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Impact of the COVID-19 pandemic on adults with type 2 diabetes care and clinical parameters in a primary care setting in Ontario, Canada: A cross-sectional study

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Key messages:

- The COVID-19 pandemic has had an impact on diabetes care in the US, Canada and the UK, including on diagnostics and ongoing treatment
- Our study corroborates previous studies and adds to the growing literature on the impact of the pandemic restrictions on routine diabetes care.

Key words: Diabetes, Canada, COVID-19, EMR, Treatment

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Abstract

Introduction

Diabetes requires ongoing monitoring and care to prevent long term adverse health outcomes. In Canada, quarantine restrictions were put into place to address the COVID-19 pandemic in March 2020. Primary care diabetes clinics limited their in-person services and were advised to manage type 2 diabetes (T2D) through virtual visits and reduce the frequency of routine diabetes-related lab tests and screening.

Methods

This retrospective cross-sectional study used de-identified patient records from a primary care electronic medical records (EMR) database in Ontario, Canada to identify people with T2D who had at least one healthcare touchpoint between March 1, 2018 and February 28, 2021.

Outcomes were described on a monthly or yearly basis: 1) number of people with primary care visits (in-person vs virtual); 2) number of people with referrals; 3) number of people with each of the vital/lab measures; and 4) results of the vital/lab measures.

Results

A total of 16,845 with T2D were included. Compared to the pre-pandemic period, the COVID-19 period saw a 16.8% reduction in the T2D population utilizing any primary care and an increase of 330.4% in the number of people with ≥1 virtual visit.

Compared to the pre-pandemic period, fewer people had vital/lab measures in the pandemic period. However, among the people with the test results available, the average values for all tests were similar in the pre- and pandemic period.

Conclusion

Further research is important to understand the impact of the reduction of in-person clinical care on the entire population with T2D.

Introduction

Diabetes affects about 8% of Canadians and requires ongoing monitoring and care to prevent long term adverse health outcomes [1]. In Canada, quarantine restrictions were put into place to address the COVID-19 pandemic beginning in March 2020 [2]. As a result of the pandemic, many primary care and outpatient diabetes clinics limited their in-person services to only the most urgent cases and addressed other cases virtually due to COVID-19 related restrictions and the overburdened healthcare system [3]. In response, a guide for primary care providers to manage type 2 diabetes (T2D) during COVID-19 was created with an emphasis on delivering diabetes care and support in Canada through virtual visits wherever possible and reducing the frequency of routine diabetes-related lab tests and screening [4].

The impact of the COVID-19 pandemic on diabetes management in the primary care setting has been assessed in several retrospective observational studies [5-9]. In Canada, a study of the population of Ontario showed a reduction in in-person visits by persons with diabetes to their family physicians from 78% to 37% during the pandemic period [10]. There were also statistically significant decreases in procedures or tests for diabetes patients, including eye exams, glycated hemoglobin (A1C) and low-density lipoprotein cholesterol (LDL-C) tests. Similarly, a study conducted in the United States (US) showed that during February and March 2020, A1C and LDL-C tests dropped by 81–90%, and new prescriptions of metformin and statins decreased by 52–60% compared to the months prior [7]. Another US study observed decreased A1C testing during the early pandemic but stable medication fill rates over time. This study also reported that 29.1% of its 2020 diabetes cohort had at least one telemedicine visit, compared to 0.3% in its 2019 cohort [8]. Additionally, a study using UK general practice data reported a 32% reduction for the observed T2D diagnosis rate between March 1 and December 10, 2020, compared to the expected rate, while the observed mortality rate in patients with T2D increased by 19% [10]. Additionally, a dramatic drop in A1C testing was noted in April 2020 [6].

There have been few studies investigating the impact of the COVID-19 pandemic on T2D management in a primary care setting in Canada. This study aimed to describe the impact of the COVID-19 pandemic on T2D care in a primary care network with existing virtual care capabilities in Ontario, Canada.

