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BY KAREN L. GILBERT, DNP, MS, RN, CDP

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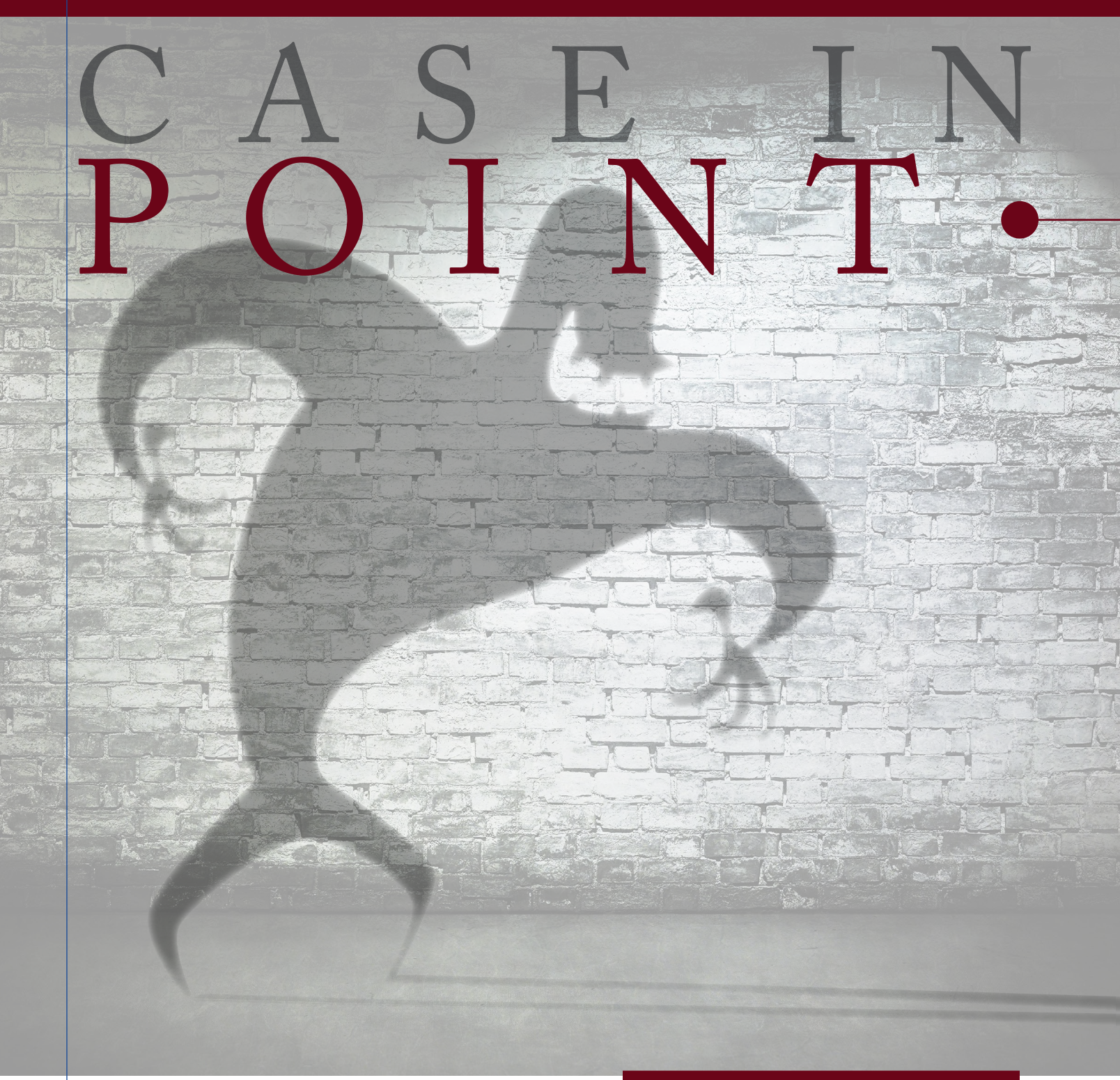

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The Risks in Underestimating Prediabetes, the Opportunities to Grasp

The disease known as diabetes was given its name by Aretaeus of Cappadocia, a Greek physician in the second century A.D. The name has its origin in the Greek word for "siphon," a reference to the patient's great thirst and excessive urination. In 1798, British surgeon John Rollo added the word "mellitus" to identify the honey-sweet taste of the patient's urine and to differentiate "sugar diabetes" from diabetes insipidus, a disease that results in excessive urination, but not in high blood glucose (sugar) levels (Lakhtakia, 2013, p. 368).

