Healthcare Utilization During the COVID-19 Pandemic and the Adoption of Telemedicine: Retrospective Study of Chronic Disease Cohorts

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Margrét Bjarnadóttir[1*] PhD; David Anderson[2*] PhD; Kelley Anderson[3] PhD, FNP; Omar Aljwfi[4] PhD; Alina Peluso[5] PhD; Adam Ghannoum[6]; Gayle Balba[7] MD; Nawar Shara[4] PhD

[1]Villanova University Philadelphia US
[2]School of Nursing, Georgetown University Washington US
[3]MedStar Health Research Institute Hyattsville US
[4]Advanced Computing for Health Sciences Section, Oak Ridge National Laboratory Oak Ridge US
[5]University of Maryland College Park College Park US
[6]Medstar Georgetown University Hospital Washington US
[*]these authors contributed equally

Corresponding Author:
Margrét Bjarnadóttir PhD

Abstract

Background: The COVID-19 pandemic accelerated telehealth adoption among patients with a range of disease types. For many patients, routine medical care was no longer an option, and others chose not to visit medical offices in order to minimize COVID-19 exposure. In this study we take a comprehensive multi-disease approach in studying the impact of COVID-19 on healthcare utilization and the supplementary role of telemedicine through the first 12 months of the COVID-19 pandemic.

Objective: We study the impact of COVID-19 on in-person healthcare utilization across chronic diseases and the supplementary role of telehealth. We aim to further understand differences in telehealth adoption across patient demographics.

Methods: We conduct a retrospective cohort study of six different disease cohorts (anxiety n=69,673, depression n=45,979, diabetes n=83,562, kidney failure n= 29,861, heath failure n=21,600 and cancer n=35,937). We use summary statistics to characterize changes in utilization and regression analysis to study how patient characteristics relate to in-person healthcare and telehealth utilization during the first 12 months of the pandemic.

Results: We observe a reduction in in-person healthcare utilization across disease cohorts. For most diseases we study, telehealth appointments make up for the reduction in in-person visits. Further, for anxiety and depression, the increase in telehealth utilization exceeds the reduction in in-person visits. We observe that younger patients, Black patients and patients from higher-income zip codes have higher telehealth utilization after accounting for other covariates.

Conclusions: The COVID-19 pandemic affected healthcare utilization across diseases, and the role of telehealth in replacing in-person visits varies by disease cohort. Understanding these differences can inform current practices and provides opportunities to further guide modalities of in-person and telehealth visits. Critically, further study is needed to understand barriers to telehealth service utilization for patients in lower-income areas. A better understanding of the role of social determinants of health may lead to more support for patients and help individual healthcare providers improve access to care for patients with chronic conditions.

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Abstract

Background: The COVID-19 pandemic accelerated telehealth adoption across patients disease cohorts. For many patients, routine medical care was no longer an option, and others chose not to visit medical offices in order to minimize COVID-19 exposure. In this study we take a comprehensive multi-disease approach in studying the impact of COVID-19 on healthcare utilization and the adoption of telemedicine through the first 12 months of the COVID-19 pandemic.

Objective: We study the impact of COVID-19 on in-person healthcare utilization and telehealth adoption across chronic diseases to understand differences in telehealth adoption across disease cohorts and patient demographics (such as the Social Vulnerability Index (SVI)).

Methods: We conduct a retrospective cohort study of six different disease cohorts (anxiety n=67,578, depression n=45,570, diabetes n=81,885, kidney failure n= 29,284, heart failure n=21,152 and cancer n=35,460). We use summary statistics to characterize changes in utilization and regression analysis to study how patient characteristics relate to in-person healthcare and telehealth adoption and utilization during the first 12 months of the pandemic.

Results: We observe a reduction in in-person healthcare utilization across disease cohorts (ranging from 10-24%). For most diseases we study, telehealth appointments offset the reduction in in-person visits. Further, for anxiety and depression, the increase in telehealth utilization exceeds the reduction in in-person visits (by up to 5%). We observe that younger patients and men, have higher telehealth utilization after accounting for other covariates. Patients from higher SVI areas are less likely to utilize telehealth, however if they do, they have a higher number of telehealth visits, after accounting for other covariates.

Conclusions: The COVID-19 pandemic affected healthcare utilization across diseases, and the role of telehealth in replacing in-person visits varies by disease cohort. Understanding these differences can inform current practices and provides opportunities to further guide modalities of in-person and telehealth visits. Critically, further study is needed to understand barriers to telehealth service utilization for patients in higher SVI areas. A better understanding of the role of social determinants of health may lead to more support for patients and help individual healthcare providers improve access to care for patients with chronic conditions.

Keywords: telehealth utilization, healthcare utilization, demographic differences, cohort study.

