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COVID-19 and Diabetes: Unintended Medical, Financial and Societal Consequences

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Even In the absence of a pandemic, diabetes is a costly medical condition that can have a devastating impact on older adults. In the current COVID-19 pandemic, the presence of diabetes among adults is well established a risk for longer hospitalizations and likelihood of death. Beyond the direct combined health effects of COVID-19 and diabetes, the added financial strain, absence of regular care due to physician office closures and social isolation has the potential to worsen diabetes outcomes. In this paper, we explore the impact of the COVID-19 pandemic on adults with diabetes and diabetes-related complications. This review considers the financial, social and behavioral consequences of having diabetes during a global pandemic and the long-term health implications for adults residing in a country where reducing your risk for contracting COVID-19 might in turn, increase your risk of worsening long-term health outcomes. It also examines the financial implications of uncontrolled disease spread and the wide-spread mortality among elderly Americans in conjunction with the combined effects of changes in diet, physical activity and personal care caused by the pandemic.

Introduction
Throughout American history, few events have had such a life-altering impact as World War II, the Great Depression, the terror attacks on 9/11 and the novel coronavirus of 2019 (COVID-19). Not only has COVID-19 fractured the American way of life, but it has: changed how the healthcare system operates, forced changes in health behaviors resulting from strategies to reduce the impact of virus and wide-ranging societal perspectives on health and preservation of good health. More importantly the presence of diabetes among individuals with COVID-19 has the potential to impact the health and well-being of Americans with diabetes in many unforeseen ways. This paper outlines the lesser publicized dangers facing those with diabetes and discusses how the combined effects of abrupt changes in the healthcare system operations (i.e. closure of doctors' offices), the beginning of an economic recession and the implementation of stay-at-home orders, forced some individuals to make choices that were not associated with good diabetes outcomes. Specially, we will examine the impact of patients with diabetes: 1) reducing or stopping prescription medication due to the financial strain, 2) altering diet, activity and lifestyle patterns, 3) experiencing heightened stress and anxiety while also 4) forgoing preventative care critical to positive diabetes outcomes [1].

COVID-19 – Implications for Individuals with Diabetes
While the long-term healths implications of COVID-19 are unknown, early studies have shownthat those with diabetes often experience much more severe consequences of COVID-19 than those without the condition [2]. Although it is unclear if individuals with diabetes are more likely to contract COVID-19, there is clear evidence that they are at a greater risk of respiratory failure and cardiac complication [3]. In addition, diabetes in those with COVID-19 has been linked to greater with mortality, COVID-19 severity, and the presence of acute respiratory distress syndrome. The association between COVID-19 and diabetes was strong even in studies of younger and less hypertensive patients [4, 5]. Studies have also found that the increased severity of COVID-19 in patients with diabetes may result in other conditions such as pneumonia, lung consolidation, cytokine release syndrome, endotheliitis, coagulopathy, multiple organ failure and death [6, 7].

In the US, the Centers for Disease Control and Prevention (CDC) found that 10.9 percent of all patients with COVID-19 admitted to intensive care units (ICU) have diabetes [7]. These reports are a major concern because the serious infections observed and associated with COVID-19 can damage insulin sensitivity which partially explains the high mortality of diabetic patients from COVID-19 [8]. While data on mortality in the US has not yet been released, the National Institutes of Health in Italy reported that the prevalence of diabetes in patients who died of COVID-19 was 35.5 percent [9].

In addition to making people with diabetes more vulnerable to severe illness and mortality, a growing body of evidence suggests that COVID-19 might also trigger diabetic ketoacidosis (DKA) in some newly or previously undiagnosed diabetic patients [10]. It is well established the DKA is the consequence of very high blood sugar levels that result in dangerous levels of ketone build up in the body and if left untreated can cause coma or death. To date, individuals arriving at the hospital with COVID-19 and

high levels of blood sugar and ketones has been documented in many countries [11]. This phenomenon has been observed with the onset of other respiratory infections including SARS, MERS and influenzas—those that causes severe acute respiratory syndrome [12, 13].

COVID-19 – Cost of Care for Older Adults with Diabetes, COVID-19
Beyond the struggle of managing patients with diabetes and COVID-19, the treatment of the combined conditions has the potential to place a major financial strain on the US healthcare system. COVID-19 has been estimated to independently cost the US hospital system $202.6 billion in the first four months of the pandemic [14]. A single symptomatic COVID-19 case incurs a median direct medical cost of $3,045 during the course of the infection and, if the patient has comorbidities or confounding chronic conditions such as diabetes, this cost could double or triple [15].

Separate from COVID-19, diabetes already ranks as one of the most expensive chronic disease in the US [16, 17, 18]. Individuals with diabetes incur average medical expenditures of $16,752 per year, $9,601 of which is attributed to diabetes. On average, people with diagnosed diabetes have medical expenditures 2.3 times higher than those without the disease or roughly $4,800 more a year for those taking insulin [18-20]. The combined costs of the two conditions has yet to be clearly established but most anticipate numbers over and above the conditions separately.

