Disruptions to Outpatient Care and Adverse Health Events: Evidence from Medicaid Patients with Chronic Diseases

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Abstract

Disruptions in access to health care during the start of the COVID-19 pandemic make it possible to test whether a large negative shock to outpatient services leads to adverse downstream health events for those with chronic diseases. We investigate this issue using a cross-cohort analysis focusing on non-elderly adult Medicaid beneficiaries in Wisconsin with previously diagnosed chronic diseases. From March to May 2020 there were sharp reductions in outpatient service utilization and chronic disease monitoring for this population. Total outpatient visits returned to normal rates by summer 2020, but with a shift toward telehealth visits. These outpatient service disruptions were not followed by a rise in adverse events: inpatient and emergency department services for preventable chronic disease exacerbations were broadly similar, and in some cases somewhat lower, for the 2020 cohort over a two-year period relative to prior cohorts. These findings suggest that despite disruptions to outpatient health care, beneficiaries with chronic diseases did not experience deteriorations in health that led to downstream health events requiring emergency visits and hospitalizations. We also saw no rise in all-cause mortality rates for this population, apart from periods corresponding with peak COVID infection, suggesting that disruptions in access to hospital services during the peak of COVID-19 hospitalizations late in 2021 may have led to an increase in mortality for this population.

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1. Introduction

Understanding how access to health care services impacts health has major implications for policymakers seeking to address the rapid growth in health care costs. For example, the value of increased access to preventative care, value-based insurance designs that subsidize the management of chronic disease management, and the net cost of insurance expansions all depend on what patients gain from additional care and miss when they cannot access it.

The onset of the COVID-19 pandemic generated a natural experiment for evaluating the effects of health care disruptions on health outcomes. Beginning in March 2020, the pandemic and the associated public health emergency brought a wide-scale shut down of public accommodations and services. The disruptions to health care access, especially early in the pandemic, led many to fear there would be a wave of adverse downstream consequences, especially for those with chronic diseases (e.g., Lim et al., 2020). However, cross-geographic evidence has demonstrated that higher utilization of health care services is not universally associated with improved outcomes (see Fisher et al., 2003 for a brief review), and some believe that there is opportunity to reduce medical care utilization in the U.S. without adverse consequences (e.g., Berwick and Hackbarth, 2012, Schwarz et al., 2014, Schrank et al., 2019, Moynihan et al., 2020).

We investigate the immediate impact of the COVID-19 pandemic on outpatient utilization and track downstream changes in emergency and inpatient services for a period of two years for a potentially vulnerable group -- low-income Medicaid members with previously diagnosed chronic conditions. We analyze patterns of health services from the Wisconsin Medicaid program, known as BadgerCare. We study the universe of non-elderly, non-disabled adults enrolled in Medicaid as of February 2020 and compare their use of medical services over time to prior cohorts of those enrolled in February 2019 and 2018. Among these non-elderly adult enrollees, we focus on those who had a diagnosis for a chronic disease at some point during the prior year, which includes over 122,000 beneficiaries in each cohort. We examine the extent to which pandemic-related disruptions in outpatient care in early 2020 were followed by adverse downstream health events, measured by emergency department (ED) visits and hospitalizations related to chronic disease management.

For this population, outpatient visits and common medical tests associated with chronic disease monitoring fell sharply in the initial months of the public health emergency (March to May of 2020) with the trough occurring in April 2020. In addition to the large reduction in overall visits, there was a significant shift in visit modality toward telehealth services. Telehealth

visits, which were virtually unused in this population prior to 2020, made up over 40% of outpatient visits at the peak of the disruption in April 2020. Visit and testing rates recovered to historical levels by June 2020 and remained that way through December 2021.[1] We find similar patterns for both primary care and specialist-care visits with somewhat larger proportional reductions for primary care visits. There was no period during 2020 where visit rates exceeded historical norms, meaning there was never a "catch-up" in missed visits or testing. Ultimately, relative to historical expectations, the effect of the onset of the pandemic was an estimated loss of around 112,000 outpatient visits and at least 17,000 diagnostic tests associated with chronic disease management over a 3-month period.

Did these significant temporary disruptions to outpatient care and the more permanent shift of some outpatient visits to telehealth lead to downstream adverse health events? To isolate effects related to reduced health care use among individuals with chronic diseases, we use the Performance Quality Indicator (PQI) classifications from the Association for Healthcare Research and Quality (AHRQ) to identify emergency department and inpatient visits for ambulatory care-sensitive conditions (ACSC) that could have potentially been minimized through proper chronic disease care. We can track these events through the end of 2021 allowing us to detect any potential rise in these types of emergency and inpatient events for a period of almost two years after the start of the pandemic. We find that there were no increases, and instead generally modest decreases, in the rates of these adverse events for the 2020 cohort compared to earlier cohorts. Limiting the analysis further to a subset of the patients with chronic diseases who had adverse health care events in the past 1 year or who had multiple comorbidities yields similar patterns.

If taken at face value, the modest reductions in chronic disease related events would seem to indicate overall improvements in chronic disease related outcomes for this population. However, the reductions in PQI ED and inpatient visits could also reflect shifts in decisions patients and physicians made about how severe a problem needed to be before a patient received ED or inpatient care (Becker et al., 2022). We conduct additional analyses to understand the extent to which utilization patterns might be masking underlying rises in adverse events related to poorly controlled chronic diseases. First, we investigate the PQI-related ED and inpatient trends separately for different chronic conditions and find that they vary by condition. For example, asthma and chronic obstructive pulmonary disease (COPD) emergency department visits fell sharply in 2020-2021, while for diabetes and hypertension there were much more

[1] Telehealth stabilized at around 18% of all outpatient visits after June of 2020.

muted reductions, but also no increases, relative to historical rates. The declines in adverse events are more concentrated among respiratory conditions for which social-distancing and masking may have plausibly led to true reductions in adverse events.

Second, we analyzed average hospital length of stay for inpatient admissions. The overall trend in length of stay for PQI inpatient admissions was stable over the 2020-2021 period. There were, however, exceptions: small spikes in the length of stay for these admissions in April 2020, December 2020, and winter of 2021 that all coincide with peak periods of COVID-related inpatient admissions in Wisconsin. Among our study population of Medicaid members with chronic conditions, we observe spikes in length-of-stay for PQI inpatient admissions without a simultaneous COVID diagnosis during these periods. This suggests that high loads at hospitals may deter some potential PQI admissions and result in more serious observed admissions. The fact that length of stay matched historical rates outside of these COVID-admission peaks suggests that there was not a general rising trend in the severity of the average PQI inpatient admission for this population.

Third, we analyze ED and inpatient visits for cardiac arrest and acute heart failure for those who had a prior diagnosis for hypertension. These events are typically considered non-discretionary and are serious complications for those with chronic hypertension. We find stable rates of cardiac arrest and acute heart failure relative to historical norms throughout 2020-2021, including during the peak of pandemic health-services disruptions in April 2020.

Fourth and finally, we analyze rates of all-cause mortality for Medicaid members with previously diagnosed chronic diseases from 2017 through 2021. We find that the rates of death through 2020 were slightly higher than the average from 2017-2019, but were quite similar to those observed during the last quarter of 2019. We also see no overall rising trend in mortality rates up to the middle of 2021. This stability is true for both younger and older groups of Medicaid members with prior chronic diseases, and suggests that the disruptions to outpatient services in early 2020 did not have widespread direct impacts on mortality for this population. However, we do detect two significant increases in mortality rates coinciding with peak periods of COVID-19-related hospitalizations. First, in the fourth quarter of 2020, mortality was moderately elevated relative to the last quarter of 2019. This uptick in mortality is concentrated in Medicaid members from ages 45-64 who had a COVID-19 diagnosis recorded in the same quarter. We also observe a significant increase in mortality in the last two quarters of 2021, which coincides with a prolonged rise in COVID-19 inpatient admissions for this population (and throughout Wisconsin). Part of the increase in mortality in this second period comes from

older individuals with a concurrent COVID-19 diagnosis. However, there is also a rise in deaths for those without COVID-19 diagnoses or health care visits prior to death in this period. These increases in mortality could imply that some people died from COVID-19 (and associated complications) without receiving a COVID-19 diagnosis in their claims records. Alternatively, they could imply that strained hospital services, causing either reduced quality of care or reduced access to care, during peak COVID-19 admissions contributed to mortality from other causes.

Overall, our results suggest that for individuals with chronic disease the significant but short-lived shock to outpatient services at the onset of the pandemic did not lead to an increase in downstream adverse health events or increased emergency department or inpatient admissions, including those typically associated with preventable chronic-disease complications. These findings run counter to the expectations we had coming into this research, which were informed by prior evidence that access to comprehensive primary care leads to a broad range of health benefits and reduces the need for more costly downstream health care (see for example, Sidorov et al., 2002; Starfield et al., 2005; Menec et al., 2006; Maciosek et al., 2010; Dolton & Pathania, 2016; Whittaker et al., 2016).[2] Our results could indicate that while outpatient services are broadly valuable and necessary for treating chronic diseases, there is more scope than previously understood to reduce utilization in some areas without significant downstream consequences. Our findings may also suggest that telehealth has the potential to support chronic disease management, given high persistent rates of telehealth use without observed negative health consequences. In the concluding section, we discuss potential implications and hypotheses that warrant further exploration, including the value of telehealth services in chronic disease management, the relationship between ambulatory health care engagement and health outcomes, and the consequences for patients and health systems when access to care is more limited.

Our study contributes to an ongoing literature analyzing the impacts of the COVID-19 pandemic on health care utilization. Many papers have documented similar reductions in outpatient services at the onset of the pandemic followed by recoveries beginning early summer 2020 and large shifts to telehealth across a range of different populations and insurance markets (e.g., Baum et al., 2021; Bose et al., 2022; Mafi et al., 2022; Moynihan et al., 2021; Patel et al., 2021; Tilhou et al. 2022; Zhu et al., 2022; Tilhou et al., 2023). A number of studies have also

[2] There is also some literature suggesting that primary care may largely move the timing but not the incidence of major health complications (e.g,. Weinberger et al., 1996; Walsh et al., 2019). There is also prior evidence that cost-sharing causes people to reduce use of both low and high-value care, appears to be especially important for lower-income populations, and can lead to negative health consequences (e.g., Chandra, Gruber, & McKnight 2010; Baicker, Mullainathan, & Schwartzstein 2015; Chandra, Flack, & Obermeyer 2021). On the other hand, Ruhm (2000) provides evidence that recessions may lead to improvements in physical health.

shown reductions in emergency department visits and inpatient admissions across a range of acuity levels consistent with our results (e.g., Becker et al., 2022; Mafi et al., 2022; Rennert-May et al., 2021; Yu et al., 2021). Our study design and findings are most similar to Becker et al., (2022) who analyzed the rates of ambulatory care-sensitive inpatient admissions for a large commercially insured population in Michigan from March 2020 to February 2021 versus a cohort the prior year. Our findings are consistent with theirs, with both studies documenting a) modest *reductions* in ACSC admissions overall, b) pronounced reductions for respiratory-related events but not for diabetes, and c) no upward trends in length of stay that would indicate admissions becoming more serious. Our study contributes analysis of some important additional measures (emergency department use, rates of cardiac arrest and acute heart failure, and, particularly, mortality rates), and complements theirs by analyzing low-income patients with prior chronic diseases who might have been expected to be at highest risk of adverse consequences from outpatient service access. The baseline rates of ambulatory-care-sensitive-condition inpatient admissions in our study population prior to 2020 were about 6 times higher than their population (3 per 1,000 vs. 5 per 10,000). Taken together, our two studies provide fairly robust evidence that the early COVID-19 disruptions to outpatient services did not lead to downstream increases in ACSC-related adverse hospital events.

These findings run somewhat counter to those in an important concurrent working paper by Ziedan, Simon, and Wing (2022) that concludes reductions in outpatient visits at the start of the pandemic had significant negative mortality impacts. Ziedan et al. use data on electronic health records for a very large population spread throughout the U.S. and compare one-year mortality rates for those who had an outpatient appointment scheduled for mid- March to mid-April 2020 to those with scheduled visits in mid-February to mid- March. Those in the March-April cohort were about 15 percentage points less likely to have their appointment completed (due to rising cancellations) and they estimate that the one-year mortality rate was about 5% higher for those in the March-April group. One possible explanation for the differences in the Ziedan et al. findings and ours is that the population in their study included nearly half who were above age 65, while our population does not include anyone over 65. A relative strength of our study is that unlike the study by Ziedan et al., we can compare not only mortality but also downstream utilization of emergency and inpatient services at the individual level. Those results help give us confidence that the results for our population are meaningfully different and not just the result of lower baseline mortality risk for younger populations.

The combined evidence from these different studies suggests a mixed view of the impacts of reducing access to health care services. Current evidence suggests that disruptions to outpatient services may have had meaningful negative mortality impacts for older and high-risk populations, and we also see evidence that disruptions to hospital services for acute care may also have negatively impacted mortality. Yet disruptions to outpatient services did not appear to have widespread negative impacts requiring costly emergency and inpatient hospital services among non-elderly populations, including among relatively high-risk individuals with low-incomes and chronic diseases. Overall, our results suggest there may be opportunities to increase the efficiency of health care utilization even among a low-income, nonelderly, chronically ill population.

2. Data and Methods

In this study, we use administrative enrollment and health care claims and encounter data from Wisconsin's Medicaid program (called BadgerCare Plus) for nonelderly, nondisabled adults. The program covers parents and caretakers of dependent children as well as adults without dependent children ("childless adults") with income up to 100% of the federal poverty line. Wisconsin did not expand Medicaid under the Affordable Care Act but instead implemented a "partial expansion" in April 2014 (Dague, Burns, and Friedsam 2022). The data cover the universe of program beneficiaries from January 2017-Decemeber 2021 and include monthly enrollment status, categorical basis for eligibility, income, demographics (age, sex, race, ethnicity, education, and county of residence), as well as standard fields present in health care claims and encounters from 2017-2021, from which we identify emergency department (ED) visits, inpatient stays, and outpatient visits.

Our primary methodology for this study is a cohort comparison analysis. We identified all adults ages 19-64 who were enrolled in the Wisconsin Medicaid program as either childless adults or parents/caretakers as of February 2020. We then identified two comparison cohorts with the same restrictions who were enrolled as of February 2018 or February 2019.[3] Our primary analysis involves a comparison of various health utilization measures across cohorts based on the average frequency of different visit and encounter types for enrolled members in each cohort over time. For each cohort we include data on claims for members of that cohort for a period of 12 months prior to the start of the cohort, spanning back to January of the year prior

[3] Naturally with this structure there are many Medicaid members who are in multiple cohorts. We treat these individuals' cohort observations independently.

(e.g., January 2019 for the February 2020 cohort). For the 2018 and 2020 cohorts we analyze data for 22 months after the start of the cohort spanning to December of the subsequent year (e.g., December 2021 for the February 2020 cohort). For the 2019 cohort we stop the analysis of their utilization at the end of 2019 so as not to cross into the pandemic-onset period in early 2020.

The observable demographic characteristics of the three cohorts as of February of each cohort year are extremely similar, suggesting that the 2018 and 2019 cohorts can serve as a good counterfactual benchmark for what would have occurred in 2020 in the absence of the COVID-19 pandemic. The first three columns of **Table 1** provides summary statistics for the three cohorts for those enrolled in Medicaid as of February of the cohort year. Enrollment levels are similar, ranging from just over 294,000 members in 2018 to approximately 283,000 members in both 2019 and 2018. On nearly all dimensions the average characteristics of the cohorts are essentially identical and on the few that differ the differences are modest (e.g., percent white 56% in 2020 vs. 59-60% in 2019 and 2018).

To investigate how the pandemic affected utilization for those with chronic diseases, for each cohort, we use 13 months of claims data prior to the start of the cohort to identify chronic disease diagnoses (e.g., January 2019 through January 2020 for the cohort identified as of February 2020). We used ICD-10 codes from the Medicaid claims records along with the AHRQ H-CUP Clinical Classification Software to identify enrollees with chronic conditions.[4] We investigate nine chronic diseases (listed in Table 2) and flag members as having been diagnosed with that disease if they have at least one prior claim (outpatient, ED, or inpatient) that includes a diagnosis code associated with that disease.

Table 2 provides a tabulation of the share of members with a prior chronic disease diagnosis for each of the specific diseases separately by cohort and age group. It also provides a tabulation of the total number of chronic diseases. Comparing the 2020 cohort with the other two reveals nearly identical rates of chronic diseases for each disease and age group, again providing evidence that 2018 and 2019 provide a good comparison group for 2020.

The overall rates of chronic disease in this population are slightly higher than data reported for the US population as a whole. Approximately 42-43% of all adults in each cohort have at least one chronic disease diagnosis. For comparison, using data from the National Health Interview Survey, Boersma et al., (2020) find that 37% of adults 18-64 years old have at least

[4] https://www.hcup-us.ahrq.gov/toolssoftware/chronic_icd10/chronic_icd10.jsp

one chronic disease. In our population, the most commonly diagnosed chronic diseases overall are anxiety and depression at around 20%of members. Among adults 45-64, however, hypertension is the most common diagnosis, with approximately 30% of each cohort having a hypertension diagnosis in their prior claim record. Our primary analysis uses members with at least one prior chronic disease diagnosis and we present analogous results for members with no chronic disease diagnosis in the appendix.