Introduction

The COVID-19 pandemic exerted both direct and indirect impacts on individual health and well-being. Prior to March 2020, routine clinic visits were performed as preventative measures to identify conditions that may result in severe diseases and as a component of chronic condition management. When COVID-19 lockdowns were instituted across the United States, many clinical offices and laboratories closed. Routine medical care was no longer an option for many patients, and in other cases patients chose not to visit medical offices in order to minimize COVID-19 exposure.

Across studies, the median reduction in healthcare utilization during the pandemic (across visits, admissions, diagnostics and therapeutics) was 37%, with healthier individuals being more likely to reduce their use of healthcare services [1]. Many chronic disease patients experienced detrimental effects: the literature documents a significant decrease in the treatment and detection of chronic disease [2,3], as well as adverse effects on chronic disease management as patients reduced their utilization and experienced barriers in access to care. For example, New York City witnessed a 139% increase in deaths related to heart disease during the pandemic [4]. Experts attribute this increase in mortality to a decrease in diagnostic procedures as patients were unable to access facilities and as those facilities experienced an overwhelming influx of COVID-19 patients. Cancer rates also increased during the pandemic. For instance, due to COVID-19 lockdowns, routine breast cancer screening was suspended throughout 2020, and it is anticipated that this delay in detection will lead to an estimated 7.9–9.6% short-term increase in deaths due to breast cancer [5].

Beyond the numerous studies that have evaluated healthcare outcomes, there is a growing body of studies about healthcare resource utilization during and post-pandemic [6-8] and about the widespread adoption of telehealth. Telehealth, i.e., the use of audio and video consultations, is time efficient, socially distanced, and low-cost [8]. Therefore, unsurprisingly, the use of telehealth surged during the pandemic, as many of the barriers to its adoption were removed to support clinical care [9]. Telehealth was utilized by patients who were immunocompromised and by others wary of possible COVID-19 infection or affected by lockdowns [9].

While telemedicine consultations are not suitable for all patients, the pandemic has permanently changed telemedicine utilization patterns, and the use of telemedicine may well become a new standard of care, although patient and healthcare providers satisfaction and views are mixed [11-16]. Therefore, disparities in the adoption of telehealth are an important consideration. Such disparities have been documented in a number of studies, which show that overall, there is less adoption among older patients [17,18], patients of lower socioeconomic status [17-21], minorities [18,20,21] and men [19,20]. These disparities are driven by lack of access to the necessary technology, particularly for patients of lower socioeconomic status and older patients [19].

In this study we take a comprehensive approach to study healthcare utilization and the adoption of telemedicine through the first 12 months of the COVID-19 pandemic. We selected conditions that are common with high healthcare utilization in the categories of mental health (depression and anxiety), cardiovascular disease (heart failure), cancer, renal disease (kidney failure), and endocrine disorder (diabetes)[22-24]. We also evaluated the impact of specific social determinants of health indicators on healthcare utilization in general and telehealth adoption in particular. Importantly, this study allows us to compare the utilization and adoption of telehealth across chronic disease cohorts in the context of healthcare disparities. We aim to contribute to our understanding of how various patient populations utilized telemedicine during the pandemic which can inform improved access to care for vulnerable groups.

Methods

Cohort definition

Information about diagnosis and utilization was extracted from the electronic health records (EHR) of a regional healthcare system serving Virginia, Maryland and the District of Columbia. For each of our study diseases (anxiety, depression, diabetes, kidney failure, heart failure, and cancer), we defined a disease cohort of patients to include any patient diagnosed with the disease before October 2019. The corresponding ICD-9 and ICD-10 codes are provided in the Supplement Section A. Since a single patient suffering from multiple chronic diseases may be in more than one disease cohort, we conducted a robustness check that independently repeated the analysis only on those members who are in a single disease cohort. The results are materially the same and are included in the Supplement Section B.

We then evaluated members' healthcare utilization in the six months prior to the pandemic lockdowns, from October 2019 through March 2020. We next compared utilization in this period to utilization during a 12-month pandemic period, from June 2020 through May 2021. Note that we excluded April and May 2020 from the study, as healthcare services in the system under study were significantly disrupted during that period.

Demographic, socioeconomic and clinical variables

We extracted each patient's age, gender, race and county from the EHR data. For gender, due to low numbers in the non-binary and not reported categories, we grouped all patients in those categories together. Similarly, and also due to low numbers, we grouped together all patients not identified as Black or White. We extracted the FIPS county-level Social Vulnerability Index (SVI) from the CDC [24] and matched it with the patient's zip code. Finally, we calculated each member's Charlson comorbidity index, based on the patient's visits from January 2018 to the end of the pre-pandemic period. As we are explicitly using age in our models, the age-free version was calculated [25].

