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ORIGINAL RESEARCH

Frequency and Type of Outpatient Visits for Patients With Cardiovascular Ambulatory-Care Sensitive Conditions During the COVID-19 Pandemic and Subsequent Outcomes: A Retrospective Cohort Study

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BACKGROUND: Because the impact of changes in how outpatient care was delivered during the COVID-19 pandemic is uncertain, we designed this study to examine the frequency and type of outpatient visits between March 1, 2019 to February 29, 2020 (prepandemic) and from March 1, 2020 to February 28, 2021 (pandemic) and specifically compared outcomes after virtual versus in-person outpatient visits during the pandemic.

METHODS AND RESULTS: Population-based retrospective cohort study of all 3.8 million adults in Alberta, Canada. We examined all physician visits and 30- and 90-day outcomes, with a focus on those adults with the cardiovascular ambulatory-care sensitive conditions heart failure, hypertension, and diabetes. Our primary outcome was emergency department visit or hospitalization, evaluated using survival analysis accounting for competing risk of death. Although in-person outpatient visits decreased by 38.9% in the year after March 1, 2020 (10 142 184 versus 16 592 599 in the prior year), the introduction of virtual visits (7 152 147; 41.4% of total) meant that total outpatient visits increased by 4.1% in the first year of the pandemic for Albertan adults. Outpatient visit frequency (albeit 41.4% virtual, 58.6% in-person) and prescribing patterns were stable in the first year after pandemic onset for patients with the cardiovascular ambulatory-care sensitive conditions we examined, but laboratory test frequency declined by 20% (serum creatinine) to 47% (glycosylated hemoglobin). In the first year of the pandemic, virtual outpatient visits were associated with fewer subsequent emergency department visits or hospitalizations (compared with in-person visits) for patients with heart failure (adjusted hazard ratio [aHR], 0.90 [95% CI, 0.85–0.96] at 30 days and 0.96 [95% CI, 0.92–1.00] at 90 days), hypertension (aHR, 0.88 [95% CI, 0.85–0.91] and 0.93 [95% CI, 0.91–0.95] at 30 and 90 days), or diabetes (aHR, 0.90 [95% CI, 0.87–0.93] and 0.93 [95% CI, 0.91–0.95] at 30 and 90 days).

CONCLUSIONS: The adoption and rapid uptake of virtual outpatient care during the COVID-19 pandemic did not negatively impact frequency of follow-up, prescribing, or short-term outcomes, and could have potentially positively impacted some of these for adults with heart failure, diabetes, or hypertension in a setting where there was an active reimbursement policy for virtual visits. Given declines in laboratory monitoring and screening activities, further research is needed to evaluate whether long-term outcomes will differ.

Key Words: cardiovascular ■ COVID-19 ■ outcomes ■ virtual care

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CLINICAL PERSPECTIVE

What Is New?

- The frequency of outpatient follow-up and prescribing patterns were similar for patients with cardiovascular ambulatory-care sensitive conditions in the first year of the pandemic as prepandemic, although 41% of the outpatient visits were virtual, and the frequency of laboratory testing declined by 20% to 47%.
- Virtual outpatient visits were associated with fewer subsequent emergency department visits or hospitalizations than in-person visits for patients with heart failure (adjusted hazard ratio [aHR], 0.90 [95% CI, 0.85–0.96] at 30 days and 0.96 [95% CI, 0.92–1.00] at 90 days), hypertension (aHR, 0.88 [95% CI, 0.85–0.91] and 0.93 [95% CI, 0.91–0.95] at 30 and 90 days), or diabetes (aHR, 0.90 [95% CI, 0.87–0.93] and 0.93 [95% CI, 0.91–0.95] at 30 and 90 days).

What Are the Clinical Implications?

- The increase in virtual outpatient care during the COVID-19 pandemic did not negatively impact follow-up frequency, prescribing, or short-term outcomes for adults with common cardiovascular ambulatory-care sensitive conditions, and could have potentially positively impacted some of these outcomes.

Nonstandard Abbreviations and Acronyms

ACSC	ambulatory-care sensitive conditions

We and others have previously reported a substantial shift in outpatient medical care from in-person office visits to virtual care (mostly via telephone) during the COVID-19 pandemic.[1–6] Although several studies reported that patients with chronic conditions were less likely to be seen by any modality (even virtually) after the onset of the pandemic,[7–11] these studies only examined the first few months after pandemic onset or focused only on primary care visits. Importantly, the impact of these ambulatory care pattern changes on patient outcomes is unclear. Although the lack of in-person contact, and the absence of information from physically examining patients could negatively influence patient outcomes, it is also possible that the introduction of virtual physician assessments may have improved outcomes because of increased ease and frequency of patient monitoring.

In this study, we examine changes in the frequency, type, and outcomes of all outpatient visits, with specialists as well as primary care physicians, during the pandemic for patients with and without ambulatory-care sensitive conditions (ACSCs) and focus particularly on those ACSCs most relevant to cardiovascular specialists: heart failure (HF), hypertension, and diabetes. ACSCs are health conditions and diagnoses for which appropriate outpatient care is felt able to reduce the risks of hospitalization by preventing the onset of the condition, controlling acute exacerbations, or managing chronic disease.[12] In addition to the cardiovascular conditions we examined, most definitions of ACSCs also include conditions like chronic obstructive pulmonary disease, asthma, or epilepsy.[12] Although some definitions also include angina, we did not include angina, because the *International Classification of Diseases* (*ICD-10-CA*)-based administrative codes poorly distinguish cases of chronic stable angina from patients with prior coronary events and no ongoing angina or those with new-onset acute angina or escalating angina patterns.