Methods

Study design and data source

This was a retrospective cross-sectional study using de-identified patient records extracted from a primary care electronic medical records (EMR) database. Primary care data for more than one million unique persons since 2010 were sourced from a network of clinics across major cities and rural regions in Ontario, Canada's largest province. The EMR database captures patient-level clinical information over time, including demographics, visits, diagnoses, referrals, Ontario Health Insurance Plan (OHIP) billing, vitals, lab tests, and prescriptions. Prior to the pandemic, this primary care network had already established some level of virtual care capabilities such as scheduling and telemedicine technology.

People with T2D who had at least one healthcare touchpoint between March 1, 2018 and February 28, 2021 were analysed annually and monthly for the following periods: baseline period from March 1, 2018 to February 28, 2019; pre-COVID-19 period from March 1, 2019 to February 29, 2020; and COVID-19 period from March 1, 2020 to February 28, 2021.

Study population and healthcare touchpoints

People with T2D were eligible for this analysis if: (1) they had at least one prescription for a non-insulin antihyperglycemic medication in their prescription history in the EMR database; (2) they were ≥18 years old at the start of the analysis period (March 1, 2018); and 3) they did not have any pregnancy-related diagnosis during the analysis period (March 1, 2018 to February 28, 2021).

Within the selected T2D population, the following healthcare touchpoints were analyzed if they occurred at or after the first non-insulin antihyperglycemic prescription date minus 90 days, and between March 1, 2018 and February 28, 2021: (1) visits (in-person or virtual was determined by OHIP billing codes); (2)

referrals with the physician specialty to which the patient was referred; (3) vital measures including body mass index (BMI) and blood pressure (BP); and (4) lab tests including A1C, glucose test (all types of plasma glucose tests, e.g., fasting, random), LDL-C, urine albumin-creatinine ratio (UACR), and estimated glomerular filtration rate (eGFR).

Study outcomes

The following outcomes were described by aggregating the healthcare touchpoints on a monthly or yearly basis: (1) number of people with primary care visits, total and by visit type (in-person vs virtual); (2) number of people with referrals (total and by referral specialty); (3) number of people with each of the vital/lab measures (BMI, BP, A1C, glucose test, LDL-C, UACR, eGFR); and (4) results of the vital/lab measures (BMI, BP, A1C, LDL-C, UACR, eGFR).

Data analysis

Descriptive statistics were used throughout the analysis. Continuous variables were presented as mean with standard deviation (SD) and median with interquartile range (IQR). Categorical variables were presented as frequencies with percentages.

SAS version 9.4 (SAS Institute, Cary, North Carolina) was used for data extraction from the database, data manipulation, and data analysis.

Results

Cohort selection and demographics

A total of 16,845 people meeting the selection criteria were included in the analysis between March 1, 2018 and February 28, 2021. Table 1 describes the patient demographics across the baseline, pre-COVID-19 and COVID-19 periods. The mean age and gender distribution was comparable across all three periods, with average age of 60.5 years old and 46% female. The COVID-19 period saw a 16.8% reduction in the T2D population utilizing any primary care (virtual or in-person) as compared to the pre-COVID-19 period

(10,692 visits from March 2019 – February 2020 compared to 8,850 visits from March 2020 – February 2021). The bulk of the reduction in visits occurred during the early phase of the pandemic (March to May 2020) and returned to near pre-pandemic levels by October 2020 (Figure 1).

In-person vs virtual visits

At the beginning of the pandemic, a sharp drop was observed in number of people with ≥1 in-person visit to the clinics, which was offset by a rise in people with virtual visits (Figure 1). The total number of people with in-person or virtual visits were comparable towards the end of the study period.

Compared to the year before, the COVID-19 period saw an increase of 330.4% in the number of people with ≥1 virtual visit, and the average number of virtual visits per person for those who had virtual visits increased from 1.7 to 3.6. On the contrary, 34.8% fewer people had in-person visits during the COVID-19 period, and the average number of in-person visits per person for those who had in-person visits decreased from 4.4 to 3.0.

