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CLINICAL INVESTIGATIONS

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Risk from delayed or missed care and non-COVID-19 outcomes for older patients with chronic conditions during the pandemic

Maureen Smith MD, PhD, MPH[1,2,3] | **Mary Vaughan Sarrazin PhD[4]** | **Xinyi Wang PhD[3]** | **Peter Nordby MA[3]** | **Menggang Yu PhD[5]** | **Allie J. DeLonay MS[3]** | **Jonathan Jaffery MD, MS[6,7]**

[1]Department of Population Health Sciences, University of Wisconsin – Madison School of Medicine and Public Health, Madison, Wisconsin, USA

[2]Department of Family Medicine and Community Health, University of Wisconsin – Madison School of Medicine and Public Health, Madison, Wisconsin, USA

[3]Health Innovation Program, University of Wisconsin-Madison School of Medicine and Public Health, Madison, Wisconsin, USA

[4]Department of Internal Medicine, College of Medicine, University of Iowa, Iowa City, Iowa, USA

[5]Department of Biostatistics and Medical Informatics, University of Wisconsin – Madison School of Medicine and Public Health, Madison, Wisconsin, USA

[6]Office of Population Health, UW Health, Madison, Wisconsin, USA

[7]Department of Medicine, University of Wisconsin-Madison School of Medicine and Public Health, Madison, Wisconsin, USA

Correspondence
Maureen Smith, Department of Population Health Sciences, School of Medicine & Public Health, University of Wisconsin – Madison, 800 University Bay Dr., Room 210-31, Madison, WI 53705, USA.
Email: maureensmith@wisc.edu

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Abstract

Background: During the COVID-19 pandemic, patients with chronic illnesses avoided regular medical care, raising concerns about long-term complications. Our objective was to identify a population of older patients with chronic conditions who may be at risk from delayed or missed care (DMC) and follow their non-COVID outcomes during the pandemic.

Methods: We used a retrospective matched cohort design using Medicare claims and electronic health records at a large health system with community and academic clinics. Participants included 14,406 patients over 65 years old with two or more chronic conditions who had 1 year of baseline data and up to 9 months of postpandemic follow-up from March 1, 2019 to December 31, 2020; and 14,406 matched comparison patients from 1 year prior. Risk from DMC was defined by 13 indicators, including chronic conditions, frailty, disability affecting the use of telehealth, recent unplanned acute care, prior missed outpatient care, and social determinants of health. Outcomes included mortality, inpatient events, Medicare payments, and primary care and specialty care visits (in-person and telehealth).

Results: A total of 25% of patients had four or more indicators for risk from DMC. Per 1000 patients annually, those with four or more indicators had increased mortality of 19 patients (95% confidence interval, 4 to 32) and decreased utilization, including unplanned events (−496 events, −611 to −381) and primary care visits (−1578 visits, −1793 to −1401).

Conclusions: Older patients who had four or more indicators for risk from DMC had higher mortality and steep declines in inpatient and outpatient utilization during the pandemic.

KEYWORDS

COVID-19 pandemic, delayed care, Medicare, multiple chronic conditions

INTRODUCTION

Delaying or missing regular care for chronic conditions could exacerbate long-term complications,[1] although we have limited tools to identify those patients who are most at risk. This concern became particularly acute during the COVID-19 pandemic, as some patients avoided medical attention for their conditions for fear of catching the virus or because they were sheltering at home.[2] Health systems also rapidly transformed care delivery by delaying elective care and shifting outpatient care to telehealth,[3] although substantial barriers to telehealth exist for older adults.[4] By June 2020, 41% of U.S. adults had delayed or avoided medical care,[5] while admissions and emergency department (ED) visits had declined precipitously.[6] Fewer patients were presenting with acute cardiovascular conditions,[7] and cancer diagnosis and treatment had been delayed.[8] Most concerning, non-COVID-19 mortality increased during the pandemic for those with specific chronic conditions, including heart disease, Alzheimer disease–dementia, and diabetes.[9] Since we may need to cope with the pandemic for an extended period[10] as well as prepare for future pandemics, there is an urgent need to support the clinical identification of patients with chronic conditions to determine how they fared during the pandemic and to support identification of these patients at risk for poor outcomes such as increased mortality.