METHODS

Data Availability

To comply with Alberta's Health Information Act, the data set used for this study cannot be made publicly available. The data set from this study is held securely in coded form within the Alberta Support for Patient Oriented Research Unit Data Platform. Although legal data sharing agreements between the investigators, Alberta Support for Patient Oriented Research Unit, and Alberta Health Services/Alberta Health prohibit us from making the data set publicly available, access may be granted to those who meet prespecified criteria for confidential access, available at www.abspor.ca. The data set analytic codes are available from the authors upon request, understanding that the computer programs may rely upon coding templates or macros that are unique to the Alberta Support for Patient Oriented Research Unit.

Study Design

This was a retrospective cohort study and has been described more fully elsewhere.[1] We included all adult Albertans who used physician services in 2 sequential time periods: March 1, 2019 to February 29, 2020 (classified as prepandemic), and March 1, 2020 to February 28, 2021 (pandemic).

Data Sources and Study Sample

This study linked population-based health administrative data sets in Alberta, Canada for 3.8 million adults. All health care in the province is publicly funded, with universal access and without user fees for physician services, emergency department (ED) use, or hospitalizations.

Several data sets were linked deterministically via encrypted unique health identifier number to create our study's analytical data set. The Discharge Abstract Database captures all acute care hospitalizations recording admission and discharge date, as well as up to 25 diagnoses and 16 procedures indicated with *International Classification of Diseases, Ninth Revision* and *Tenth Revision, Canada* (*ICD-9*, *ICD-10-CA*) and *Canadian Classification of health Interventions* codes, respectively. The Ambulatory Care Database captures all ED assessments and hospital-based physician office visits, recording the date along with up to 10 diagnostic codes. The Healthcare Provider Claims Database captures claims for all physician visits (including those shadow-billed by salaried physicians), recording the date and up to 3 diagnoses. The Pharmacy Information Network captures all medication dispensations from community pharmacies. The Alberta Health Care Insurance Registry captures all patient demographics, addresses, and dates of death/emigration from the province. The comprehensiveness of the databases and the validity of the *ICD-9* and *ICD-10-CA* case definitions we used in this study have been previously established.[1]

Identifying and Classifying Physician Visits

We retrieved all encounters with physicians, EDs, or hospitals during the 2 sequential study time periods. All physician encounters were classified as outpatient, ED, or hospital based. We report the number of visits per 1000 adults in the health care registry each month (and per 1000 adults with each of the conditions we focused on); although 1 patient could contribute >1 visit to the numerator in any given month, they could only be represented in the denominator once.

The Alberta physician billing codes were modified on March 17, 2020 to include specific codes (v codes) for virtual (telephone or video) visits; before this, physicians were required to see patients in person for remuneration. In our comparison of outcomes after virtual versus in-person outpatient visits during the first year of the pandemic, we defined outpatient visit type based on the first visit for each patient in each of the study time periods (prepandemic and during the pandemic). In sensitivity analyses, we explored the robustness of our findings using the following 3 methods: (1) by restricting the analyses to only those patients with a single outpatient visit in the outcome period, (2) by examining total events and analyzing the association between visit type using 0-inflated Poisson regression, or (3) by calculating inverse probability treatment-weighted estimates for the primary analysis using a propensity score created with age, sex, Pampalon Deprivation Index, and Charlson score, and matching with all covariates balanced with standardized mean differences <20%.

Outcomes

We examined the proportion of outpatient visits followed by an ED visit or a hospitalization (and each outcome separately) within 30 and 90 days. Patients who presented to an ED and were subsequently admitted to the hospital would have contributed an event to both the estimate of ED visits and the estimate of hospitalizations, but only 1 event to the composite of ED visit or hospitalization. We also report the frequency of death within 30 and 90 days of outpatient visits, and our primary analysis (the composite of ED visit or hospitalization) was examined using survival analysis accounting for the competing risk of death.

Comorbidities

We identified patient comorbidities using *ICD-9* and *ICD-10-CA* case definitions previously validated in Alberta for any hospitalizations, any ED visits, and any outpatient visits in the year before and including the index visit.[1,12] We used previously validated case definitions from the Canadian Institute for Health Information to identify those patients with ACSCs who accessed health care in either time period (Table S1).

Statistical Analysis

We report patient characteristics, care patterns, and subsequent outcomes across cardiovascular ACSCs (HF, hypertension, and diabetes) in the year before and the year after March 1, 2020 (onset of the COVID-19 pandemic). Given the large sample size, we assessed for standardized differences between the 2 comparator years. To compare events after outpatient encounters in the year before and after pandemic onset (March 1, 2020), we calculated events per 1000 visits and used the Wilcoxon ranked test to compare differences in ED visits or hospitalizations between the before and after period, and χ^2 test to compare differences in death and laboratory tests between the before and after period. To compare outcomes after virtual versus in-person visits during the pandemic year, we calculated adjusted hazard ratios (aHRs) for each of the outcomes in the 30 and 90 days after outpatient visits, using Cox regression analyses and including age, sex, Pampalon Deprivation Index, which also controls for geography, because it is based on postal code, and the Charlson comorbidity score, and modeled death as a competing risk. Although our primary analysis examined the primary outcome (ED visit or hospitalization) as a binary composite outcome and assigned the exposure based on the patient's first visit in each timeframe (because less than one-fifth of patients had a mix of virtual and outpatient visits), we conducted the sensitivity analyses described earlier: one restricted to only those patients with 1 outpatient visit (virtual or in person) and another where we used 0-inflated Poisson models to evaluate the associations for total number of events in patients with multiple events. We also calculated inverse probability treatment weighted estimates for the primary analysis using age, sex, Pampalon Deprivation Index, and Charlson score. All statistical analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC), and figures were generated using R 4.1.2 (R Foundation for Statistical Computing, Vienna, Austria).

Ethics

The University of Alberta Health Research Ethics Board approved this study (Pro00115481) and waived individual patient consent, because we were only provided with deidentified data after linkage to conform with provincial privacy regulations.