Utilization

Before the pandemic telehealth services were available, primarily through an eVisit app. Telehealth services were available across various ambulatory sites, offering options such as video visits, audio-only phone visits and eConsults. Despite the availability, utilization remained modest. With the pandemic onset there was a significant surge in telehealth demand, peaking at over 400 visits daily. In response, strategic adaptations were made, including temporarily waiving patient fees until June 30, 2021. In this study we define a telehealth visit as both video and audio visits. We defined in-person utilization as the number of inpatient, outpatient and emergency department visits in a given period, for any reason (not disease-specific).
We then defined overall utilization as the sum of in-person utilization and the number of telehealth visits.

Statistical analysis

We conducted a longitudinal cohort study comparing utilization using summary statistics and regression analysis. First, for each disease we compared the in-person and overall utilization in the pre-pandemic period to utilization during the pandemic time period (broken into two six-month subperiods to highlight temporal patterns).

Then, for each disease, we constructed a regression model that explains the number of pandemic period in-person visits as a function of the utilization in the pre-pandemic period and patients' demographic, socioeconomic and clinical characteristics. Because the distribution of in-person visits is left-skewed, we transformed the dependent variable to ensure statistical fit. Specifically, we fit a regression model with the natural logarithm of the pandemic period in-person visits as the dependent variable and in-person visits in the pre-pandemic period, Charlson Index score, race, age, gender and county average SVI as the independent variables.

Finally, we ran a regression model on the number of telehealth visits. Since only one-third of patients have a telehealth visit in their data, we fit a zero-inflated negative binomial regression model. The zero-inflated model is a two-step regression model, and in the first step a logistic regression model is fit to explain which patients have no telehealth appointment. In the second step, for the patients who have a telehealth appointment, a negative binomial regression model is fit (to best fit the distribution in the number of telehealth visits). We use the same independent variables: in-person visits in the pre-pandemic period, Charlson Index score, race, age, gender and county average SVI. We finally highlight the adoption patterns of telehealth, broken down by race and SVI.

Results

Cohort characteristics

Table 1 summarizes the cohort characteristics for the different disease groups. The average age is lowest for the anxiety and depression cohorts and highest for those suffering from kidney failure and heart failure. Interestingly, while men constitute almost half the kidney failure and heart failure cohorts, they constitute close to 45% of patients with cancer and diabetes and close to 30% of those with anxiety and depression. We also observe variation by race: White patients are the majority in the anxiety, depression and cancer cohorts, while Black patients are the majority in the diabetes, kidney failure and heart failure cohorts. These differences reflect both expected variation by disease (i.e., typically older patients have kidney and heart failure) and the demographics served by the healthcare system we study. Across disease cohorts, between 22% and 33% of patients live in counties with high SVI. The highest percentage of patients living in high SVI counties are patients in the diabetes, kidney failure and heart failure cohorts. Between 24% and 32% of patients live in counties with low SVI.

Table 1: Summary statistics for the six disease cohorts.

		Anxiety	Depression	Diabetes	Kidney failure	Heart failure	Cancer
	Cohort size	67,578	45,570	81,885	29,284	21,152	35,460
	Age	51.9	54.4	65.5	70.9	71.3	68.2
	Charlson Index[a]	1.00	1.28	2.37	2.63	3.54	3.48
Gender	% female	70.7%	69.7%	54.9%	48.9%	50.3%	55.1%
	% male	29.2%	30.3%	45.1%	51.1%	49.7%	44.9%
	% other	0.01%	0.01%	0.004%			
Race	% Black	30.3%	35.0%	53.4%	58.2%	54.3%	35.3%
	% Other	8.1%	7.3%	9.0%	6.8%	4.9%	9.2%
	% White	61.6%	57.6%	37.6%	35.1%	40.8%	55.5%
SVI	% high	21.6%	24.4%	33.1%	32.2%	32.6%	22.1%
	% medium	46.2%	47.0%	41.0%	43.4%	42.7%	45.8%
	% low	31.3%	27.9%	25.2%	23.7%	23.9%	31.5%
	% unknown	0.8%	0.7%	0.7%	0.7%	0.8%	0.7%
# of visits[b]	Pre-COVID	4.3	4.7	4.5	5.9	6.2	5.4
	During COVID	3.8	4.0	4.0	4.8	4.8	4.3

% any telehealth[c]	35.0%	33.4%	30.3%	31.1%	27.7 %	32.1 %

[a] Without age.
[b] Average number of visits in a six-month period.
[c] In the pandemic period.