Older patients with multiple chronic conditions are likely at particular risk as they are major users of health care, often seeing multiple physicians, frequently visiting the ED, and having multiple admissions each year.[11–13] Missed outpatient appointments have been associated with increased admissions,[14] all-cause mortality (particularly for those with mental health conditions),[1] and suboptimal glycemic control for diabetes.[15] Since missed care can lead to poor outcomes, health systems often identify patients with chronic conditions and provide outreach or case management to ensure the appropriate use of outpatient care.[16] This identification may use a tool or predictive model to find patients at high-risk of hospital admissions or cost,[17] but these tools may miss others who would be at risk from delayed or missed care (DMC) during a pandemic such as those with mental health conditions.

Our goal was to identify a population of older patients with chronic conditions who may be at risk from DMC and follow their non-COVID outcomes during the pandemic. We focused on patients either at risk for long-term complications due to clinical factors, or who might have had difficulty in accessing the resources they need to manage their conditions due to socioeconomic vulnerability, for example, Medicaid patients. Medicaid is a means-tested federal and state healthcare program that provides coverage for low-income adults, pregnant women, and children. To achieve our goal, we first developed indicators to identify patients who were at high-risk for poor health outcomes

Key points

- Of a population of 14,406 Medicare patients, 25% had four or more indicators putting them at risk from DMC.
- Patients with four or more indicators of risk from DMC had higher mortality and steep declines in inpatient and outpatient utilization during the pandemic.

Why does this paper matter?

Older patients who are at risk from DMC due to the pandemic may benefit from outreach and care coordination to ensure proactive management of their chronic conditions.

from DMC and validated that those indicators predicted higher rates of visits, hospital events, and payments in a baseline timeframe. Second, we examined the impact of the pandemic on utilization and mortality outcomes in the follow-up timeframe for these patients according to how many indicators they had for high-risk from DMC.

METHODS

Study design and setting

We used a 1:1 matched cohort study design with measures of the outcomes throughout baseline and follow-up. Specifically, we used baseline characteristics to match a "pandemic cohort" of patients to a "comparison cohort" representing the year prior to the pandemic, where the start of the pandemic was defined as March 1, 2020 (Figure 1). The pandemic cohort included patients who received primary care during the 12 months prior to the pandemic, with patient baseline characteristics measured from March 1, 2019 to February 28, 2020. The comparison cohort included patients who received primary care during the 12 month period starting 2 years prior to the pandemic, with baseline characteristics measured from March 1, 2018 to February 28, 2019.

We examined the impact of the pandemic on monthly utilization and mortality outcomes in the follow-up year by comparing the two groups at different levels of DMC. The "follow-up period" is 9 months or until death or censoring due to lack of data for both groups (April 1, 2020 to December 31, 2020 for the pandemic cohort and April 1, 2019 to December 31, 2019 for the comparison cohort). The month of March was excluded as it was a transition into the pandemic. We used electronic health records (EHR) linked to Medicare claims data from UW Health, a health system and Medicare Accountable Care Organization (ACO) with 30 community-based and academic primary care clinics and 279 primary care providers (PCPs) across the state of Wisconsin.[18–22] This project was deemed exempt from Institutional Review Board oversight at University of Wisconsin-Madison.