RESULTS

Of 3.8 million Albertan adults, the number who had at least 1 health care encounter declined from 2 807 604 in 2019 to 2020, to 2 684 694 in 2020 to 2021 (ie, 122 910 [4.4%] fewer adults had a health care encounter in the first year of the pandemic than in the prior year [Figure S1]). Between 2019 and 2020 and the first year of the pandemic, the proportion of community-dwelling Albertan adults presenting to an ED at least once in that year decreased, from 40.1% to 34.3% for those with ACSCs and from 25.5% to 22.3% for those without ACSCs, as did the proportion requiring hospitalization, from 16.2% to 14.8% of those with ACSCs and from 5.5% to 5.3% of those without ACSCs. Although the proportion of outpatient visits that were followed by subsequent ED visits or hospitalizations also declined after the onset of the pandemic, deaths increased slightly both in patients with and without ACSCs (Figures S2 and S3).

Although in-person outpatient physician visits declined by 38.9% in the year after pandemic onset (from 16 592 599 to 10 142 184), the adoption of virtual visits (7 152 147 in 2020–2021) meant that total outpatient encounters actually increased by 4.1% in the first year of pandemic. Overall, 41.4% of outpatient visits in the first year of the COVID-19 pandemic were virtual (Figure), and 17.3% of virtual outpatient visits were followed by an in-person outpatient visit within 30 days.

Although the frequency of outpatient encounters and prescribing patterns were fairly stable after the onset of the pandemic for patients with HF, hypertension, or diabetes (Table 1), the proportion of patients who presented to an ED or were hospitalized within 30 or 90 days after an outpatient encounter decreased significantly in all 3 patient groups compared with the prior year (all $P<0.001$; Table 2). However, the proportion dying at any point during 2020 to 2021 increased, including within 30 and 90 days of an

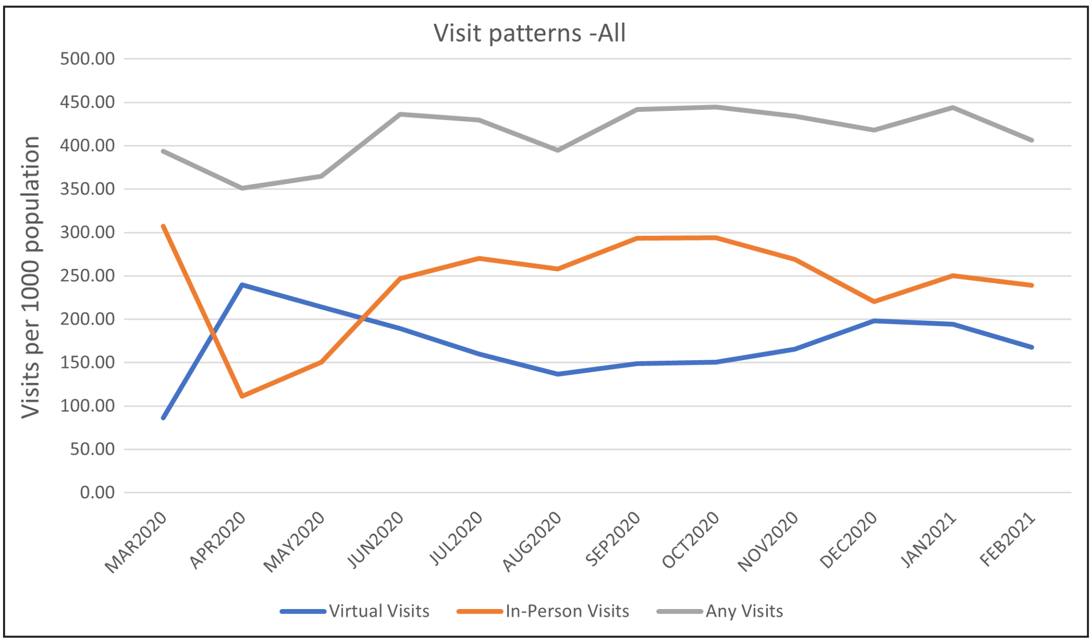

Figure. Monthly outpatient visits during the first year of the COVID-19 pandemic, reported per 1000 adults.

Note that we report the number of visits per 1000 adults in the health care registry that month, but 1 patient could contribute >1 visit to the numerator in any given month.

Table 1. Characteristics and Health Service Use by Community-Dwelling Adults in Alberta With Cardiovascular Conditions in the Year Before and After Pandemic Onset (March 1, 2020), Per Patient

