



Type 1 Diabetes and COVID-19: Preliminary Findings From a Multicenter Surveillance Study in the U.S.

Diabetes Care 2020;43:e83–e85 | <https://doi.org/10.2337/dc20-1088>

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The Centers for Disease Control and Prevention states that individuals with diabetes are at higher risk for severe illness with coronavirus disease 2019 (COVID-19) and poorer health outcomes (1). Research suggests the underlying reason for an increased risk of COVID-19 complications in individuals with diabetes may be poor glycemic control or hyperglycemia (2). Information on clinical outcomes for patients with type 1 diabetes who have confirmed cases of COVID-19 is limited. To our knowledge, this is the first U.S.-based multicenter study that addresses these questions in a population with type 1 diabetes.

This study aimed to examine patient characteristics and adverse outcomes among patients with type 1 diabetes with confirmed COVID-19. As a secondary objective, we investigated patient attributes and clinical outcomes in people with COVID-19–like symptoms for whom testing was unavailable or results were pending.

The T1D Exchange Quality Improvement Collaborative (T1DX-QI) (3) is conducting this study in collaboration with an additional 49 endocrinology clinics (a total of 64 U.S. sites). The study was approved as exempt by a central review board (Western Institutional Review

Board [WIRB]). Each clinic obtained approval locally as appropriate. In this study, clinics report deidentified data from their patients with type 1 diabetes who tested positive for COVID-19 as well as for patients with symptoms and a medical history consistent with COVID-19 illness.

In the registry, patients were classified as COVID-19 positive if they had tested positive for COVID-19 through a molecular test (RT-PCR) of samples collected from nasopharyngeal swabs, throat swabs, sputum, etc. (1).

Patients were classified as having COVID-19–like cases if they exhibited any of the most common COVID-19 symptom profiles as identified by the Centers for Disease Control and Prevention including fever, cough, shortness of breath, myalgia, runny nose, sore throat, headache, nausea or vomiting, abdominal pain, diarrhea, or any combination of these symptoms (4). Additionally, household exposures for COVID-19 were recorded for patients who presented with any of the above-listed symptoms.

Data were collected using a 33-item questionnaire via the Qualtrics survey tool (<https://t1dexchange.org/COVID19>). As of 5 May 2020, we described data available on 33 COVID-19–positive and 31 COVID-19–like patients with type 1

diabetes, reported from participating clinics within the U.S. (Table 1).

In the COVID-19–positive group ($N = 33$), 54.5% of patients were female and 36.4% were non-Hispanic white. The mean age was 24.8 years (SD 17.49, range 7.0–79.0). Median HbA_{1c} for all COVID-19–positive patients was 8.5%. The most prevalent presenting symptom reported was high blood glucose (48.5%), followed by elevated temperature (45.5%), dry cough (39.4%), excess fatigue (33.3%), vomiting (33.3%), shortness of breath (30.3%), nausea (27.3%), and body/headaches (21.2%). A smaller proportion (<15%) of patients experienced chills, chest pain, loose stools, abdominal pain, loss of taste, and loss of smell.

The most prevalent comorbidity among patients with a confirmed case of COVID-19 was obesity (39.4%), followed by hypertension or cardiovascular disease (12.1%). The most prevalent adverse outcome within COVID-19–positive patients was diabetic ketoacidosis (DKA) (45.5%).

In the group that presented with COVID-19–like symptoms ($N = 31$), 48.3% of patients were female and 61.3% were non-Hispanic white. The mean age was 16.8 years (SD 10.1). Median HbA_{1c} was 8.0%. The most prevalent adverse outcome was DKA

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Received 8 May 2020 and accepted 16 May 2020

This article is part of a special article collection available at <https://care.diabetesjournals.org/collection/diabetes-and-COVID19>.