Overall utilization

Figure 1 (a) summarizes the in-person healthcare utilization for the different disease cohorts. In order to capture temporal patterns, we break the 12-month pandemic period into two six-month subperiods, (with June 2020 through November 2020 as pandemic subperiod 1 and December 2020 through May 2021 as pandemic subperiod 2). We note that in-person utilization decreased from the pre-pandemic period for every disease cohort. The reduction was the greatest for cancer (-18% and -22% in pandemic subperiods 1 and 2, respectively), heart failure (-20% and -24%) and kidney failure (-18% and -19%). Smaller decreases are seen for anxiety, depression and diabetes. We then compare Figure 1 (a) with Figure 1 (b), which shows the overall utilization. We observe that during the pandemic period, the number of telehealth visits exceeds the reduction in in-person visits for both depression and anxiety; we see an increase in overall utilization for these disease cohorts during this period. We also note that for the diabetes cohort, the number of telehealth visits almost equals the decrease in in-person visits. However, for the cancer, heart failure and kidney failure cohorts, there remains a significant reduction in the total number of visits.

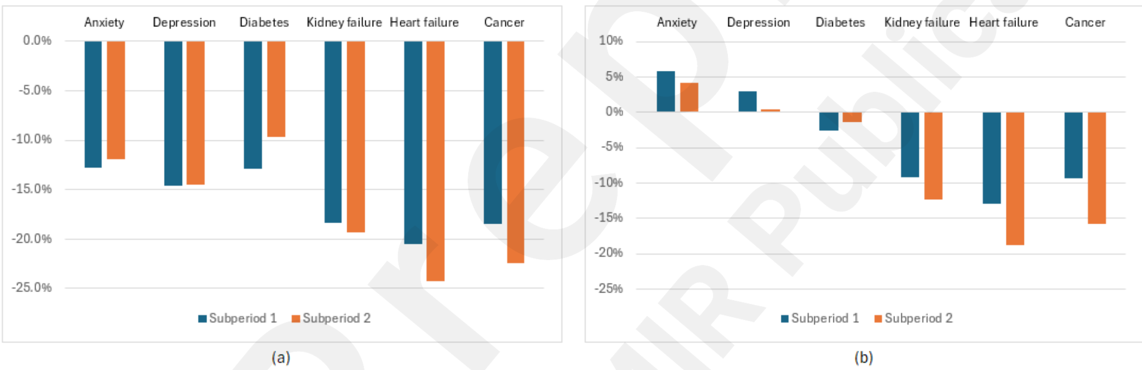

Figure 1: The percent difference in in-person visits (a) and overall utilization (b) during the 12-month pandemic period from June 2020 through November 2020 (Subperiod 1) and December 2021 to May 2021 (Subperiod 2) for the six disease cohorts.

In-person visits

We run a linear regression model for each disease group for the number of visits in the pandemic period. Recall that the dependent variable was the natural logarithm of the number of in-person visits; therefore, we exponentiate the regression coefficients and interpret the coefficients as multiplicative.

The results are summarized in Table 2 below. We note that across disease groups, the higher the number of pre-period visits, the higher the expected number of pandemic period visits. We then observe that both White and, to a larger extent, Other race patients have on average fewer in-person encounters than Black patients, after accounting for all other variables in the model. (Compared to similar Black patients, White patients have 1.8-9.8% fewer visits and Other race patients had 14.2-19.7% fewer visits). For all diseases except heart failure, the Charlson Index is negatively associated with number of visits, indicating that, all else being equal, sicker patients have fewer visits. While the impact of age is statistically significant across diseases, the directionality of the impact differs by disease. Age is negatively associated with the number of visits for both heart and kidney failure patients, has a small association with the number of visits for diabetic and cancer patients, but is positively associated with the number of visits for anxiety and depression. Across diseases, men have on average fewer visits than women (holding everything else constant, estimates range from -5.6% for heart failure to -13.9% and -15.8% for depression and anxiety, respectively). Finally, across most diseases and holding everything else constant, patients from high and medium SVI counties have more visits on average than patients from counties with the lowest SVI (The exception are patients from high SVI counties in the anxiety cohort, where the association is not statistically significant.)

Table 2: In-person regression results by disease cohort ; for each disease cohort the dependent variable is the natural logarithm of the number of in-person visits during the 12-month pandemic period, June 2020 to May 2021.[a]