Pandemic and matched comparison patients

We included only patients aged 65 years and older who met the following criteria: (a) uninterrupted EHR and claims data available for at least 1 year prior to follow-up; (b) assigned to a UW Health PCP; (c) assigned to the ACO during baseline and follow-up periods; (d) at least 1 month of continuous EHR and claims data during follow-up, and (3) at least two chronic conditions.[23] We excluded patients not enrolled in Medicare Part A or Part B or enrolled in Medicare Part C throughout the baseline and follow-up periods. We excluded 575 patients diagnosed with COVID-19 during follow-up; those patients were retained in a sensitivity analysis.

We matched each patient in the pandemic cohort to the closest eligible patient in the comparison cohort using exact matching on 18 baseline variables, including sociodemographics (age, gender, race, rural–urban, disability, Medicaid), chronic conditions (diabetes, end-stage renal disease [ESRD]), utilization (Medicare payments, hospice), and enrollment in case management or home-based primary care programs. If multiple comparison patients matched the pandemic patients, we picked one comparison patient with the closest risk of hospitalization or death in the next 6 months.[19]

The final sample included 14,406 patients for the pandemic cohort and 14,406 for the comparison cohort. Across both the comparison and pandemic cohorts, 2.2% of patients ($N = 322$) were identified as the exact match for themselves in the other cohort. We also ran a sensitivity analysis on our mortality outcome to remove the 2.2% of patients who used their own prior year as their comparison episode to assess for the possibility of survivorship bias and our conclusions did not change. However, all results for the mortality outcome are presented after removing these 2.2% of patients. We also note that 83% of

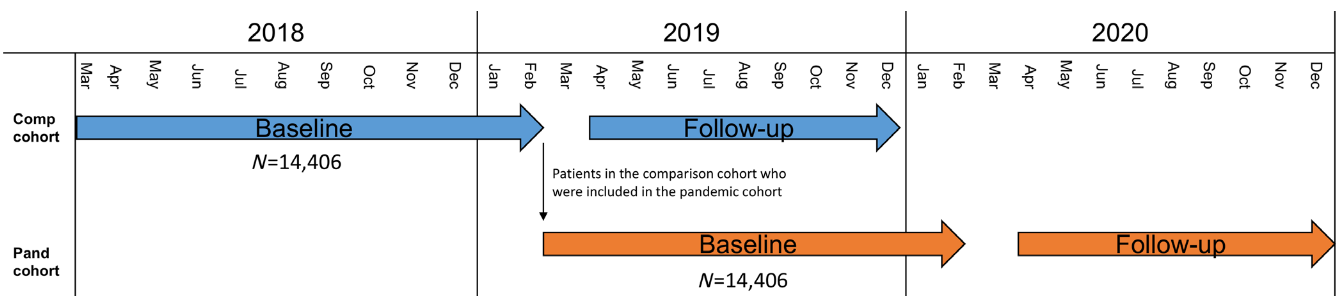

FIGURE 1 Pandemic and comparison cohort observation periods

the patients in the comparison cohort were also included in the pandemic cohort and followed throughout the pandemic. Because the pandemic and comparison cohorts were treated as independent, and not followed as a single cohort, patients in the pandemic cohort who were also in the comparison cohort, but not included as their own control, should not have an issue of survivorship bias.

Indicators of risk from DMC

We identified 13 indicators of possible risk from DMC that represented high-risk chronic conditions, frailty, disability affecting the use of telehealth, recent unplanned acute care, prior missed outpatient care, and social determinants of health. Indicators were based on (1) a conceptual model of disability, frailty, and comorbidity,[24] (2) a conceptual model for episodes of acute unscheduled care,[25] (3) Centers for Disease Control and Prevention recommendations for subgroups of patients who required extra attention during the COVID-19 pandemic,[26] and (4) evaluation of content validity by an expert review panel of five primary care physicians.[27] We operationalized these concepts using data accessible through EHR and/or claims, allowing for rapid and scalable deployment of the tool in a health system or ACO.