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Table 1—Preliminary data: patient characteristics, symptoms, and outcomes in the T1D COVID-19 study

| Patient attributes | All patients (N = 64) | COVID-19–positive case group (N = 33) | COVID-19–like case group (N = 31) |
|--|--------------------------|--|--------------------------------------|
| Mean age in years (SD) | 20.9 (14.84) | 24.8 (17.49) | 16.8 (10.10) |
| Age categories | | | |
| ≤18 years | 42 (65.6) | 17 (51.52) | 25 (80.6) |
| >19 years | 22 (34.4) | 16 (48.5) | 6 (19.4) |
| Female sex | 39 (60.9) | 18 (54.5) | 15 (48.3) |
| Race/ethnicity | | | |
| Non-Hispanic white | 31 (48.4) | 12 (36.4) | 19 (61.3) |
| Non-Hispanic black | 12 (18.8) | 10 (30.3) | 2 (6.5) |
| Hispanic | 16 (25) | 7 (21.2) | 9 (29.0) |
| Asian/other/unknown | 5 (7.8) | 4 (12.1) | 1 (3.23) |
| Education level (patient, or parent if patient <18 years of age) | | | |
| No high school | 8 (12.5) | 3 (9.1) | 5 (16.1) |
| High school graduate | 12 (18.8) | 7 (21.2) | 5 (16.1) |
| College graduate or above | 7 (10.9) | 6 (18.2) | 1 (3.2) |
| Unknown | 37 (57.8) | 17 (51.5) | 20 (64.5) |
| Insurance | | | |
| Private | 20 (31.3) | 9 (27.3) | 11 (35.5) |
| Public | 36 (56.3) | 23 (69.7) | 13 (41.9) |
| HbA _{1c} median, % | 8.0 | 8.5 | 8.0 |
| Duration of type 1 diabetes | | | |
| New onset | 6 (9.8) | 5 (15.6) | 1 (3.4) |
| <1 year | 2 (3.1) | — | 2 (6.9) |
| 1–2 years | 9 (14.8) | 2 (6.3) | 7 (24.1) |
| 3–5 years | 15 (24.6) | 9 (28.1) | 6 (20.7) |
| 6–10 years | 12 (19.7) | 4 (12.5) | 8 (27.6) |
| >10 years | 17 (27.9) | 12 (37.5) | 5 (17.2) |
| CGM use (yes) | 32 (52.5) | 13 (40.6) | 19 (65.5) |
| Insulin pump use (yes) | 27 (44.3) | 9 (28.1) | 18 (62.1) |
| Care managed remotely (yes) | 37 (60.7) | 15 (46.9) | 22 (75.9) |
| Video/telemedicine as primary mode of remote care | 17 (46) | 8 (53.3) | 9 (40.9) |
| COVID-19 symptoms and medical care information | | | |
| Most prevalent symptoms | | | |
| High blood glucose | 32 (50.8) | 16 (48.5) | 16 (51.6) |
| Elevated temperature | 26 (41.3) | 15 (45.5) | 11 (36.7) |
| Dry cough | 24 (38.1) | 13 (39.4) | 11 (36.7) |
| Nausea | 19 (30.2) | 9 (27.3) | 10 (33.3) |
| Excess fatigue | 18 (28.6) | 11 (33.3) | 7 (23.3) |
| Body/headaches | 17 (27.0) | 7 (21.2) | 10 (33.3) |
| Shortness of breath | 17 (27.0) | 10 (30.3) | 7 (23.3) |
| Vomiting | 16 (25.4) | 11 (33.3) | 5 (16.7) |
| Loss of taste | 7 (11.1) | 3 (9.1) | 4 (13.3) |
| Loss of smell | 6 (9.5) | 1 (3.0) | 5 (16.7) |
| Low blood glucose | 5 (7.9) | 1 (3.0) | 5 (16.7) |
| Loose stools | 5 (7.9) | — | 5 (16.7) |
| Most prevalent comorbidities | | | |
| Obesity | 25 (39.7) | 13 (39.4) | 12 (40) |
| Hypertension/CVD | 9 (14.3) | 4 (12.1) | 5 (16.7) |
| Asthma | 5 (7.9) | — | 5 (16.7) |
| Hashimoto thyroiditis | 7 (4.8) | 4 (12.1) | 3 (10.0) |
| Hyperlipidemia | 3 (4.8) | 1 (3.0) | 2 (6.7) |
| Smoking/vaping history | | | |
| Yes (current or previous) | 6 (9.8) | 2 (6.3) | 4 (13.8) |
| No | 41 (64.1) | 20 (60.1) | 21 (67.7) |
| Unknown | 15 (23.4) | 11 (32.3) | 4 (12.9) |
| Influenza vaccine this season | | | |
| Yes | 26 (42.6) | 14 (43.8) | 12 (41.4) |
| No | 12 (18.8) | 3 (8.8) | 9 (29.0) |
| Unknown | 26 (40.6) | 16 (47.1) | 10 (32.3) |