Diabetes, a non-communicable disease, has substantial global impact. The International Diabetes Federation (IDF) estimated the worldwide number of patients with diabetes in 2019 as 463 million adults (age 20–79) and predicted the number would increase to 700 million by 2045 (IDF, 2020).

Diabetes is associated with numerous chronic health conditions because high blood glucose levels damage blood vessels in two ways – microvascular and macrovascular. Microvascular damage affects the blood vessels of the eyes, kidneys, and peripheral nerves. This can result in retinopathy (threatening vision), end-stage kidney disease, and neuropathy (producing weakness and/or numbness). Macrovascular damage affects larger blood vessels, such as the

coronary arteries of the heart and those in the limbs and brain (Zimmerman, 2016). This potential combination of micro- and macrovascular damage may lead to blindness, kidney failure, chronic neuropathy, heart attack, stroke, limb amputation, and eventually may damage the blood vessels of the brain, which can result in irreversible, progressive cognitive and physical decline.

Two Types of Diabetes

Both Type 1 and Type 2 diabetes mellitus (T2DM) result in high blood glucose levels.

As of 2018, an estimated 34.2 million people in the United States had diabetes. Of this number, approximately 1.4 million had Type 1 diabetes, 32.8 million had Type 2 diabetes. Of this number, an estimated 7.3 million age eighteen and older were undiagnosed (Centers for Disease Control and Prevention [CDC], 2020, p. 2). Those aged 65 or older represent 2.9 million of the total undiagnosed (CDC, 2020, p. 3).

The rate of diabetes in the United States has been increasing. There was a 40% increase in diabetes in the U.S. population from the early 1990s to 2015 – going from 10% of the population affected to 14%. Minority populations, particularly Asian and Hispanic people, are more likely to have diabetes that is undetected (Rapaport, 2015, para. 1).

Type 1 Diabetes Mellitus

Type 1 was previously known as "juvenile diabetes" as most cases were diagnosed in children. However, this form of diabetes can manifest in adulthood as well.

Type 1 diabetes is an autoimmune disorder. The body's immune system destroys the insulin-producing cells of the pancreas known as beta cells. While Type 1 diabetes is believed to have a genetic component (a family history of a parent or sibling with the disease) and result from some environmental exposure (American Diabetes Association, n.d.), the precise cause is unknown. Its onset cannot necessarily be predicted, nor can it be prevented.

From its earliest identification more than 3,000 years ago, and into the early 20th century, Type 1 diabetes was a fatal disease. With only a primitive method of urine testing, inaccurate for identifying actual blood glucose levels, and insulin not yet available as a treatment, management was attempted with dietary restrictions. Life expectancy could be only days or weeks once symptoms began (Rawshani, 2017).

Through the work of Fredrick Banting and Charles Best, insulin for injection became widely available as a treatment in 1923, transforming Type 1 diabetes from a fatal diagnosis to a chronic, treatable condition. Still, patients were faced with the prospect of serious, debilitating, and life-threatening complications. Blindness, kidney failure, and foot or leg amputations were common complications throughout the early and mid-20th century.

In the 1980s, the development of ever-improving home blood glucose testing methods, and eventually continuous glucose monitors, provided Type 1 diabetics with the means to manage blood glucose in real time and achieve the best possible control of blood sugar levels.

Insulin is not a cure. There is no cure for Type 1 diabetes, however, insulin therapy through injection or insulin pump, and the convenient blood glucose monitoring devices have made Type 1 diabetes more manageable and less likely to significantly decrease life expectancy. Management, though, does not eliminate the risks of debilitating blood vessel and nerve damage.