Table 1. Summary Statistics by Cohort

	Cohort			Remained Enrolled December		
	2018	2019	2020	2018	2019	2020
N (unique subjects)	294,371	283,269	283,359	212,745	212,766	257,095
Female %	58.0%	57.7%	57.0%	60.8%	60.6%	57.7%
CLA %	51.9%	53.3%	54.9%	47.2%	47.4%	53.4%
Parent%	48.1%	46.7%	45.1%	52.8%	52.6%	46.6%
Average age	37.7	37.8	37.8	37.9	37.8	37.5
Age group						
19-34 (%)	46.3%	45.7%	45.7%	45.0%	44.9%	46.1%
35-44 (%)	24.2%	24.9%	25.3%	25.4%	26.3%	25.8%
>45 (%)	29.5%	29.4%	29.0%	29.6%	28.8%	28.2%
Education						
less than High School (%)	62.3%	61.4%	61.0%	61.1%	60.1%	60.4%
High School (%)	34.8%	35.7%	36.1%	35.9%	36.8%	36.6%
More than High School (%)	2.9%	2.9%	2.9%	3.0%	3.0%	2.9%
Race						
White (%)	59.9%	59.0%	55.7%	60.4%	59.4%	55.9%
Black (%)	20.7%	21.1%	21.0%	20.6%	21.0%	21.2%
Hispanic (%)	8.4%	8.4%	8.8%	8.2%	8.4%	8.9%
Other (%)	2.8%	3.0%	3.7%	2.6%	2.8%	3.6%
Asian (%)	3.2%	3.2%	3.0%	3.3%	3.3%	3.1%
American indian (%)	2.1%	2.1%	2.1%	2.1%	2.1%	2.1%
Missing (%)	2.8%	3.1%	5.6%	2.7%	3.0%	5.2%
Citizen	97.3%	97.2%	97.2%	97.1%	97.0%	97.2%
Income						
<=50 FPL (%)	66.4%	67.9%	69.3%	66.5%	67.2%	69.2%
50-100% FPL (%)	33.4%	32.1%	30.7%	33.3%	32.8%	30.8%
Average Income %FPL	29.9	28.8	27.5	29.9	29.4	27.6
Average months enrolled prior	10.3	10.4	10.4	10.9	10.9	10.5

Notes: This table reports summary statistics on demographics for adult enrollees in the Wisconsin Medicaid program. Columns 1 through 3 report data for adults aged 19-64 who were enrolled with coverage as either parents/caregivers or childless adults at some point during February of the respective cohort year. Columns 4 through 6 report the same statistics for the fraction of the initial February enrollees who remained enrolled in as of December of the cohort year.

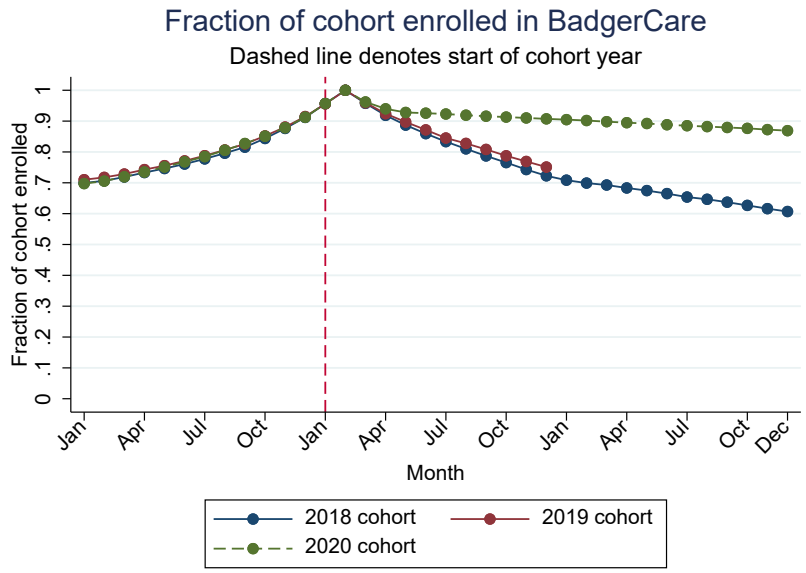
Table 2. Chronic Disease Tabulation by Cohort and Age Group

	All Adults			Adults 19-44			Adults 45-64		
Cohort	2018	2019	2020	2018	2019	2020	2018	2019	2020
N	294,371	283,269	283,359	207,532	199,979	201,140	86,839	83,290	82,219
Chronic condition indicated in past claims									
Hypertension	10.1%	10.3%	10.0%	7.6%	7.8%	7.7%	30.2%	31.4%	31.1%
Diabetes	4.7%	4.8%	4.7%	3.6%	3.7%	3.6%	13.3%	13.9%	14.0%
Coronary Artery Disease	0.9%	0.9%	1.0%	0.4%	0.5%	0.5%	4.6%	4.9%	5.1%
Asthma	7.8%	8.1%	8.3%	8.8%	9.1%	9.4%	7.9%	8.3%	8.5%
COPD	1.4%	1.4%	1.3%	0.7%	0.7%	0.6%	6.2%	6.5%	6.4%
Kidney disease	0.8%	0.8%	0.8%	0.5%	0.5%	0.6%	2.7%	2.9%	3.0%
Anxiety	18.0%	19.1%	20.1%	20.3%	21.6%	22.8%	18.7%	20.0%	20.5%
Depression	17.4%	18.2%	18.9%	19.0%	20.0%	21.1%	20.0%	20.9%	21.0%
Thyroid disorders	3.7%	3.7%	3.7%	3.4%	3.5%	3.4%	7.6%	8.0%	8.1%
Number of conditions									
0	58.3%	56.9%	56.6%	63.2%	61.9%	61.2%	46.7%	45.0%	45.3%
1	18.5%	18.6%	18.1%	17.7%	17.8%	17.4%	20.5%	20.4%	19.8%
2	14.1%	14.7%	15.1%	12.9%	13.5%	14.2%	17.0%	17.7%	17.4%
3	5.9%	6.5%	6.6%	4.5%	5.0%	5.2%	9.4%	10.0%	10.1%
4+	3.1%	3.3%	3.5%	1.8%	1.8%	1.9%	6.4%	6.9%	7.4%

Notes: This table reports chronic conditions proportion for adults aged 19-64 who were enrolled with coverage as either parents/caregivers or childless adults in February of the respective cohort year in the Wisconsin Medicaid program. We use ICD-10 diagnosis codes from AHRQ H-CUP Clinical Classification Software to identify related visits. A member is considered to have a certain chronic condition if she had at least one such visit within 13 months prior to the start of the cohort.

The one major difference between the 2020 cohort and the prior two cohorts is that the 2020 cohort exited Medicaid coverage at a significantly slower rate than the prior cohorts. **Figure 1** shows enrollment patterns for each cohort. Given the definition of cohorts, 100% of the cohorts are enrolled as of February of the cohort year by construction. Enrollment patterns look similar for the three cohorts through March of the cohort year: just over 70% of each cohort had been enrolled as of 12 months prior to the cohort start. However, starting in April 2020 there is a divergence with fewer members of the 2020 cohort leaving Medicaid, which is consistent with the start of new maintenance of eligibility requirements that took effect with the onset of the public health emergency (Dague et al. 2022; Dague and Ukert 2023). In 2018 and 2019, approximately 75% of members enrolled as of February remained enrolled in December, but in 2020 approximately 90% were still enrolled in December. By the end of the study period the 2020 cohort shows a 26% higher retention rate than was observed for a similar period for the 2018 cohort.

Figure 1. Enrollment Patterns by Cohort



Notes: This figure plots the share of each cohort, defined as members enrolled as of February of each cohort year, who were also enrolled in months prior to and following February of the cohort year. We do not require continuous eligibility for this graph (e.g., allow for temporary exits and re-entry into Medicaid) so that a member of a cohort could contribute enrollment in some but not necessarily all prior or future months.

Since our main analysis uses average utilization frequencies among cohort members enrolled at a point in time, there is a concern that the differential exit rate from Medicaid in 2020 could create a compositional shift that biases comparisons with prior cohorts. However, as we highlight in Columns 4-6 in **Table 1**, the characteristics of the population enrolled as of December of the cohort year look nearly identical for each cohort, except for childless adults vs. parent/caregiver status. A greater share of the 2020 enrollees later in the year were childless adults than observed in prior cohorts. This difference is because childless adults tend to exit Medicaid at higher rates than parents/caregivers and saw a more dramatic reduction in disenrollment with the start of the public health emergency. Although more members remained enrolled in 2020, and especially at higher rates for childless adults, the average age, educational attainment, race, and income of those additional enrollees were quite similar on average to those who remained in 2018 and 2019. We also find that the rates of chronic diseases (measured as of the start of the cohort year) among members remaining enrolled through 2020 were very similar to those in prior cohorts, again suggesting that there was not a major compositional shift in the health of enrolled members in 2020. Appendix Figure A1 shows that in general exit rates are lower, and the differences in exit rates between 2020 and prior cohorts are smaller, among those with chronic conditions and especially for those with multiple chronic conditions or prior

histories of hospitalizations for chronic disease complications; in other words, the sickest patients were always more likely to remain enrolled in Medicaid.

Overall, the similarity of the cohorts, despite the differential attrition in 2020, gives us confidence in comparing average utilization rates across cohorts. To further account for potential differences in the cohorts, we supplement our baseline comparisons of average utilization rates with regression analyses that controls for demographic characteristics of the enrolled cohorts. We use regressions with the following structure:

$$y_{it} = \alpha + \delta_t + \beta_t I_i^{2020} \delta_t + \theta X_i + \varepsilon_{it,}$$

where i denotes individuals, t denotes months since the start of the individual's cohort year with $t = 0$ denoting January of the cohort year, y_{it} is the count of visits of a particular type for the individual at time t, δ_t are fixed effects for the month since start of the cohort year. The primary coefficients of interest are the β_t, which are estimated coefficients on the interaction between an indicator for being in the 2020 cohort (I_i^{2020}) and the month relative to cohort year start fixed effects. The effects for 2020 captured by the β_t estimates are relative to the average across the prior two cohorts for that same time period (i.e., month since cohort start). We control for a set of individual characteristics X_i that are determined about an individual as of the start of the cohort year, namely their age group (19-34, 35-44, 45-54, and 55-64), an indicator for being a childless adult (as opposed to a parent/caregivers), an indicator for being female, and fixed effects for each of the prior chronic-condition diagnoses in Table 2. The inclusion of these controls allows us to account for the observable compositional changes in the 2020 cohort resulting from the slower attrition from Medicaid of that cohort relative to prior cohorts. Standard errors are clustered at the individual level to account for the fact that we have repeated observations for individuals across months.

This cross-cohort analysis relies on the assumption that the cohorts would have been similar if not for the time of their enrollment in Medicaid. The main threat to identification is coincident differences in cohorts that are correlated with the outcome variables. As discussed, because of the maintenance of eligibility policy, continued enrollment was somewhat different for the 2020 cohort. There is no way to completely rule out endogeneity or residual confounding from this cause, but we believe that the ongoing observable similarities between the cohorts shown in Tables 1-2 support our strategy. If those who typically would be disenrolled, but remained in the cohort in 2020, were unobservably healthier than those who would typically remain enrolled, the results would be biased towards finding lower utilization of health care services during the latter parts of 2020 and 2021. All of the qualitative patterns we report below,

however, are similar when we restrict analysis to subsets where there is less differential in attrition rates for the 2020 cohort (such as focusing on parents/caregivers or those with multiple chronic conditions and prior hospitalizations for chronic-disease complications).

3. Changes in Outpatient Service Utilization

This section presents results for members with a prior chronic disease diagnosis. We present analogous results for members without chronic conditions in Appendix B. In each graph, the x-axis is months, with a dashed red line denoting the start of the cohort year (e.g., January 2018 for the 2018 cohort, January 2019 for the 2019 cohort, and January 2020 for the 2020 cohort). The lines display the average number of visits of a particular type observed in the claims and encounter data for a member of that cohort who was enrolled in that month. Each line is shaded with a 95% confidence interval around the observed sample mean in that month. The confidence intervals help provide a visual indication of how precisely estimated the average is, which depends on both how rare or variable the outcome is and how many individuals are represented in the cohort. For many of the initial figures, the confidence intervals are very narrow and not easily visible in the graph because the cohorts are large and the averages are precisely estimated. For later figures when we present analysis by finer subsets and analyze less common outcomes, the confidence intervals are wider.

Figure 2a shows trends in the monthly average number of outpatient visits for adult Medicaid members with prior chronic-disease diagnoses. Prior to 2020, the average number of outpatient visits per member was around 1.7 visits per month and the patterns for the cohorts track closely up until March 2020. The onset of the COVID-19 pandemic led to a dramatic reduction in outpatient services for March through May of 2020: at the peak of the decline in April 2020 outpatient visit rates were approximately 30% lower than the same period in 2019 (1.20 vs. 1.73). Overall visit rates recovered fully back to expected levels by June 2020 and stayed at expected levels into December 2021. However, visit rates in early summer 2020 did not *exceed* those in prior years meaning that while outpatient visit rates recovered to historical levels, they did not make up for the missed visits during March through May of 2020.

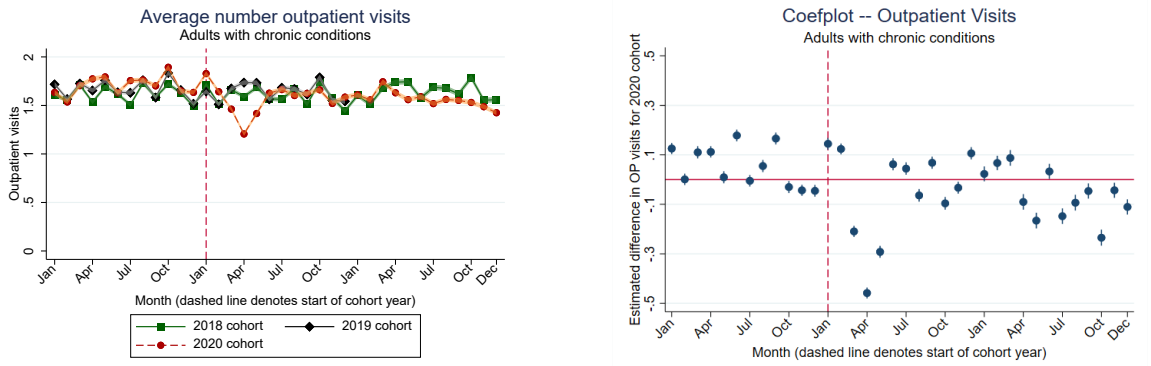
Figure 2b shows the regression-adjusted estimated differences in average visit counts for the 2020 cohort relative to the 2018 and 2019 cohorts using the regression specification in Equation 1 in Section 2.[5] We see that the patterns observed in the raw averages are also present

[5] The 95% confidence intervals vary substantially across months. This is because we are estimating a model with fixed effects for month relative to cohort-year start date and interactions of those fixed effects with 2020. Since we

after we account for potential differences in observable characteristics between cohorts. This approach also allows us to quantify an average estimate of the change in utilization rate in 2020 relative to the prior two cohort years. We estimate reductions of 0.21, 0.46, and 0.30 visits per month per member respectively for March, April and May 2020, resulting in an estimated total reduction of 112,352 outpatient visits over that three-month period for this population of adults with chronic diseases.

Figure 2. Outpatient Visit Patterns

a. Averages per enrolled member b. 2020-cohort reg-adjusted differences in OP visits



Notes: Panel a. plots the average number of outpatient visits (defined as any office visit or other outpatient encounter, excluding emergency department and inpatient hospital services) for each cohort over time. Each graph is shaded with the 95% confidence interval on the mean for that month. Panel b. plots the coefficients on the interaction between the 2020 cohort and the month relative to cohort start date from the regression specification described in Equation 1 in Section 2. These points can be interpreted as the estimated difference in the average number of outpatient visits for an individual in a month in 2020 relative to the 2018 and 2019 cohorts for the equivalent month. Bars shows the 95% confidence interval on the estimated difference.

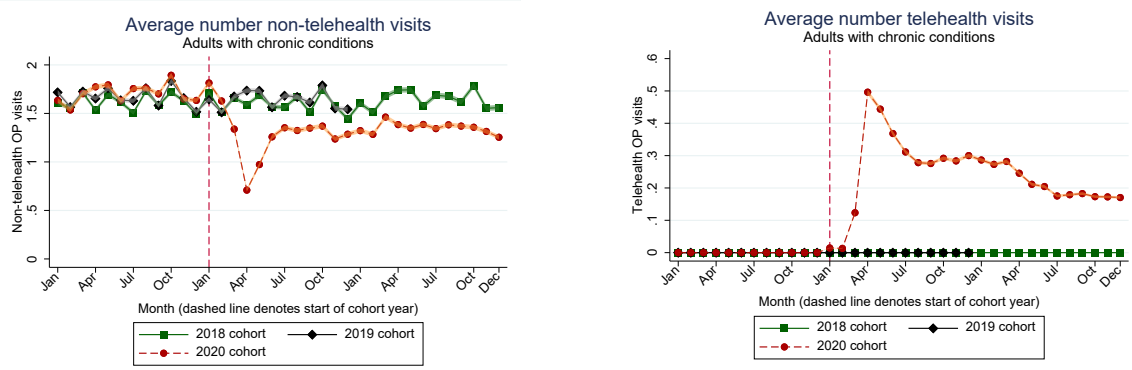
Although total outpatient visit rates recovered to historical levels by June 2020, there was a meaningful shift away from in-person visits toward telehealth visits. **Figure 3** shows the pattern of average visits rates for both non-telehealth and telehealth visits over time. Telehealth played a major role in mitigating the drop in outpatient visits during the peak of the pandemic onset: in April 2020 non-telehealth visits were around 59% below their historical levels and telehealth visits (averaging .5 visits per member in April 2020) accounted for 40% of all visit rates. After June 2020, when overall visit rates stabilized to historical levels, we observe that approximately 18% of visits shifted to telehealth, a rate that was stable until it began to fall somewhat in April 2021. To the extent that telehealth was an imperfect substitute for in-person

only have two prior cohort years from which these fixed effects are estimated, any substantial differences by month between 2018 and 2019 will result in more noisy estimates.

visits, this shift to telehealth could also be seen as a potential disruption to outpatient care, though the relative advantages and disadvantages of telehealth visits are not yet well understood.

Figure 3. Outpatient Utilization – Telehealth and Non-telehealth

a. Non-telehealth visits b. Telehealth visits



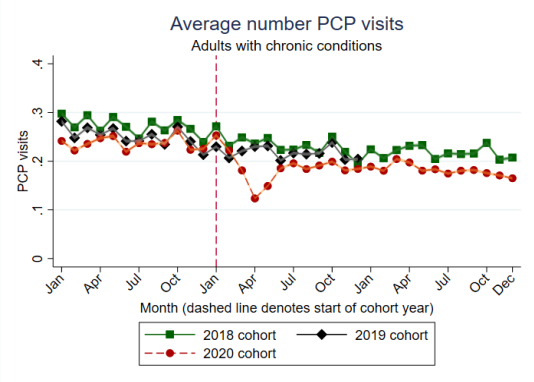
Notes: This graph shows analogous patterns to Figure 2a but dividing visits into non-telehealth (Panel a) and telehealth visits (Panel b).