Specific DMC indicators included significant polypharmacy (defined as five or more unique prescribed medications ordered or billed);[28] any diagnosis of cardiovascular disease[29] or stroke[30]; uncontrolled hypertension (systolic blood pressure [BP] >140 or diastolic BP >90 and a diagnosis of hypertension[31,32]); uncontrolled diabetes (most recent HbA1c ≥9 and a diagnosis of diabetes[33]); end-stage liver disease (ESLD),[34] ESRD[35] and stage 4/5 chronic kidney disease (CKD),[35] and mental health condition (defined as bipolar disorder, schizophrenia, psychotic disorders; behavior and personality disorders; substance abuse; or mental health-related hospitalization or ED visit[29]). Frailty was operationalized using the list of frailty indicators from the Johns Hopkins Ambulatory Care Groups (e.g., incontinence, mobility, dementia–cognitive impairment, falls, malnutrition); a patient was considered frail if they had three or more frailty conditions.[36] We created an indicator for any hearing impairment-related condition,[29] representing a prevalent disability in older adults that might affect the use of telehealth. Recent unplanned acute care was represented by unplanned hospitalizations or ED visits using established definitions.[29] We also created an indicator for possible poverty or homelessness using lack of–inadequate housing or inadequate material resources diagnosis codes or if the patient's social history documentation included the word "shelter" or "homeless."[37] Lastly, we created an indicator for two or more unplanned missed appointments to any specialty.[38] Detailed information on these indicators is available at HIPxChange (https://www.hipxchange.org/DelayedMissedCare).

Outcome measures

Our outcome measures described the extent of hospital admissions, observations stays, ED visits, Medicare payments, and mortality from Medicare claims during the baseline and follow-up period. ED visits that resulted in hospitalization were not counted as an ED visit but were counted as part of the hospitalization. Unplanned hospital events were defined as admissions, observation stays, or ED visits. We used total Medicare payments excluding payments for planned hospitalizations[39,40] and pharmacy payments. We also examined outpatient visits for face-to-face and telehealth (video or telephone) primary and specialty care visits. To construct repeated measures of our outcomes, we created a dataset with one observation per patient per month. The first month was 12 months prior to March and continued for a minimum of 1 month and a maximum of 9 months after April, unless the patient died or was otherwise censored due to lack of data.

Baseline variables

Sociodemographics included age (continuous), gender, race, Medicaid insurance (ever), Medicare disability entitlement, rural–urban residence,[41] and the Hierarchical Condition Categories score.[42] Chronic conditions were measured from the diagnosis codes associated with medical encounters in the EHR data and included 28 medical conditions defined by Elixhauser et al. using ICD-9-CM diagnosis codes along with a count of the conditions and an indicator variable for three or more conditions.[43]

Analysis

Descriptive analyses compared means and proportions for baseline characteristics between pandemic and comparison patients, as well as average baseline and annualized follow-up utilizations from Medicare claims. Pearson correlation was used to assess the association between the count of DMC indicators and baseline utilization.

Models included terms for the baseline time trend (except for mortality models), change in level between baseline and follow-up times, and follow-up time trends in our monthly events for both pandemic and

TABLE 1 Sociodemographics, baseline utilization, and chronic conditions for age 65+ primary care patients with 2+ chronic conditions[a]