Referrals

The monthly number of people with ≥ 1 referral decreased by 17% from the period March 2019 – February 2020 (4,250 total referrals) to the pandemic period of March 2020 – February 2021 (3,432 total referrals). However, this was similar to the total number of referrals in the March 2018 – February 2019 period (3,716 referrals). Internal medicine was the most common referral across all three time periods, however referrals to Family Medicine/General Practice (FM/GP) and Endocrinology & Metabolism increased as a proportion of all referrals during the pandemic period. In the periods beginning March 2018 and March 2019, referrals to FM/GP accounted for 11% and 8%, respectively, compared to 18% in the pandemic period. In the periods beginning March 2018 and March 2019, referrals to Endocrinology & Metabolism accounted for 10% and 9%, respectively, compared to 13% in the pandemic period.

Vital measures

Compared to the pre-COVID-19 period, 49.7% and 29.7% fewer people had BMI and BP measures recorded by the primary care clinics during the COVID-19 period, respectively. Among the people with BMI or BP measurements, the proportion of people with high BP (>130/80 mmHg) (75.6%, 76.0% and 77.5%) and people with obesity (47.9%, 47.0% and 44.6%) remained similar across all three time periods (Table 2).

Laboratory tests

During the COVID-19 period, fewer people had A1C (−19.6%), blood glucose (−17.6%), eGFR (−19.7%), LDL-C (−19.1%), UACR (−14.2%) tests as compared to the pre-COVID period (Table 2). Similar trends were also observed in all other lab tests. Among people with the test results available, the average values for all lab tests were similar across the three time periods (Table 2).

Monthly data showed a sharp drop in number of people getting A1C tests during the period of March to May 2020 which increased but remained below pre-COVID-19 levels towards the end of the study (Figure 2a). A1C levels were found to be comparable amongst all three time periods, with a large proportion of people (32.0%, 30.4% and 34.9% for baseline, pre-COVID-19 and COVID-19 periods) successfully maintaining an A1C of ≤ 6.5% (Figure 2b). However, a considerable proportion of people were found to have A1C>6.5% (68.0%, 69.4% and 65.1% for baseline, pre-COVID-19 and COVID-19 periods, respectively) or A1C>7.0% (47.8%, 48.4% and 44.6% for baseline, pre-COVID-19 and COVID-19 periods, respectively).

Discussion

This study describes the patterns of primary care for a large population of T2D patients during the COVID-19 pandemic. Overall, fewer people with T2D were found to have healthcare touchpoints in the first year of the pandemic, with the majority of the impact observed in the first seven months. Though the initial phase of the pandemic had fewer people making in-person visits every month, this was mostly offset with a rise in virtual visits. While there was a concerning reduction in the measurement and recording of BP, BMI and blood tests, the vitals and lab test outcomes did not differ considerably between the baseline, pre-COVID-19, and COVID-19 periods for those who had tests performed. Evidence from other national emergencies have revealed that such disruptions can worsen outcomes in patients suffering from acute and chronic diseases, including diabetes, during and after such events [9, 11-13].

During the pandemic, the need to reallocate health-care resources towards managing COVID-19 patients and controlling cross-infection among patients discouraged non-urgent outpatient visits, hospital admissions and elective surgeries [14]. Although the number of patients utilizing healthcare touchpoints and undergoing periodic laboratory testing had dropped rapidly and significantly during the initial months of the pandemic, there was a gradual recovery to pre-pandemic levels. However, it is important to note that even by February 2021, those levels had not completely returned to pre-pandemic levels. This could be due to the ongoing risk of COVID-19 and some pandemic restrictions at that time. The convenience of virtual consultations over in-person visits could also be contributing to the persistence in fewer in-person visits.

Our study corroborates findings from a study in Ontario which found that diabetes-related care was impacted during the pandemic and resulted in a reduction of GP and specialist visits as well as decreased probabilities of important laboratory tests for patients with diabetes [10]. Similar to our study, the findings from Ontario did not find worse outcomes for patients with diabetes during the pandemic time period. Although one interpretation is that there was no impact on health outcomes, it is important to note that there were fewer lab assessments during the pandemic period. Therefore, one can only conclude that among those who sought health care during the pandemic period, their control was similar to pre-pandemic levels. There is no way to determine the impact on health outcomes among those who did not access health care during that time due to pandemic restrictions.

