

## Timing of Comprehensive Optometric Eye Examination is Crucial to Reducing Diabetes Complications

Data from the Centers for Disease Control and Prevention (CDC) describe that 34.2 million Americans (one in 10) have diabetes and 88 million American adults (one in three) have prediabetes.<sup>1</sup> It is estimated that 7.3 million (21.4% of people with diabetes) had type 2 diabetes (T2DM) but were not aware of it.<sup>2</sup>

Diabetes is a disease that occurs when the blood sugar (glucose) is too high. As diabetes affects the chemistry balance of the blood, it can cause significant damage to the blood vessels. Smaller, weaker blood vessels like those found throughout the eye, are the first to be affected. The most frequently affected area in the eye to be affected is the retina and can commonly lead to a condition called diabetic retinopathy. Diabetic retinopathy is a condition in which excessive glucose in the blood prompts disproportionate production of reactive oxygen species that destroy healthy retinal blood vessels, damages pericytes, and causes leakage resulting in retinal hypoxia. The hypoxia elicits the formation of new, even more leaky blood vessels causing significant retinal damage and vision loss.<sup>3</sup> Early access to comprehensive eye examination (i.e., dilated eye examination by a doctor of optometry) allows diabetic retinopathy (leading cause of blindness among working-age adults), and other complications of diabetic eye disease, including but not limited to cataracts (twice as likely with T2DM), and glaucoma (five times as likely with T2DM), to be diagnosed and managed.

Evidence demonstrates the positive role of optometrists to diagnose and manage the adverse effects of uncontrolled hyperglycemia. Specifically, the earliest stages of disease pathogenesis are most efficiently observed in the retina. In the case of T2DM, the eye provides a window to a major complication of diabetes, diabetic retinopathy, defining the clinically measurable endpoint of T2DM diagnosis as fasting plasma glucose (FPG)  $\geq 126$  mg/dl (7.0 mmol/l). Diabetic retinopathy itself may serve as an initial sign of T2DM.

Because undiagnosed T2DM, diabetic retinopathy, glaucoma and cataract together often go unnoticed (are asymptomatic), people with or at risk of T2DM should receive a comprehensive, dilated eye examination each year.

## Setting new targets

The “dilated and comprehensive eye examination” is a required element of evidenced-based diabetes care.<sup>4</sup> The American Diabetes Association’s (ADA’s) January 2020 [Diabetes Care](#)<sup>®</sup> continues to reinforce, “Patients with type 1 diabetes should have an initial dilated and comprehensive eye examination by an ophthalmologist or optometrist within five years after the onset of diabetes. Patients with type 2 diabetes should have an initial dilated and comprehensive eye examination by an ophthalmologist or optometrist at the time of diagnosis.”

Because diabetic eye disease includes diabetic retinopathy, diabetic macular edema (DME), glaucoma, cataract, and refractive changes, among other disorders, in-person examinations by an eye doctor are essential as primary eye health and vision care services are not achievable through telehealth. Importantly, any degree of retinopathy requires comprehensive eye examination and management by an ophthalmologist or optometrist. Any delay in achieving this level of care may result in increased morbidity and mortality. The ADA recommends lowering HbA1c to <7.0% in most diabetes patients and more stringent targets (6.0–6.5%) in selected patients if achieved without hypoglycemia. Since maintaining HbA1c at <6.0% prevents the development of retinopathy altogether, most individuals with either undiagnosed T2DM or diagnosed diabetes will have a glycemic status that places them in high risk for retinopathy. The estimated prevalence of diabetic retinopathy has been reported by the CDC at 28.5% (95% confidence interval [CI]) among U.S. adults with diabetes.<sup>5</sup>

These data closely follow trends in T2DM detection among adults in the U.S., 1999-2014 as reported by the Division of Diabetes Translation (DDT) at the CDC. That 2018 study shows only small improvements in detection of T2DM among some advantaged population subgroups, including non-Hispanic whites, adults age 65 and over and higher-income (presumably college graduates) adults, the same advantaged population subgroups most often receiving dilated eye exams. They report that between 2011-2014 the probability of finding undiagnosed T2DM among individuals with less than high school education as opposed to education greater than high school education was just over twice (4.9/2.4) as likely. The probability of finding undiagnosed T2DM among individuals with lowest incomes as opposed to highest income was just over three times (4.6/1.5) as likely. The probability of finding undiagnosed T2DM among Mexican-American individuals as opposed to non-Hispanic white individuals was just under three times (6.0/2.2) as likely.

These CDC/DDT data show that policies and practices are needed to focus efforts to increase T2DM detection among Mexican Americans, non-Hispanic blacks, adults younger than 65 years of age, and those with lower incomes. Additionally, new data indicate that among US children and adolescents younger than 20 years, incidence of type 1 and type 2 diabetes has significantly increased.<sup>6</sup> Because undiagnosed T2DM and diabetic retinopathy, together, often go unnoticed, it would be helpful if these same groups were targeted to receive annual, dilated eye exams.