		Anxiety	Depression	Diabetes	Kidney failure	Heart failure	Cancer
	Intercept	1.12 (<0.001)	1.14 (<0.001)	1.37 (<0.001)	1.78 (<0.001)	1.84 (<0.001)	1.38 (<0.001)
	Pre-COVID visits	0.08 (<0.001)	0.08 (<0.001)	0.08 (<0.001)	0.06 (<0.001)	0.07 (<0.001)	0.07 (<0.001)
	Charlson Index	-0.01 (<0.001)	-0.02 (<0.001)	-0.02 (<0.001)	-0.03 (<0.001)	-0.03 (<0.001)	-0.03 (<0.001)
	Age	0.005 (<0.001)	0.004 (<0.001)	0.0004 (0.14)	-0.004 (<0.001)	-0.01 (<0.001)	0.001 (0.002)
Gender	Male	-0.16 (<0.001)	-0.14 (<0.001)	-0.10 (<0.001)	-0.08 (<0.001)	-0.06 (<0.001)	-0.10 (<0.001)
	Unknown	0.27 (0.47)	0.05 (0.89)	-0.34 (0.52)			
Race	Other	-0.15 (<0.001)	-0.17 (<0.001)	-0.16 (<0.001)	-0.16 (<0.001)	-0.17 (<0.001)	-0.22 (<0.001)
	White	-0.07 (<0.001)	-0.07 (<0.001)	-0.03 (<0.001)	-0.05 (0)	-0.02 (0.3)	-0.1 (<0.001)
SVI	High	-0.002 (0.82)	0.02 (0.09)	0.03 (0.004)	0.02 (0.16)	0.01 (0.49)	0.07 (<0.001)
	Medium	0.05 (<0.001)	0.07 (<0.001)	0.1 (<0.001)	0.09 (<0.001)	0.1 (<0.001)	0.13 (<0.001)
	Missing	-0.01 (0.88)	-0.05 (0.31)	-0.09 (0.03)	-0.05 (0.52)	-0.01 (0.95)	-0.02 (0.77)

[a] *P-values* reported in parentheses.

Use of telehealth

We study two aspects of telehealth utilization: first the percent of patients utilizing telehealth, and second the average number of telehealth visits for those patients that have at least one telehealth visit. In Figure 2 we break down the utilization by race and SVI.

The highest rate of telehealth adoption (any usage) is by the anxiety and depression cohorts. We note that Other race patients are most likely to have at least one telehealth visit for both conditions (Fig. 2(a)), however amongst patients who utilize telehealth, Black patients have a higher average number of visits (Fig. 2(b)). For kidney failure, heart failure, and cancer, while the rate of any telehealth usage by White patients is moderately lower than for Black patients, the average number of visits for those patients who do use telehealth are similar.

When telehealth utilization for anxiety and depression is broken down by SVI, we note a more nuanced pattern. SVI does not appear to be associated with whether or not members in the Anxiety cohort utilize telehealth (Fig. 2(c)), but among those who do, those with the lowest SVI have the lowest number of visits (Fig. 2(d)). For depression we also note that patients from low SVI areas have significantly fewer telehealth visits on average. Across all disease cohorts except anxiety, patients from low SVI areas are more likely to utilize telehealth, followed by patients from medium and then high SVI areas (Fig. 2(c)). However, except for anxiety and depression the differences in number of telehealth visits for patients that utilize telehealth are generally small.

Figure 2: The percent of patients that have at least one telehealth visit (left) and the average number of telehealth visits for patients with at least one visit (right) during the 12-month pandemic period, broken down by race (top) and SVI group (bottom).

To quantify these relationships, and account for the many other factors that may affect utilization, we next regress the number of telehealth visits in the pandemic period on the independent variables. Table 3 summarizes the results by disease group. For each disease group there are two regression coefficients. The first corresponds to the logistic regression model that explains which members do not have a telehealth visit. The second coefficient is associated with the negative binomial regression model that explains the number of visits.

We note that the more in-person pre-COVID visits a patient had, the less likely they are to have a telehealth visit (holding everything else constant). On average, for each additional in-person visit in the pre-COVID period, the odds of not having a telehealth visit increases by 31.0% and 29.7% for anxiety and depression, respectively. We further note that across diseases, for those utilizing telehealth, a higher number of pre-COVID in-person visits is associated with fewer telehealth visits during the pandemic period.

Similarly, we note that the higher the Charlson Index, the less likely the patient is to utilize telehealth during COVID period. However, while for kidney failure and heart failure, a higher Charlson Index is associated with a higher number of telehealth visits, for other disease groups, it is negatively associated with the number of visits.

Across disease groups, older patients are more likely to utilize telehealth, and for patients that do utilize telehealth older patients typically have a higher number of visits (holding everything else constant). Male patients are similarly more likely to utilize telehealth and have a higher number of telehealth compared to female patients (holding everything else constant).

For anxiety, Black patients are less likely to utilize telehealth compared to White patients, for diabetes, kidney failure and heart failure this is reversed, Black patients in these cohorts are more likely to have at least one telehealth appointment compared to white patients (holding everything else constant). Across diseases, among those who utilize telehealth, White patients have a higher number of visits on average, holding everything else constant.

Finally, there is a diverging relationship between SVI group and telehealth utilization. Patients from high SVI counties are less likely to utilize telehealth across all disease cohorts (except for kidney failure). However, among patients that do utilize telehealth, patients from high-SVI counties have a higher number of telehealth visits on average compared to than patients from low-SVI counties (everything else being the same).

