Research Article

The Role of Chronic Disease and Multiple Chronic Conditions on the Level and Change in Per Capita Health Care Spending, 2010-2021

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Abstract

Objective: To estimate the key factors accounting for the level and change in inflation-adjusted per capita spending among all adults, privately insured adults aged 18-64 and Medicare beneficiaries. In addition to examining demographic factors, we focus on the role of patients with multiple chronic conditions and in the most recent years the impact that COVID-19 had on per capita spending.

Methods: We used generalized linear regression models (GLM) with log-link given the skewness of the data. Our analysis focuses on 2010 to 2021. We report results for 2010, 2016 and 2021. The regressions models control for patient demographics, income, race/ethnicity, region of the country, the number of diagnosed chronic conditions and whether the adult was treated for COVID-19.

Results: The number of chronic conditions treated were the strongest predictor of per capita health care spending. Moreover, in each of the populations examined, the impact of patients with 5 or more chronic on per capita spending increased dramatically. Patients diagnosed and treated, even controlling for comorbid chronic conditions, had a significant impact on increasing per capita spending.

Conclusions: Adults with multiple chronic conditions are the key drivers of the level and growth in spending. During 2021, the COVID-19 pandemic also independently increased spending. With the prevalence of COVID-19 waning, this trend should take some pressure off the growth in spending. New more effective team-based care coordination models are needed to prevent and manage complex patients with multiple chronic conditions. The system need to continue to integrate the various silos of care into a more comprehensive patient centered focus.

INTRODUCTION

This paper examines changes in total spending per adult aged 18 and above, per privately insured adult aged 18- 64 and Medicare beneficiaries over the past decade (2010-2021). The analysis updates and expands upon previous work examining trends in chronic disease prevalence and spending. (1-2) [1]. Over 60 percent of adults have at least one chronic health care condition which accounts for approximately 90 percent of overall health care spending [2].The analysis focuses on trends in spending among patients with multiple chronic conditions and the role they have assumed in rising spending between 2010 and 2021. In addition, we also focus on the incremental healthcare spending associated with treating COVID-19 patients. The COVID-19 analysis focuses on spending in 2021. The analysis highlights key medical conditions that policymakers could target to reduce the level and growth in health care spending.

The analysis starts by looking at trends in total per capita spending among all adults, spending among privately insured adults aged 18 to 64 and Medicare beneficiaries from 2010 through 2021. We are particularly interested in understanding the role that changes in chronic disease prevalence and spending has assumed in driving the growth in inflation adjusted spending. In addition, we also examine the role that patients diagnosed and treated for COVID-19 played in increasing per capita health care spending.

MATERIALS AND METHODS

We use the Medical Expenditure Panel Survey-Household Component MEPS-HC) for the years 2010 through 2021. The MEPS-HC collects data from a sample of families and individuals in selected communities across the United States, drawn from a nationally representative subsample of non-institutionalized, non-military households that participated in the National Health Interview Survey (conducted by the National Center for Health Statistics) [3].

During the interviews, MEPS-HC collects detailed information

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for each person in the household on the following: demographic characteristics, health conditions, health status, use of medical services, health care charges and source of payments, access to care, satisfaction with care, health insurance coverage, income, and employment. The panel design of the survey, which includes several rounds of interviewing covers two full calendar years.

In this paper, we use the data on disease prevalence, chronic disease expenditure and total annual spending. We link each self-reported medical encounter in the dataset to a maximum of four disease states, using diagnosis codes. We use the Agency for Health Care Research and Quality (AHRQ) Clinical Classifications Software for International Classification of Diseases Ninth Revision (ICD-10) to collapse the ICD-10 codes into broader groups of medical conditions. Spending estimates include all payments, regardless of payer, for each encounter (physician interactions, outpatient care, inpatient care, emergency care, home-health services, and prescription medications). For encounters linked to more than one disease state, we distribute total encounter spending equally across all conditions associated with the visit. We aggregate condition specific spending across all individuals to obtain total annual spending per condition.

We defined chronic disease as having one or more of the following conditions: dementia, depression, asthma, cancer, back problems, congestive heart failure, heart disease, diabetes, hypertension, hyperlipidemia, arthritis and stroke.