	Heart failure			Hypertension			Diabetes		
	Before	After	SD	Before	After	SD	Before	After	SD
N	31 032	29 481		367 242	342 387		224 821	217 873	
Median age, y (IQR)	75 (64–84)	75 (64–84)	−0.06	64 (54–73)	64 (54–73)	−0.06	62 (52–71)	62 (52–71)	−0.19
Women, n (%)	13 831 (44.6)	13 093 (44.41)	0.00	176 921 (48.2)	165 272 (48.27)	0.00	98 243 (43.7)	95 154 (43.67)	0.00
Median no. of Charlson comorbidities (IQR)	2 (1–3)	2 (1–4)	0.31	0 (0–1)	0 (0–1)	0.24	1 (1–2)	1 (1–2)	0.50
Urban residence	25 355 (81.7)	24 281 (82.36)	−0.02	312 981 (85.2)	293 522 (85.73)	−0.02	189 714 (84.4)	184 539 (84.70)	−0.03
Pampalon Material Deprivation Index, n (%)									
Missing	3140 (10.1)	2823 (9.58)	0.05	21 327 (5.8)	20 083 (5.87)	0.03	12 599 (5.6)	12 354 (5.67)	0.03
1, least deprived	4474 (14.4)	4238 (14.38)		55 999 (15.2)	53 537 (15.64)		30 270 (13.5)	29 567 (13.57)	
2	4798 (15.5)	4626 (15.69)		61 176 (16.7)	57 854 (16.90)		35 581 (15.8)	34 756 (15.95)	
3	5297 (17.1)	5054 (17.14)		67 075 (18.3)	62 412 (18.23)		40 501 (18.0)	39 352 (18.06)	
4	6345 (20.4)	6147 (20.85)		77 091 (21.0)	71 006 (20.74)		48 708 (21.7)	46 554 (21.37)	
5, most deprived	6978 (22.5)	6593 (22.36)		84 574 (23.0)	77 495 (22.63)		57 162 (25.4)	55 290 (25.38)	
Had at least 1 outpatient visit with a PCP in person or virtual	28 282 (91.1)	27 578 (93.54)	0.16	361 256 (98.4)	336 610 (98.31)	0.01	218 136 (97.0)	211 562 (97.10)	0.07
Saw a PCP in office setting	28 282 (91.1)	24 159 (81.95)	−0.17	361 256 (98.4)	310 477 (90.68)	−0.31	218 136 (97.0)	193 795 (88.95)	−0.23
Median no. of PCP office visits (IQR)	6 (3–10)	3 (1–6)	−0.43	6 (4–9)	3 (2–6)	−0.59	6 (4–9)	3 (2–6)	−0.45
Virtual visit with PCP, n (%)	0 (0.0)	23 628 (80.15)	N/A	0 (0.0)	266 866 (77.94)	N/A	0 (0.0)	168 907 (77.53)	N/A
Median no. of PCP virtual visits (IQR)	0 (0.0)	3 (1–7)	N/A	0 (0.0)	2 (1–5)	N/A	0 (0.0)	2 (1–5)	N/A
Had at least 1 outpatient visit with a specialist in person or virtual, n (%)	24 917 (80.3)	23 308 (79.06)	0.02	213 594 (58.2)	188 356 (55.01)	−0.07	141 832 (63.1)	132 953 (61.02)	−0.06
Saw specialist in office setting, n (%)	24 917 (80.3)	19 473 (66.05)	−0.25	213 594 (58.2)	159 603 (46.61)	−0.24	141 832 (63.1)	111 790 (51.31)	−0.25
Median no. of specialist office visits (IQR)	3 (1–5)	1 (0–3)	−0.33	1 (0–3)	0 (0–2)	−0.27	1 (0–3)	1 (0–2)	−0.29
Virtual visit with specialist, n (%)	0 (0.0)	17 492 (59.33)	N/A	0 (0.0)	106 173 (31.01)	N/A	0 (0.0)	79 427 (36.46)	N/A
Median no. of specialist virtual visits (IQR)	0 (0.0)	1 (0–2)	N/A	0 (0.0)	0 (0–1)	N/A	0 (0.0)	0 (0–1)	N/A
Had at least 1 medication dispensation, n (%)	30 390 (97.9)	28 914 (98.08)	0.03	363 250 (98.9)	338 651 (98.91)	−0.02	221 870 (98.7)	215 125 (98.74)	0.00
Median no. of medications dispensed (IQR)	17 (11–24)	16 (10–23)	−0.05	9 (5–14)	8 (5–13)	−0.19	11 (7–17)	10 (6–16)	−0.17
Had at least 1 ED visit that year, n (%)	23 339 (75.2)	20 609 (69.91)	−0.02	134 077 (36.5)	108 146 (31.59)	−0.09	92 154 (41.0)	80 153 (36.79)	−0.08
Median no. of ED visits (IQR)	2 (1–3)	1 (0–3)	−0.08	0 (0–1)	0 (0–1)	−0.08	0 (0–1)	0 (0–1)	−0.07
Had at least 1 hospitalization that year, n (%)	18 925 (61.0)	16 675 (56.56)	−0.03	58 706 (16.0)	49 582 (14.48)	−0.07	40 169 (17.9)	37 033 (17.00)	−0.08
Median no. of hospitalizations (IQR)	1 (0–2)	1 (0–2)	−0.07	0 (0–0)	0 (0–0)	−0.07	0 (0–0)	0 (0–0)	−0.10

Data are reported as counts and percentages or IQR. ED indicates emergency department; IQR, interquartile range; N/A not applicable; and PCP, primary care physician.

Table 2. Events After Any Outpatient Encounter, Whether in Person or Virtual, Per 1000 Visits in the Year Before and After Pandemic Onset (March 1, 2020)

	Heart Failure			Hypertension			Diabetes		
	Before	After	*P* value	Before	After	*P* value	Before	After	*P* value
In 30 d									
ED visit	260.2	192.8	<0.01	88.5	65.2	<0.01	108.0	83.6	<0.01
Hospitalization	122.3	100.5	<0.01	25.1	20.6	<0.01	28.6	24.4	<0.01
Death	6.6	7.4	<0.01	0.6	0.7	<0.01	1.2	1.4	<0.01
Any event	389.1	300.8	<0.01	114.2	86.5	<0.01	137.7	109.4	<0.01
Had at least 1 electrolyte panel done	9665 (32.68)	6684 (23.46)	<0.01	73 039 (20.07)	38 081 (11.23)	<0.01	46 160 (20.84)	28 548 (13.29)	<0.01
Had at least 1 serum creatinine done	10 225 (34.57)	6929 (24.32)	<0.01	82 485 (22.67)	43 286 (12.77)	<0.01	53 883 (24.33)	33 181 (15.44)	<0.01
Had at least 1 HbA1C done	4098 (13.85)	2342 (8.22)	<0.01	60 505 (16.63)	30 050 (8.86)	<0.01	52 327 (23.62)	31 451 (14.64)	<0.01
In 90 d									
ED visit	725.7	578.0	<0.01	242.9	189.5	<0.01	299.5	242.2	<0.01
Hospitalization	332.8	290.8	<0.01	69.6	59.1	<0.01	79.4	70.8	<0.01
Death	27.7	31.6	<0.01	2.5	3.0	<0.01	4.5	5.5	<0.01
Any event	1086.2	900.4	<0.01	315.0	251.7	<0.01	383.3	318.5	<0.01
Had at least 1 electrolyte panel done	16 616 (56.17)	12 783 (44.87)	<0.01	132 407 (36.39)	80 847 (23.85)	<0.01	87 892 (39.68)	61 725 (28.73)	<0.01
Had at least 1 serum creatinine done	17 448 (58.99)	13 415 (47.09)	<0.01	149 167 (41.00)	92 786 (27.37)	<0.01	102 753 (46.39)	72 883 (33.92)	<0.01
Had at least 1 HbA1C done	8517 (28.79)	5794 (20.34)	<0.01	111 626 (30.68)	66 413 (19.59)	<0.01	108 844 (49.14)	74 919 (34.87)	<0.01