Other countries have evaluated a negative impact on diabetes outcomes due to pandemic restrictions. A UK study revealed an 80% drop in A1C testing in April 2020, including 1.41 million missed/delayed diabetes monitoring tests, 2.67 million screening tests and 2.52 million diagnostic tests during the initial 6 months of the pandemic [15]. An estimated 76% patients were expected to see their A1C levels rise by >1 mmol/mol more than expected due to disruptions. As per a US study, a 70% reduction in A1C testing was reported during the early months of the pandemic, which correlated with an increase in abnormal A1C results [16]. Another study reported a 66% drop in A1C testing during the first 2 months of the pandemic compared to that in the previous year, which could possibly translate to delayed/missed testing and further adverse impacts on glycemic control and clinical outcomes [17]. These findings highlight the importance of ensuring routine care to the population with diabetes through transitioning to alternative modalities of care such as teleconsultation, in-home visits, or physical consultations in separate clinics to minimize risk of cross-infection, as well as the importance of an uninterrupted supply of medication [18-22].

Our study, as well as several previous studies, have highlighted the importance of virtual health care during the COVID-19 pandemic. In response to pandemic restrictions implemented by governments in various countries, primary and secondary care through virtual and telephone consultations were advisable over in-person visits [23]. Digital healthcare aids in treatment adherence and empowers patients to proactively manage their own health [24]. In the US, additional efforts were made to communicate with patients at home to ensure continued disease management. The effectiveness of remote management of diabetes has been verified through few studies. A randomized controlled study found remote management of diabetes to be effective in maintaining BP, fasting blood glucose (FBG), postprandial blood glucose (PBG), preventing weight gain and improving patients' self-management and compliance during the pandemic [25]. A US study found no evidence of a negative association with medication fills and glycemic control, possibly attributed to small increase in medication fill rates during the pandemic that offered protection against disruptions in diabetes management [8]. Mail-order pharmacies and pharmacy delivery services were the key to ensuring timely supply of medicines to patients [8]. The findings also negated any evident association between visit frequency and glycemic control, thus reiterating the efficiency of remote management [8].

The primary care network used for this study already had some virtual care capabilities prior to the COVID-19 pandemic, although this was not highly used, as shown by the relatively low number of people who had at least one virtual visit before March 2020. The pre-existing facilities seemingly offered smooth transition from in-person to virtual visits as soon as the risks associated with the pandemic surfaced, thus guaranteeing uninterrupted diabetic care during that period. The increasing number of people with virtual visits in a short period also showed the quick adaptation to pandemic restrictions, which possibly explains clinical outcomes of patients remaining unaltered during the COVID-19 period.

Though the use of telehealth platforms has been steadily increasing over the past few years, some sections of the population find it challenging to adapt to this approach due to limited internet access as well as the technical skills required for operation [23]. Lack of optimal infrastructure required for virtual health platforms and inequal access to quality health services amongst different regions and nations might have led to varied impact of the pandemic on patient care, and thus health outcome, especially in low-to-middle income countries (LMICs) [26]. A combination of technology and in-person services helps address the disparity to some extent and in some cases direct combination of both types proved necessary [27, 28]. The availability of new billing codes to support telemedicine made this care more accessible for Ontarians, however it remains to be seen if this is a sustained change to healthcare delivery in Ontario, especially if these codes do not remain in effect going forward [29].

One of the major strengths of the study was the size of the population, which was included from a major primary care network in Ontario, the most populous province in Canada. Diabetes treatment is similar across provinces in Canada; however, there may be regional differences within and between provinces. The study was also comprehensive in documenting real-world vital and lab results of T2D over a 3-year period where the impact of the pandemic was examined on different aspects of T2D management, including visits, referrals, vital measures, and lab tests.

This study had some limitations. Firstly, selection of the T2D population from the EMR database involved evaluating the prescription history and non-insulin antihyperglycemic medication used for each person to identify T2D status, which could lead to exclusion of patients getting eligible prescriptions outside of the clinical network. In case of off-label use of eligible prescriptions by people, they would be incorrectly determined to have T2D. Furthermore, this study had an objective to determine the impact of Covid on treatment escalation and therefore focused on patients who could still escalate to treatment with insulin.