Type 2 Diabetes Mellitus

In T2DM, the body does not make enough insulin or does not use available insulin effectively (National Institute of Diabetes and Digestive and Kidney Diseases [NIDDK], 2017, para. 1). In either scenario, the body's cells are unable to use the glucose circulating in the bloodstream. This "insulin resistance" leads to rising blood glucose levels.

T2DM conveys the same potentially debilitating and life-threatening complications as Type 1 diabetes. It is said to be "the leading cause of kidney failure and new cases of blindness among adults in the United States" (US Preventive Services Task Force, 2021, p. 736). T2DM also increases the risk of cardiovascular disease, stroke, and irreversible, progressive neurocognitive decline caused by damage to the blood vessels of the brain (vascular dementia) and Alzheimer's disease (Sridhar et al., 2015, p. 745).

Evaluating the Risks for T2DM

The risk factors for T2DM are well recognized and include a family history of diabetes, age, a diet high in sugars/carbohydrates and saturated and trans fats, obesity, inactivity, and smoking.

Obesity can be categorized by calculating *body mass index* (BMI). To calculate BMI in the English (versus metric) system, the formula is weight in pounds divided by height in inches *squared*, with the result multiplied by 703. Using this formula, a five-foot-ten, 220-pound man would have a BMI of 31.6. A five-foot tall, 120-pound woman would have a BMI of 23.4.

BMI calculators are readily available on the internet; the BMI is automatically calculated after entering

height in inches and weight in pounds (CDC, 2014). The table below defines categories of weight and obesity relative to BMI (Purnell, 2018).

Calculating BMI provides information with which an individual can begin to understand their risk of developing T2DM, and the comorbidities so often associated with it.

BMI can also predict the risk of an individual developing **metabolic syndrome**, which often coexists with prediabetes and increases the risk of developing diabetes and cardiovascular disease. Said to affect approximately *one-third* of U.S. adults (Hirode & Wong, 2020, p. 2526), metabolic syndrome is a combination of three or more of the following conditions: waist circumference greater than 40 inches for men and 35 inches for women (Purnell, 2018, p. 3); high blood pressure; insulin resistance with high fasting blood glucose; and dyslipidemia, which refers to *high* blood levels of triglycerides and cholesterol and *low* levels of good cholesterol, the high-density lipoproteins, or HDL (Merck Manual, 2021, para. 1).

Prediabetes, a Clandestine Threat to Health

Prediabetes occurs when fasting blood glucose is between 100 and 125 mg/dL, a lower threshold than that for diabetes, which is a fasting blood glucose of 126 mg/dL or higher. Those at risk for prediabetes have one or more of these risk factors:

- Obesity
- Diet that is high in simple sugars/carbohydrates, saturated and trans fats
- Advanced age
- Family history of diabetes
- Smoking

These risk factors for prediabetes are notably the same as those for T2DM.

The Problem with a False Sense of Security in Being Prediabetic

Prediabetes should not be ignored. *It does not mean that one is safe from the impacts of diabetes*. Rather, prediabetes is an "at-risk state with high probability of developing diabetes and confers a high risk of developing CVD" (Kodali & Ali, 2016, p. 143). "CVD" refers to cardiovascular disease.

Prediabetes is a "time bomb, requiring" action (Karuranga & Wiebke Ohlrogge, 2018).

Nearly 50% of adults with prediabetes are under age 50 with one-third of this group between ages 20 and 39. The "time bomb" nature of prediabetes relates to the fact that those affected may not have perceived or observed symptoms, and absent regular physical examinations, may remain undiagnosed until T2DM manifests and exacts its vascular and nerve damage on the damage *already* sustained during the clandestine period of prediabetes.

Those affected at younger ages obviously have more years during which the risk of developing T2DM looms, and more years exposed to the risks of potentially debilitating ad life-threatening complications of high blood glucose.

A review of studies on preventing prediabetes from progressing to T2DM showed that medications and lifestyle strategies did prevent onset of T2DM, however, when medications were discontinued, blood glucose rapidly increased, "indicating the drugs were *masking* rather than preventing diabetes" (Brannick et al., 2016, p. 1327). This emphasizes the need to *prevent prediabetes or act swiftly when it manifests* to prevent the vascular damage that may result in blindness, kidney failure, nerve damage, cardiovascular disease, and the neurocognitive disorders of vascular dementia and/or Alzheimer's disease.