## **High costs of diabetes**

While the CDC reports the estimated cost of diagnosed diabetes in the U.S. has risen 26% from 2012 to 2017 to \$327.2 billion, the cost of the undiagnosed T2DM and prediabetes has been silently escalating.<sup>7</sup>

New data now describe the more complete picture of the U.S. diabetes burden, including undiagnosed (adults not children), adding \$31.7 billion for undiagnosed diabetes, \$43.4 billion for prediabetes, and nearly \$1.6 billion for gestational diabetes, bringing the new total to almost \$404 billion in 2017.<sup>8</sup>

The importance of incentivizing the comprehensive eye exam is reflective of ADA's recent findings: 1) unacceptable levels of diabetes morbidity and mortality, especially with respect to T2DM; 2) that intensive treatment leads to better microvascular status (37% reduction of retinopathy); 3) at the time of T2DM diagnosis 87% of individuals will have another disease (e.g., likely one of 276 systemic diseases with eye findings); and 4) time and treatment barriers (i.e., 56.9% inadequate therapy, 14.9% non-adherent) to effective diabetes care can be countered by upscaling the role of the primary care team members (e.g., includes doctors of optometry).

## **Earlier detection is key**

There is a growing urgency to identify type 2 diabetes mellitus (T2DM) and prediabetes early to avert the disease itself, its ascendancy to overt disease, potential complications and earlier death. Undiagnosed T2DM individuals have progressive  $\beta$ -cell failure and ever-increasing insulin-resistance causing hyperglycemia.<sup>9</sup>

Several decades of clinical research provide excellent data on treatment strategies for retinopathy that are 95% effective in preventing the occurrence of severe vision loss. Earlier T2DM diagnosis and treatments (i.e., those aimed at more intensive glycemic control) can lead to better microvascular status, minimal or no retinopathy and no vision loss. Every 1% decrease in glycated hemoglobin (HbA1c) level is associated with an approximate 35% decrease in the risk of diabetic retinopathy. This large reduction in complication risk underscores the importance of early T2DM diagnosis and prediabetes and prompt attainment of improved glycemic control.

The optometrist's role in the standard clinical management of diabetes has continually grown and adapted, to a point where today 20% or more of patients first learn of their diabetes status through their optometry eye examination.<sup>10</sup> In fact, "The only recommended practice that consistently met or exceeded the Healthy People 2020 target was the dilated eye exam," notes the CDC's 2017 Diabetes Report Card.<sup>11</sup> The Healthy People 2020 target is 58.7%, which patients have exceeded every year between 2011 and 2015 (the most recent data set). Continued adjustments in optometry care have included patient education to help prevent disease-related complications throughout the body. Optometry's role in diabetes care has sparked the Pharmacy, Podiatry, Optometry, Dentistry (PPOD) Team Care Approach for Diabetes Management, helping promote an integrated risk assessment of diabetes complications and a model framework of interprofessional cooperation to advance patient-centric diabetes care.<sup>12</sup>

In total, making provisions for enhanced timing into comprehensive optometry care, within other systems of care and prevention, can be useful to address unacceptable levels of diabetes morbidity and mortality, and should become incentivized.

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<sup>1</sup> <https://www.cdc.gov/diabetes/data/statistics/statistics-report.html>

<sup>2</sup> <https://www.cdc.gov/diabetes/data/statistics/statistics-report.html>

<sup>3</sup> Modesto Rojas, Wenbo Zhang, Zhimin Xu, Tahira Lemtalsi, Phillip Chandler, Haroldo A. Toque, Robert W. Caldwell, Ruth B. Caldwell. Requirement of NOX2 Expression in Both Retina and Bone Marrow for Diabetes-Induced Retinal Vascular Injury. PLoS ONE, 2013; 8 (12):

<sup>4</sup> <https://www.aoa.org/optometrists/tools-and-resources/evidence-based-optometry/evidence-based-clinical-practice-guidelines/cpg-3--eye-care-of-the-patient-with-diabetes-mellitus>

<sup>5</sup> Zhang, X; Prevalence of diabetic retinopathy in the United States, 2005-2008. JAMA. 2010 Aug 11;304(6):649-56.

<sup>6</sup> <https://jamanetwork.com/journals/jamapediatrics/article-abstract/2755415>

<sup>7</sup> American Diabetes Association, Economic Costs of Diabetes in the U.S. in 2017. Diabetes Care 2018;41:917-928

<sup>8</sup> <http://care.diabetesjournals.org/content/diacare/early/2019/04/01/dc18-1226.full.pdf>

<sup>9</sup> Modesto Rojas, Wenbo Zhang, Zhimin Xu, Tahira Lemtalsi, Phillip Chandler, Haroldo A. Toque, Robert W. Caldwell, Ruth B. Caldwell. Requirement of NOX2 Expression in Both Retina and Bone Marrow for Diabetes-Induced Retinal Vascular Injury. PLoS ONE, 2013; 8 (12):

<sup>10</sup> Ruchman, M, Klunk, E,,The health and financial costs of diabetic retinopathy, Versant Health, 2019

<sup>11</sup> <https://www.cdc.gov/diabetes/pdfs/library/diabetesreportcard2017-508.pdf>

<sup>12</sup> <https://www.cdc.gov/diabetes/ndep/pdfs/ppod-guide-what-is-ppod.pdf>