We used generalized linear model regressions (GLM) with gamma distribution and log-link function to predict annual per capita spending in the three groups we examine. We estimate separate regression models for all adults over age 18, privately insured adults aged 18-64 and Medicare beneficiaries. We report regression results for 2010, 2018 and 2021. In each of our models, we controlled for patient characteristics, including age, gender, race/ethnicity, education, region of the country, income as percent of poverty, total number of treated conditions and for 2021 patients diagnosed and treated for COVID-19.

We used Stata, version 17.0, for data analysis [5]. Sample weights and survey estimation commands were used to adjust for the complex survey design of the MEPS-HC. All spending amounts are presented in 2021 dollars, using the gross domestic product implicit price deflator.

RESULTS AND DISCUSSION

Figures 1 through 3 provide descriptive statistics for the growth in real per capita health care spending for all adults, privately insured adults and Medicare patients. Between 2010 and 2021 per capita spending for all adults increased by 38.1 percent, an average annual growth rate of 3 percent. Real per capita spending for privately insured adults increased at a slightly lower rate of increase of 34.1 averaging 2.7 percent growth per year. Finally, the growth in Medicare spending was the lowest increasing 15.1 percent an increase of 1.3 percent per year (Appendix 1).

The percent of adults treated for one or more chronic condition stayed relatively constant over time (Figure 1). The percent of adults with no chronic condition treated increased from 53.8 percent to 54.5 percent between 2010 and 2021 (Figure 2). Among chronic diseases there was an increase is the prevalence of asthma (4.8 to 6.1) percent and diabetes (9.2 to 10.3 percent) during the same period (Appendix 2).

The percent of Medicare beneficiaries treated for chronic conditions stayed relatively constant over time (Figure 3). The number with one chronic condition increased from 19.2 percent in 2010 to 21.8 percent by 2021. However, the percent with 4 or 5 chronic conditions decreased over the same period (Appendix 3).

The prevalence of key chronic conditions also showed a slight decline over time. Both hypertension and hyperlipidemia prevalence decreased over the 11-year period (Figure 3). Similar to the trends among all adults, the reported prevalence of asthma is one condition that increased over time, from 7.7 percent in 2010 to 9.3 percent by 2021.

We next turn to our regression results for the three set of adults (Figure 4). We start with the results for all adults aged 18 and over. First looking at the demographic results. Across each of the years, females spent $722 to $1,375 more on health care than males. Low- and middle-income adults spent less on health care (around $600) relative to those under poverty.

Adults living in the South consistently spent less on health care than other regions. This ranged from % 520 less than adults in the east rising to nearly $1,920 less by 2021, an inflation adjusted increase of about $1,400. This change over time among adults in the South was significantly significant.

With respect to educational attainment, college graduates spent $1,076 to $1,515 more per year than adults that did not graduate from high school. The results were not statistically significant in 2021, however.

The most notable impacts on health care spending among all adults were the number of chronic health care conditions under treatment. In 2010, adults with 1 treated condition spent $2,385 more than those with no chronic conditions. For each additional condition treated there was a statistically significant rise in annual health care spending. Adults with 2 conditions spent over $2,700 more compared to patients with 1 condition. Similarly, patients with 3 chronic conditions spent over $3,000 more compared to those with 2 conditions, those with 4 conditions spent $3,000 more than those with 3 conditions and those with 5 or more chronic conditions spent over $6,300 more than adults with 4 chronic conditions.

Trends in spending among these populations over time provide insight into the factors driving the growth in per capita health care spending among all adults. By 2021, patients with one chronic condition spent over $4,500 more on health care than those with no conditions. Like 2010, each additional condition

Figure 1: Descriptive Statistics, All Adults 18 and over, 2010-2021, SOURCE: Tabulations from the 2010-2021 MEPS-HC

