may wish to complete a marathon. The evaluation would then tailor treatment to meet those specific goals.

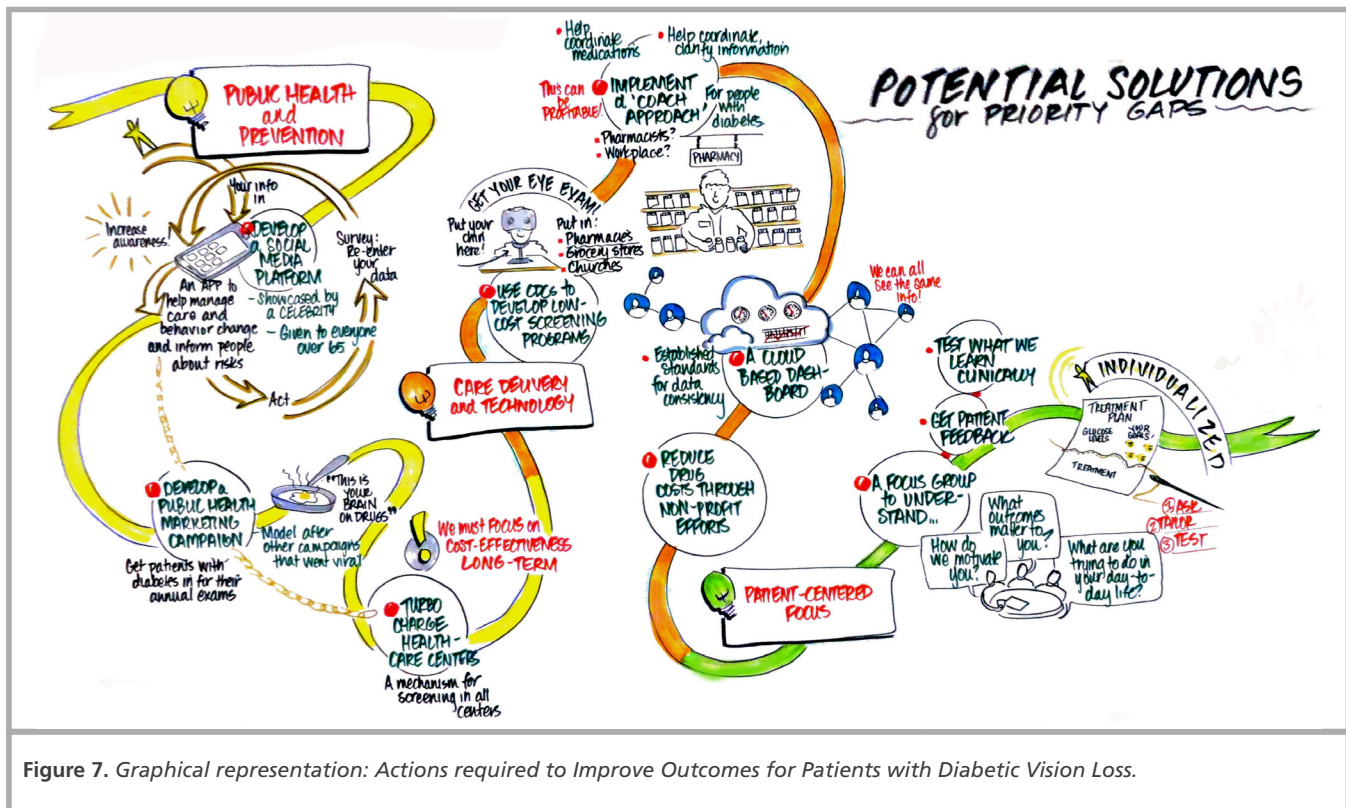


Figure 7. Graphical representation: Actions required to Improve Outcomes for Patients with Diabetic Vision Loss.

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