



## **The Impact of COVID-19 on Access to Diabetes Care, Management, and Related Complications**

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Since the beginning of the COVID-19 pandemic, studies have shown that diabetes is one of the major comorbidities associated with the development of severe COVID-19-related adverse outcomes and mortality (1–6). Additionally, some preliminary reports suggest that diabetes-related complications such as diabetic foot ulcers (DFU), hypoglycemia, and diabetic ketoacidosis (DKA) are on the rise, because of decreased access to diabetes care and services. These cases are considered unintended consequences of the pandemic. The purpose of this evidence summary is to review current published reports of the impact of the pandemic on diabetes management and complications.

### **Access to Diabetes Care and Services**

The measures put in place by governments, while necessary for infection control, have led to unintended effects such as interruptions in comprehensive diabetes care. Effective diabetes care includes regular patient–provider interactions for patient education, medication review and renewals, prevention, screening and management of complications, and mental health assessments and interventions (7–10). Diabetes care has been significantly impacted by the reduction in access to health-care programs and services due to COVID-19, with the majority of people with diabetes experiencing mental-health problems (11,12). The most common co-occurring chronic diseases for which care has been impacted by COVID-19 are diabetes and hypertension, diabetes and chronic obstructive pulmonary disease (COPD), and diabetes and heart disease (11). Interruptions in diabetes care are known to lead to morbidity and mortality (10,11,13).

Specifically, it's been shown that physical distancing measures and mandated lockdowns have increased unhealthy dietary patterns and mental health-related concerns, and decreased physical activity, in parallel with delayed care-seeking due to fear of contracting COVID-19 (7,9,11,14,15). Additional challenges include: reduced access to necessary medicines—either due to lockdown restrictions that limited movement or financial hardship that required people to ration insulin and/or skip oral medications and travel restrictions that impact rural residents who must travel to urban centres for diabetes care (15–17). Further, the pandemic has shifted the focus away from primary care, causing a disruption of care for people living with diabetes and other chronic conditions (7,15,18). Management of diabetes is known to worsen—especially for the most vulnerable—following a break in care, which impacts both a person's life expectancy and costs to the health-care system (19). Moreover, since the COVID-19 lockdown and the enforcement of pandemic measures, the number of emergency room visits has decreased, which sparks concerns that people might not



be accessing necessary acute care for their conditions, including acute diabetes complications and new-onset diabetes (14,18,20). Testing rates for LDL cholesterol and A1C fell 81-90% and new metformin and statin therapies fell by 52-60% in the early days of the pandemic restrictions in the United States (18).

Newly-released Canadian data indicate that, by April 2020, hospitals were seeing a 50% drop in ER visits (21). A decrease in emergencies, unfortunately, does not tell a complete story, as it cannot capture the impact of delayed care. During the early pandemic period—defined as March to June 2020—admissions for major cardiac events and other cardiac issues dropped by 20% and 21%, respectively, while 22% fewer people were admitted to ICU for cardiac conditions and strokes, compared to the same time period the previous year (22). Additionally, there was a 21% drop in urgent cardiac surgeries, such as bypass procedures and pacemaker insertions (22). Since diabetes contributes to 30% of strokes and 40% of heart attacks, it is reasonable to assume that a large proportion of patients who experienced delayed care were people with diabetes with complications (23).