Table 3: Telehealth regression results for the six disease cohorts; For each disease group a zero inflated negative binomial regression model is run; the first column corresponds to a logistic regression model that explains which members do not have a telehealth visit in the 12-month pandemic period, the second column reflects the results from a negative binomial regression model that explains the number of visits in the same period. [a]

		Anxiety		Depression		Diabetes		Kidney failure		Heart Failure		Cancer	
	Variable	No visits	How many	No visits	How many	No visits	How many	No visits	How many	No visits	How many	No visits	How many
	Intercept	1.9 (<0.001)	0.7 (<0.001)	1.96 (<0.001)	0.79 (<0.001)	1.51 (<0.001)	0.15 (<0.001)	1.84 (<0.001)	-0.48 (<0.001)	1.34 (<0.001)	-0.25 (0.01)	0.85 (<0.001)	-0.29 (<0.001)
	Pre-COVID visits	0.27 (<0.001)	-2.28 (<0.001)	0.26 (<0.001)	-2.33 (<0.001)	0.17 (<0.001)	-2.43 (<0.001)	0.14 (<0.001)	-2.28 (<0.001)	0.15 (<0.001)	-2.67 (<0.001)	0.15 (<0.001)	-1.73 (<0.001)
	Charlson Index	0.03 (<0.001)	-0.02 (<0.001)	0.0003 (0.91)	-0.01 (0.04)	0.09 (<0.001)	-0.001 (0.77)	0.06 (<0.001)	0.05 (<0.001)	0.07 (<0.001)	0.02 (0.003)	0.11 (<0.001)	-0.01 (0.01)
	Age	-0.01 (<0.001)	0.0004 (0.39)	-0.01 (<0.001)	-0.001 (0.37)	-0.01 (<0.001)	0.01 (<0.001)	-0.01 (<0.001)	0.02 (<0.001)	-0.01 (<0.001)	0.02 (<0.001)	-0.01 (<0.001)	0.01 (<0.001)
Gender	Male	-0.002 (0.76)	0.26 (<0.001)	0.001 (0.89)	0.3 (<0.001)	-0.2 (<0.001)	0.12 (<0.001)	-0.11 (<0.001)	0.1 (<0.001)	-0.16 (<0.001)	0.1 (0.002)	-0.07 (<0.001)	0.09 (<0.001)
	Unknown	-1.48 (0.03)	-1.86 (0.49)	-1.27 (0.01)	-5.12 (0.80)	-0.72 (0.42)	-0.17 (0.91)						
Race	Other	-0.1 (<0.001)	-0.09 (0.01)	-0.09 (<0.001)	-0.09 (0.03)	-0.06 (<0.001)	0.03 (0.37)	0.12 (<0.001)	0.01 (0.83)	-0.14 (0.002)	0.01 (0.95)	-0.16 (<0.001)	0.01 (0.77)
	White	-0.09 (<0.001)	0.03 (0.10)	0.01 (0.33)	0.05 (0.04)	0.03 (0.01)	0.02 (0.36)	0.12 (<0.001)	0.23 (<0.001)	0.07 (<0.001)	0.13 (<0.001)	-0.003 (0.84)	0.02 (0.42)
SVI	Low	-0.47 (<0.001)	-0.29 (<0.001)	-0.47 (<0.001)	-0.23 (<0.001)	-0.14 (<0.001)	-0.41 (<0.001)	0.07 (<0.001)	-0.3 (<0.001)	-0.12 (<0.001)	-0.5 (<0.001)	-0.08 (<0.001)	-0.07 (0.001)
	Medium	-0.004 (0.64)	-0.14 (<0.001)	-0.06 (<0.001)	-0.17 (<0.001)	0.05 (<0.001)	-0.16 (<0.001)	0.05 (<0.001)	-0.19 (<0.001)	0.03 (0.19)	-0.19 (<0.001)	0.11 (<0.001)	-0.27 (0.03)
	Missing	-0.1 (0.01)	0.04 (0.71)	0.22 (<0.001)	0.23 (0.07)	0.07 (0.26)	0.29 (0.01)	-0.002 (0.98)	0.33 (0.07)	0.2 (0.04)	0.14 (0.48)	-0.31 (0.002)	-0.01 (0.12)

[a] *P-values* reported in parentheses below each regression coefficient.

Discussion

This study compares the impact of COVID-19 on healthcare utilization across multiple disease cohorts. We found that, as reported in previous studies, in-person visits decreased across all disease cohorts. The largest decreases in in-person visits were observed among patients with cancer, heart failure and kidney failure. There are a number of possible reasons for this, including fear of COVID-19 infection, as all of these diseases are risk factors for COVID-19 complications, and age, as the average age was also the highest in these cohorts [27]. Across diseases, we found that the higher the pre-COVID healthcare utilization, the higher the in-person utilization in the pandemic period, and the lower the odds of utilizing telehealth. Interestingly, conditioned on a person utilizing telehealth, the higher the pre-COVID utilization, the lower the number of pandemic period telehealth appointments, perhaps indicating that sicker patients were being routed to in-person visits.