	2010	2012	2014	2016	2018	2021
Variable	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
Spending Per Capita	$5,889	$5,889	$6,144	$6,508	$7,512	$8,142
Total Spending	1,350,861,319,210	1,387,491,789,384	1,482,571,242,695	1,591,551,593,244	1,864,368,414,653	2,045,287,894,653
Number Chronic Conditions						
0_conditions	53.8%	53.6%	53.7%	56.0%	56.0%	54.5%
1_condition	19.7%	19.8%	19.5%	19.4%	19.4%	20.5%
2_conditions	11.9%	11.9%	11.3%	11.4%	11.6%	11.9%
3_conditions	7.7%	8.0%	7.9%	7.7%	7.5%	7.6%
4_conditions	4.1%	4.3%	4.5%	3.4%	3.6%	3.7%
5+_conditions	2.6%	2.5%	3.0%	2.0%	2.0%	1.9%
Dementia	0.7%	0.7%	0.7%	0.2%	0.5%	0.4%
Depression	9.0%	8.9%	9.4%	8.4%	8.2%	8.9%
Asthma	4.8%	4.6%	4.8%	4.5%	6.0%	6.1%
Cancer	6.0%	6.4%	6.8%	4.3%	5.2%	5.2%
Back problems	8.6%	8.4%	9.7%	9.4%	5.1%	6.5%
Congestive Heart Failure	0.6%	0.5%	0.7%	0.6%	0.7%	0.6%
Heart Disease	9.6%	9.4%	9.5%	7.1%	7.8%	7.6%
Diabetes	9.2%	9.6%	10.3%	9.9%	9.8%	10.3%
Hypertension	25.1%	25.2%	25.2%	25.0%	24.5%	24.1%
Hyperlipidemia	19.8%	20.0%	19.3%	18.7%	18.2%	18.7%
Arthritis	1.8%	2.0%	2.0%	0.0%	1.7%	1.5%
Stroke	1.5%	1.4%	1.5%	1.5%	1.6%	1.3%

Appendix 1. Descriptive Statistics all Adults 18 and Over

	2010	2012	2014	2016	2018	2021
Variable	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
Spending Per Capita	$5,889	$5,889	$6,144	$6,508	$7,512	$8,142
Total Spending	1,350,861,319,210	1,387,491,789,384	1,482,571,242,695	1,591,551,593,244	1,864,368,414,653	2,045,287,894,653
Female						
0	48.4%	48.0%	48.3%	48.2%	48.2%	48.7%
1	51.6%	52.0%	51.7%	51.8%	51.8%	51.3%
Race/Ethnicity						
Hispanic	14.0%	14.8%	15.4%	15.8%	16.2%	17.0%
Non-Hispanic Black	11.5%	11.5%	11.8%	11.8%	11.8%	12.1%
Non-Hispanic Other	6.6%	7.4%	8.4%	8.9%	9.2%	9.3%
Age Group						
18-34	30.7%	30.3%	30.1%	29.9%	29.6%	28.0%
35-49	26.3%	25.4%	24.5%	24.7%	24.3%	24.6%
50-64	25.9%	25.8%	26.3%	25.2%	24.9%	25.0%
65+	17.2%	18.4%	19.2%	20.2%	21.2%	22.4%
Income as Percent Poverty						
<100%	12.7%	12.5%	12.6%	10.9%	10.4%	10.3%
100-199%	17.5%	18.4%	17.7%	16.0%	15.7%	15.0%
200-399%	30.3%	30.2%	28.6%	29.0%	28.4%	28.1%
Region						
Northeast	18.5%	18.1%	18.0%	17.8%	17.4%	17.3%
Midwest	21.8%	21.4%	21.4%	20.9%	20.9%	20.9%
South	36.7%	37.2%	37.1%	37.6%	37.9%	38.2%
West	23.1%	23.3%	23.4%	23.7%	23.8%	23.6%
Educational Attainment						
Non-High School	14.7%	14.6%	14.0%	13.2%	11.6%	10.6%
High School Graduate	29.6%	28.0%	26.1%	30.9%	28.4%	28.9%
Some College	27.4%	28.4%	31.0%	25.2%	26.9%	25.1%
College Graduate	28.3%	29.0%	28.9%	30.7%	33.1%	35.5%

Number Chronic Conditions						
0_conditions	53.8%	53.6%	53.7%	56.0%	56.0%	54.5%
1_condition	19.7%	19.8%	19.5%	19.4%	19.4%	20.5%
2_conditions	11.9%	11.9%	11.3%	11.4%	11.6%	11.9%
3_conditions	7.7%	8.0%	7.9%	7.7%	7.5%	7.6%
4_conditions	4.1%	4.3%	4.5%	3.4%	3.6%	3.7%
5+_conditions	2.6%	2.5%	3.0%	2.0%	2.0%	1.9%
Dementia	0.7%	0.7%	0.7%	0.2%	0.5%	0.4%
Depression	9.0%	8.9%	9.4%	8.4%	8.2%	8.9%
Asthma	4.8%	4.6%	4.8%	4.5%	6.0%	6.1%
Cancer	6.0%	6.4%	6.8%	4.3%	5.2%	5.2%
Back problems	8.6%	8.4%	9.7%	9.4%	5.1%	6.5%
Congestive Heart Failure	0.6%	0.5%	0.7%	0.6%	0.7%	0.6%
Heart Disease	9.6%	9.4%	9.5%	7.1%	7.8%	7.6%
Diabetes	9.2%	9.6%	10.3%	9.9%	9.8%	10.3%
Hypertension	25.1%	25.2%	25.2%	25.0%	24.5%	24.1%
Hyperlipidemia	19.8%	20.0%	19.3%	18.7%	18.2%	18.7%
Arthritis	1.8%	2.0%	2.0%	0.0%	1.7%	1.5%
Stroke	1.5%	1.4%	1.5%	1.5%	1.6%	1.3%