### **Risk of Diabetic Foot Ulcers and Decreased Access to Foot Care**

Diabetic foot ulcers (DFU) remain one of the most common complications of diabetes and are the leading cause of lower extremity amputation (24). People with diabetes who have foot ulcers are at increased risk for infections, hospitalization, amputations, and death (25). Early pandemic-related reports stated an increase in lower extremity amputations in people with diabetes despite the previous decades of decline (24,26). It is important to note, though, that an increase in amputations was also reported in the United States one year before COVID-19 was declared a global pandemic (26). Since the pandemic has begun and resulted in limited access to regular foot care, most reports have indicated higher rates of amputation. An Ohio study (N=270) reported that patients were 10.8 times more likely to undergo any type of amputation during the pandemic (March 18-August 31, 2020) than before (January 1-March 17, 2020), with the severity of infections increasing during the pandemic (27). Patients in Italy (N= 63) had a threefold risk of amputation during lockdown, compared to the previous year, and were more likely to present as emergent and diagnosed with gangrene (28). And a study from the Netherlands (N=121), reporting similar rates of amputation during lockdown, also noted a higher degree of tissue loss and more extensive ischemic damage than previous years (29). It is too soon to draw robust conclusions due to differences in comparison groups and time frames, but clearly there is cause for concern.

The rapid progression of the COVID-19 pandemic has required a sudden shift in best care practices for health-care providers and institutions, especially practices specific to diabetic limb preservation (8,10,24,30). Findings from various international studies have revealed a general neglect of foot care



in people with diabetes and foot complications, including DFU (16,24). Additionally, the evolving pandemic and subsequent recommendations to reduce outpatient visits in hospitals have led DFU procedures and surgeries to be classified as non-essential (25). Patients may avoid care due to fear of exposure at hospitals as well (32). Unfortunately, without regular foot care, vascular diagnostics, or surgical intervention, people with diabetes and DFU are at risk of quickly becoming infected, which would inadvertently increase the risk of lower-limb amputations (25). Indeed, regular podiatric care reduces diabetes-related ER visits, hospitalization, length-of-stay, and amputations (25). A triage protocol for diabetic foot consultations, implemented in the early days of the pandemic, did not report a statistically significant increase in the number of minor foot amputations, demonstrating that alternatives modes of patient consultation are clinically effective (24). In Brazil, a federally regulated adoption of remote medical consultations was successful in managing severe cases of diabetes-related limb injury: 82% of patients with advanced wounds were managed as outpatients, and their conditions were controlled without the need of hospital admission (10). Finally, an Italian triage system reported positive early outcomes in terms of limb salvage, with no exposure to COVID-19 by patients admitted to hospital for treatment of their DFU (30).

Currently, no Canadian data exist on this issue. Diabetes Canada continues to monitor the situation and will update this review should Canadian statistics become available.

### **Is There an Increased Risk of Hypoglycemia?**

Severe hypoglycemia is defined as an episode with loss of consciousness or requiring hospitalization. Risk of severe hypoglycemia can be a major deterrent to intensive glycemc management, even during non-pandemic times. The current period of distress imposed by the COVID-19 pandemic can also trigger hypoglycemia (16). Stressful situations have been known to precipitate hypoglycemic episodes in people with type 1 and type 2 diabetes (16). Research on the current pandemic's impact on rates of hypoglycemia appears to be mixed, depending on type of diabetes. Data from Spain and Italy, examining glycemc management during the early days of lockdown, showed either no change in the frequency incidence of hypoglycemia in adults with type 1 diabetes or a decrease in the hypoglycemic events (32–34). In an Italian study of children with type 1 diabetes, there was a slight decrease in the number of cases of severe hypoglycemia reported in 2020 versus the same time period in 2019 (14). And another Spanish study also reported no significant increase in hypoglycemia for people with type 1 diabetes (35).

For people living with type 2 diabetes, the COVID-19 containment measures appear to have increased the risk of hypoglycemia, especially those receiving sulfonylureas (SU), insulin, prophylaxis hydroxychloroquine (HCQ), and in those patients with associated comorbidities, such as hypertension, diabetic kidney disease (DKD), and microvascular and macrovascular complications



(36). This observation may be related to stress with the lockdown, delay or non-availability of food, fear of COVID infection and financial stress related to job loss. In cases such as these, patient education, support, and telemedicine can play a pivotal role in preventing hypoglycemia (36).