Baseline characteristic	Baseline comparison cohort (pre-COVID) $N = 14{,}406$ 2018	Baseline pandemic cohort (pre-COVID) $N = 14{,}406$ 2019
Sociodemographics		
Age, mean (SD)	75.3 (6.6)	75.4 (6.5)
Female	60.7	60.7
Race		
American Indian	0.2	0.2
Asian	1.2	1.1
Black	0.9	1.0
Other–unknown	0.9	0.9
White	96.7	96.7
Medicaid Insurance Ever	5.6	5.6
Disability entitlement	4.2	4.2
Rural–urban		
Urban code	69.3	69.3
Suburban	18.8	18.8
Large town	10.7	10.6
Small town–isolated rural	1.2	1.4
HCC score, mean (SD)	1.2 (1.1)	1.2 (1.1)
Events and payments		
Unplanned events PMPM × 1000, mean (SD)	46.3 (102)	51.1 (111)
Unplanned event-days PMPM × 1000, mean (SD)	95.1 (273)	106 (297)
ED visits PMPM × 1000, mean (SD)	30.0 (72.3)	33.9 (78.5)
Unplanned hospitalizations PMPM × 1000, mean (SD)	12.0 (41.5)	12.4 (42.1)
Days in hospital PMPM × 1000, mean (SD)	60.8 (243)	67.5 (260)
Observation stays PMPM × 1000, mean (SD)	4.3 (20.4)	4.7 (21.7)
Medicare payment amount ($), mean (SD)	609 (1278)	632 (1316)
Primary and specialty care visits		
Primary care total visits PMPM × 1000, mean (SD)	345 (270)	353 (272)
Primary care face-to-face visits PMPM × 1000, mean (SD)	341 (267)	348 (267)
Primary care telehealth visits PMPM × 1000, mean (SD)	0.01 (0.7)	0.00 (0.00)
Specialty care total visits PMPM × 1000, mean (SD)	220 (250)	213 (248)
Specialty care face-to-face visits PMPM × 1000, mean (SD)	219 (250)	213 (248)
Specialty care telehealth visits PMPM × 1000 mean (SD)	0.01 (1.0)	0.00 (0.00)
Chronic conditions		
Mean condition count	6.0 (3.1)	5.8 (3.0)
COPD–asthma	25.2	25.6
Chronic kidney disease	25.0	26.2
Anxiety	29.6	31.3
ESRD	0.5	0.5
Anemia	15.4	15.8
Rheumatoid arthritis–vasculitis	8.4	8.9

TABLE 1 (Continued)

Baseline characteristic	Baseline comparison cohort (pre-COVID) $N = 14{,}406$ 2018	Baseline pandemic cohort (pre-COVID) $N = 14{,}406$ 2019
Chronic blood loss anemia	1.8	1.8
Coagulopathy	4.7	4.9
Depression	18.5	18.7
Diabetes with chronic complication	13.9	14.3
Diabetes without chronic complication	9.0	9.7
Hypertension	68.3	70.4
Hypothyroidism	21.1	20.9
Liver disease	2.7	2.9
Lymphoma	1.7	1.6
Fluid–electrolyte disorders	17.0	17.7
Metastatic cancer	2.3	2.4
Other neurological disorders	13.8	14.3
Obesity	16.1	16.7
Paralysis	1.9	2.2
Pulmonary circulation disease	4.9	4.9
Psychosis	9.7	10.9
Peripheral vascular disease	14.9	15.1
Renal failure	15.4	15.6
Solid tumor w/o metastasis	10.5	11.1
Valvular disease	10.1	10.3
Weight loss	5.4	5.6

Abbreviations: COPD, chronic obstructive pulmonary disease; ED, emergency department; HCC, hierarchical condition categories; PMPM, per member per month.

[a]Values represent percents unless otherwise indicated; per member per month (PMPM) × 1000 is used for consistency with other tables that have varied follow-up times.

comparison patients. To account for further possible changes in utilization trends during the pandemic, models also included follow-up time period indicators for both cohorts (except for mortality models). In particular, the indicators are for the first 3 months and the first 6 months in the follow-up period. For mortality, we conducted longitudinal binomial regression modeling of the risk-adjusted difference in monthly death rate trajectories between the pandemic and comparison patients using patient-month data in the follow-up time frame. We conducted longitudinal regression modeling of the risk-adjusted difference in monthly visit count, event count, and payment trajectories between the pandemic and comparison patients using patient-month data for both baseline and follow-up time frames with poisson (visit counts), zero-inflated poisson (event counts), and zero-inflated gamma (payments) regression modeling. We accounted for clustering at the patient-level due to 80% of patients overlapping between the pandemic and comparison year. Models were stratified by DMC categories.