In **Figure 4** we categorize outpatient visits into primary care physician (PCP) visits and non-PCP visits, more likely involving specialists, and plot their trends.[6] A relatively low share of outpatient visits are coded as PCP visits for this population (typically around 14%). We can also see a subtle declining trend in PCP visit rates for this population over time prior to the onset of the COVID-19 pandemic. Recognizing those trends, we observe qualitatively similar patterns of PCP and non-PCP outpatient visit rates for the 2020 cohort. Both series show a strong reduction March – May of 2020, but the reductions in PCP visits fell by over 40% while non-PCP visit rates fell by a little less than 30%. Both series also show a strong rebound starting in June 2020, with non-PCP rates returning back to pre-COVID and historical norms. The PCP-visit rate was slightly lower throughout 2020 than prior years, but that reduction is largely accounted for by the small downward trend in PCP visit rates and overall PCP visits largely returned to their trend rate throughout 2020.

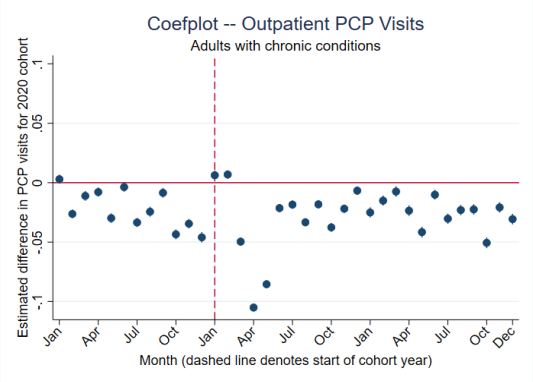
[6] We categorize an outpatient visit as a PCP visit on the basis of a combination of procedure codes, place of service, and physician specialty code. The procedure codes mainly include office visits, preventive visits, and E&M visits and these are then combined with physician specialties of family practice, general practice, geriatrics, internal medicine, pediatrician, or obstetrics and gynecology to identify a PCP visit (see Appendix C for details).

Figure 4. Outpatient Utilization – PCP and Specialty Visits

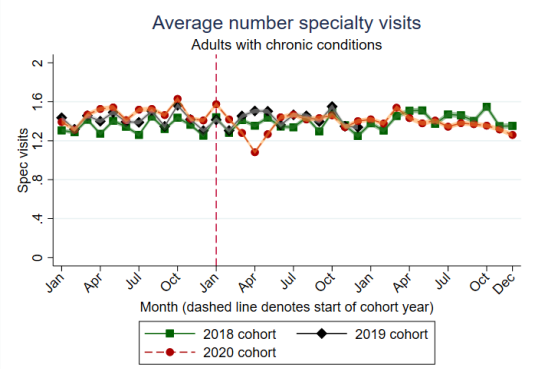
a. PCP visits



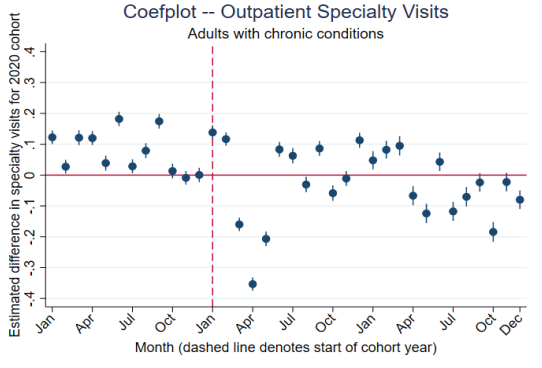
b. 2020-cohort reg-adjusted differences PCP visits



c. Specialty visits



d. 2020-cohort reg-adjusted differences specialty visits



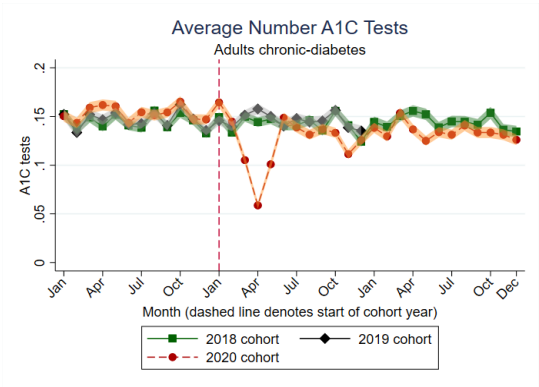
Notes: Panel a. plots the average number of outpatient PCP visits for each cohort over time. Panel b. plots the coefficients on the interaction between the 2020 cohort and the month relative to cohort start date from the regression specification described in Equation 1 in Section 2. Panel c. and d. show the similar patterns for average number of outpatient specialty visits. Appendix C shows how we define PCP visits.

In **Figure 5** we examine trends in outpatient laboratory tests for monitoring certain chronic diseases. We identify A1C tests for those diagnosed with diabetes and BMP or CMP blood tests for those with hypertension, diabetes, or chronic kidney disease as important routine screening tests indicative of appropriate chronic disease monitoring. Both series show dramatic declines during March through May of 2020, with a rebound back to historical levels in early summer. Importantly, although there was a rebound in test rates, the rates of screenings never went above those seen in 2019, suggesting that there was not a "catch-up" period for missed screenings at the onset of the pandemic. A1C tests also saw a dip relative to historical levels in November and December of 2020, which coincides with a winter peak in COVID-19 cases in Wisconsin. The average number of A1C tests between February and December of the cohort year for those with a prior diabetes diagnosis was 1.45 in 2018, 1.5 in 2019, but only 1.28 in

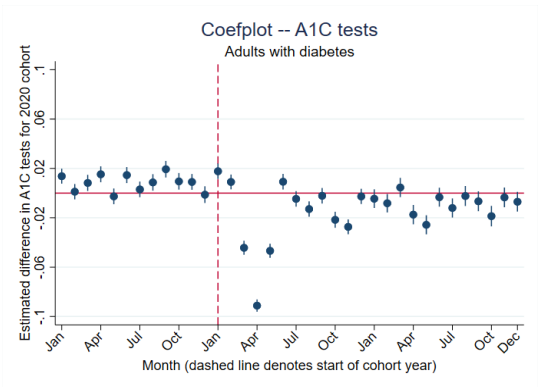
2020. The share of those with a prior diabetes diagnosis who had no A1C test for the year was 4-5% higher in 2020 (31%) relative to prior years (26% in 2019 and 27% in 2018). We see similar, but somewhat more modest, disruptions in total BMP/CMP blood tests for those with hypertension, diabetes, or chronic kidney disease.

Figure 5. Chronic-Disease Monitoring Test Patterns

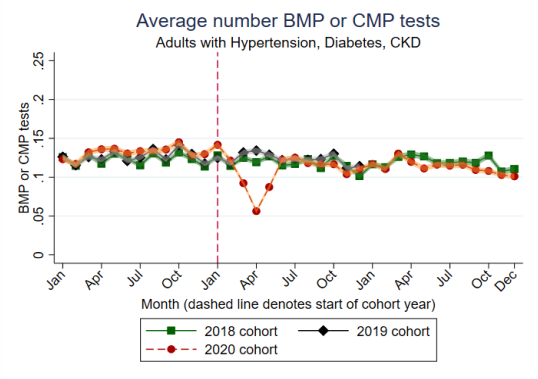
a. A1C tests for diabetes



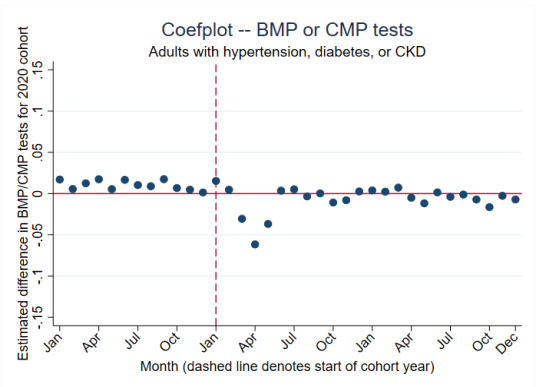
b. 2020-cohort reg-adjusted differences A1C tests



c. Common blood tests



d. 2020-cohort reg-adjusted differences blood tests



Notes: Panel a. plots the average number of A1C tests (limited to tests in outpatient setting, excluding tests in emergency department or inpatient hospital) for members with diabetes in each cohort over time. Panel b. plots the coefficients on the interaction between the 2020 cohort and the month relative to cohort start date from the regression specification described in Equation 1 in Section 2. Panel c. plots the average number of BMP or CMP tests (limited to tests in outpatient setting, excluding tests in emergency department or inpatient hospital) for members with hypertension, diabetes, or chronic kidney diseases in each cohort over time. Panel d. plots the coefficients on the interaction between the 2020 cohort and the month relative to cohort start date from the regression specification described in Equation 1 in Section 2.

In summary, we observe a substantial short-term (three month) decline in outpatient visits never made up for in catch-up visits and a longer-term shift to telehealth. We also observe a large disruption in chronic disease monitoring laboratory tests with a return to historical levels but

similarly no increase to make up for lost monitoring, resulting in a net loss in the share of people with any monitoring. Together, these amount to a large decline in outpatient services received and a significant change in how care was delivered for this population of low-income patients with chronic conditions.

4. Changes in Emergency Department and Inpatient Utilization

In this section, we focus on patterns of emergency department (ED) and inpatient utilization. The particular question of interest is whether there is any evidence of a rise in ED or inpatient visits that might stem from disruptions in chronic disease management.

4.1 ED Utilization

Figure 6 Panels a and b show the graphs for ED visits. Historically, members with chronic diseases averaged a little over 0.12 ED visits per month or an average of around 1.5 ED visits per year.[7] ED visits fell at the start of the pandemic in 2020, with an especially sharp drop in April 2020 when visits were more than 40% below historical levels. ED visits rebounded into the summer of 2020 but remained consistently below historical levels by around 20%. In 2021, ED visits rose gradually but didn't reach historical levels.

Although total volumes of ED visits fell during the pandemic in 2020, these aggregate statistics could mask potential consequences of reduced or worsened chronic disease management. In particular, utilization for injuries and diseases unrelated to chronic diseases could have fallen enough to offset and obscure potential increases in emergencies for chronic disease complications. We investigate this possibility in two ways.

First, in **Figure 6** Panels c and d we examine the patterns for ED visits that include a diagnosis that falls into the AHRQ performance quality indicator (PQI) codes related to the chronic diseases we focus on for this study.[8] These PQI visits provide a measure of ED visits associated with complications related to the chronic diseases. We see very similar patterns when

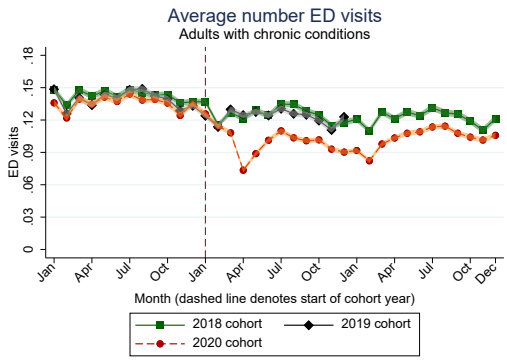
[7] Note that there is a visible downward trend in ED visits over months for all cohorts. That is a natural consequence of mean reversion related to the fact that we are selecting a subset of Medicaid members who are identified as of February of a given cohort year with some prior diagnosis of a chronic condition. ED visits are a channel through which these chronic diagnoses can emerge and as such this selected group on average tended to have somewhat higher ED visits in the period prior to the start of the cohort year.

[8] We identify preventable visits related to members' chronic conditions using a subset of PQI ACSCs that include uncontrolled diabetes mellitus or diabetic complications, chronic obstructive pulmonary disease, hypertension, and asthma. Since the PQI measures do not include depression or anxiety, we include additionally any diagnosis codes for these conditions. An overview of PQI can be found at https://qualityindicators.ahrq.gov/measures/pqi_resources and details of the AHRQ CCRS list can be found at https://www.hcup-us.ahrq.gov/toolssoftware/chronic_icd10/chronic_icd10.jsp.

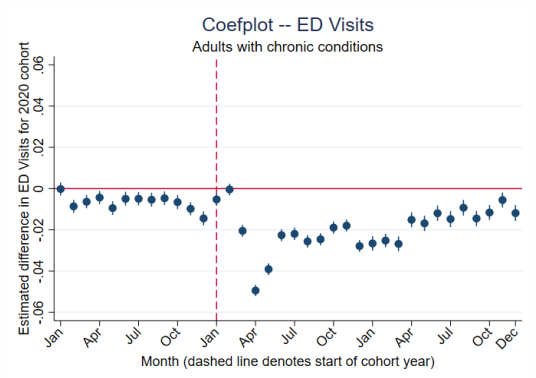
we isolate on the smaller subset of ED visits that are associated with a PQI indicator for chronic diseases. The rates of PQI-related ED visits fell sharply at the onset of the pandemic, but remained approximately 25% below historical levels throughout 2020. PQI-related ED visits rose modestly during the first half of 2021, reaching historical levels in June, but then fell again for the second half of 2021. This timing coincides with a wave of COVID-19 inpatient admissions that began in July 2021 and lasted through December 2021 (see Appendix Figure A2) Overall, we find no evidence that the disruptions in outpatient care at the start of the pandemic were followed by a rise in ED visits associated with poorly managed chronic diseases.

Figure 6. Emergency Department Visit Patterns

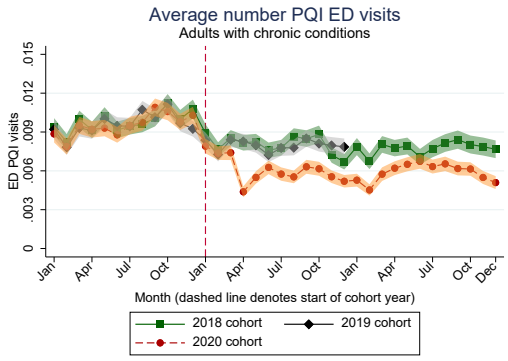
a. Average ED visits – all types



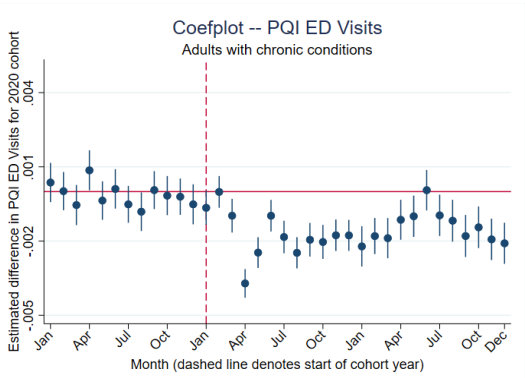
b. 2020-cohort reg-adjusted differences in ED visits



c. Average PQI ED visits



d. 2020-cohort reg-adjusted differences in PQI ED visits



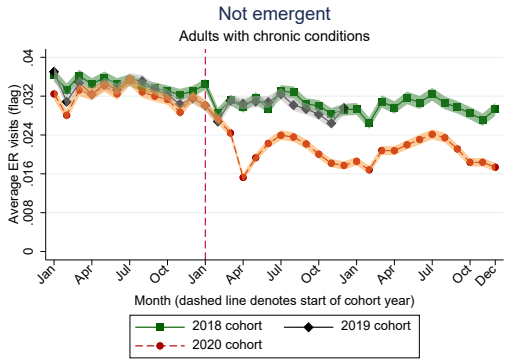
Notes: Panel a. plots the average number of emergency department visits for each cohort over time. Panel b. plots the coefficients on the interaction between the 2020 cohort and the month relative to cohort start date from the regression specification described in Equation 1 in Section 2. Panel c. and d. show the similar patterns for average number of emergency department visits, but limited to those with a PQI diagnosis.

Our second approach to investigating whether overall rates of ED-visit reductions might be masking increases in more serious issues caused by poorly managed chronic diseases is by

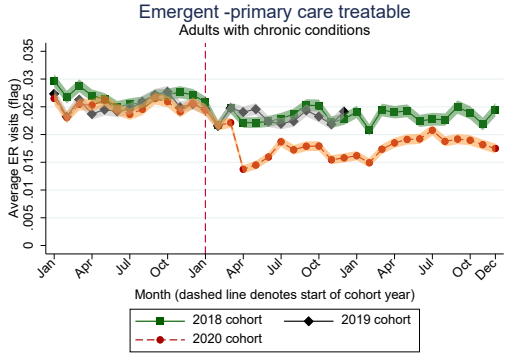
implementing an algorithm developed at NYU (Billings et al., 2000) for categorizing ED visits. The NYU algorithm gives a score to ED encounters across categories of "not emergent", "emergent-primary care treatable", "emergent ED care needed, but preventable/avoidable", and "emergent ED care needed, not preventable/avoidable" based on diagnosis and procedure codes.[9] The scores are meant to reflect the likelihood that the visit fell within these categories (scores add to one). Most ED visits cannot be conclusively classified and often have scores with weight across multiple categories. To isolate patterns for visits that have clearer labeling, we focus our attention here on ED visits for which the NYU algorithm generates a score of greater than 0.5 in one of these categories (53% of all ED visits receive a score of greater than 0.5 in one category).

Figure 7. ED Visits by NYU-Algorithm Classification

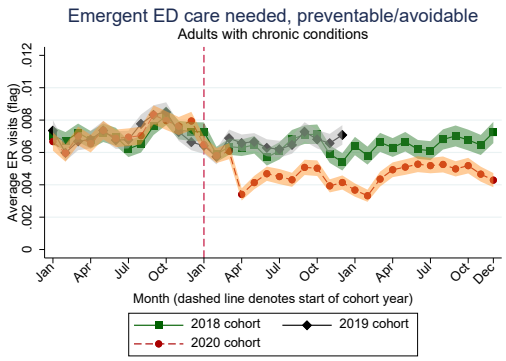
a. ED visits classified Not Emergent



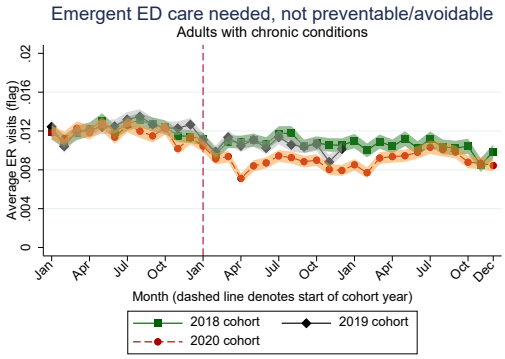
b. ED visits classified Primary-Care Treatable



c. ED visits classified Preventable/Avoidable



d. ED visits classified Not Preventable/Avoidable



Notes: For each visit, a 0/1 flag is assigned to each category to identify ED visits for which the NYU algorithm generates a score of greater than 0.5. Panel a. plots the average number of ED visits with a 'not emergent' flag for each cohort over time. Panel b. plots the average number of ED visits with a 'primary care treatable' flag. Panel c. plots the average number of ED visits with a 'preventable/avoidable' flag. Panel d. plots the average number of ED visits with a 'not preventable/avoidable' flag.