Figure 2: Descriptive Statistics, Adults aged 18-64 with Private Insurance , 2010-2021. SOURCE: Tabulations from the MEPS-HC 2010-2021

	2010	2012	2014	2016	2018	2021
Variable	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
Spending per Capita	$5,005	$ 5,394	$ 5,016	$ 5,035	$ 6,338	$ 6,714
Total Spending	579,146,449,796	624,952,925,931	587,577,145,393	627,665,630,340	804,367,235,721	841,841,801,221
Number Chronic Conditions						
0_conditions	59.1%	59.6%	61.2%	64.4%	65.9%	64.2%
1_condition	22.2%	22.5%	22.0%	20.5%	20.0%	21.7%
2_conditions	10.7%	10.4%	9.5%	9.0%	8.6%	8.7%
3_conditions	5.2%	5.2%	4.8%	4.0%	3.8%	3.8%
4_conditions	1.9%	1.7%	1.7%	1.5%	1.2%	1.2%
5+_conditions	0.9%	0.7%	0.8%	0.5%	0.6%	0.4%
Dementia	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Depression	7.9%	7.7%	7.3%	6.5%	6.7%	8.2%
Asthma	4.3%	4.2%	4.1%	3.9%	4.9%	4.8%
Cancer	4.1%	3.9%	4.2%	2.0%	2.9%	2.5%
Back problems	8.6%	7.8%	9.0%	8.4%	4.2%	5.4%
Congestive Heart Failure	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%
Heart Disease	5.1%	4.5%	4.2%	2.9%	3.2%	3.0%
Diabetes	6.2%	6.2%	6.1%	6.1%	5.6%	5.9%
Hypertension	18.2%	17.8%	16.8%	16.4%	15.6%	15.2%
Hyperlipidemia	14.9%	14.4%	12.8%	12.4%	10.8%	10.7%
Arthritis	0.9%	1.1%	0.9%	0.0%	1.0%	0.7%
Stroke	0.4%	0.3%	0.5%	0.4%	0.5%	0.4%

treated added to total spending (all p<.05 except for the move from 2 to 3 conditions treated significant at p<.10). In 2021, adults with 5 or more chronic conditions spent over $26,660 per year more than those with no chronic conditions.

This higher level of spending among chronically ill patients, adjusted for inflation, increased over time. Patients with 2 chronic conditions incurred health care expenditures nearly $4,200 more in 2021 than patients with 2 chronic conditions in 2010 (p<.05). Adults with 3 chronic conditions spent nearly $4,300 more in 2021 than the same patients in 2010 (p<=.05). Similar results were observed for patients with 4 and 5 or more chronic conditions over time. Adults with 4 chronic conditions spent over $5,500 more on health care compared to the same group in 2010 (p<.05). Finally, adults with 5 or more chronic conditions spent over $8,920 more on health care in 2021 compared to the same group in 2010 (p<.05). These trends in health care spending over time among patients with multiple chronic conditions are a key driver of rising per capita health care spending among all adults.