### **Pediatric Type 1 Diabetes: Delayed Diagnoses, Diabetic Ketoacidosis (DKA), and Viral Impact on New Diagnoses**

Are diagnoses of new cases of pediatric type 1 diabetes being delayed due to the pandemic, leading to more presentations of and more severe DKA? DKA is an urgent complication that is the result of insulin deficiency, resulting in excess ketones (acids created when fat is broken down to be used for energy). Calls from health-care professionals to avoid non-urgent medical visits are intended to curb the spread of COVID-19. This reduction in non-COVID medical care has resulted in the delayed presentation of pediatric disease, preventing timely diagnosis and treatment (14,37–39). The longer it takes for children and young people to be diagnosed, the more likely it is they will present with severe DKA. Researchers in the UK reported a marked increase in DKA, both mild and severe cases, during presentation of new-onset type 1 diabetes, compared to before the pandemic (38,40). A series of case studies in the United States and Italy have observed the delayed diagnosis of new-onset type 1 diabetes, with patients presenting in severe DKA (37). In contrast, another Italian study reported no significant increases of DKA from 2019 to 2020 (14). Canadian data revealed a significant increase in the frequency of DKA at diagnosis and an increase in the incidence of severe DKA, even though the number of children presenting with newly diagnosed type 1 diabetes was similar to the same time period the previous year (41,42).

There have been factors hypothesized to influence development of type 1 diabetes, including psychological stress, exposure to the coronavirus, or delayed presentation (37,43–45). It is important to note, though, that viral infections impacting development of type 1 diabetes are reported to precede actual diagnosis by months to years (39,46). In a review of cases across 217 German pediatric diabetes centres, Tittel et al reported no significant increase in new cases of type 1 diabetes due to the pandemic lockdown, compared to the previous nine years (43). There have been other reports of new-onset type 1 diabetes, with authors speculating that exposure to the novel coronavirus is at play in these handful of cases (45). Longer-term research is planned to ascertain this potential link. In the meantime, health-care providers can continue to encourage parents to contact their doctor if their child is feeling unwell and avoid delays that may lead to severe outcomes like DKA.

In the early days of the pandemic, there was a global push to adopt virtual visits for pediatric endocrinology (47). Management of sick day protocols, and reinforced during telemedicine visits, can



aid diabetes professionals in identifying children already living with type 1 diabetes who are at risk of DKA, which will also help prevent it and minimize emergencies requiring hospital visits (48).

## **Glycemic Management in People with Type 2 Diabetes**

The pandemic and subsequent adjustments to lifestyle have changed the way people eat and exercise—what, where, and when. Healthy eating and physical activity are important components of glycemic management for people living with type 2 diabetes. Pandemic lockdown measures, which have impacted people’s ability to exercise in groups and at gyms, have the potential to negatively impact glucose management. Not all people living with type 2 diabetes have grappled with keeping their glucose levels within the target range because of lockdown measures. A Greek study reported decreased A1C, body mass index (BMI), and total cholesterol during the lockdown, compared with patients’ most recent pre-lockdown visit (13). Similarly, an Indian study also reported decreased A1C, post-prandial blood glucose, and improved glycemic management during lockdown (49). These authors noted that study participants increased their physical activity and experienced a corresponding weight loss.

Currently, Canadian data are unavailable. Diabetes Canada continues to monitor the situation and will update this review should Canadian statistics become available.

## **Glycemic Management and Glucose Monitoring in People with Type 1 Diabetes**

Advanced glucose monitoring devices are an effective glycemic management tool for people with type 1 diabetes. While there has been concern that a reduction in access to diabetes health-care teams would negatively impact glycemic management, this potential has not been borne out. Multiple studies have reported improved glycemic management for adults and children who utilize advanced glucose monitoring devices. Only one study from India indicated glucose levels outside the target range during lockdown; though the authors indicated that the inability to access insulin and test strips impacted patients’ results (50). Several small-scale studies in Italy reported no change or improvements in time in range, for adults with type 1 diabetes using a variety of glucose monitoring devices (32,34). It is possible that lockdown measures resulted in a less rushed lifestyle and fewer external commitments, allowing people with diabetes to focus on healthy eating, physical activity, and more regular insulin administration. An observational study of Scottish adults with type 1 diabetes using flash glucose monitors reported a small but significant improvement in time in range during lockdown (51). Two Spanish studies also reported increased time in range for adults using both flash and continuous glucose monitoring devices (35,52). And a study of Greek children with type 1 diabetes reported no significant difference in their mean time in range in the two-week period immediately following lockdown, compared to the two-week period immediately before lockdown