Diabetes and Alzheimer's Disease

Advancing age is an unmodifiable risk factor for both diabetes and Alzheimer's disease. As medical principles

TABLE 1. CATEGORIES OF WEIGHT AND OBESITY RELATIVE TO BMI

CLASSIFICATION	DISEASE RISK	BMI
Underweight		Under 18.5
Normal weight		18.5 – 24.9
Overweight	Increased	25 – 29.9
Obese – Class 1	High	30 – 34.9
Obese – Class 2	Very high	35 – 39.9
Severe obesity – Class 3	Extremely high	40 or higher

and effective treatments have been developed for many formerly fatal chronic conditions and cancers, the prevalence of both diabetes and Alzheimer's disease is increasing (Sridhar et al., 2015, 749). The following data supports this increased prevalence as it relates to the aging population. According to the U.S. Census Bureau, the population aged 65 and older, grew from about 3 million in 1900 to more than 50 million by 2018 (2019, para. 4). Currently, of adults 65 years of age and older, about 6.2 million have Alzheimer's disease; this is expected to increase to 13.8 million by the year 2060 if there is no medical advancement that results in prevention, disease modification, or cure (Alzheimer's disease facts and figures, 2021, p. 327). Those over age 65 have a significantly higher risk of developing T2DM (WebMD, 2021, para. 5).

Diabetes and Alzheimer's disease are both influenced by aging, obesity, high blood pressure, high cholesterol, smoking, and insufficient physical activity (CDC, 2021; Galvin, 2017, p. 2129).

The commonalities between the development of prediabetes, T2DM and Alzheimer's disease, as well as vascular dementia, suggest that addressing one addresses the others.

As Alzheimer's disease remains with neither cure nor substantive disease-modifying treatment, strategies are now focusing on risk-reduction and prevention (Galvin, 2017, p. 2128), which include lifestyle changes, also an important way to prevent or manage diabetes.

A proactive approach to preventing prediabetes and eventual diabetes has obvious health benefits over trying to reverse the process once it has begun. Prediabetes is amenable to strategies that reduce body weight, improve blood lipid levels, and lower blood pressure. Fortunately, while age and family history cannot be changed, the other risk factors of diet, body weight, smoking, and physical activity are modifiable. A variety of lifestyle choices are totally within the individual's control.

Reducing prediabetes and resulting T2DM risk, and indirectly the risks of vascular dementia and Alzheimer's disease, is predicated on:

- Diet
- Weight loss
- Exercise

The Mediterranean (Mayo Clinic, 2019) and DASH (Mayo Clinic, 2021) diets from the Mayo Clinic emphasize fresh fruits and vegetables, nuts, legumes, fish, poultry, healthy oils, such as extra virgin olive oil, and whole grains. Red meat, processed foods, and sugar intake are minimized in these diets (Maiorino et al., 2017).

Weight loss of 5-7% of body weight is considered preventive, as is a total of 150 minutes of exercise each week, or 30 minutes on each of five days a week, according to the NIDDK (2016, para. 3).

Prediabetes and T2DM are overwhelmingly

THE ROLE OF THE PRIMARY CARE PROVIDER IN MAKING HEALTHY LIFESTYLE CHOICES

The type of primary care health care provider one accesses can influence one's motivation to adopt and sustain preventive lifestyle strategies. In his best-selling book *Being Mortal,* Dr. Atul Gawande describes three distinct types of relationships that patients may have with their provider, which he identifies as emerging from the writings of medical ethicists Ezekiel and Linda Emanuel (Gawande, 2014, p. 199).

The **paternalistic** provider tells the patient what to do, what medications to take, etc., the "doctor-knows-best model." The **informative** provider tells the patient what the options are and lets the patient decide what they want, as an autonomous decision-maker, but perhaps not fully informed or able to recognize how such choices impact lifestyle, or vice versa (Gawande, 2014, p. 200).

The **interpretive** provider provides the information, allows for the patient to control the course, but also offers guidance. In this model, the patient's lifestyle, and desires for how they want to live, are key to decision making (pp. 200-201).