Telehealth utilization for some disease cohorts was equivalent to the reduction in in-person visits. In the two mental health cohorts we studied, the number of telehealth visits exceeded the reduction of in-person visits, leading to an increase in overall healthcare utilization for both anxiety and depression. In contrast to the other diseases we studied, depression and anxiety may be treated and managed without physical examination [28,29], and therefore these findings are not surprising. Our finding that telehealth adoption is concurrent with the decrease in in-person mental health appointments is congruent with other recent studies [30,31]. There are additional possible explanations for the increase in utilization among the anxiety and depression cohorts, including the impact of the COVID-19 pandemic on mental health.

During the pandemic, telehealth provided access to care and may have supplemented in-person visits to varying degrees. Therefore it is critical that this mode of healthcare delivery does not introduce new disparities or exacerbate pre-existing ones. When studying the impact of patients' demographic characteristics association with telehealth utilization we find that women (except for anxiety and depression) and younger patients were less likely to utilize telehealth, consistent with previous publications [16-19]. In contrast to earlier works, we do not find consistent differences between telehealth adoption of Black and White patients after accounting for all other covariates. However, conditioned on that patients use telehealth, and accounting for all other factors, White patients have more visits on average (compared to Black patients). This is in contrast with the average numbers presented in Figure 2, highlighting the importance of accounting for the many factors influencing telehealth adoption with regression modeling.

The observed relationship between SVI and telehealth usage patterns offers nuanced understanding of telehealth adoption across SVI areas. Across disease groups, patients from low SVI counties are more likely to use telehealth, but for fewer visits on average. On the other hand, patients from high SVI counties are less likely to utilize telehealth, but if they do, they utilize telehealth more on average. Understanding barriers to telehealth adoption, including inadequate connectivity, lack of privacy and other hidden barriers, is therefore especially important as telehealth visits may become a standard of care.

Telemedicine can facilitate effective communication between patients and healthcare workers. However, some patients find it difficult to adapt to telehealth communication. Additionally, a number of older patients who are not as familiar with telehealth communication reported a relative lack of an emotional connection with the healthcare worker compared to in-person visits [31]. Telehealth consultations have been found to be more effective in primary care appointments and mental health consultations than they are for patients with high-risk conditions, based on both patient feedback and staff evaluations [8]. Our results reflect previous observations in which telehealth visits did not compensate for decreased in-person visits for patients with cancer, heart failure or kidney failure, who experienced the greatest pandemic-related decrease in visits. As patients with these diagnoses require frequent visits to ensure stabilization of these chronic conditions, further research is needed to understand these differences. Our study also indicates that sicker patients (as captured by the Charlson index, and accounting for all other covariates) are less likely to utilize telehealth, and if they do they have lower number of telehealth visits on average, except for patients in the heart failure and kidney failure groups. Further study is needed to understand the nuances behind these utilization patterns.

This study has several limitations. In only rare cases did we observe death of patients in our study population, so we cannot confirm whether some of the reduction in visits is due to mortality in our disease cohorts. We note that cancer, heart failure and kidney failure were the three disease cohorts with the largest reduction in visits in the second pandemic subperiod, and this may reflect higher mortality rates in these cohorts. We also note that we do not observe patient healthcare encounters outside the regional health system. Therefore, the extent to which patients moved away or sought services elsewhere is not captured. Finally, since our cohort has limited geographical scope, the results may not generalize beyond the regional service area.

In summary, this study offers a unique comparison across disease cohorts from the same health system. In doing so, we highlight that many of the previously observed demographic differences consistently hold across disease cohorts. The study further takes a detailed analytical approach to study telehealth adoption, highlighting that while adoption is lower for high SVI areas, once telehealth is adopted by high SVI patients' telehealth usage exceeds that of other patients.

Conclusion

The COVID-19 pandemic has affected healthcare utilization across multiple disease conditions. The impacts of the pandemic on healthcare utilization and the role of telehealth in replacing in-person visits vary among different disease cohorts. Understanding these differences can inform current practices and provides opportunities to further guide modalities of in-person and telehealth visits. Critically, further study is needed to ensure that all patients have equal access to telehealth services. A better understanding of the role of social determinants of health may lead to more support for patients and help individual healthcare providers improve access to care for patients with chronic conditions.

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Ethical statement

The original data collection and the study protocol was reviewed by the IRB review board of Georgetown-Howard Universities Center for Clinical and Translational Science(approval ID: STUDY00003813). The analysis followed the approved protocol and the authors therefore had the permission to use the data for this study.

Data availability

The data sets generated for and analyzed during this study are not publicly available due the approved study protocol restrictions and patient privacy considerations. The data can be made available following a study protocol review and an appropriate IRB approval.

Conflicts of Interest

The authors have no conflicts of interest to report.

Other declarations

Generative AI (including ChatGPT) was not used at any point in the development of the manuscript.