(53). One study of hybrid closed-loop systems (HCLs)—where the continuous glucose monitor can alert the pump to suspend insulin delivery—reported that children spent more time in range and less time below range (i.e., hypoglycemia) during lockdown in Italy than in the two weeks immediately before lockdown (54). It has been recommended that patients strive for time in range more than 70% of the time, and time in hypoglycemia less than four percent of the time (55).

### **Affordability, Disparities, and Access to Diabetes Medicines and Supplies**

Significant health-care disparities exist, in that people living with type 1 diabetes who are low-income are more likely to experience higher rates of hospitalization for DKA, higher A1C levels, and lower use of technology to manage their condition (56,57). These gaps have been further exacerbated by the pandemic (56). In other countries, it is also impacting affordable access to insulin, medications, self-monitoring blood glucose (SMBG) devices, and diagnostic tools, as well as loss of access to essential health-care services (including primary and acute care), which can lead to the development of various diabetes-related complications (7,50,58). People living with diabetes who have experienced decreases—or losses altogether—in their income are especially at risk of being unable to afford their diabetes medications and/or devices. Further, people with diabetes at all income levels are highly likely to miss physician’s appointments and routine clinic visits for fine-tuning of diabetes medications among other things, due to the imposed lockdowns (15,16). This can result in prolonged episodes of hyperglycemia and hypoglycemia (16). Indeed, a Scottish study of adults with type 1 diabetes reported that a deterioration of time-in-range and estimated A1C during lockdown was more likely in people with higher levels of socioeconomic deprivation (51).

To counteract these unintended consequences, it is essential to continue to use new methods of care, such as telemedicine, which has been shown to have sustainable and long-lasting benefits for people with type 1 diabetes, especially children whose families are experiencing economic hardships related to the pandemic (39,56). However, we must also acknowledge that delivery of health care via technological methods such as video visits and telemedicine may inadvertently omit some populations (15). Disparities exist in terms of digital access (i.e., high-speed internet and smartphones with wireless data plans), with lack of access higher for people of colour (59).

### **Conclusion**

Long-term studies will describe the impact of the COVID-19 pandemic on people living with diabetes, both those with pre-existing diabetes as well as individuals who were newly diagnosed during the pandemic (8,43,60). While many researchers and clinicians have attempted to quantify how the pandemic is impacting diabetes care and subsequent complications, data are limited. Longer-term, post-pandemic, fulsome research to accurately assess the impact will be needed (8). In



the current climate, diabetes practitioners need to focus on decreasing the burden of diabetes and, at the same time, reducing the burden on the health-care system, which is already overtaxed by the coronavirus pandemic.

To avoid a rise in non-COVID-19-related morbidity and mortality, including diabetes-related complications and increased rates of mental health problems such as depression and anxiety, it is important that people with diabetes continue to receive routine care (7,11,61). This requires alternative modalities of care such as telehealth, in-home visits, or face-to-face consultations in clinics that are away from people with COVID-19 (7,10,11,25). Continuing diabetes care for patients includes reducing their risk of contracting COVID-19, and requires practitioners to assess what aspects of care must remain the same versus what can be shifted to virtual care or deferred to a later date (15,47,62). Now more than ever, people living with diabetes need to be encouraged to increase self-management of their condition (15,16,62,63). The use of technologies such as advanced glucose monitoring systems can further assist people with diabetes and their health-care teams support self-management (64). Diabetes professionals also need to be cognizant of the individual differences in their patients, to understand who will thrive during periods of uncertainty and decreased activity, and who will need additional support to maintain a healthy lifestyle and within-range glycemic management.

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