SciMedCentral

Appendix 2. Descriptive Statistics, Privately Insured Adults 18-64

Variable	2010 Mean	2012 Mean	2014 Mean	2016 Mean	2018 Mean	2021 Mean
Spending per Capita	$5,005	$ 5,394	$ 5,016	$ 5,035	$ 6,338	$ 6,714
Total Spending	579,146,449,796	624,952,925,931	587,577,145,393	627,665,630,340	804,367,235,721	841,841,801,221
Female						
0	49.0%	48.4%	49.0%	49.3%	49.2%	49.3%
1	51.0%	51.6%	51.0%	50.7%	50.8%	50.7%
Race/Ethnicity						
Hispanic	9.4%	10.6%	10.9%	12.6%	13.1%	13.6%
Non-Hispanic Black	9.3%	9.4%	9.8%	10.1%	10.2%	10.0%
Non-Hispanic Other	7.1%	8.0%	9.5%	9.7%	9.5%	10.6%
Age Group						
18-34	30.7%	32.5%	32.6%	33.7%	34.4%	32.7%
35-49	33.6%	32.1%	31.6%	32.1%	31.8%	33.4%
50-64	35.7%	35.4%	35.8%	34.2%	33.7%	34.0%
65+						
Income as Percent Poverty	3.2%	3.4%	3.0%	2.7%	2.5%	2.9%
<100%	8.9%	9.4%	8.4%	7.5%	7.7%	7.1%
100-199%	32.3%	31.8%	30.5%	30.2%	28.9%	27.7%
200-399%	55.6%	55.4%	58.1%	59.5%	60.9%	62.4%
Region						
Northeast	19.4%	18.9%	18.8%	18.4%	18.6%	18.2%
Midwest	22.6%	23.3%	23.1%	22.0%	22.2%	22.1%
South	35.4%	35.3%	35.6%	36.7%	36.1%	36.1%
West	22.6%	22.5%	22.5%	22.9%	23.1%	23.6%
Educational Attainment						
Non-High School	6.9%	7.0%	6.7%	6.7%	6.4%	6.1%
High School Graduate	24.1%	23.0%	20.8%	26.4%	23.3%	22.7%
Some College	29.8%	30.4%	32.5%	26.8%	27.4%	25.0%
College Graduate	39.2%	39.7%	39.9%	40.2%	43.0%	46.3%
Number Chronic Conditions						
0_conditions	59.1%	59.6%	61.2%	64.4%	65.9%	64.2%
1_condition	22.2%	22.5%	22.0%	20.5%	20.0%	21.7%
2_conditions	10.7%	10.4%	9.5%	9.0%	8.6%	8.7%
3_conditions	5.2%	5.2%	4.8%	4.0%	3.8%	3.8%
4_conditions	1.9%	1.7%	1.7%	1.5%	1.2%	1.2%
5+_conditions	0.9%	0.7%	0.8%	0.5%	0.6%	0.4%
Dementia	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Depression	7.9%	7.7%	7.3%	6.5%	6.7%	8.2%
Asthma	4.3%	4.2%	4.1%	3.9%	4.9%	4.8%
Cancer	4.1%	3.9%	4.2%	2.0%	2.9%	2.5%
Back problems	8.6%	7.8%	9.0%	8.4%	4.2%	5.4%
Congestive Heart Failure	0.2%	0.2%	0.1%	0.1%	0.1%	0.1%
Heart Disease	5.1%	4.5%	4.2%	2.9%	3.2%	3.0%
Diabetes	6.2%	6.2%	6.1%	6.1%	5.6%	5.9%
Hypertension	18.2%	17.8%	16.8%	16.4%	15.6%	15.2%
Hyperlipidemia	14.9%	14.4%	12.8%	12.4%	10.8%	10.7%
Arthritis	0.9%	1.1%	0.9%	0.0%	1.0%	0.7%
Stroke	0.4%	0.3%	0.5%	0.4%	0.5%	0.4%

Figure 3: Descriptive Statistics, Medicare Beneficiaries 2010-2021. SOURCE: Tabulations from the MEPS-HC, 2010-2021