Data are reported as counts per 1000 visits. ED indicates emergency department; and HbA1C, glycosylated hemoglobin.

outpatient encounter, although the magnitudes were small (Table 2) and consistent with the increases we also saw in patients with other ACSCs and even in patients without ACSCs (Figures S2 and S3). For example, in the year before the pandemic, 91.1% of patients with HF saw a primary care physician at least once (median 6 visits), and 80.3% had at least 1 specialist visit (median 3 visits), compared with 93.5% (median 3 in-person and 3 virtual) and 79.1% (median 1 in-person and 1 virtual) during the first year of the pandemic (Table 2). Moreover, 97.9% received at least 1 prescription in 2019 to 2020, and the median number of prescriptions dispensed was 17, compared with 98.1% and 16 during the first year of the pandemic. However, laboratory testing frequency declined by 20% (serum creatinine within 90 days of visit) to 47% (glycosylated hemoglobin within 30 days of visit) in the first year of the pandemic (Table 2).

During the first year of the pandemic, outcomes were different after virtual visits compared with in-person visits (Table 3). For example, among patients with HF, ED visits, or hospitalizations were less common after virtual outpatient visits than after in-person visits: 139.0 versus 152.6 per 1000 visits (aHR, 0.90 [95% CI, 0.85–0.96]) at 30 days and 326.5 versus 334.3 per 1000 visits (aHR, 0.96 [95% CI, 0.92–1.00]) at 90 days. This included both fewer subsequent ED visits and fewer hospitalizations (Table 3). Our sensitivity analyses (1) restricted to patients with only 1 outpatient visit in each outcome timeframe or (2) examining total events or (3) using inverse probability treatment weights were almost identical to the primary analyses, confirming the robustness of our findings (Table S2). Of note, only 17.3% of patients with virtual outpatient visits also had an in-person visit within the subsequent 90-day outcome time frame. Patterns and magnitude of associations were similar for patients with all 3 cardiovascular conditions of interest (Table 3).

DISCUSSION

Our finding that during the first year of the pandemic patients with ACSCs, including those with the cardiovascular ACSC we examined, as well as patients without ACSCs, were less likely to present to an ED or a hospital, but were more likely to die, mirrors data from other jurisdictions.[2,13–17] All-cause mortality rates increased in just about every nation during the COVID-19 pandemic, with one-quarter to one-half of the excess all-cause deaths in North America not directly related to SARS-CoV-2 infection.[18–22] Similarly, our finding that outpatient care shifted from an almost exclusively in-person model prepandemic to a mixed model rapidly has been reported by others, although we were able to examine specialist follow-up and not just primary care visits, and for an entire province and not just individual

Table 3. Outcomes After Outpatient Visits Reported Per 1000 Visits During the First Year of the Pandemic

	In the subsequent 30 d			In the subsequent 90 d		
	ED visit	Hospitalization	ED visit or hospitalization	ED visit	Hospitalization	ED visit or hospitalization
Patients with heart failure						
Any physician in-person visit, reported per 1000 visits	198.8	104.5	152.6	590.9	297.0	334.3
Any physician virtual visit, reported per 1000 visits	183.2	94.1	139.0	557.2	280.8	326.5
Adjusted HR* (and 95%CI) for virtual vs in-person visits	0.95 (0.89–1.01)	0.91 (0.84–0.99)	0.90 (0.85–0.96)	0.98 (0.94–1.03)	0.96 (0.91–1.01)	0.96 (0.92–1.00)
Patients with hypertension						
Any physician in-person visit, reported per 1000 visits	68.5	21.1	53.5	196.4	59.2	125.6
Any physician virtual visit, reported per 1000 visits	59.3	19.8	47.1	177.5	58.9	118.5
Adjusted HR* (and 95%CI) for virtual vs in-person visits	0.91 (0.88–0.94)	0.93 (0.88–0.98)	0.88 (0.85–0.91)	0.94 (0.92–0.96)	0.97 (0.94–1.00)	0.93 (0.91–0.95)
Patients with diabetes						
Any physician in-person visit, reported per 1000 visits	88.3	25.1	64.1	252.4	71.6	150.8
Any physician virtual visit, reported per 1000 visits	75.1	23.2	58.0	224.1	69.4	142.3
Adjusted HR* (and 95%CI) for virtual vs in-person visits	0.93 (0.90–0.97)	0.91 (0.86–0.97)	0.90 (0.87–0.93)	0.95 (0.92–0.97)	0.95 (0.91–0.98)	0.93 (0.91–0.95)

Data are reported as counts per 1000 visits. ED indicates emergency department; and HR, hazard ratio.