Each patient is unique. Patients may differ as to which of the approaches above is more likely to result in compliance with a regimen that will reduce risk or prevent disease. Patients may benefit by exploring their preferences and accessing the primary care provider whose approach aligns with their desires for how they want to live, making it more likely that they can sustain a risk-reducing, preventive, and proactive lifestyle.

influenced by lifestyle. This gives individuals the power to understand their distinct risk factors and make intentional, risk-reducing, and preventive choices.

Lessons from the COVID-19 Pandemic

Modifying lifestyle factors has even greater implications as we learn of the role diabetes has played in COVID-19 severity and death. Diabetes has been a common comorbidity in patients diagnosed with COVID-19, as reported by Caballero et al., (2020) in the *Journal of Diabetes and its Complications,* "but even more significantly among those who have been hospitalized and in those who have died from COVID-19" (p. 5). The authors also note that COVID-19 infection can identify patients whose diabetes was undiagnosed prior to contracting COVID-19, as well as those who were prediabetic (p. 6). This further illustrates the dangers of undiagnosed prediabetes as a health threat often without obvious symptoms, as well as the risks in failing to diagnose and treat Type 2 diabetes.

The Promise of Proactive Strategies

It can be argued that for *any* disease, prevention is better that treatment. Second best is the earliest possible diagnosis and intervention. Modern medicine has realized dramatic improvements in *primary prevention* (the multiple strategies people can use to prevent illness), and secondary prevention (the routine screening tests to identify the earliest sign of disease).

Prediabetes and T2DM are common denominators for so many chronic conditions. Widespread acceptance of preventive and proactive strategies to prevent, reverse, and manage prediabetes and T2DM may also have dramatic impact on reducing the incidence of heart disease, stroke, kidney failure, and irreversible neurocognitive impairment. Outcomes can be expected to include marked improvement in quality of life and striking reduction in avoidable health care costs.

CASES IN POINT

A Case with No Cure

Emma was approaching her twentieth birthday and the start of her second year of college. She was enjoying a brief break until fall classes resumed, working full time to help cover her discretionary expenses.

Emma was five feet, six inches tall, and weighed 120 pounds. Her body mass index (BMI) was 19.4, well within the normal range. She had always been slim.

Emma was physically fit, exercising whenever she had the opportunity. She began to experience some subtle symptoms that she could not explain, but that she initially dismissed. She felt tired at times that she had never experienced fatigue in the past. She sometimes felt that her eyeglasses were no longer the correct prescription, although they had been prescribed just a few months earlier.

After a few weeks of the mildly annoying, but not alarming symptoms, more troubling issues emerged. Emma realized that she was thirsty "more than usual," and realized she was urinating far more frequently for several days.

She called her parents and described her symptoms. Her parents recognized what sounded like new onset Type 1 diabetes. They urged Emma to ask her roommate to take her to the nearest emergency room. Emma, not as alarmed as her parents, said she would go to the emergency room the next day. Her parents insisted she go immediately. They understood that if this was Type 1 diabetes, Emma's blood sugar might be on its way to an extremely high level, putting her at risk for diabetic acidosis or coma, potentially fatal conditions.

Emma did go the emergency room that night. Her blood glucose on arrival was 315 mm/dL.

Though she had eaten earlier that evening, this blood glucose level was more than twice what it would be expected to be two hours after a meal.

Emma spent two days in the hospital. Her complete workup resulted in the diagnosis of Type 1 diabetes.

Emma was motivated to get and keep her diabetes under control. She learned all she could about foods to choose and foods to avoid, and how to balance meals with exercise. Within one year, Emma began taking her insulin with a programmable insulin pump. Not long thereafter, she began using a continuous blood glucose meter that would provide continual measures of her blood sugar, and alert her to highs and lows. The combination of the insulin pump and the continuous glucose monitoring helped Emma achieve the best possible control of her diabetes. Her next hemoglobin A1C, a measure of her average blood glucose over the prior 90 days, was 5.9%, just above normal.

As Emma was so young at the onset of her diabetes, maintaining a near non-diabetic A1C was critical to reducing the risk of diabetes complications in the many decades ahead of her.