[9] The algorithm also provides separate classifications for injury, mental health problems, alcohol, or substance abuse visits. See appendix Figure A3 for detail.

Figure 7 graphs the trends in each of these ED visit types and each figure can be interpreted as showing the average number of ED visits that can be relatively conclusively labeled with that classification. All categories of ED visits show substantial disruptions in 2020 relative to the benchmark. The series for non-avoidable/preventable emergent cases shows the smallest reduction, which is sensible given that these cases should be less sensitive to patient discretion in visiting the ED during the pandemic. Most importantly for our interest, Panel c reveals sizeable reductions of about 25% throughout 2020 in emergent but potentially preventable or avoidable ED visits. This is the category where poorly managed chronic diseases are likely to be most important for generating ED visits. Of course, it could be that the NYU algorithm is too coarse to pick up cases related to poorly managed chronic diseases (even with our use of the 0.5 scoring threshold) and that again reductions in other types of visits are masking problems with chronic disease management. However, this is additional evidence consistent with Panels c and d of Figure 7 to suggest that there was not an increase in ED visits during 2020 associated with poorly managed chronic diseases.

4.2 Inpatient Utilization

Figure 8 shows the utilization series for inpatient (IP) visits and presents results for both all IP visits (Panels a and b) and for IP visits that include a diagnosis within the AHRQ set of PQI indicators for one of the chronic diseases (Panels c and d). Inpatient admissions are naturally rarer than outpatient and emergency visits, typically averaging between 0.015 to 0.025 per month historically for Medicaid members with a chronic disease diagnosis.[10]

Similar to what we observed for ED visits, after the onset of the pandemic there were reductions in IP visit volumes relative to historical norms that persisted throughout 2020 and 2021. We note that these declines occurred despite the inclusion of admissions associated directly with COVID-19, which spiked during November 2020 and surged again in late 2021 in Wisconsin (See Appendix Figure A2).[11] While the overall patterns in IP admissions could be driven by reductions in elective procedures, importantly for our analysis we see similar patterns

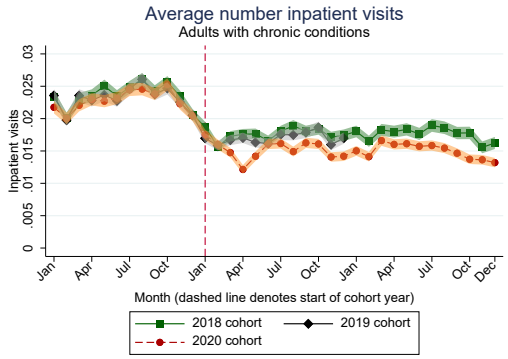
[10] Note that the declining average number of inpatient visits observed from -12 through 1 for each cohort in Figure 8 is mechanically related to how we identify members with chronic diseases and is not an indication of a data problem. This series focuses on those with at least one chronic disease diagnosis as of February of the cohort year. Given that inpatient visits generate substantial numbers of diagnoses, the average number of inpatient visits is high in the past for those with a chronic disease diagnosis.

[11] Overall COVID inpatient admissions were small relative total IP volumes for this population of non-elderly adults with Medicaid: at the peak in November 2020 for this population of members with chronic conditions there was an average of just over 6 COVID-related IP admissions per 10,000 members compared to around 150 overall IP admissions per 10,000 members.

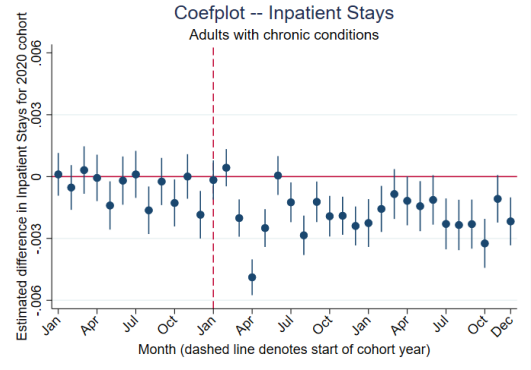
when we isolate to IP admissions with a PQI diagnosis (Panels c and d). Overall, in the later months of 2020 and into 2021 the rate of PQI IP visits was down by around 15% compared to historical averages.

Figure 8. Inpatient Visit Patterns

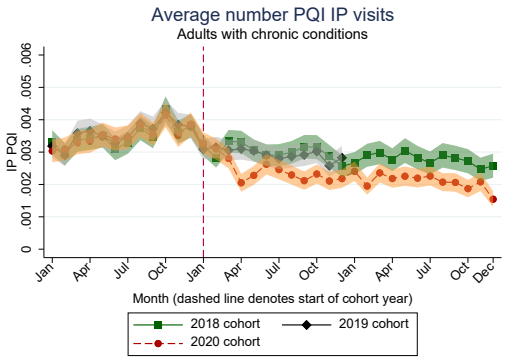
a. Average Inpatient visits – all types



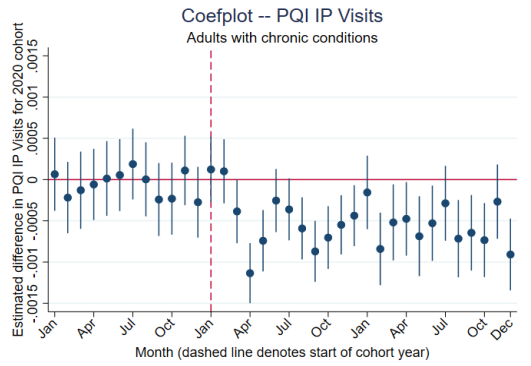
b. 2020-cohort reg-adjusted differences in IP visits



c. Average PQI Inpatient visits



d. 2020-cohort reg-adjusted differences in PQI IP visits



Notes: Panel a. plots the average number of inpatient visits for each cohort over time. Panel b. plots the coefficients on the interaction between the 2020 cohort and the month relative to cohort start date from the regression specification described in Equation 1 in Section 2. Panel c. and d. show the similar patterns for average number of inpatient visits, but limited to those with a PQI diagnosis.

4.3 ED and Inpatient Visit Patterns by Disease Category and Enrollee Sub-groups.

In this subsection we present analysis that partially disaggregates the visit patterns explored in the prior two subsections. Rather than focusing on the full sample of enrollees with chronic diseases and averages in overall visit rates across categories, we dive more into specific chronic diseases and sub-populations.

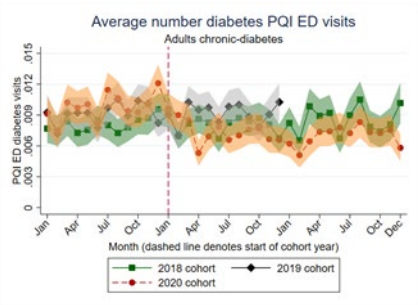
In **Figure 9**, we show PQI ED and inpatient series separately for diabetes, hypertension, asthma or COPD, and anxiety or depression. In each series, we limit to the enrollees who had a

prior diagnosis for each condition. These graphs suggest some reasons for the drops in overall ED and inpatient trends observed in the prior subsections. Asthma and COPD PQI ED visits were significantly lower in 2020 and inpatient admissions for these categories also appear meaningfully lower, though our estimates for inpatient admissions once we limit to specific disease categories are somewhat imprecise. While we cannot conclusively determine the source of these reductions, a plausible conjecture is that reductions in interpersonal contact through the 2020 pandemic period may have reduced respiratory infections overall for those with asthma and COPD. We also see sizeable declines in ED and inpatient admissions for depression and anxiety in 2020. These patterns are harder to reconcile with other reports suggesting general worsening of mental health through 2020 (Daly et al., 2020; Giuntella et al., 2021). For both diabetes and hypertension, the rates of ED and inpatient visits look much more similar in 2020 relative to prior cohort years. While these series are all somewhat noisy given the rarer nature of visits for specific disease complications and the isolation on a smaller sample with that particular diagnosis, there is no evidence of rising or falling rates of adverse events related to these disease categories. In appendix Figure A4, we provide the regression coefficient plots of the series.

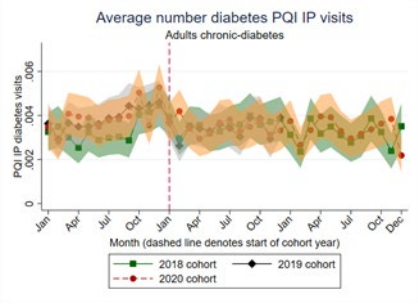
Another potentially valuable way to disaggregate the results is to focus on even smaller subsets of the enrollee population who are more likely to be vulnerable to adverse events. We also investigate the patterns for the subset of enrollees with chronic diseases in each cohort who had a prior ED visit or IP admission with a PQI diagnosis related to chronic disease. In this way we isolate on a group of members with chronic conditions who appear to have needed emergent or inpatient care related to their chronic conditions at some time in the prior year. We identify 32,878 members in the 2020 cohort (26.7% of total chronic population), 31,537 members in the 2019 cohort (25.9% of total chronic population), and 31,474 members in the 2018 cohort (25.6% of total chronic population) with these prior PQI-related ED or inpatient visits.

Figure 9. PQI ED and IP Visit Patterns – Disease Category

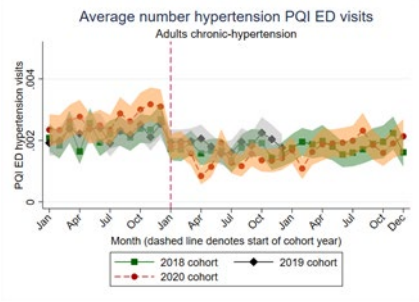
a. Diabetes PQI ED visits



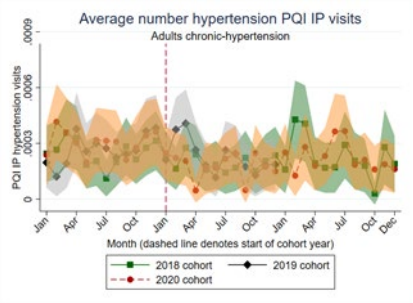
b. Diabetes PQI IP visits



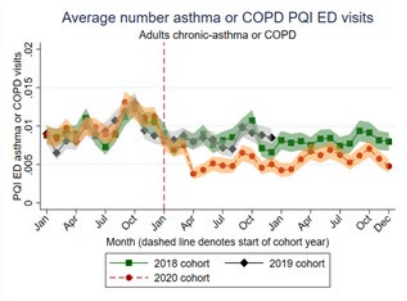
c. Hypertension PQI ED visits



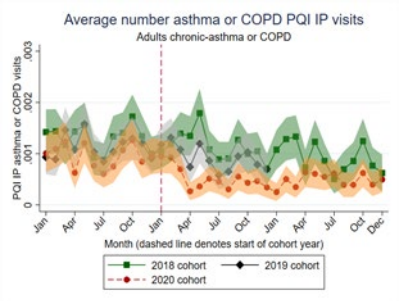
d. Hypertension PQI IP visits



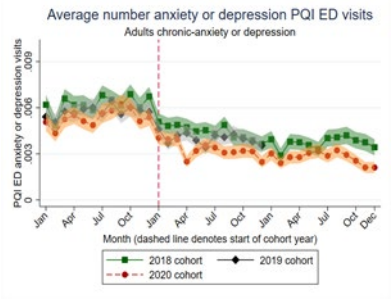
e. Asthma or COPD PQI ED visits



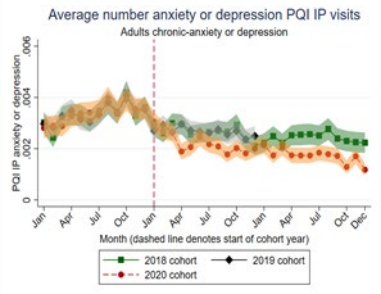
f. Asthma or COPD PQI IP visits



g. Anxiety or depression PQI ED visits



h. Anxiety or depression PQI IP visits

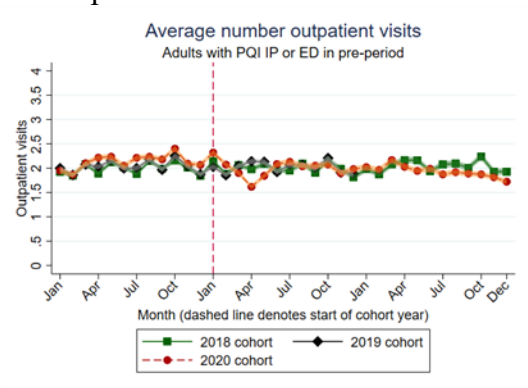


Notes: Panel a. and b. plot the average number of visits for members with diabetes over time. Panel c. and d. show the similar patterns for members with hypertension. Panel e. and f. show the similar patterns for members with asthma or COPD. Panel g. and h. show the similar patterns for members with anxiety or depression.

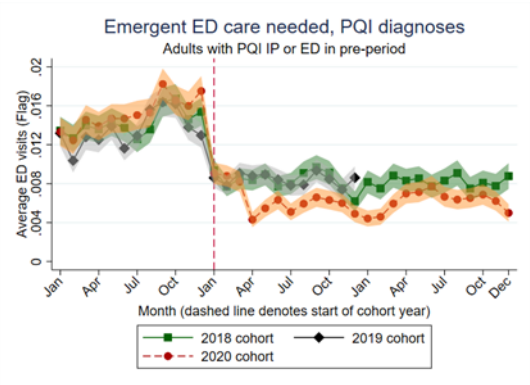
Figure 10 shows patterns of utilization for this group. Figure 10a shows that this group had a very similar overall pattern of outpatient visits as documented for the broader group of members with chronic diseases, with a sharp drop in March – May 2020 followed by a return to historical levels of total outpatient visits thereafter.

Figure 10. Utilization Patterns for those with prior PQI-related ED or IP visits

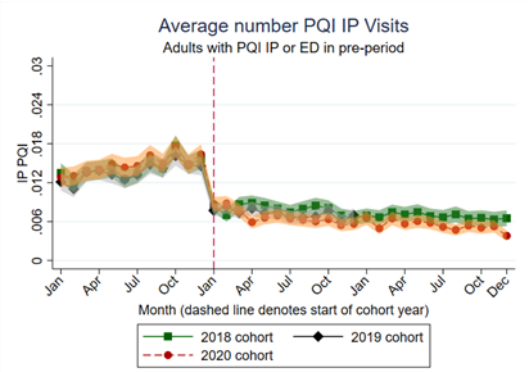
a. Outpatient visits



b. PQI ED w/ NYU category ED care needed



c. PQI IP visits



Notes: These graphs show the utilization patterns for members with chronic conditions who had emergent or inpatient PQI visits related to their chronic conditions at some time in the prior year. Panel a. shows analogous patterns to Figure 2a, average number of outpatient visits. Panel b. shows the rate of ED visits with a PQI diagnosis that also scored a 0.5 or higher on the NYU algorithm for falling into one of the two categories of "ED care needed". Panel c. shows analogous patterns to Figure 8c, average number of PQI inpatient visits

The level of outpatient visits is higher for this group than the broader group of members with chronic conditions, but in April 2020 their reduction in visits was similar at around 26% lower than historical norms. Figure 10b analyzes the rate of ED visits with a PQI diagnosis that also scored a 0.5 or higher on the NYU algorithm for falling into one of the two categories of "ED care needed" (see Panels c and d of Figure 7). Here again we see a persistent drop throughout 2020, suggesting that even when we isolate to a group with a history of ED and IP admissions for chronic diseases and focus on ED visits related to chronic diseases that are classified as being

likely ED necessary, we still see reductions during 2020. Finally in Figure 10c we analyze rates of PQI inpatient admissions. The reductions relative to historical norms in this IP admissions are more modest, but again as we have seen in the analysis above there is no indication of a rise in admissions rates.

We then investigate these trends for those with 2 or more chronic conditions (results available in Appendix Figure A5). This group contains approximately 24% of all cohort members, or 56% of members with chronic conditions. The trends are quite similar to those for all chronic members and similar to our analysis for enrollees with prior hospitalizations, suggest that the patterns are robust to considering enrollees at higher risk for adverse chronic disease-related health events. We also split the chronic members by age group for a similar analysis. Both the younger (age 19-44, results in Appendix Figure A6) and older (age 45-64, results in Appendix Figure A7) groups show similar patterns as all chronic members, suggesting that the trends are not impacted much by age within this non-elderly population.

4.4 Additional Potential Indicators of Downstream Adverse Health Events

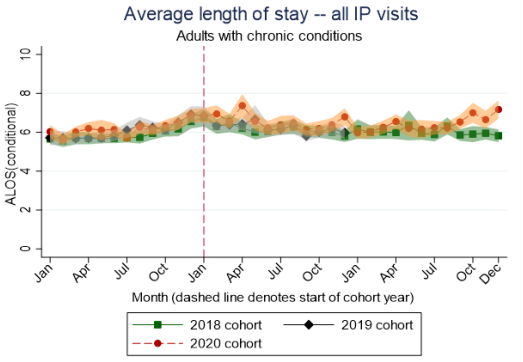
The evidence in the prior subsection shows that chronic disease related ED visits and hospitalizations were flat or lower during 2020, depending on the disease condition, relative to historical rates for this population. This lack of adverse events that come through the health system does not necessarily mean, though, that there was not a significant deterioration in health status. Changes to individuals' perceptions of the risks of health care and the operation of health systems during the COVID pandemic may have changed the thresholds for severity of illness at which people received care. For example, both PQI ED and inpatient admissions fell in December 2021 when COVID-19 inpatient admissions were especially high. While our reliance on insurance claims data for this study naturally prevents us from conclusively analyzing this issue, in this subsection we present a series of additional analyses that helps to shed light on whether the patterns of utilization observed thus far might be masking a trend of rising adverse health events.