Additionally, the EMR system did not capture all types of healthcare resources accessed by patients: touchpoints with out-of-clinic physicians to which the patient was referred, primary care accessed outside of the medical clinical system, hospital care, diabetes care/services accessed in a pharmacy or care obtained outside of the province were not included. While analyzing vital and lab results, only people who had tests performed during each time period were included. People not receiving care during the COVID-19 period may have had different health outcomes/health care seeking behaviors compared to those with vital/lab tests. Lastly, the primary care model (e.g., fee-for-service vs capitation) was not assessed in this study. Not all EMRs and clinics have the same capabilities and approaches related to telemedicine and patient access, and therefore may have seen different results.

The longer-term impact of the COVID-19 pandemic on diabetes-related complications and standard of care is unknown and it is important to continue to study this relationship. For future studies and analyses, it would be vital to follow people longitudinally to understand the change in T2D management and outcomes at the individual level during the pandemic. This information will be helpful for diabetes treatment planning as virtual medicine may play a larger role in primary care medicine in the future. It is also important to analyze prescription patterns of antihyperglycemic medications before and during the COVID-19 pandemic using pharmacy or claims data. In addition, studies should try to examine those who were able to access care compared to those who were not. There may be a systematic difference between these populations that may impact future health outcomes. Finally, survey-based approaches should be implemented to understand the impact of the COVID-19 pandemic on T2D management from a patient and/or physician perspective.

Conclusion

Overall, this study highlighted that there was a large decrease in the number of in-person visits to clinics which was offset by a rise in virtual care visits during the pandemic. The study also found that there was a decrease in the number of laboratory tests done that are critical for monitoring patients with diabetes. Though the values of the laboratory tests that were done were similar across the pre- and pandemic periods, it is important to understand the impact of the reduction of in-person clinical care on the entire population with diabetes.

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Author contributions

All authors were involved in the design of this study. All authors participated in the interpretation of the results, review, and revision of the paper, and approved the final manuscript.

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Tables

Table 1. Patient demographics

Time period	Baseline: Mar 2018 to Feb 2019	Pre-COVID-19: Mar 2019 to Feb 2020	COVID-19: Mar 2020 to Feb 2021
People with T2D who had ≥1 healthcare touchpoint	10,429	11,014	9,169
Age, years			
Mean (SD)	60.7 (14.7)	60.3 (14.9)	60.5 (14.8)
Median (IQR)	61.0 (52.0, 71.0)	61.0 (51.0, 71.0)	61.0 (51.0, 71.0)
Age category, n (%)			
18–24 years	537 (5.1%)	641 (5.8%)	505 (5.5%)
35–49 years	1709 (16.4%)	1887 (17.1%)	1474 (16.1%)
50–64 years	3872 (37.1%)	4086 (37.1%)	3463 (37.8%)
65–79 years	3306 (31.7%)	3394 (30.8%)	2856 (31.1%)
80+ years	1005 (9.6%)	1006 (9.1%)	871 (9.5%)
Gender, n (%)			
Female	4808 (46.1%)	5178 (47.0%)	4213 (45.9%)
Male	5619 (53.9%)	5836 (53.0%)	4954 (54.0%)
Unknown	2 (0.0%)	0 (0.0%)	2 (0.0%)
Smoking status, n (%)			
Current smoker	1518 (14.6%)	1600 (14.5%)	1239 (13.5%)
Former smoker	1132 (10.9%)	1171 (10.6%)	900 (9.8%)
Never smoked	7219 (69.2%)	7716 (70.1%)	6452 (70.4%)

Unknown	560 (5.4%)	527 (4.8%)	578 (6.3%)