To improve interpretation, results were transformed into the annualized predicted difference in mortality rate, the number of event counts or visit counts, and Medicare payments for 1000 patients during the pandemic follow-up time compared to the comparison follow-up time. Bootstrapped confidence intervals (CI) were calculated using 200 replications. Analyses were carried out using SAS software (SAS Institute, Inc., Cary, North Carolina).

RESULTS

Baseline characteristics

Our comparison and pandemic cohorts have essentially identical characteristics in their baseline timeframes; the

TABLE 2 Baseline delayed or missed care (DMC) indicators for age 65+ primary care patients with 2+ chronic conditions

Indicator	Baseline comparison cohort (pre-COVID) $N = 14{,}406$ 2018	Baseline pandemic cohort (pre-COVID) $N = 14{,}406$ 2019
Polypharmacy (5+)	78.8	79.2
Uncontrolled hypertension	15.9	16.9
Uncontrolled diabetes	1.5	1.5
Cardiovascular disease or stroke	76.3	77.8
Mental health condition	9.7	9.7
3+ frailty conditions	12.1	13.0
2+ no show appointments	3.7	3.9
Hearing loss	19.9	19.7
ESLD	0.5	0.6
ESRD or stage 4/5 CKD	3.6	3.6
Unplanned hospitalization	10.4	11.0
ED visit not resulting in admission	23.0	25.4
Possible poverty or homelessness	0.7	0.6
Any indication DMC	94.3	94.5
0 or 1 DMC indicator	23.1	22.4
2 DMC indicators	30.7	29.2
3 DMC indicators	23.7	23.6
4+ DMC indicators	22.5	24.8

Note: Values represent percents.
Abbreviations: CKD, chronic kidney disease; ESLD, end-stage liver disease; ESRD, end-stage renal disease.

average age across the comparison and pandemic study cohort was 75 and patients were more likely to be female, (60%), white (96%), and urban (69%) (Table 1). The cohorts also had similar distributions of unplanned events, ED visits, hospitalizations, and Medicare payments. As expected, visits in the baseline were almost entirely face-to-face; telehealth visits were negligible. In both cohorts, patients had an average of six chronic conditions with the most prevalent chronic conditions, including hypertension, chronic obstructive pulmonary disease (COPD)–Asthma, CKD, and anxiety.

DMC indicators

Across our DMC indicators, the comparison and pandemic cohorts were also very similar, and showed high rates of polypharmacy (79%), risk for cardiovascular disease or stroke (77% and 78%), frailty (13%), and hearing loss (20%) (Table 2). When we compared patients with three DMC indicators and those with four or more DMC indicators (data not shown), the patients with four or more indicators were more likely to experience polypharmacy (99% compared to 95%), have uncontrolled hypertension (34% compared to 22%), be at risk for cardiovascular disease or stroke (98% compared to 94%), have a mental health condition (25% compared to 9%), have three or more frailty conditions (42% compared to 9%), and suffer from hearing loss (40% compared to 25%). Approximately 25% of patients had four or more DMC indicators. As expected, the count of DMC indicators was highly correlated with baseline utilization (Table S1).

Pandemic mortality and healthcare utilization by DMC indicators

Mortality increased significantly ($p = 0.025$) during the pandemic for patients with four or more DMC indicators, while both unplanned events and Medicare payments declined for all patients (Table S2). As expected, the drop in utilization during the pandemic was evident across all utilization measures except for telehealth visits. Declines

TABLE 3 Annualized difference in adjusted predicted outcomes per 1000 patients during the pandemic year compared to the prior year, overall and by level of risk from delayed or missed care (DMC)