Our first additional analysis focuses on hospital length of stay. If reductions in hospitalizations were primarily driven by changes in thresholds for severity when patients come to the hospital, we might expect to see a pattern of rising hospital length of stay conditional on an inpatient admission throughout 2020. In **Figure 11** we plot the average inpatient length of stay for those with an inpatient admission over time. The average length of stay rose from a baseline of about 6 days to around 7 days in April 2020, which is consistent with the possibility that during the height of the disruption there were shifts in the severity of inpatient admissions.

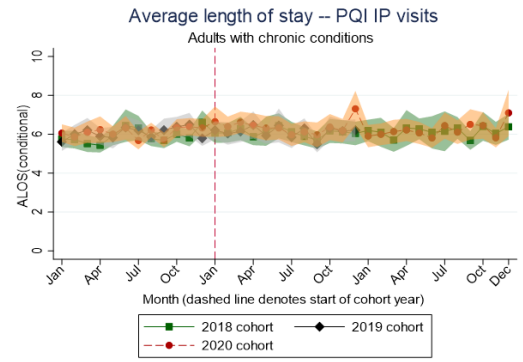
Throughout most of the remainder of 2020 the average length of stay was very similar to 2018 and 2019 and showed no evidence of an increase that might be expected if average admission severity was rising over time due to poorly managed chronic diseases. However, there is some evidence of a tick up in average length of stay in November and December 2020 as well as October to December 2021, coinciding with the peak of COVID-19 admissions. The fact that length of stay fell back to historical levels in early 2021 is again suggestive that the IP visit volumes are not masking a rising trend in more severe admissions for poorly-controlled chronic diseases among this population. PQI-related IP admissions show a similar pattern for average length of stay as all IP admissions, but with a wider confidence interval. In Appendix Figure A8 we plot the 90th percentiles of inpatient length of stay by cohort for all chronic members and members by age group, using the 90th percentile as an indicator for the most severe stays. The 90th percentiles of length of stays vary between 10 to 12 days. While the overall trend stays stable, the 90th percentiles for older group (age 45-64) during COVID-19 peaks are higher.

Figure 11. Average Inpatient Length of Stay

a. Length of stay -- All Inpatient Visits



b. Length of stay – PQI Inpatient Visits



Notes: Panel a. shows the average length of stay of all inpatient admissions for each cohort over time. The average length of stay is conditional on having an inpatient admission. Panel b. shows the average length of stay of PQI inpatient admissions excluding COVID admission for each cohort over time.

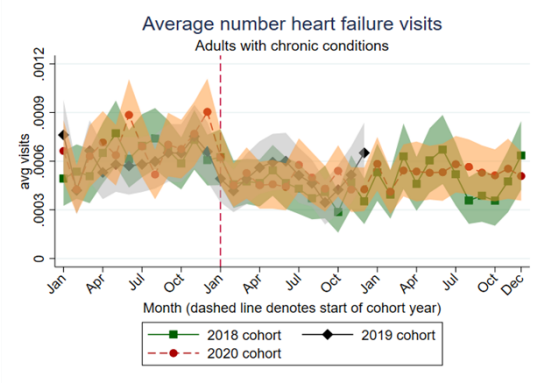
As a second approach we focus on episodes of cardiac arrest and acute heart failure. Although they are relatively rare, the reason to focus on these specific incidents is that they are both potentially associated with poorly controlled chronic diseases (especially for those with diabetes and/or hypertension) and are the type of event for which a person is highly likely to seek medical care.

In **Figure 12**, we show trends in visits in ED and inpatient with diagnoses related to cardiac arrest and acute heart failure. The overall patterns in this figure show a fairly stable rate

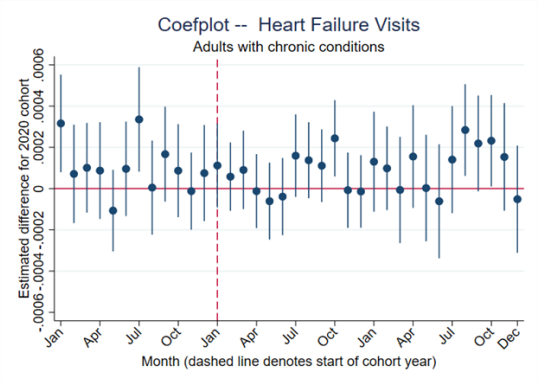
of cardiac arrest and acute heart failure events for the 2020 cohort compared to early cohorts. Additionally, we restricted the sample to individuals with a prior diagnosis of hypertension, as inadequate management of hypertension could lead to heart problems. Within this subgroup, the average rate of acute heart failure and cardiac arrest is predictably higher, but again there are no differential trends for the 2020 cohort. This series does not show the same type of reductions in volumes we observe for other ED and inpatient visit rates, which may suggest that the reductions observed in the broader series include reductions for some potentially avoidable services. We interpret the evidence in Figure 12 as additional evidence that overall health conditions did not meaningfully deteriorate for this population in 2020 relative to earlier cohorts.

Figure 12. Trends in acute heart failure and cardiac arrest

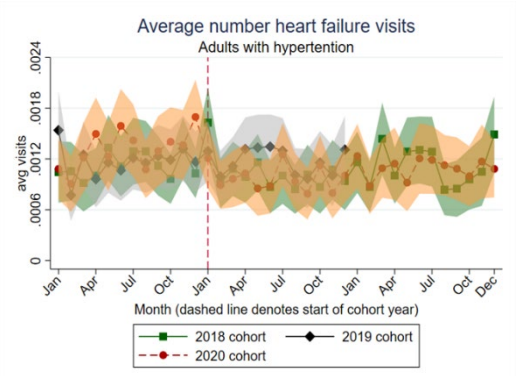
a. Average heart failure visits



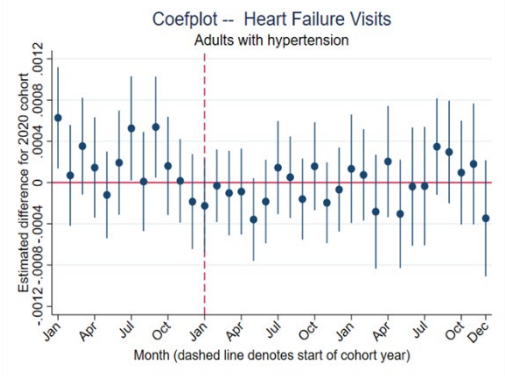
b. 2020-cohort reg-adjusted differences in heart failure visits



c. Average heart failure visits – hypertension members



d. 2020-cohort reg-adjusted differences in heart failure visits – hypertension members



Note: Panel a. plots the average number of heart failure visits for each cohort over time. Panel b. plots the coefficients on the interaction between the 2020 cohort and the month relative to cohort start date from the regression specification described in Equation 1 in Section 2. Panel c. and d. show the similar patterns for average number of heart failure visits, but limited to those with a prior hypertension diagnosis. We use ICD-10 codes to identify the visits in inpatient or emergency departments. The diagnoses include acute myocardial infarction, acute heart failure, cardiac arrest, ventricular fibrillation, ventricular flutter, hypertensive crisis, and hypertensive emergency.

In **Table 3** we provide regression results to help summarize the effects we have observed in Section 4 for downstream outcomes. We present the average estimated difference in the monthly rates of the outcomes from July 2020 to December 2021 for the 2020 cohort relative to the average from July 2018 through December 2019 for the 2018 cohort and July through December 2019 for 2019 cohort (see Table 3 notes for regression details).[12] Looking at the results we see that nearly all estimated effects are negative, and often with significant percentage reductions. The exceptions are for ED or IP visits for heart failure and cardiac arrest for those with a prior hypertension diagnosis, IP visits with a hypertension PQI diagnosis for those with a prior hypertension diagnosis, and the IP length of stay measures. For heart failure and cardiac arrest and IP visits with a hypertension PQI diagnosis, we measure an average increase in the rate of 12% and 11% respectively for the 2020 cohort, however, both are rare outcomes, and the standard errors are larger than the estimated effect, implying wide 95% confidence intervals that include zero difference. The estimated average increase in the IP length of stay measures is modest and can be explained by the temporary increases during peak COVID-admissions periods discussed above. Overall, the table helps to provide a brief summary of the key result that across a range of measures of health care utilization that could be associated with a deterioration in health for members with chronic diseases, we fail to detect any long run increases and typically detect decreases after the start of the public health emergency.

[12] As a robustness measure, we conducted additional regression analyses by excluding the 2019 cohort, focusing solely on the 2018 cohort as our baseline. The outcomes closely align with the current results, indicating a substantial similarity between the analyses despite the absence of the 2019 cohort.

Table 3. Regression Results Summary for Downstream Outcomes

Utilitzation measure	Figure(s)	Avg. monthly rate per 1,000 members in the 2019 & 2018 cohort	Estimated avg. difference in rate per 1,000 members for 2020 cohort	Standard error of estimated difference	Estimated avg. difference as percent change
ED visits all types	6a,b	123.3	-19.10	0.690	-15.5%
ED visits with any PQI diagnosis	6c,d	7.9	-1.69	0.128	-21.4%
ED visits by PQI diagnosis:					
Diabetes	9a	8.6	-1.73	0.322	-20.0%
Hypertension	9c	1.8	-0.17	0.094	-9.2%
Asthma or COPD	9e	8.3	-2.69	0.264	-32.4%
Anxiety or depression	9g	3.9	-1.21	0.098	-31.0%
ED visit flagged by NYU algorithm:					
Not emergent	7a	29.9	-8.90	0.240	-29.8%
Primary-care treatable	7b	23.4	-4.96	0.208	-21.2%
Preventable/avoidable	7c	6.6	-1.51	0.114	-23.1%
Not preventable/avoidable	7d	10.5	-0.94	0.135	-9.0%
Inpatient (IP) visits all types	8a,b	17.7	-1.90	0.181	-10.7%
IP visits with any PQI diagnosis	8c,d	2.8	-0.60	0.066	-21.1%
IP visits by PQI diagnosis:					
Diabetes	9b	3.4	-0.10	0.208	-3.1%
Hypertension	9d	0.2	0.02	0.031	11.2%
Asthma or COPD	9f	0.9	-0.32	0.056	-34.9%
Anxiety or depression	9h	2.5	-0.78	0.071	-31.0%
ED or IP visits for heart failure among those with prior hypertension diagnosis	12c,d	0.5	0.05	0.071	11.7%
		Avg. days in 2019 & 2018 cohorts	**Estimated avg. difference in days for 2020 cohort**		
IP length of stay all visits	11a	6.1	0.47	0.068	7.8%
IP length of stay visits with PQI diagnosis	11b	6.1	0.34	0.114	5.6%

Notes: This table presents a quantitative summary of utilization measures during the "downstream period". We use regressions with a similar structure as mentioned in section 2: $y_{ip} = \alpha + \delta_p + \beta_p I_i^{2020} \delta_p + \theta X_i + \varepsilon_{ip,}$ where p denotes period relative to the start of the cohort year. We use 3 temporal categories: "before" representing the year prior to cohort year, "during" standing for January to June of the cohort year, and "after" spanning from July of the cohort year until the end (i.e., July 2018 through December 2019 for the 2018 cohort, July through December 2019 for 2019 cohort, and July 2020 to December 2021 for the 2020 cohort). The effects captured by the β_p estimates are effects relative to the average outcomes observed across the two preceding cohorts specifically during the "after" period. Standard errors are clustered at the individual level. The tabulated averages represent rates observed during the "after" period.

As a final piece of evidence, we turn to data on mortality for this population. The records available to us are administrative data from the state Medicaid program with indicators for members who have died at the monthly level. Unfortunately, these data do not come from vital statistics and we have no information on the cause of death.

Figure 13a plots the average monthly mortality rates among adult Medicaid members with a prior chronic disease diagnosis (deaths per enrolled member) by quarter of the year from

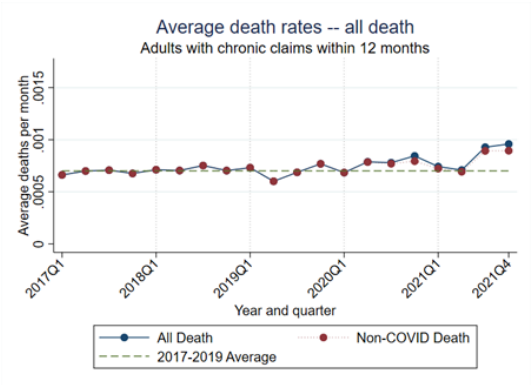
2017 through the last quarter of 2021.[13] For this period, deaths have ranged from 6 to 10 per 10,000 members monthly. The average monthly mortality rate from 2017 through 2019 (7 per 10,000) is plotted as a horizontal line for reference. The mortality rates during the first three quarters of 2020 were at or slightly above the longer-run average but very similar to those observed in the last quarter of 2019. There was then a modest rise in the mortality rate in the fourth quarter of 2020, coinciding with the winter 2020 wave of the COVID-19 pandemic, which was followed by mortality rates similar to the long-run average in the first two quarters of 2021. The rate rose again more dramatically in the third and fourth quarter of 2021, which coincides with a wave of COVID-19 infections and hospitalizations in Wisconsin (see Appendix Figure A.2.). Overall, there is no clear rising trend in mortality that would be associated with gradual worsening of chronic disease management.

The data are, however, consistent with COVID-19 having an impact on mortality. Panel c and e show rates of deaths without and with a medical visit in the month prior to death, respectively. Panel e also shows the rates of death with a recent visit and COVID-19 diagnosis. The small spike in mortality at the end of 2020 appears to be fully explainable by increases for those with a COVID-19 diagnosis. The increase in deaths in the second half of 2021, however, is more broad based. We interpret this evidence as suggestive that the second half of 2021, when hospitals had large COVID-19 admissions volumes to handle, led to increases in mortality for this population that could plausibly be related to a combination of undiagnosed COVID-19 complications as well as the adverse effects of avoidance or lack of access to acute hospital care. There is little reason to suspect, however, that these sharp rises in mortality coincident with the wave of COVID-19 infections result from a decrease in utilization among individuals with chronic-disease during the outpatient disruptions in early 2020.

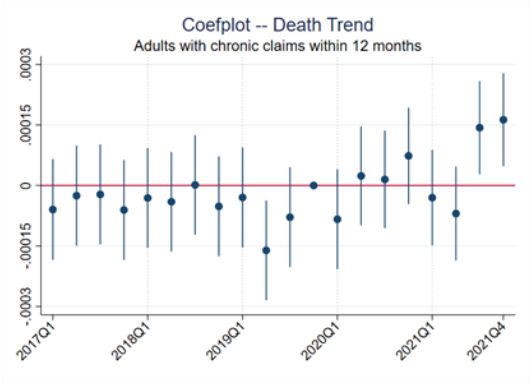
[13] For this analysis we do not limit the sample to those enrolled in February of a given year like we do for our main cohort comparisons. Instead, we look at each adult member enrolled in Medicaid in a particular month and then check if the member had any visits with a chronic disease diagnosis in a 12-month lookback period.

Figure 13. Average mortality rates

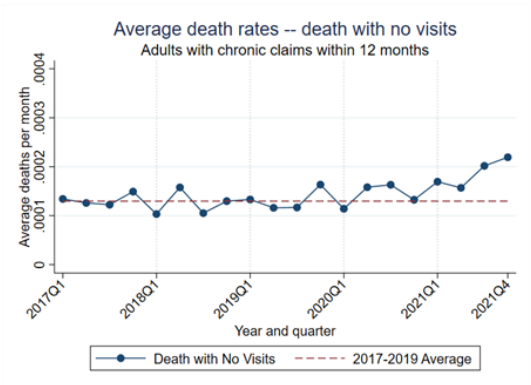
a. Average death rate -- all death



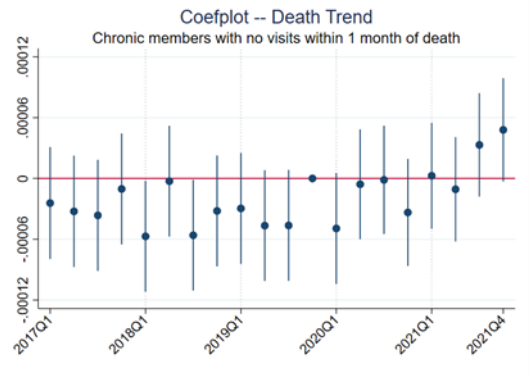
b. reg-adjusted differences in death rate



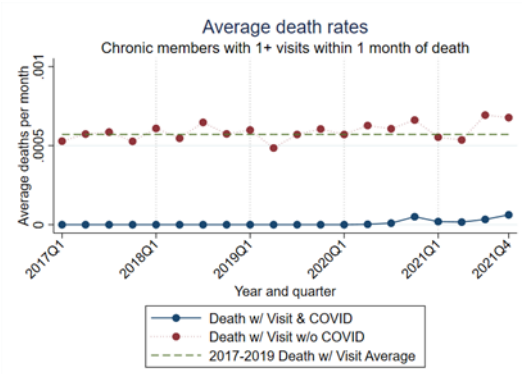
c. Average death rate -- death with no visits



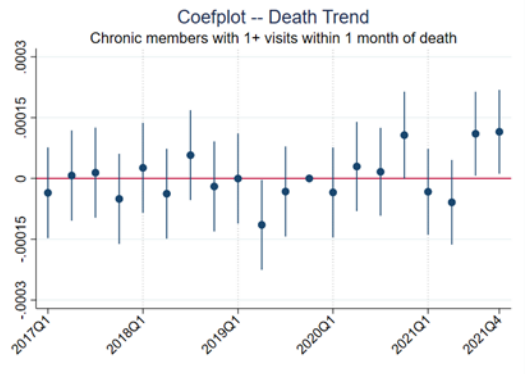
d. reg-adjusted differences in death rate (no visits)



e. Average death rate – death with 1+ visits



f. reg-adjusted differences in death rate (1+ visits)



Notes: Panel a. plots the average death rates for members who had visits with a chronic disease diagnosis in the 12-month lookback period. This panel also includes a series for deaths that occurred without a COVID-19 diagnosis (note that deaths with a COVID-19 diagnosis were not necessarily caused by COVID-19). Panel b. plots the coefficients on quarter of year dummies in a regression of an indicator for death on time effects and individual-level characteristics as described in the text. The omitted category is the last quarter of 2019. Panel c. and d. show the similar patterns for average death rates, but limited to death without any insured health care visits within one month of death. Panel e. and f. show the patterns for average death rates, limited to death with at least 1 insured health care visits within one month of death.