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Table 1—Continued

| Patient attributes | All patients (N = 64) | COVID-19–positive case group (N = 33) | COVID-19–like case group (N = 31) |
|------------------------------|--------------------------|--|--------------------------------------|
| Highest level of care | | | |
| Intensive care unit | 14 (22.2) | 10 (30.3) | 4 (13.3) |
| Inpatient or hospitalization | 11 (17.5) | 9 (27.2) | 2 (6.7) |
| Emergency room | 5 (7.9) | 1 (3.0) | 4 (13.3) |
| Clinic or urgent care | 8 (12.7) | 4 (12.1) | 4 (13.3) |
| At home | 22 (34.9) | 9 (27.3) | 13 (43.3) |
| Unknown | 3 (4.8) | — | 3 (10.0) |
| Adverse outcome | | | |
| Death | 2 (3.2) | 1 (3.0) | 1 (3.3) |
| DKA | 19 (30.2) | 15 (45.5) | 4 (13.3) |
| Severe hypoglycemia | 3 (4.8) | 1 (3.0) | 2 (6.7) |
| Other | 6 (9.5) | 5 (15.2) | 1 (3.3) |
| None | 33 (52.4) | 13 (39.4) | 20 (66.7) |
| Unknown | 3 (4.8) | 1 (3.0) | 2 (6.7) |

Data are *n* (%) unless otherwise indicated. Data submitted to the registry as of 5 May 2020. CGM, continuous glucose monitoring; CVD, cardiovascular disease.

(13.3%). Most patients reported symptoms similar to those of patients who tested positive for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), including high blood glucose (51.6%), elevated temperature (36.7%), dry cough (36.7%), nausea (33.3%), body/headaches (33.3%), excess fatigue (23.3%), and shortness of breath (23.3%).

This preliminary report describes the most common presenting symptoms and outcomes for 64 people with type 1 diabetes who have confirmed or suspected COVID-19. More than 50% of all cases reported hyperglycemia, and nearly one-third of patients experienced DKA.

Future publications will address risk factors, provide regional insights, and describe associations and outcomes in

pediatric and adult patients as more data are collected and analyzed.

Acknowledgments. The authors greatly appreciate all the participating endocrinologists and their teams who all took the time to contribute cases to the registry. The authors also appreciate Rishika Gupta and other members of the T1D Exchange team for editorial support.

Funding and Duality of Interest. The Helmsley Charitable Trust funds the T1D Exchange Quality Improvement Collaborative. The T1D Exchange received financial support for this study from Abbott Diabetes, Dexcom, JDRF, Insulet Corporation, Lilly, Medtronic, and Tandem Diabetes Care. No other potential conflicts of interest relevant to this article were reported.

None of the sponsors of this study were involved in initiating the study, study design, or manuscript review.

Author Contributions. All authors were involved in writing, study design, review, editing, and final approval. O.A.E. is the guarantor of this

work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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