	Overall ($N = 28{,}812$)	
	Prediction	**95% CI**
Annualized difference in mortality per 1000 patients	12.5	(8.2, 16.9)
Annualized difference in unplanned events per 1000 patients	−87	(−114.5, −61.5)
Annualized difference in Medicare payments per 1000 patients	−315,446	(−618,471, 25,109)
Annualized difference in total primary care visits per 1000 patients	−909	(−970.9, −853.8)
Annualized difference in total specialty care visits per 1000 patients	−422	(−467.7, −376.6)
	0 or 1 DMC indicator ($N = 6559$)	
	Prediction	**95% CI**
Annualized difference in mortality per 1000 patients	0.1	(−3.9, 3.7)
Annualized difference in unplanned events per 1000 patients	18.7	(−16.9, 52.3)
Annualized difference in Medicare payments per 1000 patients	96,334	(−255,367, 463,559)
Annualized difference in total primary care visits per 1000 patients	−460	(−555.1, −358.8)
Annualized difference in total specialty care visits per 1000 patients	−136	(−227.2, −46.4)
	2 DMC indicators ($N = 8626$)	
	Prediction	**95% CI**
Annualized difference in mortality per 1000 patients	−1.2	(−7.6, 4.6)
Annualized difference in unplanned events per 1000 patients	−69.9	(−122.2, −17.3)
Annualized difference in Medicare payments per 1000 patients	−339,992	(−829,398, 275,075)
Annualized difference in total primary care visits per 1000 patients	−798	(−945.3, −662.5)
Annualized difference in total specialty care visits per 1000 patients	−223	(−322.4, −112.1)
	3 DMC indicators ($N = 6810$)	
	Prediction	**95% CI**
Annualized difference in mortality per 1000 patients	2.8	(−6.4, 10.7)
Annualized difference in unplanned events per 1000 patients	−69.3	(−157.0, 1.7)
Annualized difference in Medicare payments per 1000 patients	−840,734	(−1,814,662, 142,904)
Annualized difference in total primary care visits per 1000 patients	−1138	(−1301.2, −974.9)
Annualized difference in total specialty care visits per 1000 patients	−588	(−722.5, −457.9)
	4 or more DMC indicators ($N = 6817$)	
	Prediction	**95% CI**
Annualized difference in mortality per 1000 patients	19.2	(4.4, 32.2)
Annualized difference in unplanned events per 1000 patients	−495.5	(−611.3, −380.5)
Annualized difference in Medicare payments per 1000 patients	−2732,498	(−4,592,609, −1,318,849)
Annualized difference in total primary care visits per 1000 patients	−1578	(−1792.5, −1401.1)
Annualized difference in total specialty care visits per 1000 patients	−889	(−1036.1, −755.1)

in utilization included ED visits, observation stays, and hospitalizations, as well total primary and specialty care visits and face-to-face primary and specialty care visits. In contrast, telehealth (including both video and telephone) visits increased with the higher rates of telehealth visits among patients with more DMC indicators. The steepest declines in both inpatient and outpatient utilization were among patients with four or more DMC indicators.

After modeling changes in mortality and utilization rates during the pandemic, these results did not change (Table 3; Figure S1). Overall, mortality increased by 13 patients per 1000 annually but this finding was due to an increase in mortality in patients with four or more DMC indicators of 19 patients per 1000 annually. The number of unplanned events and Medicare payments declined significantly overall; the most striking decline was seen in patients with four or more DMC indicators, with a decrease of almost 500 unplanned events per 1000 patients annually and a decrease in Medicare payments of $2.7 million per 1000 patients annually ($2732 Per Beneficiary Per Year). Total primary care visits and total specialty care visits also declined, with the greatest decline in patients with four or more DMC indicators representing decreases of over 1500 total primary care visits per 1000 patients annually and almost 900 total specialty care visits per 1000 patients annually. Results were essentially identical in sensitivity analysis that did not exclude 575 patients diagnosed with COVID-19 during the pandemic follow-up period.