Managing Diabetes during a Pandemic
A major clinical concern has emerged related to the increased complexity of diabetes management during the COVID-19 pandemic, as the lifestyle and behavioral changes which are key to diabetes management have become more difficult [21]. It is well established that preventing, managing and treating chronic conditions like diabetes requires a tremendous amount of effort around eating right, engaging in physical activity, taking medication and managing stress—all of which have been disrupted to varying degrees as the nation moves through this coronavirus pandemic [22]. Diet and physical activity are fundamental for diabetes self-management and can reduce risk of worse outcomes in those with diabetes and metabolic multi-morbidities [23]. While diet and behavior are important is maintaining glucose level and metabolic health, normal routines have been disrupted while respecting social distancing measures [24]. Unfortunately, a recent survey of people with diabetes found more than a third reported having a less healthy diet and half reported less exercise than before the pandemic [25]. Evidence from other national emergencies shows that such disruptions can lead to worse diabetes outcomes during and after events that drastically alter lifestyle and activity patterns [26-28].

In addition to disrupting home life, COVID-19 associated lockdowns have greatly affected the ability of individuals with diabetes to access and receive health care, obtain diabetes medications and supplies, and maintain a healthy lifestyle and social connections [29]. The COVID-19 pandemic has challenged the traditional physician-centered approach of diabetes care which is primarily based on routine clinic visits. While telehealth visits are available by some providers, their comparative effectiveness is still unknown [30]. Further, there is concern about individuals with diabetes who live alone attempting to manage their condition. Recent evidence has shown that adults who live alone are less likely to engage in healthy behaviors than their counterparts who live with others [31]. These findings highlight the importance

of housing structure as a social determinant of health and its causal relationship to health outcomes [32]. To date, scant data is available regarding diabetes management adherence, a study from India showed that only 30 percent of patients taking oral anti-diabetic medication and insulin were checking their blood sugar levels regularly during the lockdown [33]. Despite the vastly different health infrastructure in India, these finding offer cause for concern regarding diabetes management during the COVID-19 pandemic.

Diabetes and Access to Care during COVID-19
Another clinical concern is related to access to care as many adults with diabetes remain at home and isolated from family and friends. Consequently, they forgo preventative care and other routine health screenings. Effective diabetes control and prevention of severe complications rely on ready access to care [34]. Limited access to health care, especially for a long period, is significantly associated with being a "missed patient" with diabetes. While undetected diabetes puts one's health at substantial risk, timely detection of diabetes is difficult without access to health care [35]. Not only is access to care important in diagnosing diabetes, continuity of care is fundamental in preventing, treating and managing diagnosed diabetes [36-38]. Diabetes, namely type II, takes a long time to develop and reach its diagnostic threshold. During the progression to diabetes, access to primary care plays a crucial role in its timely detection and proper maintenance post-diagnosis [4].

The Long-Term Impact of COVID-19 and Diabetes
Unlike other situations, this pandemic has potential to last for many months and even a short-term disruption in care can be catastrophic for individuals with diabetes [39]. A pre-pandemic study found that at least three out of four people with diabetes were not adequately controlling the four major factors that increase the risk of serious complications—blood glucose, blood pressure, blood cholesterol and smoking. Poorly managed diabetes can have devastating complications, such as heart disease, nerve damage, blindness, kidney failure and amputations. Furthermore, despite significant advances in the delivery of diabetes care and availability of more effective medications, there has been little or no improvement in managing diabetes and preventing or delaying the damage it can cause [34, 40].

COVID-19 and Mental Health among Adults with Diabetes
Studies show that individuals with diabetes are more prone to depression and anxiety as a result of the sociological factors related to their disease [41, 42]. Evidence suggests that anxiety disorder, depressive symptoms and sleep quality became more prevalent and often worsened during COVID-19 as a result of the social isolation resulting from stay-at-home orders and closures have limited contact with family, friends and society [43]. Further, a recent study demonstrated that many adults with diabetes experience loneliness which is associated with other associated conditions such as lack of blood pressure control [44]. Although the study did not show a significant correlation between loneliness and blood glucose control, there is general concern because increased rates of mood disorders canalso lead to poor adherence of medications and worsening of risk factor control [45-48]. More importantly, adherence to treatment can decrease when people are distressed or have depression, as seen both during and after disasters [47, 49, 50].

While the dramatic shift towards social distancing forced all American to physically distance themselves, online technologies could be harnessed to provide social support networks and a sense of belonging. However, access to these platforms is not

always available [51]. Lack of available technology could results in self-isolation disproportionately affecting low-income, rural and elderly individuals whose primary social contact, such as churches and community centers, are closed and whose access digital resources or technological literacy may be limited [52, 53]. Those with medical, cognitive or social frailty as less able to compensate when their environment is altered [54]. Withdrawal of the formal and informal functional supports may compound these problems.

Conclusions

Individuals with diabetes face many challenges during this troubling time. In addition to facing more severe consequences from COVID-19, they must also manage their disease at a time when regular health care is not always readily available. Disease management becomes increasingly difficult as diet, activity and lifestyle habits are altered to accommodate facility closures and social distancing requirements. In addition to these physical risks, the diabetic population, who is already more likely to experience depression that non-diabetic individuals, they face greater social and physical isolation increasing the strain on their mental and emotional health—a factor know to compound disease difficulties. Attention to these issued faced by those individuals diagnosed with diabetes is paramount, the health consequences of those living with undiagnosed diabetes could be even more catastrophic. Unmanaged diabetes coupled with more limited health services and pandemic-induced lifestyles changes poses and unprecedented threat to 7.3 million American living with undiagnosed diabetes. Heightened attention to these issues among with diagnosed and possibly undiagnosed diabetes is imperative. Treatment of these unintended and often ignored consequences of COVID-19 could pose a substantial long-run cost burden on the health community [55-58].

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