Figure 13b presents regression coefficients on quarter of year dummies in a regression of an indicator for death in a month on these quarter-of-year indicators as well as controls for age, gender, income levels, and coverage category (childless adult vs. parent/caregiver), which help to account for observable changes in the composition of members over time. The omitted category is the last quarter of 2019, so the points in the figure can be interpreted as the estimated difference in death rate relative to the last quarter of 2019. The regression results are consistent with the unadjusted patterns discussed above.

5. Conclusion

This study evaluates the health care utilization patterns of non-elderly adult Medicaid beneficiaries with chronic diseases during the first year of the COVID-19 pandemic relative to cohorts of beneficiaries enrolled in prior years. We document that there were substantial reductions in outpatient visits from March – May 2020 but that outpatient utilization largely recovered to historical levels by June 2020. Similar trends also hold if outpatient visits are split into PCP and non-PCP visits or focus on common chronic-disease monitoring tests. There was, however, a meaningful and lasting shift in outpatient visits toward telehealth visits.

These reductions in outpatient utilization were not followed by subsequent increases in emergency department visits or inpatient admissions for this population during our study period. Across a range of analyses, including analyzing ACSC and restricting to those with past histories of adverse events or multiple comorbidities, we fail to detect any sign of rising ED or inpatient events and instead typically find modest decreases in these events throughout 2020 and 2021. Our examination of specific conditions suggests that a large part of the reduction in ED visits and hospitalizations came from reductions in events for respiratory conditions, which may suggest that some of these decreases represented real health improvements from social distancing and masking. We see less of a change for conditions like diabetes and do not detect any upward trend in visits for acute heart failure or cardiac arrest.

The results suggest that in the short to medium term, the Medicaid program in Wisconsin was able to manage disruptions to outpatient services at the onset of the pandemic in a way that did not result in clear deteriorations in health status for members with pre-existing chronic diseases. An important potential caveat is that our results are based on health care events that generate insured claims. It is possible that health conditions may have deteriorated without individuals seeking medical care in ways that are difficult to detect via claims data.

These results suggest a few potential implications and hypotheses worth investigating in future research. First, we may be learning that potentially vulnerable patients with chronic diseases can withstand short-term disruptions in access to care even if longer-run disruptions to that access would be detrimental. The fact that health systems were able to return to baseline outpatient visit volumes after three months may have been an important component of avoiding adverse downstream effects. Second, and relatedly, part of the ability to resume historical levels of outpatient visits came from the emergence of telehealth options. It is possible that telehealth might have been particularly effective relative to traditional modalities at helping to manage chronic diseases. Third, it is possible that patients and health systems were able to make substantial reductions in outpatient care volumes by effectively prioritizing those for whom that care was most valuable. If true, this would suggest that there is scope to reduce care for these populations, perhaps even for primary care, though the longer-term impact of such reductions remains unclear. That conjecture would be in line with prior work that has highlighted scope for care reductions without adverse effects, especially for specialty services (e.g., Skinner, 2011). We note, though, that within our data we do not detect any clear patterns of this type of prioritization. Care volumes fell in similar proportions for primary care and other types of care and for patients with more and less severe prior chronic disease episodes or multiple comorbidities. Nonetheless, it is likely that there is scope for prioritization based on finer levels of information available to patients and clinicians. From another angle, our results cannot speak to the resilience of older adult and elderly populations above age 65, who may be adversely affected by even short-term disruptions (Zeidan et al., 2022). Ultimately our results suggest there may be value in future studies that further explore these issues using more micro-level data on health outcomes and health care practices during the COVID-19 pandemic period.

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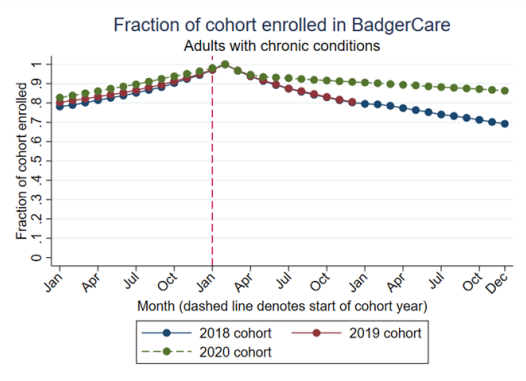
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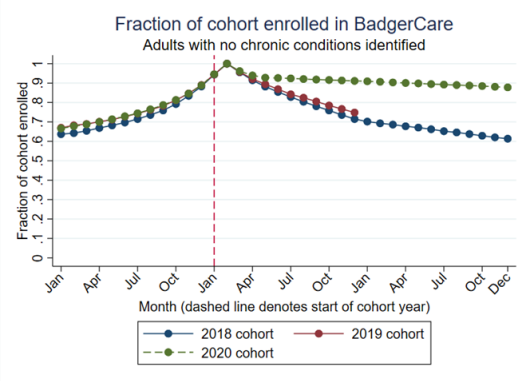
Appendix A: Additional Utilization Figures for Members with Chronic Disease

Figure A1. Enrollment Pattern by Members' Condition

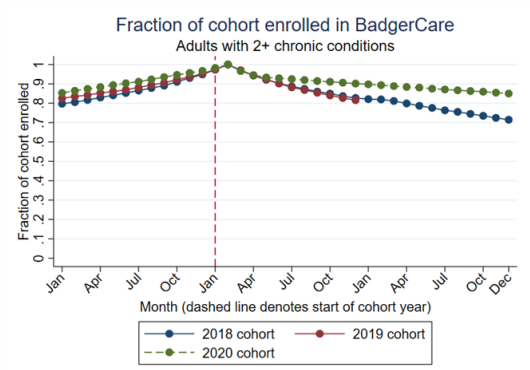
a. Enrollment pattern – chronic members



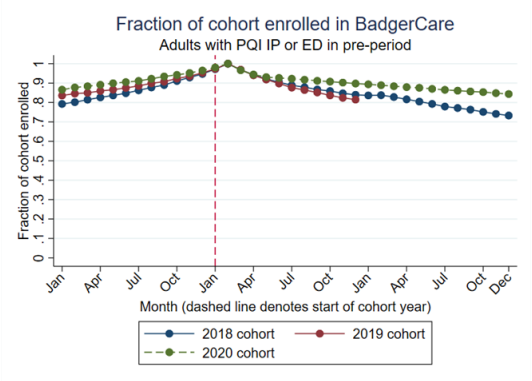
b. Enrollment pattern – non-chronic members



c. Enrollment pattern – members w/ 2+ chronic conditions

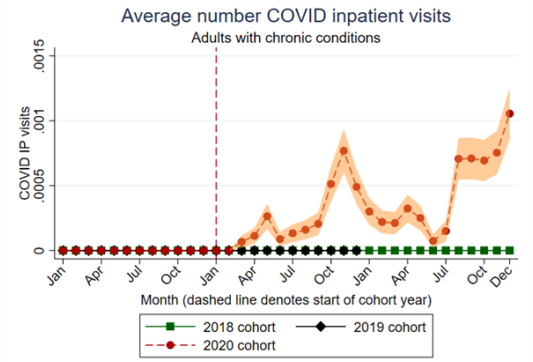


d. Enrollment pattern – members w/ prior PQI IP or ED visits



Notes: These figures plot the share of each cohort, defined as members enrolled as of February of each cohort year, who were also enrolled in months prior to and following February of the cohort year. We do not require continuous eligibility for this graph (e.g., allow for temporary exits and re-entry into Medicaid) so that a member of a cohort could contribute enrollment in some but not necessarily all prior or future months. Panel a. is for members with chronic condition detected in the prior year. Panel b. is for members with no chronic condition detected in the prior year. Panel c. is for members with at least 2 chronic conditions detected in the prior year. Panel d. is for members with PQI inpatient or ED visits in the prior year.

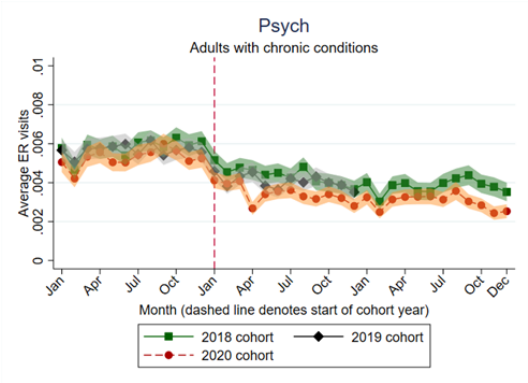
Figure A2. COVID Inpatient Visit Patterns



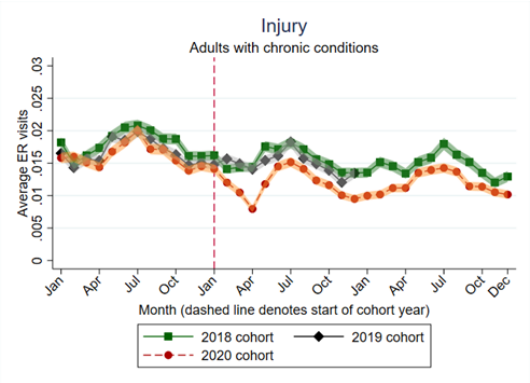
Notes: The graph plots the average number of inpatient visits with a COVID-19 diagnosis.

Figure A3. ED Visits by NYU-Algorithm Classification

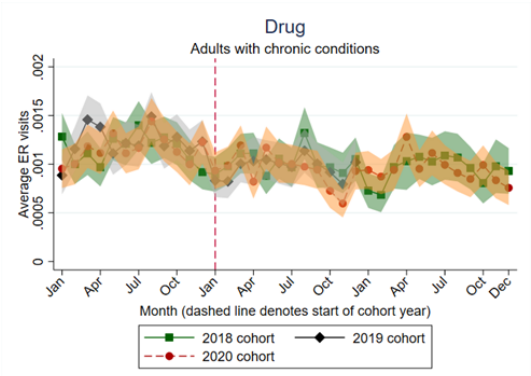
a. ED Psych visits



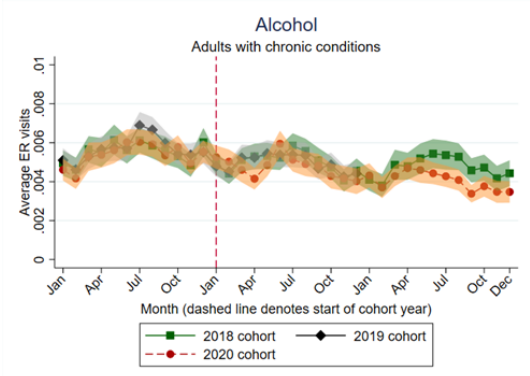
b. ED Injury visits



c. ED Drug visits



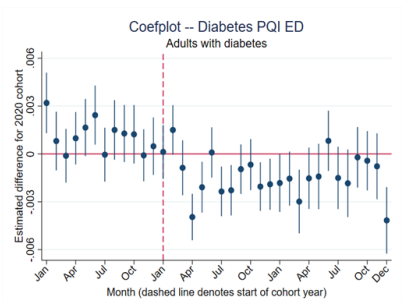
d. ED Alcohol visits



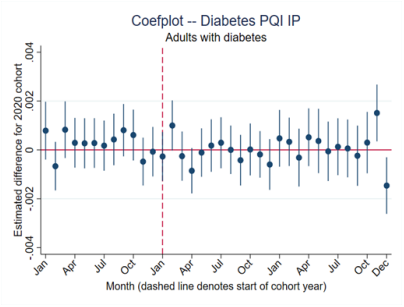
Notes: The NYU algorithm also provides separate classifications for visits with a primary diagnosis of injury, mental health problems, alcohol, or substance abuse. Panel a. shows average number of ED visits with a primary diagnosis of mental health problems. Panel b. shows average number of ED visits with a primary diagnosis of injury. Panel c. plots average number of ED visits with a primary diagnosis of substance abuse. Panel d. plots average number of ED visits with a primary diagnosis of alcohol.

Figure A4. 2020-Cohort Reg-Adjusted Differences in PQI ED and IP Visit by Disease Category

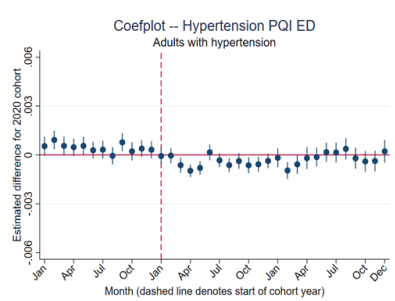
a. Diabetes PQI ED visits



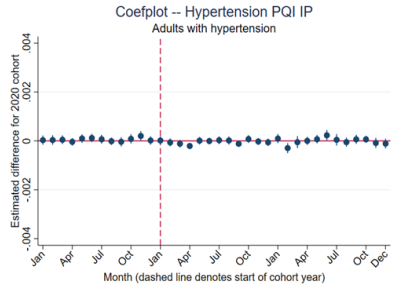
b. Diabetes PQI IP visits



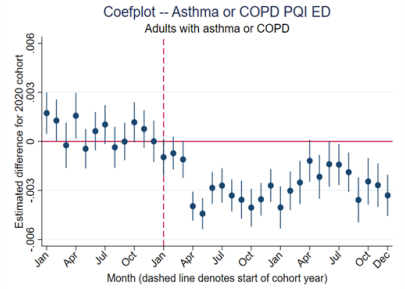
c. Hypertension PQI ED visits



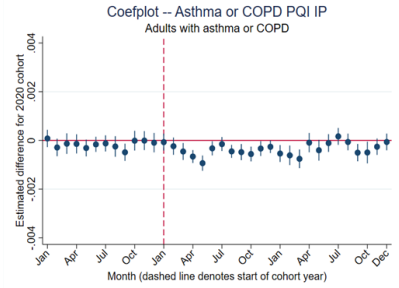
d. Hypertension PQI IP visits



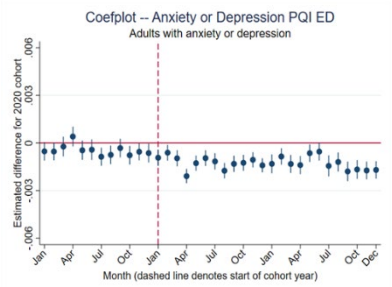
e. Asthma or COPD PQI ED visits



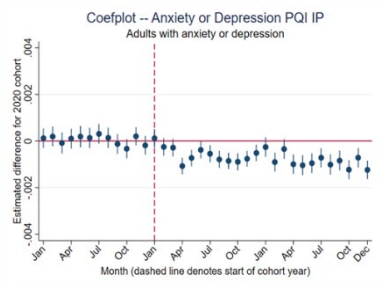
f. Asthma or COPD PQI IP visits



g. Anxiety or depression PQI ED visits



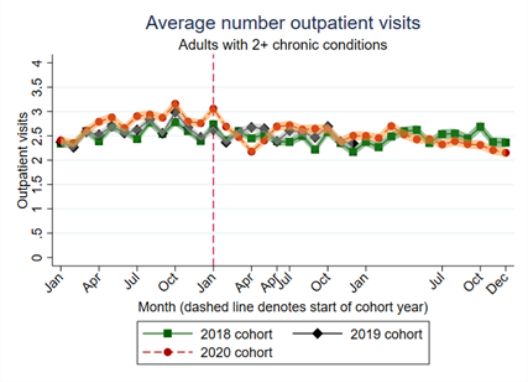
h. Anxiety or depression PQI IP visits



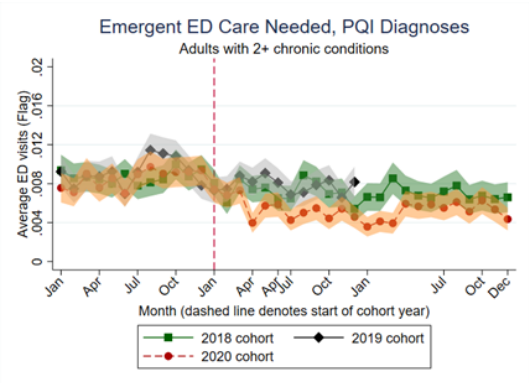
Notes: These series figures plot the coefficients on the interaction between the 2020 cohort and the month relative to cohort start date from the regression specification described in Equation 1 in Section 2. These points can be interpreted as the estimated change in the average number of outpatient visits in 2020 relative to the 2018 and 2019 cohorts for the equivalent month. Bars show the 95% confidence interval on the estimated difference.
Panel a. and b. are for members with diabetes over time. Panel c. and d. show similar patterns for members with hypertension. Panel e. and f. show the similar patterns for members with asthma or COPD. Panel g. and h. show similar patterns for members with anxiety or depression.