*Survival analysis accounting for death as a competing risk, with exposure defined on the basis of first visit and adjusted for age, sex, Pampalon Deprivation Index, and Charlson score. Only 17.3% of patients with virtual visits also had an in-person visit within the specified time frames.

health maintenance organizations.[2–11] Our finding that outpatient encounter rates and prescriptions remained relatively stable after onset of the pandemic for patients with cardiovascular ACSCs is also consistent with the demonstration in another Canadian province[3] that outpatient visits declined least in 2020 among those with the highest health care needs. However, it should be noted that our findings were in the context of a health care system where virtual visits were strongly encouraged in lieu of in-person visits, and the government funder provided similar reimbursement rates for both during the pandemic. On the other hand, in countries where virtual visits were not as strongly encouraged, it is likely that encounter rates and prescriptions would decline: for example, in Italy, new prescriptions for direct oral anticoagulants fell by 21% and for sacubitril-valsartan by 40% in the first few months of the pandemic.[23,24] Our finding of marked declines in diagnostic test ordering practices for patients with cardiovascular ACSCs during the pandemic mirrors findings from a US academic health system that reported a two-thirds decline in the frequency with which 6 primary care screening quality measures were done in the early months of the pandemic and a persistent one-third lower rate even in the lull between the first and second waves.[25]

However, our findings of differences in short-term outcomes after virtual visits compared with in-person visits adds novel information to the debate about whether the 2 types of outpatient visits are interchangeable. Two earlier studies have also examined this issue; one[10] found that virtual visits for patients with a variety of cardiovascular diagnoses were associated with fewer ED visits and hospitalizations in the subsequent 30 days, but the other[11] reported higher 90-day rates of ED visits, hospitalization, or death for patients with HF after virtual visits compared with in-person visits. Both of those studies and ours can only demonstrate association and not causation, and without randomized trial evidence, it is impossible to declare one type of outpatient encounter superior to another. Several factors that may have influenced physician or patient decisions about type of outpatient follow-up could have led to outcome differences. For example, it is possible that virtual visits were done preferentially in sicker, frailer patients or those with more comorbidities because of concern that their risks from potential SARS-CoV-2 exposure were higher than for other patients (collider bias) or because they had more difficulty in physically attending clinics. Without access to testing data, we cannot tell how many of these patients were infected with SARS-CoV-2 and were thus being followed virtually for that reason. However, these factors would have biased our data in the opposite direction to what we found (ie, virtual visits would have been associated with higher event rates). Alternately, it is plausible that physicians chose to see sicker or frailer patients in person to see if they could stave off ED visits. Moreover, it is possible that patients who wanted virtual visits rather than in-person would be less willing to attend ED or be hospitalized subsequently. Both of these possibilities would have been biased toward higher event rates after in-person visits. Ultimately, to evaluate the impact of virtual care properly requires a randomized trial, which was not possible given the pandemic realities, and ideally a wider spectrum of outcomes, including patient- and provider-reported experience measures. Regardless, although our findings do raise questions about the equivalency of outpatient visit types that warrant further study, we believe our data at least provide reassurance that virtual visits do not appear to disadvantage patients with cardiovascular ACSCs.

Although this study includes data from an entire population in a universal access, government-funded health care system without user fees at the point of care, there are some limitations to our data. A limitation of our study is that we did not have access to medication dosing, which is important, because a recent study[11] reported that patients with HF were 61% less likely to have their antifailure therapy intensified after a virtual visit than an in-person visit. Other studies have reported that virtual visits were associated with far fewer assessments of blood pressure, cholesterol, or other screening diagnostic tests than in-person visits.[8–10] Thus, further research is needed to investigate whether the shift toward virtual outpatient care has negatively impacted medication intensification for chronic cardiovascular conditions. A second limitation is that without information on the content of the outpatient encounters we cannot assess the appropriateness, quality, or cost-effectiveness of virtual or in-person visits. This is an open question, because a US study of nearly 37 million individuals enrolled in private health plans reported that annual health care costs were 65% higher in people with at least 1 virtual visit in 2020 compared with those with only in-person ambulatory visits in 2020.[4] Third, although we adjusted for age, sex, and comorbidity burden, we cannot judge the acuity or severity of illness for patients seen virtually versus in person. Fourth, we do not know whether it was the physician or the patient who decided which visits should be virtual and which should be in person. Fifth, we do not know the extent to which changes in the availability of personal protective equipment or patient vaccination status may have altered the balance between virtual and in-person visits. Finally, the impact of virtual visits on continuity of care is also uncertain, an important factor to evaluate because patients who report higher care continuity, based on face-to-face encounters, exhibit greater satisfaction, better quality of care, better medication adherence, fewer ED visits, fewer hospitalizations, and fewer deaths.[26,27] There is emerging evidence that, despite being younger and having fewer comorbidities, patients interacting with stand-alone telemedicine clinics that do not offer ongoing care do exhibit >2-fold higher rates of subsequent ED visits compared with patients seen virtually by their regular primary care physician.[28]

In conclusion, our data provide reassurance that pandemic-induced increases in virtual outpatient care did not negatively impact frequency of follow-up, prescribing, or short-term outcomes for patients with HF, hypertension, or diabetes in a setting where there was an active reimbursement policy for virtual visits. It is unclear whether these findings are generalizable to other health care settings where virtual visits are not reimbursed or adequate infrastructure for virtual care does not exist. Whether long-term outcomes will be different as a result of the increase in virtual care is also unknown and certainly a possibility given declines in screening activities that we observed and data from other studies suggesting less medication intensification with virtual visits.[9,10] There is an urgent need for research to define which patients are most suitable for virtual outpatient follow-up and, as with all outpatient care, the optimal frequency of such visits.

ARTICLE INFORMATION

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None.

Supplemental Material

Table S1–S2
Figure S1–S3

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SUPPLEMENTAL MATERIAL

Table S1. List of case definitions for ambulatory care sensitive conditions

Defined by 1 hospitalization or 1 ED visit or 2 Practitioner Claims in the year of study period.