	2010	2012	2014	2016	2018	2021
Variable	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
Spending Per Capita	$2,838	$11,551	$13,445	$13,738	$14,006	$14,785
Total Spending	531,815,924,615	526,052,929,604	648,120,536,830	703,730,531,216	771,545,392,222	853,059,803,860
Number Chronic Conditions						
0_conditions	13.0%	13.7%	13.8%	17.0%	17.1%	17.5%
1_condition	19.2%	18.7%	17.9%	21.7%	21.1%	21.8%
2_conditions	22.9%	23.0%	22.3%	22.6%	23.9%	23.7%
3_conditions	21.1%	20.7%	20.8%	20.7%	19.9%	19.8%
4_conditions	13.6%	14.6%	14.3%	10.8%	11.4%	10.8%
5+_conditions	10.2%	9.3%	10.9%	7.1%	6.6%	6.5%
Dementia	3.6%	3.1%	2.8%	0.9%	1.7%	1.6%
Depression	13.9%	13.5%	15.3%	14.3%	12.4%	11.4%
Asthma	7.7%	7.7%	7.7%	7.0%	9.3%	9.3%
Cancer	18.1%	19.1%	19.0%	13.5%	14.8%	15.5%
Back problems	13.3%	14.1%	15.5%	15.7%	9.1%	11.7%
Congestive Heart Failure	2.3%	1.9%	2.9%	2.2%	2.6%	1.8%
Heart Disease	31.5%	29.7%	30.1%	22.6%	23.6%	22.1%
Diabetes	22.8%	23.7%	25.8%	23.1%	23.2%	22.8%
Hypertension	0.2%	0.7%	0.0%	1.0%	0.7%	0.7%
Hyperlipidemia	0.9%	1.1%	0.9%	0.0%	1.2%	0.6%
Hypertension	62.3%	60.7%	60.8%	58.9%	56.7%	54.3%
Hyperlipidemia	50.5%	50.7%	49.8%	47.0%	45.5%	46.9%
Arthritis	4.9%	5.0%	5.5%	0.0%	4.0%	4.0%
Stroke	6.0%	5.2%	5.3%	4.7%	4.9%	4.0%

Appendix 3. Descriptive Statistics Medicare Beneficiaries

	2010	2012	2014	2016	2018	2021
Variable	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**	**Mean**
Spending Per Capita	$2,838	$11,551	$13,445	$13,738	$14,006	$14,785
Total Spending	531,815,924,615	526,052,929,604	648,120,536,830	703,730,531,216	771,545,392,222	853,059,803,860
Female						
0	43.6%	45.1%	44.7%	45.2%	45.8%	45.8%
1	56.4%	54.9%	55.3%	54.8%	54.2%	54.2%
Race/Ethnicity						
Hispanic	7.1%	7.3%	7.8%	8.0%	8.4%	8.2%
Non-Hispanic Black	9.9%	9.6%	9.8%	9.8%	10.6%	10.9%
Non-Hispanic Other	4.6%	5.2%	6.0%	6.5%	6.2%	6.8%
Age Group						
18-34	1.3%	0.8%	0.9%	1.2%	1.0%	1.0%
35-49	3.7%	3.2%	3.3%	2.7%	2.9%	2.3%
50-64	8.8%	9.6%	10.0%	9.2%	9.4%	8.7%
65+	86.2%	86.4%	85.7%	87.0%	86.7%	87.9%
Income as Percent Poverty						
<100%	12.3%	12.2%	13.1%	12.0%	12.4%	12.4%
100-199%	25.9%	25.7%	24.7%	22.9%	20.9%	21.2%
200-399%	29.5%	27.9%	26.0%	27.6%	27.3%	26.4%
Region	32.3%	34.1%	36.2%	37.6%	39.4%	39.9%
Northeast	19.1%	18.9%	18.5%	18.1%	17.8%	18.3%
Midwest	23.1%	22.8%	22.6%	21.8%	21.5%	21.8%
South	37.4%	37.3%	37.8%	38.2%	39.3%	38.5%
West	20.4%	21.0%	21.2%	22.0%	21.4%	21.3%
Educational Attainment						
Non-High School	20.0%	18.8%	17.3%	16.2%	12.4%	10.3%
High School Graduate	36.2%	33.2%	31.7%	32.8%	32.6%	32.5%
Some College	22.6%	23.6%	27.1%	22.6%	26.1%	25.7%

College Graduate	21.2%	24.4%	23.9%	28.4%	28.9%	31.5%
Number Chronic Conditions						
0_conditions	13.0%	13.7%	13.8%	17.0%	17.1%	17.5%
1_condition	19.2%	18.7%	17.9%	21.7%	21.1%	21.8%
2_conditions	22.9%	23.0%	22.3%	22.6%	23.9%	23.7%
3_conditions	21.1%	20.7%	20.8%	20.7%	19.9%	19.8%
4_conditions	13.6%	14.6%	14.3%	10.8%	11.4%	10.8%
5+_conditions	10.2%	9.3%	10.9%	7.1%	6.6%	6.5%
Dementia	3.6%	3.1%	2.8%	0.9%	1.7%	1.6%
Depression	13.9%	13.5%	15.3%	14.3%	12.4%	11.4%
Asthma	7.7%	7.7%	7.7%	7.0%	9.3%	9.3%
Cancer	18.1%	19.1%	19.0%	13.5%	14.8%	15.5%
Back problems	13.3%	14.1%	15.5%	15.7%	9.1%	11.7%
Congestive Heart Failure	2.3%	1.9%	2.9%	2.2%	2.6%	1.8%
Heart Disease	31.5%	29.7%	30.1%	22.6%	23.6%	22.1%
Diabetes	22.8%	23.7%	25.8%	23.1%	23.2%	22.8%
Hypertension	0.2%	0.7%	0.0%	1.0%	0.7%	0.7%
Hyperlipidemia	0.9%	1.1%	0.9%	0.0%	1.2%	0.6%
Hypertension	62.3%	60.7%	60.8%	58.9%	56.7%	54.3%
Hyperlipidemia	50.5%	50.7%	49.8%	47.0%	45.5%	46.9%
Arthritis	4.9%	5.0%	5.5%	0.0%	4.0%	4.0%
Stroke	6.0%	5.2%	5.3%	4.7%	4.9%	4.0%