DISCUSSION

These results suggest that older patients with chronic conditions and four or more indicators for risk from DMC had higher risk of mortality during the pandemic and the steepest declines in inpatient and outpatient utilization when compared to those with three or fewer indicators for risk from DMC. As the results did not change when patients diagnosed with COVID-19 were included, this increase in mortality was not due to deaths from COVID-19.

Our results suggest that patients with four or more indicators of risk from DMC had increased mortality. This is consistent with a study that identified excess non-COVID-19 mortality from heart disease, Alzheimer disease–dementia, and diabetes during pandemic surges.[9] These three conditions are prevalent among older adults but it is unlikely that these three conditions are the only conditions associated with increased risk for non-COVID-19 mortality.[44] Vulnerable patients who have comorbidities, disability, and/or frailty have increased healthcare needs[24] and are at risk for complications if their conditions are not managed. The CDC (2020) had recommendations for multiple subgroups of patients who required extra attention during the COVID-19 pandemic, including patients with disabilities,[45] patients with developmental and behavioral disorders,[46] those experiencing homelessness,[47] and patients with drug use and substance use disorder.[48] Increased adoption of telemedicine for chronic disease management offers another avenue for care coordination, but implementation of telemedicine may increase disparities in healthcare access for certain subgroups of patients, including older adults who may have a digital literacy barrier.[49]

Managing patients at risk from DMC might involve identifying these subgroups of patients with complex needs and providing additional services such as outreach or case management to ensure the appropriate use of outpatient care. Because many case management programs involve a significant telephonic component,[50] case managers are well-positioned to continue or expand their outreach activities during the pandemic to coordinate needed care for vulnerable patients. Older patients with multiple chronic conditions frequently see multiple physicians,[11] suggesting that, in addition to outreach, care coordination across these physicians might be a critical activity during the COVID-19 pandemic as patients avoided seeing both primary and specialty care physicians. These patients also may have difficulty in accessing the resources they need to manage their conditions due to the COVID-19 pandemic as, for example, patients with elevated health risks are overburdened by transportation barriers and may need extra help to access health care.[51]

As with any study, our study has limitations. Unmeasured confounding is a limitation of all observational studies. However, given our extensive matching process and similarity of our matched populations, it is unlikely that any remaining small differences explain our findings. We only followed outcomes for 9 months after the start of the pandemic, although the major effects of the pandemic on utilization happened almost immediately. In addition, we were limited to evaluating the impact of the pandemic in a single large health system with both academic and community clinics. This health system did participate in Medicare ACO programs, indicating that they had a strong base of primary care patients.[52] Finally, our data did not include detailed information on patient-level income or education.

In conclusion, we determined that older patients who had four or more indicators for risk from DMC had higher mortality during the pandemic, along with steep declines in inpatient and outpatient utilization. These patients may benefit from outreach and care coordination to ensure proactive management of their chronic conditions, particularly as future pandemic scenarios suggest that countries, communities, and individuals may need to cope in the longer-term with the possibility of a continued threat from COVID-19 and its variants.[10]

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Study concept and design: Maureen Smith, Mary Vaughan Sarrazin, Menggang Yu. *Acquisition, analysis, or interpretation of data*: All authors. *Drafting of the manuscript*: All authors. *Critical revision of the manuscript for important* *intellectual content*: All authors. *Final approval of the version to be published*: All authors.

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ORCID

Maureen Smith https://orcid.org/0000-0003-4370-000X

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

Table S1. Pearson correlation and *p*-values for the relationship between the count of delayed or missed care (DMC) indicators and baseline utilization for age 65+ primary care patients with 2+ chronic conditions.
Table S2. Follow-up utilization for age 65+ primary care patients with 2+ chronic conditions, for pandemic and comparison cohorts, by level of risk from delayed or missed care (DMC).
Figure S1. Annualized difference in adjusted predicted outcomes per 1000 patients during the pandemic year compared to the prior year, by level of risk from delayed or missed care (DMC).

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