

## Timing of Comprehensive Optometric Eye Examination Vital 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> CDC estimated that 7.3 million (21.4% of people with diabetes) had type 2 diabetes (T2D) but were not aware of it.<sup>2</sup>

Diabetic retinopathy is a condition in which excessive glucose in the blood prompts oxidation that destroys healthy retinal blood vessels, damages pericytes, and causes leakage resulting in retinal hypoxia (lack of oxygen). 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 T2D) and glaucoma (five times as likely with T2D), to be diagnosed and managed.

Evidence demonstrates the positive role of doctors of optometry to diagnose and manage the adverse effects of hyperglycemia. Specifically, the earliest stages of disease pathogenesis are most efficiently observed in the retina. In the case of T2D, the eye provides a window to a major complication of diabetes, diabetic retinopathy, defining the clinically measurable endpoint of T2D diagnosis as fasting plasma glucose (FPG)  $\geq 126$  mg/dl (7.0 mmol/l). Diabetic retinopathy itself may serve as an initial sign of T2D.

Because undiagnosed T2D, diabetic retinopathy, glaucoma and cataract together often go unnoticed (are asymptomatic), people with or at risk of T2D 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 2021 *Diabetes Care*<sup>®</sup> continues to reinforce, “Patients with type 1 diabetes (T1D) 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.”<sup>5</sup>

Diabetes adversely affects the entire eye and has a diverse influence on visual function. 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.<sup>6</sup> <sup>7</sup>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.

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 T2D 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 37% decrease in the risk of diabetic retinopathy.<sup>8</sup> This large reduction in complication risk underscores the importance of early T2D diagnosis and prediabetes and prompt attainment of improved glycemic control.

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 T2D 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) among U.S. adults with diabetes.<sup>9</sup>

These data closely follow trends in T2D detection among adults in the U.S., 1999-2014, as reported in 2018 by the Division of Diabetes Translation (DDT) at the CDC. That 2018 study shows only small improvements in detection of T2D among some advantaged population subgroups, including non-Hispanic whites, adults aged 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 T2D among individuals with less than high school education as opposed to education greater than high school education was more than twice (4.9/2.4) as likely. The probability of finding undiagnosed T2D among individuals with lowest incomes as opposed to highest income was more than three times (4.6/1.5) as likely. The probability of finding undiagnosed T2D among Mexican-American individuals as opposed to non-Hispanic white individuals was nearly three times (6.0/2.2) as likely.

These CDC/DDT data show that policies and practices are needed to focus efforts to increase T2D detection among Mexican American and non-Hispanic Black individuals, adults younger than 65 years of age, and those with lower incomes. Additionally, new data indicate that among U.S. children and adolescents younger than 20 years, incidence of T1D and T2D has significantly increased.<sup>10</sup> Because undiagnosed T2D and diabetic retinopathy, together, often go unnoticed, it would be helpful if these same groups were targeted to receive annual, dilated eye exams. In a prospective observational trial implementing point-of-care diabetic retinopathy screening, data describe that non-white youths were less likely to undergo diabetic eye examinations yet more likely to have diabetic retinopathy compared with white youths.<sup>11</sup> Furthermore, the prevalence of diabetes in pregnancy has been increasing in the U.S. in parallel with the worldwide epidemic of obesity. Women with preexisting T1D or T2D who are planning pregnancy or who have become pregnant should be counseled on the risk of development and/or progression of diabetic retinopathy. Dilated eye examinations should occur ideally before pregnancy or in the first trimester, and then patients should be monitored every trimester and for one year postpartum as indicated by the degree of retinopathy and as recommended by the eye care provider.<sup>12</sup>

## COVID-19 Raises Diabetes Concerns

Diabetes mellitus has been identified as one of the most common comorbidities associated with COVID-19: people with diabetes, especially T2D, infected with SARS-CoV-2 are susceptible of worse clinical outcomes (higher hospitalization rate and mortality).<sup>13</sup> Additionally, the increased risks of COVID-19 among people with T1D are even greater.<sup>14</sup> Among those aged 65 years or older, a population at higher risk for death from COVID-19, 26.8% have diabetes. Hypertension and severe obesity are present in 68.4% and 15.5% of individuals diagnosed with diabetes.<sup>15</sup> Among people with diabetes with COVID-19, it is possible that higher BMI and A1c levels are linked to worse outcomes.<sup>16</sup> Also, researchers believe that disruptions caused by the pandemic, including increased stress and changes to care, diet and physical activity routines, could contribute to worse outcomes for people with diabetes, and could exacerbate health disparities.<sup>17</sup> On October 16, 2020, the Centers for Medicare & Medicaid Services (CMS) reported new survey data on Medicare and dual eligible beneficiaries and COVID-19 indicating that 21% of Medicare beneficiaries report forgoing non-coronavirus (COVID-19) disease care due to the pandemic.

More recent data show that the 493,167 Medicare beneficiaries were hospitalized with a COVID-19 diagnosis through November 21, 2020 translating to 782 hospitalizations per 100,000 beneficiaries in urban areas and 692 hospitalizations per 100,000 beneficiaries in rural areas. Among those hospitalized with COVID-19, the five most prevalent chronic conditions for Medicare fee-for-service beneficiaries were: hypertension (80%); hyperlipidemia (62%); chronic kidney disease (51%); anemia (48%); and diabetes (50%).<sup>18</sup>

Research also suggests that COVID-19 and diabetes may be a two-way street. Not only do people with diabetes and COVID-19 suffer disproportionately higher rates of severe outcomes, it is also possible that COVID-19 is triggering new cases of T1D and T2D or a new type of diabetes, and among people with existing diabetes, it may be triggering severe metabolic complications, such as diabetic ketoacidosis.<sup>19</sup> Other new studies show that nearly half of hospitalized COVID-19 patients without a prior diabetes diagnosis have hyperglycemia, and the latter is an independent predictor of mortality at 28 days.<sup>20</sup> These potential new cases of diabetes arising from post COVID-19 disease increase the necessity of comprehensive eye examination to assist early diagnosis of diabetes.