Figure A5 Utilization Patterns for Those with 2+ Chronic Conditions

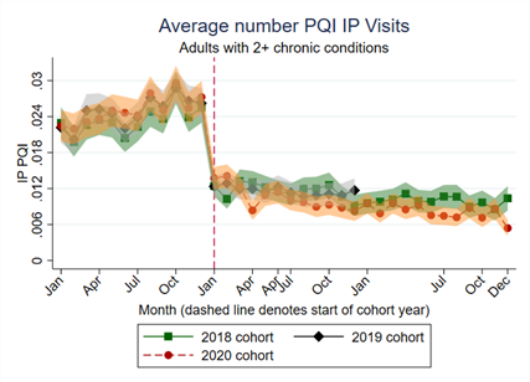
a. Outpatient visits



b. PQI ED w/ NYU category ED care needed



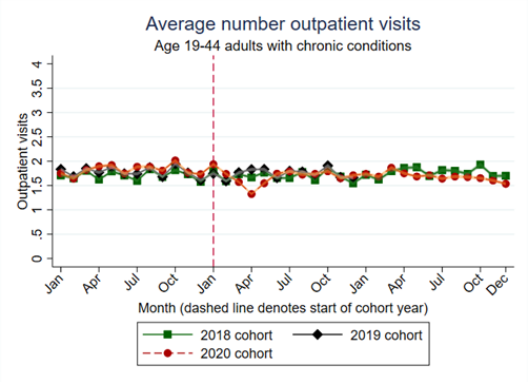
c. PQI IP visits



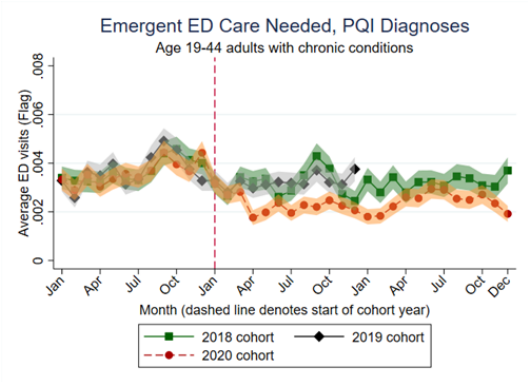
Notes: These graphs show the utilization patterns for members with 2 or more chronic conditions. Panel a. shows analogous patterns to Figure 2a, average number of outpatient visits. Panel b. shows the rate of ED visits with a PQI diagnosis that also scored a 0.5 or higher on the NYU algorithm for falling into one of the two categories of "ED care needed". Panel c. shows analogous patterns to Figure 8c, average number of PQI inpatient visits

Figure A6 Utilization Patterns for Age 19-44 Members

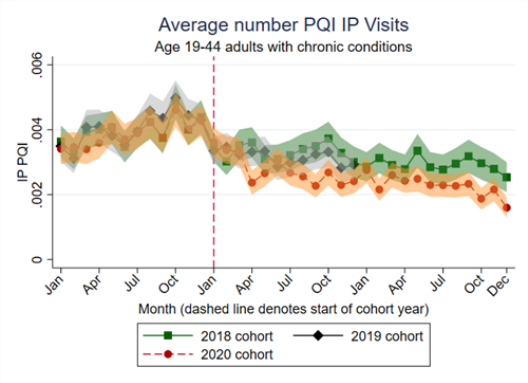
a. Outpatient visits



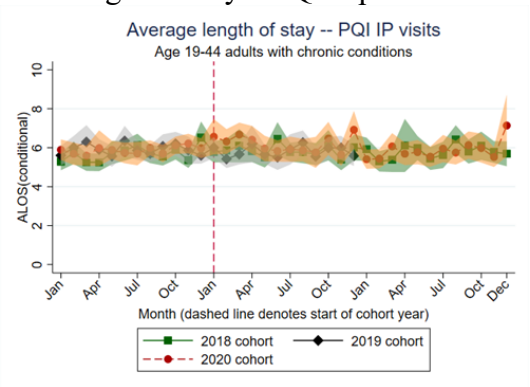
b. PQI ED w/ NYU category ED care needed



c. PQI IP visits



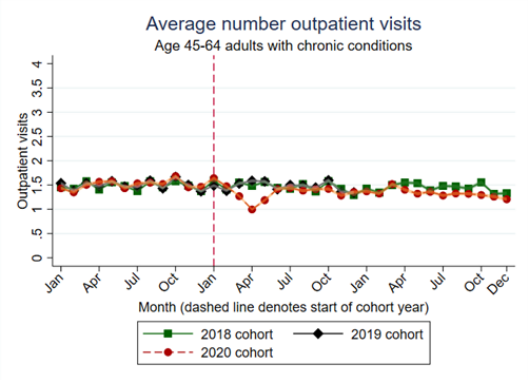
d. Length of stay – PQI Inpatient Visits



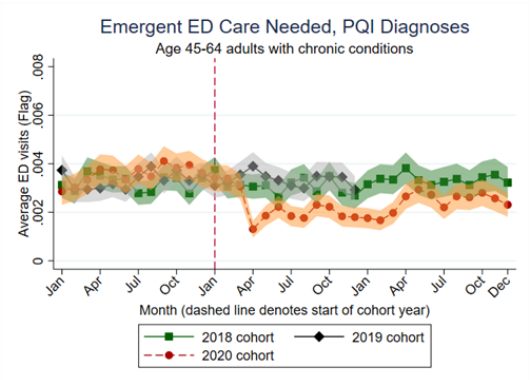
Notes: These graphs show the utilization patterns for members with chronic conditions and age between 19 and 44. Panel a. shows analogous patterns to Figure 2a, average number of outpatient visits. Panel b. shows the rate of ED visits with a PQI diagnosis that also scored a 0.5 or higher on the NYU algorithm for falling into one of the two categories of "ED care needed". Panel c. shows analogous patterns to Figure 8c, average number of PQI inpatient visits. Panel d. shows average length of stay of PQI inpatient admissions excluding COVID admissions for each cohort over time.

Figure A7 Utilization Patterns for Age 45-64 Members

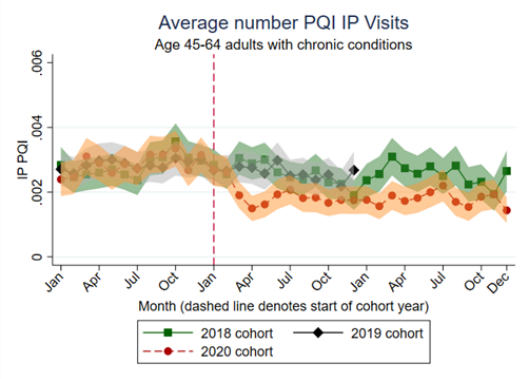
a. Outpatient visits



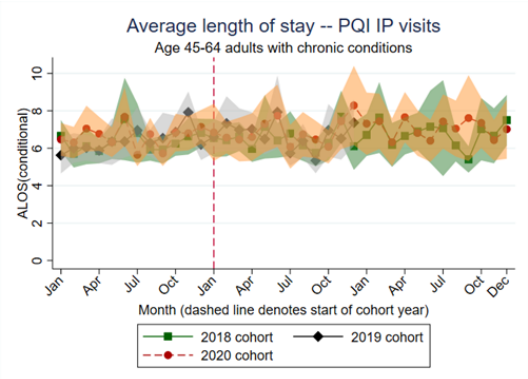
b. PQI ED w/ NYU category ED care needed



c. PQI IP visits



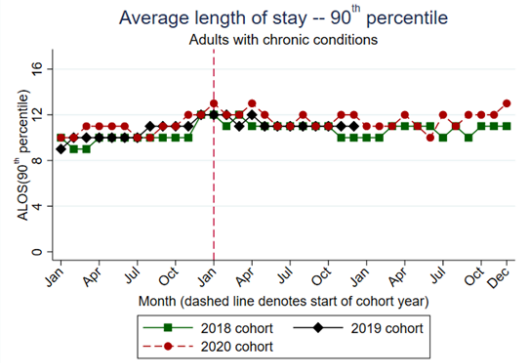
d. Length of stay – PQI Inpatient Visits



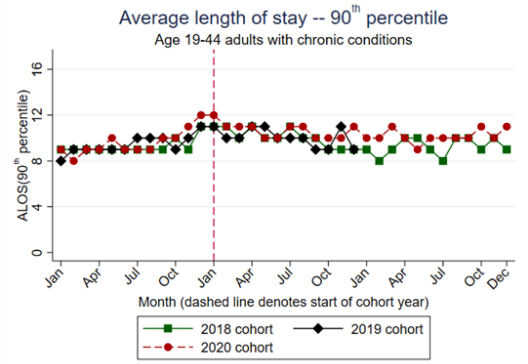
Notes: These graphs show the utilization patterns for members with chronic conditions and age between 45 and 64. Panel a. shows analogous patterns to Figure 2a, average number of outpatient visits. Panel b. shows the rate of ED visits with a PQI diagnosis that also scored a 0.5 or higher on the NYU algorithm for falling into one of the two categories of "ED care needed". Panel c. shows analogous patterns to Figure 8c, average number of PQI inpatient visits. Panel d. shows average length of stay of PQI inpatient admissions excluding COVID admissions for each cohort over time.

Figure A8 90th Percentiles for Length of Stay

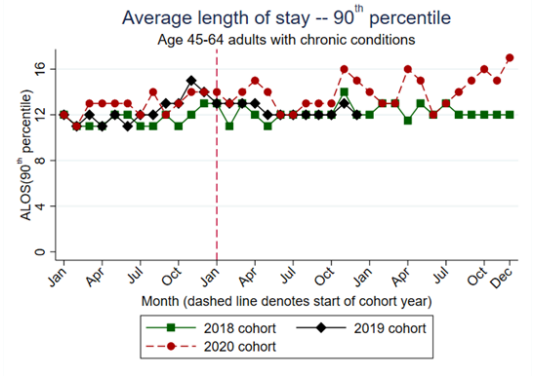
a. LOS 90th percentile – chronic members



b. LOS 90th percentile –age 19-44 chronic members



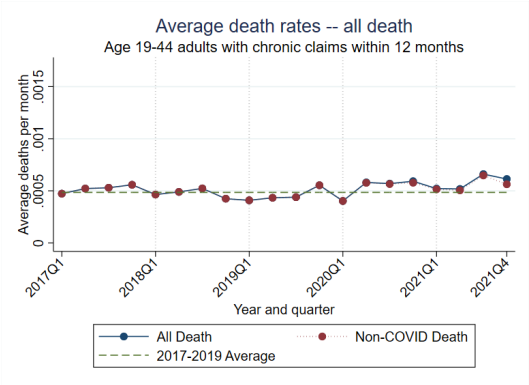
c. LOS 90th percentile –age 45-64 chronic members



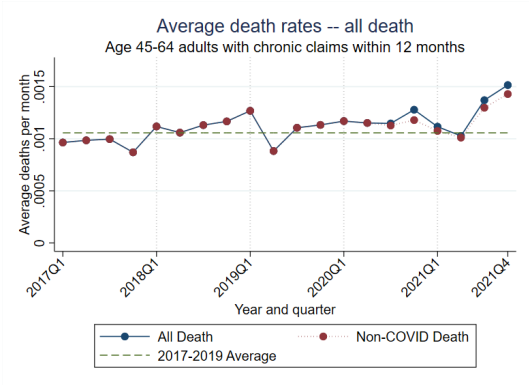
Notes: These graphs show the 90th percentile of length of stays in each month by cohort. Panel a. shows the trend for all chronic members. Panel b. shows the trend for chronic members between age 19 and 44. Panel c. shows the trend for chronic members between age 45 and 64.

Figure A9. Average Mortality Rates by Age Group

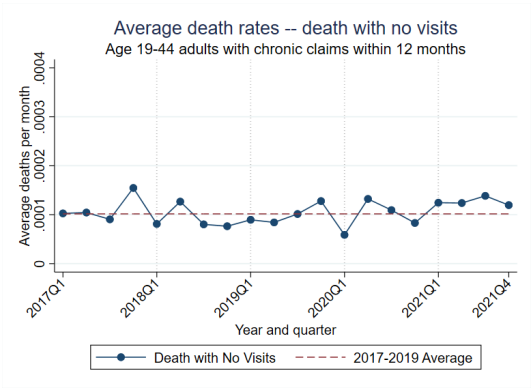
a. Death rate – age 19-44



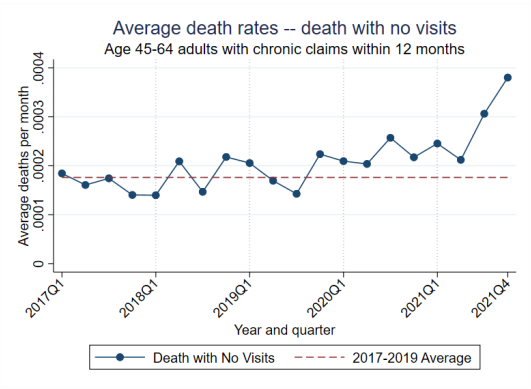
b. Death rate – age 45-64



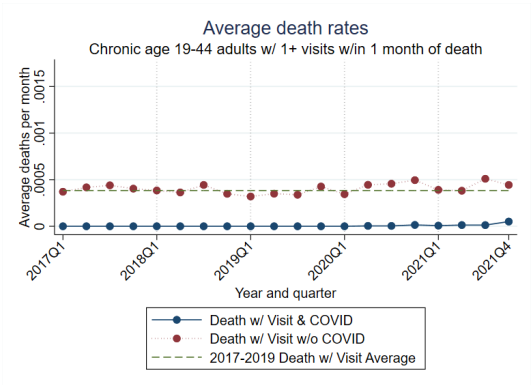
c. Death rate (no visit) – age 19-44



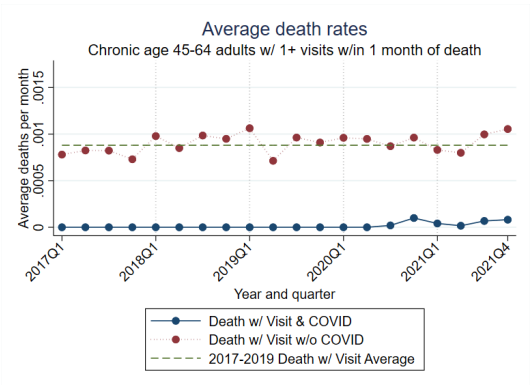
d. Death rate (no visit) – age 45-64



e. Death rate (1+ visit) – age 19-44



f. Death rate (1+ visit) – age 45-64



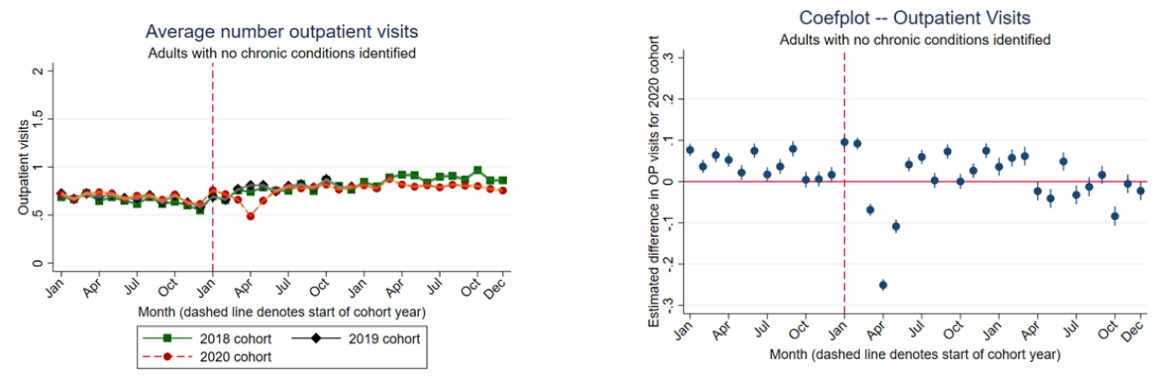
Notes: Panel a. plots the average death rates for members aged 19-44 who had visits with a chronic disease diagnosis in the rolling 12-month lookback period. Panel b. shows similar patterns for the age 45-64 group. Panels c. and d. plot patterns for average death rates among those who did not have any visits in or within one month of death, separated by the age groups 19-44 and 45-64. Panels e. and f. display the patterns for average death rates among those who had at least 1 insured healthcare visit within one month of death, also by age group.

Appendix B: Utilization for members without chronic conditions

In this appendix, we show the same set of graphs as for the chronic group. Results are qualitatively similar for members without chronic disease, but are more muted because those without chronic disease utilize services at substantially lower rates.

Figure B1. Outpatient Visit Patterns

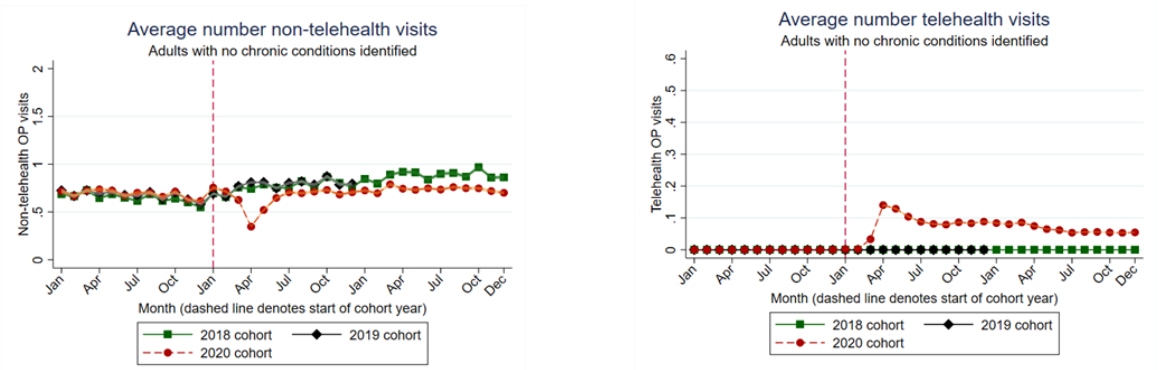
a. Averages per enrolled member b. 2020 regression-adjusted differences



Notes: Panel a. plots the average number of outpatient visits (defined as any office visit or other outpatient encounter, excluding emergency department and inpatient hospital services) for each cohort over time. Each graph is shaded with the 95% confidence interval on the mean for that month. Panel b. plots the coefficients on the interaction between the 2020 cohort and the month relative to cohort start date from the regression specification described in Equation 1 in Section 2. These points can be interpreted as the estimated change in the average number of outpatient visits in 2020 relative to the 2018 and 2019 cohorts for the equivalent month. Bars shows the 95% confidence interval on the estimated difference.

Figure B2. Outpatient Utilization – Telehealth and Non-telehealth

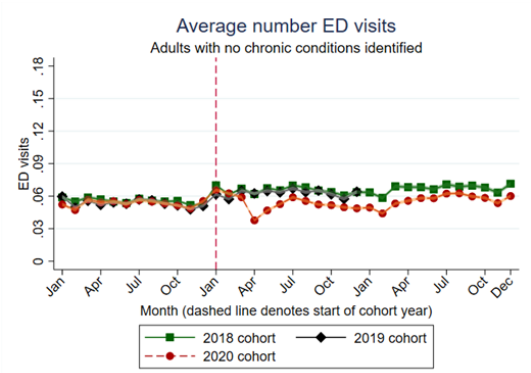
a. Non-telehealth visits b. Telehealth visits



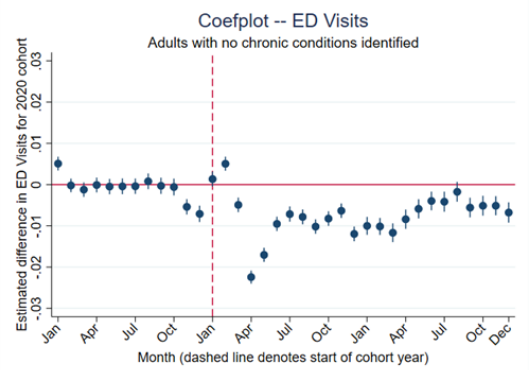
Notes: This graph shows analogous patterns to Figure 2a but dividing visits into non-telehealth (Panel a) and telehealth visits (Panel b).