Abbreviations

FIPS: Federal Information Processing Standards
EHR: Electronic Health Record
ICD-9: International Classification of Diseases, Ninth Revision
ICD-10: International Classification of Diseases, Tenth Revision
SVI: Social Vulnerability Index

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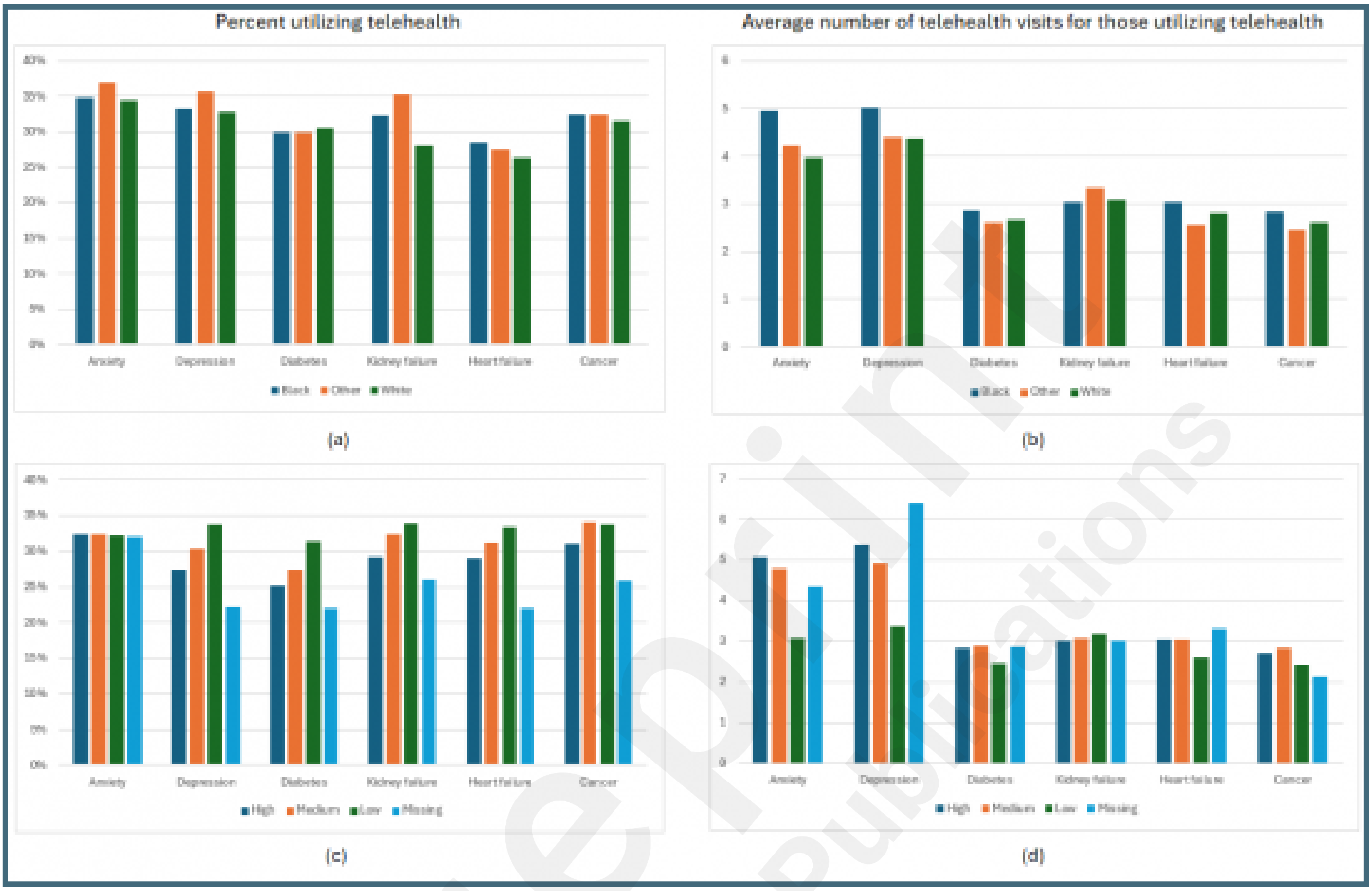
Supplementary Files

Figures

The percent difference in in-person visits (a) and overall utilization (b) during the 12-month pandemic period from June 2020 through November 2020 (Subperiod 1) and December 2021 to May 2021 (Subperiod 2) for the six disease cohorts.

The percent of patients that have at least one telehealth visit (left) and the average number of telehealth visits for patients with at least one visit (right) during the 12-month pandemic period, broken down by race (top) and SVI group (bottom).



Multimedia Appendixes

Supplementary material.
URL: http://asset.jmir.pub/assets/df6895310085ff03e574854774fcc628.pdf