Reversing Prediabetes

Rob was in his mid-forties, a successful businessman and fitness buff. His Monday to Friday occupation had its stresses, but he always found time for exercise. His favorite activity was running, and he logged a total of 20 – 25 miles each week.

Rob was about six feet tall and weighed 215 pounds. He appeared to be carrying an extra 10 -15 pounds, predominantly in his mid-section. He often boasted about his great health, which he attributed to his commitment to running. He did not believe that he needed an annual physical examination, after all, he "felt great."

Rob's family history was somewhat unremarkable. His mother had developed Type 2 diabetes mellitus at age 68 and managed it well with oral medication.

Several mornings each week, he met with a small group of friends for breakfast. While all enjoyed a typical breakfast of eggs, bacon or sausage, grits or oatmeal or toast, Rob bragged as to how he could eat whatever he wanted because he was running. He was confident that nutrition did not matter. Rob was a big eater, and often added biscuits and gravy to his egg, sausage, oatmeal, and toast breakfast. His drink of choice for breakfast was Pepsi.

For a few weeks, Rob did not join the others for breakfast. When he returned to the group, the others immediately noticed his change in appearance. He appeared to have lost at least ten pounds.

Rob explained that he had experienced what he described as a "cardiac incident." A sudden onset of chest pain led him to the emergency room at his local hospital. Lab tests there revealed that his cholesterol and triglycerides were "sky high," and one of his coronary arteries was almost completely blocked. The attending physician asked Rob if he was diabetic because his blood glucose was 250 mg/dL, two and one-half times higher than normal fasting, and about 100 points higher than it should be even two hours after a meal. Rob's blood pressure was high at 150/95. Based on his height and weight at the time, Rob's BMI was 26.2, indicating that he was overweight.

A cardiac stent was placed to open the coronary artery. The cardiologist performing the procedure told Rob that, seeing the condition Rob was in, he was surprised he had not had a heart attack 10 years earlier.

As Rob recovered from the stent procedure, he was referred to an endocrinologist to address his high blood sugar. This physician told Rob that he had apparently been prediabetic leading up the cardiac episode. He also explained metabolic syndrome to Rob. The combination of excess weight in his abdomen, the BMI greater than 25, high cholesterol and triglycerides, and high blood sugar put Rob at risk for the cardiac event that led him to the hospital, but also for stroke and Type 2 diabetes.

This was enough of a wake-up call for Rob. He changed his diet significantly. Gone was the soda, replaced by water or unsweetened juices. Whole eggs were replaced with egg whites, and breakfast included *either* oatmeal or toast, not both. He decreased his intake of processed foods, such as the breakfast sausage he had previously enjoyed, and increased his intake of fresh fruits and vegetables. He traded meat for high Omega 3 fish, such as salmon and tuna.

In addition to the ten pounds he lost in the immediate aftermath of his hospitalization, Rob continued to lose weight in the following weeks, ultimately stabilizing at 180 pounds. His BMI dropped to 24, within normal range.

He no longer carried excess weight in his abdomen. His high blood pressure resolved, and his cholesterol and triglycerides were on their way down to normal range. His fasting blood glucose returned to normal.

Rob was diligent in keeping appointments with his physicians and adhering to his new Mediterranean-type diet. In the months that followed, as he met his friends for breakfast, he was boasting of his "perfect bloodwork."

Rob's experience exemplifies how prediabetes can be reversed, and with it, the risk of life-threatening complications. •CSA

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Karen holds certification in Alzheimer's disease training from the Florida Department of Elder Affairs as well as designation as a Certified Dementia Practitioner from the National Council of Certified Dementia Practitioners.

Karen was awarded the 2017 Palm Beach County Medical Society *Hero in Medicine Award* for Education and has published several articles on the unique needs of patients with Alzheimer's disease and their caregivers. These include "Standard, Routine Cognitive Screening: An Idea Whose Time Has Come?", "Vulnerabilities of Cognitively Impaired Patients in Acute and Post-Acute Care Settings," "Delirium: Still Elusive After all These Years," and "Managing Alzheimer's Disease as a Chronic Illness: Reaching and Honoring the Person Within."

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