- **Chronic obstructive pulmonary diseases (COPD)**
  ICD-9-CM: 416, 490, 491, 492, 493, 494, 495, 496, 500, 501, 502, 503, 504, 505
  ICD-10-CA: J40, J41, J42, J43, J44, J45, J46, J47, J60, J61, J62, J63, J64, J65, J66, J67, I278, I279, J684, J701, J703
- **Asthma**
  ICD-9-CM: 493
  ICD-10-CA: J45
- **Diabetes Mellitus**
  ICD-10-CA: E100-E149
- **Epilepsy**
  ICD-9-CM: 345
  ICD-10-CA: G40, G41
- **Heart failure**
  ICD-9-CM: 428, 518
  ICD-10-CA: I50, J81
- **Hypertension**
  ICD-9-CM: 401, 402, 403, 404, 405
  ICD-10-CA: I10, I11, I12, I13, I15
- **Coronary Disease (Angina)**
  ICD-9-CM: 411, 413
  ICD-10-CA: I20, I23, I24

Table S2. Sensitivity analyses for the association between type of outpatient visit (reported per 1000 visits) and outcomes during the first year of the pandemic

	In the subsequent 30 days			In the subsequent 90 days		
	ED visit	**Hospitalization**	**ED visit or hospitalization**	**ED visit**	**Hospitalization**	**ED visit or hospitalization**
Patients with Heart Failure						
IPTW HR for virtual vs. in-person visits (exposure defined on basis of first visit*)	0.95 (0.90, 0.99)	0.91 (0.86, 0.96)	0.91 (0.87, 0.95)	0.98 (0.95, 1.01)	0.96 (0.92, 0.99)	0.97 (0.94, 0.99)
Adjusted HR[†] (sensitivity analysis restricted to only those patients with a single outpatient visit)	0.90 (0.73, 1.12)	0.90 (0.69, 1.18)	0.87 (0.70, 1.07)	1.08 (0.93, 1.24)	0.95 (0.80, 1.13)	1.03 (0.89, 1.18)
Adjusted HR (sensitivity analysis for total events, using zero-inflated Poisson regression and exposure defined on basis of first visit*)	0.97 (0.88, 1.06)	0.92 (0.76, 1.12)	N/A	0.93 (0.89, 0.97)	0.93 (0.85, 1.01)	N/A
Patients with Hypertension						
IPTW HR for virtual vs. in-person visits (exposure defined on basis of first visit*)	0.91 (0.89, 0.93)	0.93 (0.90, 0.97)	0.88 (0.87, 0.90)	0.94 (0.93, 0.96)	0.98 (0.96, 1.00)	0.94 (0.93, 0.95)
Adjusted HR[†] (sensitivity analysis restricted to only those patients with a single outpatient visit)	0.85 (0.76, 0.95)	0.93 (0.76, 1.12)	0.82 (0.73, 0.91)	0.95 (0.89, 1.01)	0.93 (0.83, 1.05)	0.93 (0.87, 0.99)

Adjusted HR (sensitivity analysis for total events, using zero-inflated Poisson regression and exposure defined on basis of first visit*)	0.89 (0.84, 0.93)	0.97 (0.86, 1.10)	N/A	0.91 (0.89, 0.94)	0.99 (0.94, 1.05)	N/A
Patients with Diabetes Mellitus						
IPTW HR for virtual vs. in-person visits (exposure defined on basis of first visit*)	0.93 (0.91, 0.96)	0.91 (0.87, 0.95)	0.90 (0.88, 0.92)	0.94 (0.93, 0.96)	0.95 (0.92, 0.97)	0.94 (0.92, 0.95)
Adjusted HR† (sensitivity analysis restricted to only those patients with a single outpatient visit)	0.91 (0.81, 1.02)	0.90 (0.74, 1.10)	0.88 (0.78, 0.98)	0.94 (0.88, 1.01)	0.88 (0.77, 1.00)	0.92 (0.85, 0.99)
Adjusted HR (sensitivity analysis for total events, using zero-inflated Poisson regression and exposure defined on basis of first visit*)	0.77 (0.73, 0.81)	0.91 (0.78, 1.06)	N/A	0.87 (0.85, 0.90)	0.96 (0.90, 1.03)	N/A

IPTW=inverse probability treatment weighted estimates, HR=hazard ratio

*Only 17.3% of patients with virtual visits also had an in-person visit within the specified timeframes

†Survival analysis accounting for death as a competing risk and adjusted for age, sex, Pampalon Deprivation Index, and Charlson score