Figure B3. Emergency Department Visit Patterns

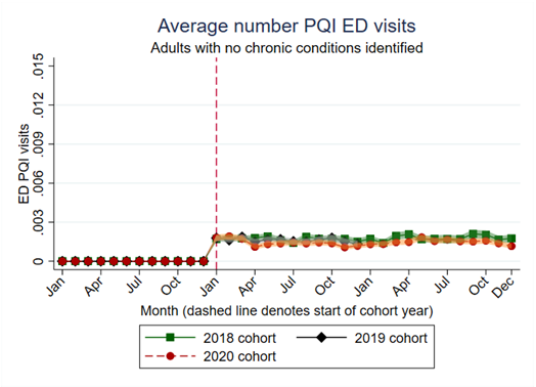
a. Average ED visits – all types



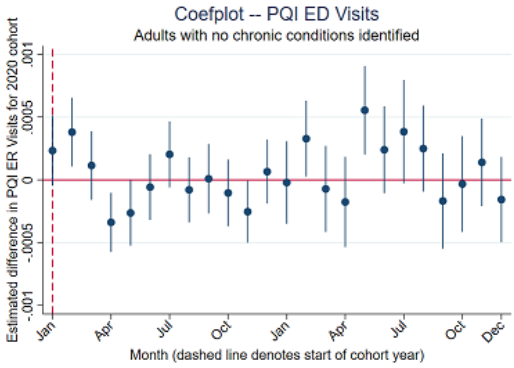
b. 2020-cohort reg-adjusted differences in ED visits



c. Average PQI ED visits



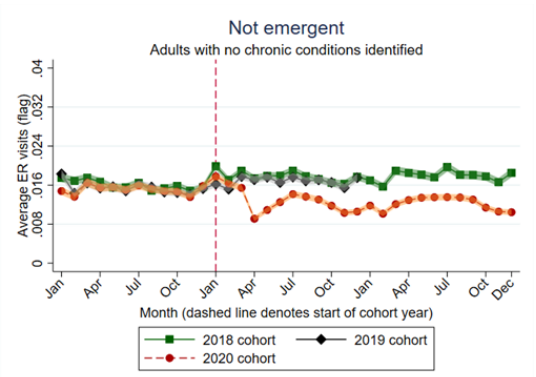
d. 2020-cohort reg-adjusted differences in PQI ED visits



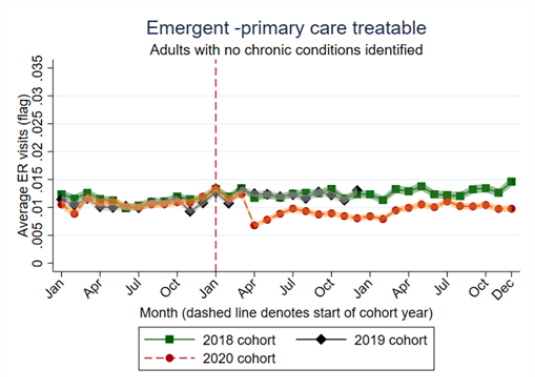
Note: Panel a. plots the average number of emergency department visits for each cohort over time. Panel b. plots the coefficients on the interaction between the 2020 cohort and the month relative to cohort start date from the regression specification described in Equation 1 in Section 2. Panel c. and d. show the similar patterns for average number of emergency department visits, but limited to those with a PQI diagnosis. The non-chronic group has no PQI visits in prior periods. We omitted the prior period in Panel d.

Figure B4. ED Visits by NYU-Algorithm Classification

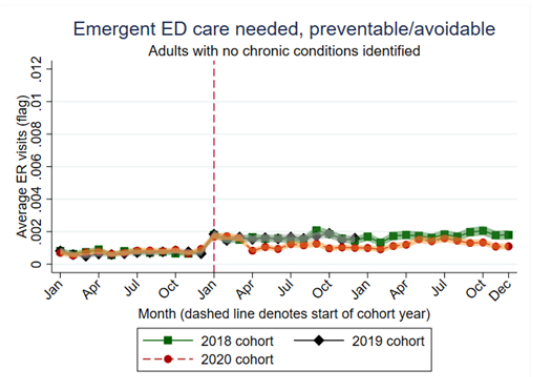
a. ED visits classified Not Emergent



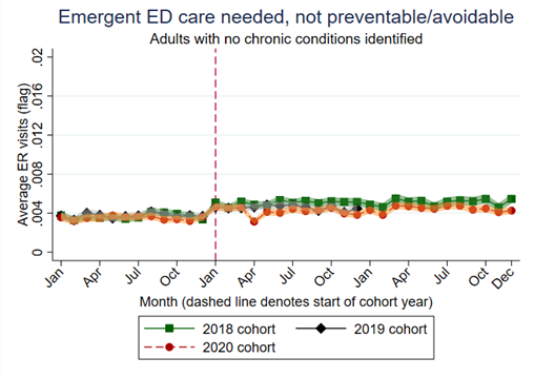
b. ED visits classified Primary-Care Treatable



c. ED visits classified Preventable/Avoidable



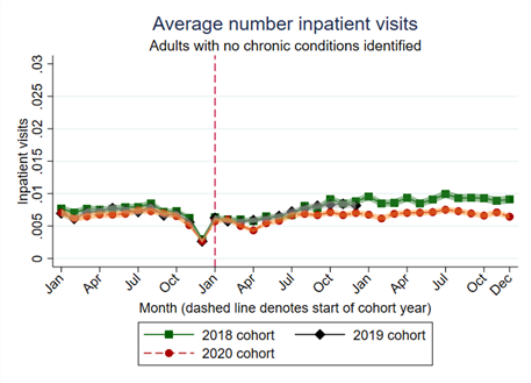
d. ED visits classified Not Preventable/Avoidable



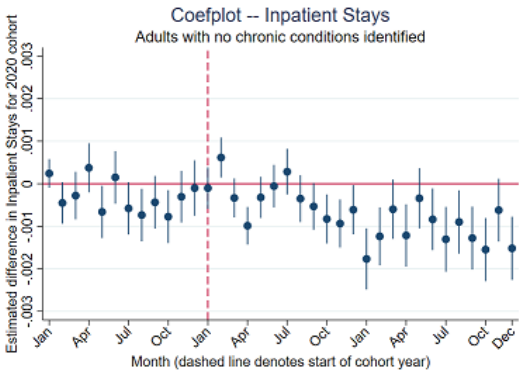
Notes: Panel a. plots the average number of ED visits with a 'not emergent' flag for each cohort over time. Panel b. plots the average number of ED visits with a 'primary care treatable' flag. Panel c. plots the average number of ED visits with a 'preventable/avoidable' flag. Panel d. plots the average number of ED visits with a 'not preventable/avoidable' flag.

Figure B5. Inpatient Visit Patterns

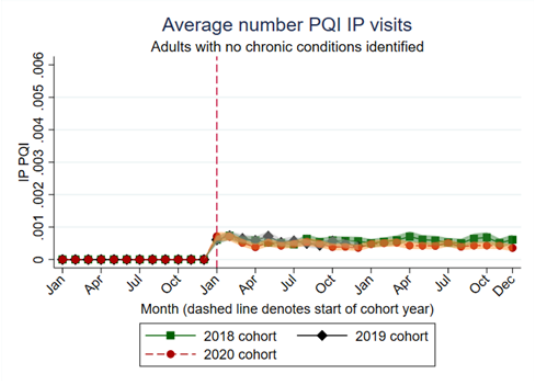
a. Average Inpatient visits – all types



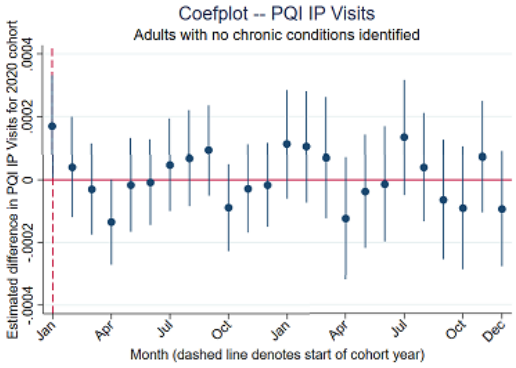
b. 2020-cohort reg-adjusted differences in IP visits



c.Average PQI Inpatient visits



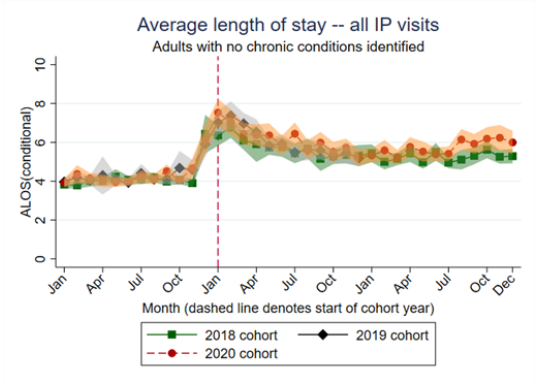
d. 2020-cohort reg-adjusted differences in PQI IP visits



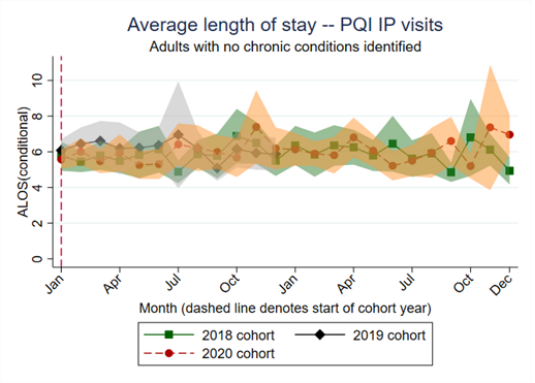
Notes: Panel a. plots the average number of inpatient visits for each cohort over time. Panel b. plots the coefficients on the interaction between the 2020 cohort and the month relative to cohort start date from the regression specification described in Equation 1 in Section 2. Panel c. and d. show the similar patterns for average number of inpatient visits, but limited to those with a PQI diagnosis. The non-chronic group has no PQI visits in prior periods. We omitted the prior period in Panel d.

Figure B6. Average Inpatient Length of Stay

a. Length of stay -- All Inpatient Visits



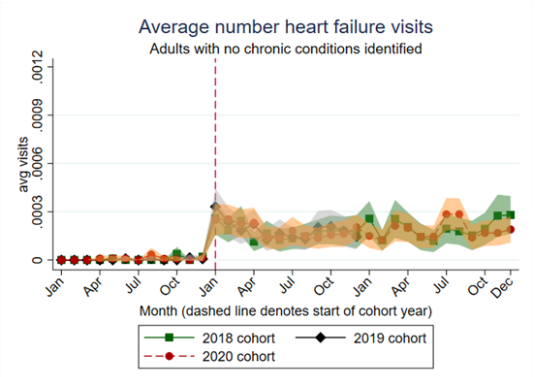
b. Length of stay – PQI Inpatient Visits



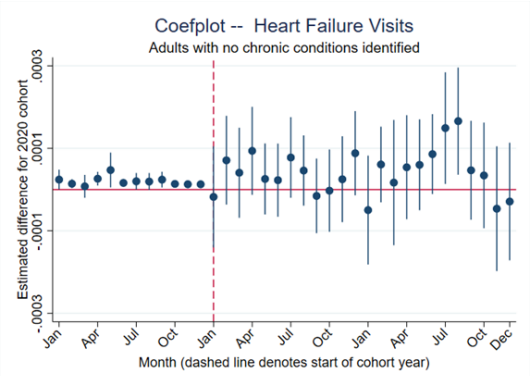
Notes: Panel a. shows the average length of stay of all inpatient admissions for each cohort over time. The average length of stay is the conditional version. Those who don't have an inpatient stay in the month will not be included in the denominator. Panel b. shows the average length of stay of PQI inpatient admissions excluding COVID admissions for each cohort over time. If the member had PQI inpatient visits in the prior period, he will be in chronic group. The non-chronic group has no record in prior periods. We omitted the prior period in Panel b.

Figure B7. Heart Failure Patterns

a. Average heart failure visits



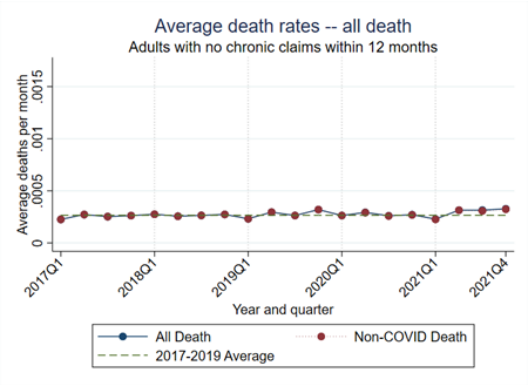
b. 2020-cohort reg-adjusted differences in heart failure visits



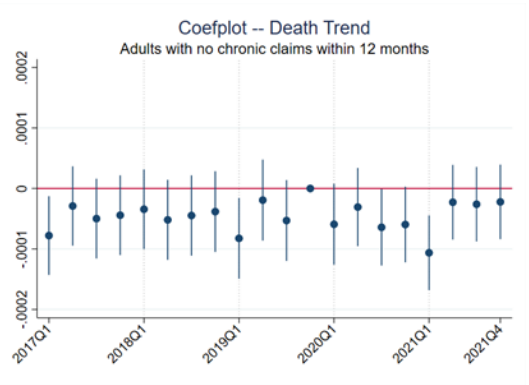
Notes: This graph shows the average number of heart failure visits for each cohort over time. We use ICD-10 codes to identify the visits. The diagnoses include acute myocardial infarction, acute heart failure, cardiac arrest, ventricular fibrillation, ventricular flutter, hypertensive crisis, and hypertensive emergency.

Figure B8. Average mortality rates

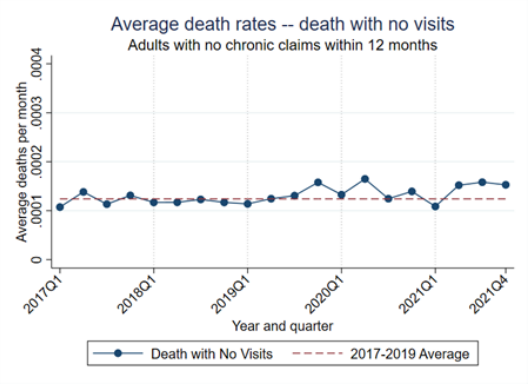
a. Average death rate -- all death



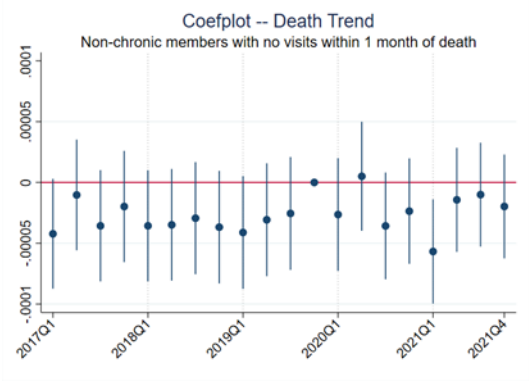
b. reg-adjusted differences in death rate



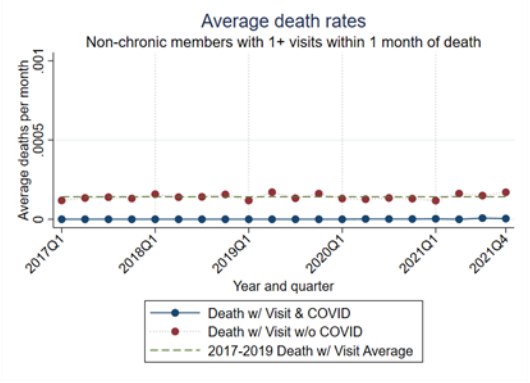
c. Average death rate -- death with no visits



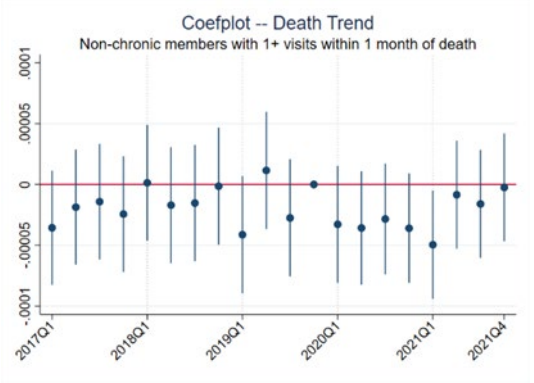
d. reg-adjusted differences in death rate (no visits)



e. Average death rate -- death with 1+ visits



d. reg-adjusted differences in death rate (1+ visits)



Notes: Panel a. plots the average death rates for members who didn't have any visits with a chronic disease diagnosis in the rolling 12-month lookback period. Panel b. plots the coefficients on quarter of year dummies in a regression. The omitted category is the last quarter of 2019. Panel c. and d. show the similar patterns for average death rates, but limited to death without any visits in or within one month of death. Panel e. and f. show the patterns for average death rates, limited to death with at least 1 insured health care visits within one month of death.

Appendix C: PCP Visits Definition

A visit is considered to be a PCP visit if it has the following characteristics.

1. Providers specialty are family practice, general practice, geriatrics, internal medicine, pediatrician, or obstetrics and gynecology.
2. Procedure code falls into the list.

Procedure Codes List	
Procedure Codes	**Description**
99201-99205, 99211-99215	Office / Outpatient Visit
99241-99245	Office Consultation
99324-99328, 99334-99340	Domicil / Rest Home Visit
99341-99350	Home Visit
99354, 99355, 99358, 99359	Prolong Service E&M / OP
99381-99387, 99391-99397	Preventive Medicine
99401-99404, 99411, 99412	Preventive Counseling
99420	Health Risk Assessment Test
99429	Unlisted Preventive Service
99499	Unlisted E&M Service

3. Place of service is not in the following list.

POS Exlcusions	
Place of Service Code(s)	**Place of Service Name**
01	Pharmacy
03	School
15	Mobile Unit
17	Walk-in Retail Health Clinic
20	Urgent Care Facility
21	Inpatient Hospital
23	Emergency Room – Hospital
24	Ambulatory Surgical Center
52	Psychiatric Facility-Partial Hospitalization
81	Independent Laboratory