IQR, interquartile range; SD, standard deviation; T2D, type 2 diabetes mellitus

Table 2. Number of people with vital/lab measures and their vital/lab results

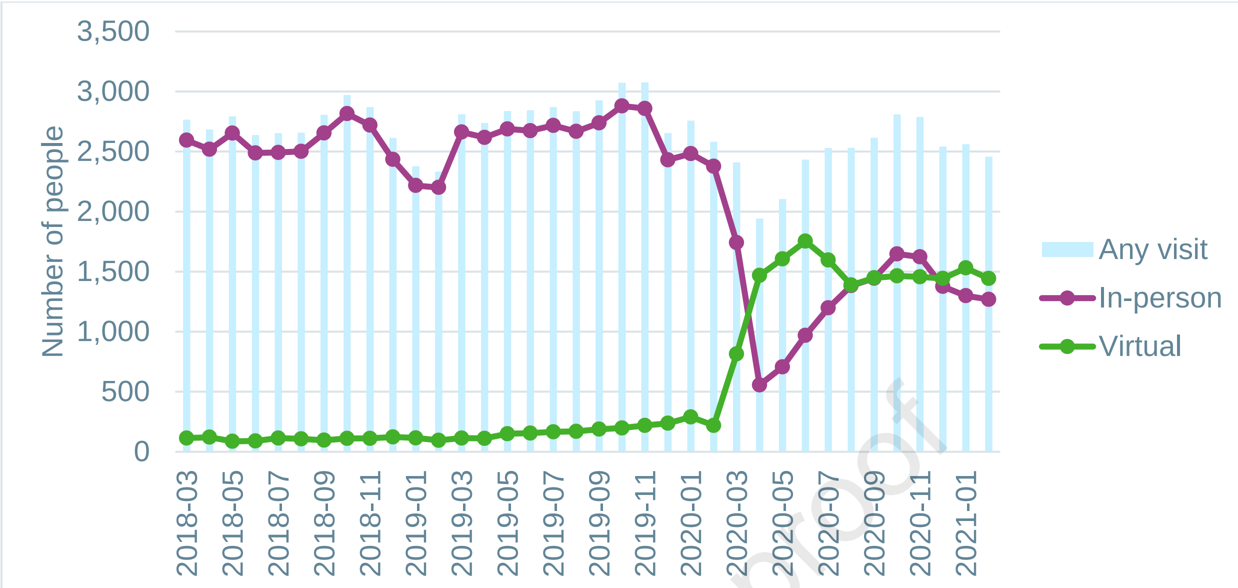
	Baseline: Mar 2018 to Feb 2019	Pre-COVID-19: Mar 2019 to Feb 2020	COVID-19: Mar 2020 to Feb 2021
People with ≥ 1 BP measure	9,190	9,909	4,988
Diastolic (mmHg), mean (SD)	82.4 (10.5)	82.4 (10.4)	82.8 (10.8)
Diastolic (mmHg), median (IQR)	82.0 (75.7, 88.6)	82.0 (75.7, 88.8)	82.3 (75.7, 89.3)
Systolic (mmHg), mean (SD)	134.3 (16.8)	134.0 (16.9)	135.6 (17.3)
Systolic (mmHg), median (IQR)	132.8 (123.0, 144.0)	132.9 (123.0, 143.6)	134.0 (124.0, 145.3)
% BP >130/80 mmHg	75.6%	76.0%	77.5%
People with ≥ 1 BMI measure	5,904	6,734	4,736
BMI (kg/m^2), mean (SD)	30.6 (6.5)	30.5 (6.5)	30.1 (6.5)
BMI (kg/m^2), median (IQR)	29.6 (26.0, 34.1)	29.4 (25.9, 34.0)	29.1 (25.6, 33.5)
% BMI ≥ 30 kg/m^2	47.9%	47.0%	44.6%
People with ≥ 1 A1C test	5,007	5,462	4,393
A1C (%), mean (SD)	7.3 (1.5)	7.3 (1.5)	7.3 (1.5)
A1C (%), median (IQR)	7.0 (6.4, 7.8)	7.0 (6.4, 7.9)	6.9 (6.3, 7.8)
% A1C > 6.5%	68.0%	69.4%	65.1%
% A1C > 7.0%	47.8%	48.4%	44.6%
People with ≥ 1 glucose test	4,241	4,683	3,861
People with ≥ 1 eGFR test	4,947	5,404	4,338
eGFR (mL/min/1.73m^2), mean (SD)	81.0 (22.7)	81.6 (22.8)	80.4 (22.9)
eGFR (mL/min/1.73m^2), median (IQR)	84.0 (65.7, 98.0)	85.0 (67.0, 98.0)	83.3 (65.5, 97.0)
% eGFR < 60 mL/min/1.73 m^2	18.6%	17.5%	18.7%
People with ≥ 1 LDL-C test	4,412	4,780	3,865