## 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 T2D and prediabetes has been silently escalating.<sup>21</sup> New data now describe the more complete picture of the U.S. diabetes burden, 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>22</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 T2D; 2) intensive treatment leads to better microvascular status (37% reduction of retinopathy); 3) at the time of T2D diagnosis 87% of individuals will have another disease (e.g., likely one of over 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. including doctors of optometry).

## Earlier detection is key

There is a growing urgency to identify T2D and prediabetes early to avert the disease itself, its ascendancy to overt disease, potential complications and earlier death. Undiagnosed T2D individuals have progressive  $\beta$ -cell failure and ever-increasing insulin-resistance causing hyperglycemia.<sup>23</sup>

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>24</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>25</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 eye health and vision 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>26</sup>

## Conclusion:

Diabetes is a significant public health problem which affects the health, economic well-being and productivity of individuals, families and society as a whole. The COVID-19 pandemic may likely exacerbate the incidence of diabetes and its complications. Making provisions for enhanced timing into comprehensive optometry care, within other systems of care and prevention, can be helpful to offsetting unacceptable levels of diabetes morbidity and mortality, and should become incentivized.<sup>27</sup>

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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> [https://care.diabetesjournals.org/content/diacare/suppl/2020/12/09/44.Supplement\\_1.DC1/DC\\_44\\_S1\\_final\\_copyright\\_stamped.pdf](https://care.diabetesjournals.org/content/diacare/suppl/2020/12/09/44.Supplement_1.DC1/DC_44_S1_final_copyright_stamped.pdf)

<sup>6</sup> Ko, M. W., & Busis, N. A. (2020). Tele-Neuro-Ophthalmology: Vision for 20/20 and Beyond. *Journal of neuro-ophthalmology : the official journal of the North American Neuro-Ophthalmology Society*, 40(3), 378–384. <https://pubmed.ncbi.nlm.nih.gov/32604247/>

<sup>7</sup> Horton, M.B, Practice Guidelines for Ocular Telehealth-Diabetic Retinopathy, Third Edition; [Telemedicine and e-Health](#). Vol. 26, No. 4 Published Online:16 Apr 2020: Accessed February 23, 2021 <https://doi.org/10.1089/tmj.2020.0006>

<sup>8</sup> [http://www.diabeticretinopathy.org.uk/prevention/hba1c\\_and\\_retinopathy.htm#:~:text=The%20progression%20rate%20of%20retinopathy,needed%20to%20assist%20good%20control.](http://www.diabeticretinopathy.org.uk/prevention/hba1c_and_retinopathy.htm#:~:text=The%20progression%20rate%20of%20retinopathy,needed%20to%20assist%20good%20control.)

<sup>9</sup> Zhang, X; Prevalence of diabetic retinopathy in the United States, 2005-2008. JAMA. 2010 Aug 11;304(6):649-56.

<sup>10</sup> <https://jamanetwork.com/journals/jamapediatrics/article-abstract/2755415>

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- <sup>12</sup>[https://care.diabetesjournals.org/content/diacare/suppl/2020/12/09/44.Supplement\\_1.DC1/DC\\_44\\_S1\\_final\\_copyright\\_stamped.pdf](https://care.diabetesjournals.org/content/diacare/suppl/2020/12/09/44.Supplement_1.DC1/DC_44_S1_final_copyright_stamped.pdf)
- <sup>13</sup> Bornstein SR, Rubino F, Khunti K, et al. Practical recommendations for the management of diabetes in patients with COVID-19. *Lancet Diabetes Endocrinol* 2020; S2213–8587(20):30152–62. [https://doi.org/10.1016/S2213-8587\(20\)30152-2](https://doi.org/10.1016/S2213-8587(20)30152-2).
- <sup>14</sup> Chowdhury S, Goswami S. COVID-19 and type 1 diabetes: dealing with the difficult duo [published online ahead of print, 2020 Jul 14]. *Int J Diabetes Dev Ctries*. 2020;1-6. doi:10.1007/s13410-020-00846-z
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- <sup>20</sup> <https://link.springer.com/article/10.1007/s00125-020-05209-1>
- <sup>21</sup> American Diabetes Association, Economic Costs of Diabetes in the U.S. in 2017. *Diabetes Care* 2018;41:917-928
- <sup>22</sup> <http://care.diabetesjournals.org/content/diacare/early/2019/04/01/dc18-1226.full.pdf>
- <sup>23</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):
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- <sup>25</sup> <https://www.cdc.gov/diabetes/pdfs/library/diabetesreportcard2017-508.pdf>
- <sup>26</sup> <https://www.cdc.gov/diabetes/ndep/pdfs/ppod-guide-what-is-ppod.pdf>
- <sup>27</sup><https://www.aoa.org/AOA/Documents/Practice%20Management/Clinical%20Guidelines/EBO%20Guidelines/Eye%20Care%20of%20the%20Patient%20with%20Diabetes%20Mellitus%2C%20Second%20Edition.pdf>