Figure S1. Cohort creation in each study period

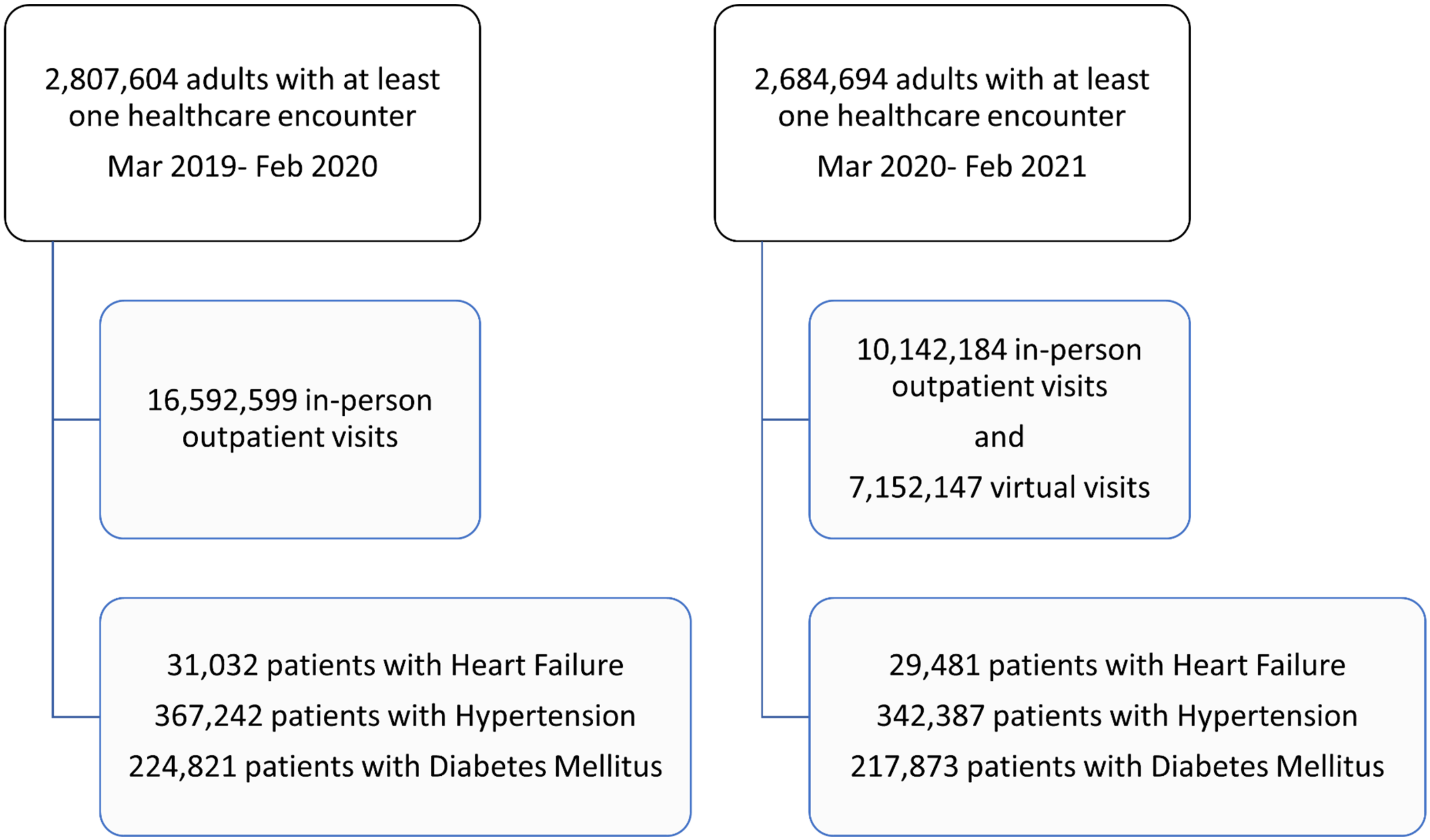

Figure S2. Outcomes within 30 days and 90 days after outpatient physician visits in the year before and the first year of the COVID-19 pandemic for patients with Ambulatory Care Sensitive Conditions, reported per thousand visits

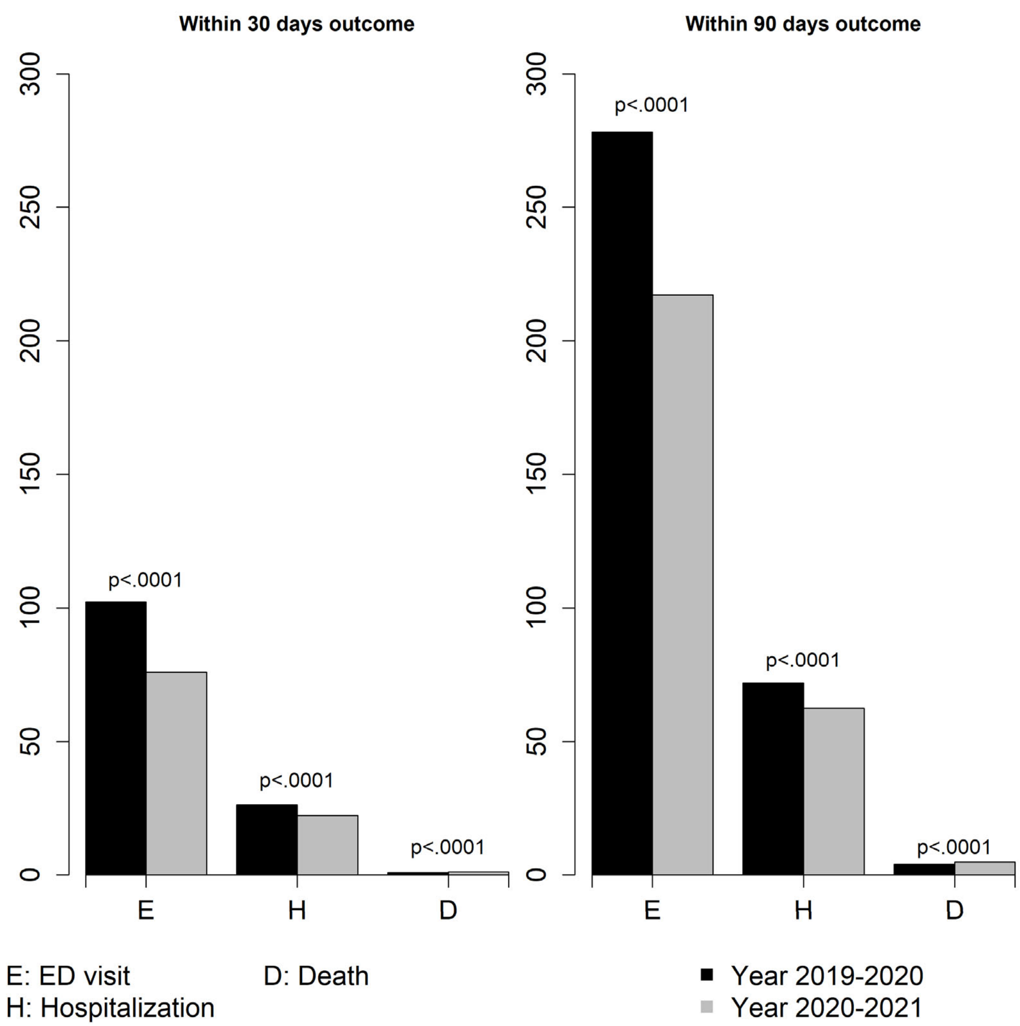

Figure S3. Outcomes within 30 days and 90 days after outpatient physician visits in the year before and the first year of the COVID-19 pandemic for patients without Ambulatory Care Sensitive Conditions, reported per thousand visits