LDL-C (mmol/L), mean (SD)	2.0 (0.9)	2.1 (0.9)	2.1 (0.9)
LDL-C (mmol/L), median (IQR)	1.8 (1.4, 2.5)	1.9 (1.4, 2.6)	1.9 (1.4, 2.6)
% LDL-C ≥ 2 mmol/L	68.0%	70.8%	69.2%
People with ≥ 1 UACR test	2,854	3,340	2,866
UACR (mg/mmol), mean (SD)	7.4 (16.9)	7.1 (16.2)	6.7 (15.4)
UACR (mg/mmol), median (IQR)	1.7 (0.7, 5.4)	1.7 (0.8, 5.4)	1.6 (0.8, 4.4)
% UACR ≥ 2 mg/mmol	54.1%	54.8%	53.8%

A1C, glycated hemoglobin; BMI, body mass index; BP, blood pressure; eGFR, estimated glomerular filtration rate; IQR, interquartile range; LDL-C, low density lipoprotein cholesterol; SD, standard deviation; T2D, type 2 diabetes; UACR, urine albumin-to-creatinine ratio

List of Figures

Figure 1



3,500
3,000
2,500
2,000
1,500
1,000
500
0
Number of people
2018-03
2018-05
2018-07
2018-09
2018-11
2019-01
2019-03
2019-05
2019-07
2019-09
2019-11
2020-01
2020-03
2020-05
2020-07
2020-09
2020-11
2021-01
Any visit
In-person
Virtual

Figure 2a

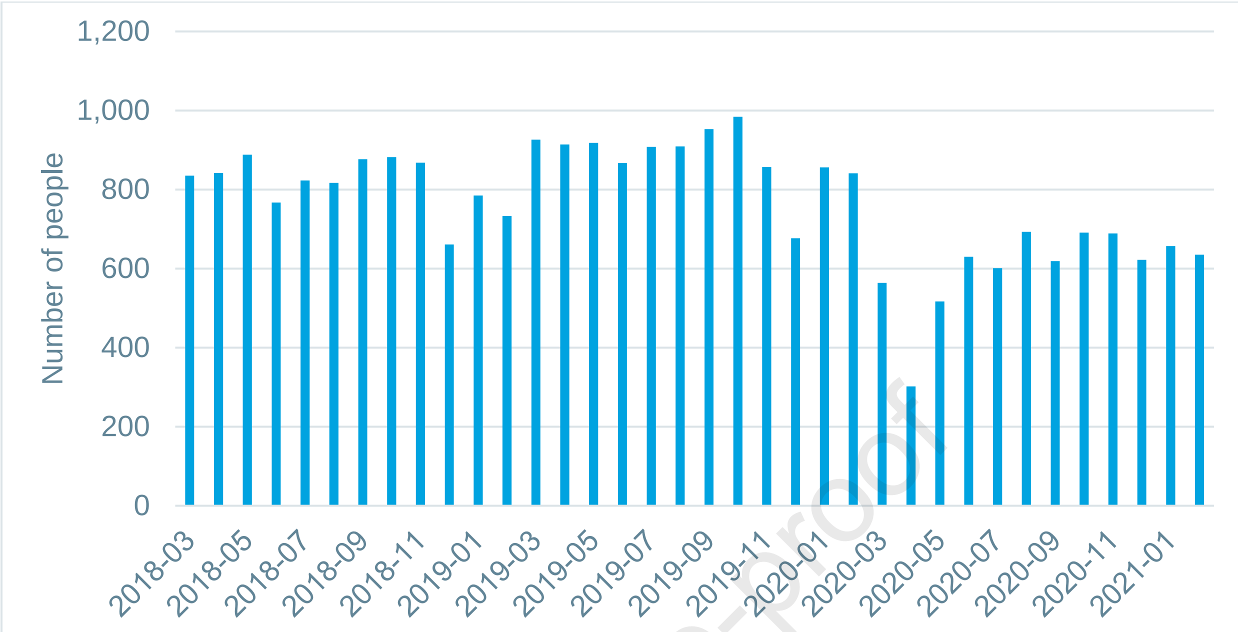
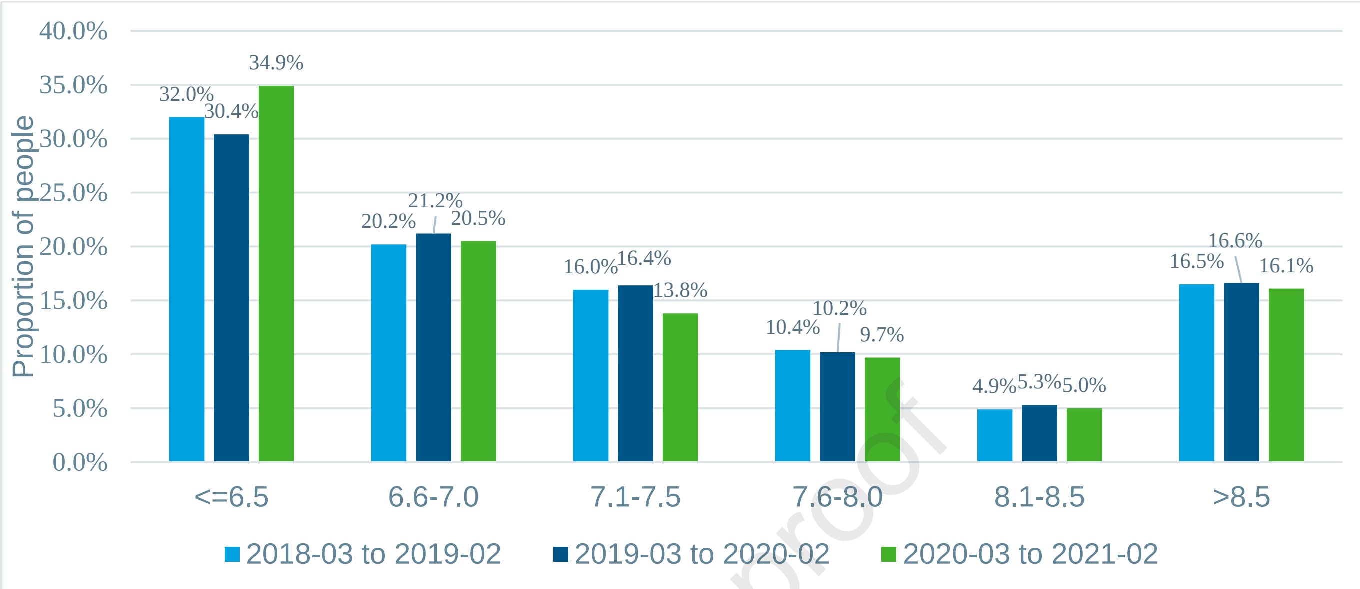

1,200
1,000
800
600
400
200
0
Number of people
2018-03
2018-05
2018-07
2018-09
2018-11
2019-01
2019-03
2019-05
2019-07
2019-09
2019-11
2020-01
2020-03
2020-05
2020-07
2020-09
2020-11
2021-01

Figure 2b


40.0%
35.0%
30.0%
25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Proportion of people
32.0%
30.4%
34.9%
20.2%
21.2%
20.5%
16.0%
16.4%
13.8%
10.4%
10.2%
9.7%
4.9%
5.3%
5.0%
16.5%
16.6%
16.1%
<=6.5
6.6-7.0
7.1-7.5
7.6-8.0
8.1-8.5
>8.5
2018-03 to 2019-02
2019-03 to 2020-02
2020-03 to 2021-02