Figure 4: Factors Associated with Health Care Spending Per Capita, All Adults, 2010-2021, Marginal Effects.SOURCE: MEPS, 2010-2021
*Significantly different from zero, p<=.05
** Significantly different from zero, p<=.10
! Coefficient in 2021 significantly different from 2010 coefficient, p<=.05

	2010		**2016**		**2021**	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Female	721.98*	177.11	1340.08*	228.19	1374.69*	435.08
Race/Ethnicity						
Hispanic	-635.68*	216.54	-1257.61*	217.29	-2162.83*	590.63
Non-Hispanic Black	248.42	295.49	-984.74*	307.55	-1251.04*	632.78
Non-Hispanic Other	-1040.47*	249.59	-1565.84*	279.54	-2189.78*	392.92
Age Group						
35-49	166.43	237.55	327.38	217.73	333.20	481.05
50-64	668.59*	237.55	736.45*	257.58	682.13	507.18
65+	1428.08*	374.90	1875.42*	427.97	959.49	645.10
Income as Percent Poverty						
100-199%	-583.93**	336.21	-968.74**	524.63	-455.11	938.67
200-399%	-756.28*	260.76	-1592.66*	399.04	-701.07	631.74
400%+	-475.76*	322.89	-1344.55*	438.94	-477.82	704.67
Region						
Midwest	171.46	318.94	-507.85	468.95	-1009.42	835.33
South	-519.17**!	279.83	-548.45	467.55	-1918.46*	838.40
West	-127.65	279.83	-265.04	448.48	-1068.65	854.91
Educational Level						
High School Graduate	367.73	255.47	477.83	317.08	-89.78	985.53
Some College	421.38**	255.63	950.82*	384.86	-42.77	971.12
College Graduate	1076.68*	300.46	1514.46*	365.15	34.84	886.30
Number of Conditions						
1_conditions	2384.95*	214.57	3047.96*	221.93	4507.32*	412.54
2_conditions	5116.84*!	345.78	6009.85*	478.62	9309.59*	894.92
3_conditions	8442.99*!	588.42	10016.53*	875.25	12738.11*	926.41
4_conditions	11433.47*!	786.58	15752.11*	1166.85	16991.98*	1308.06
5+conditions	17738.45*!	1056.76	23441.04*	2172.61	26660.63	2069.31
Covid Diagnosis					3420.0*	1014.6

Back problems	13.3%	14.1%	15.5%	15.7%	9.1%	11.7%
Congestive Heart Failure	2.3%	1.9%	2.9%	2.2%	2.6%	1.8%
Heart Disease	31.5%	29.7%	30.1%	22.6%	23.6%	22.1%
Diabetes	22.8%	23.7%	25.8%	23.1%	23.2%	22.8%
Hypertension	0.2%	0.7%	0.0%	1.0%	0.7%	0.7%
Hyperlipidemia	0.9%	1.1%	0.9%	0.0%	1.2%	0.6%
Hypertension	62.3%	60.7%	60.8%	58.9%	56.7%	54.3%
Hyperlipidemia	50.5%	50.7%	49.8%	47.0%	45.5%	46.9%
Arthritis	4.9%	5.0%	5.5%	0.0%	4.0%	4.0%
Stroke	6.0%	5.2%	5.3%	4.7%	4.9%	4.0%

Figure 5: Factors Associated with Health Care Spending per Privately Insured Adult, 2010-2021, Marginal Effects
SOURCE: MEPS 2010-2021
*Significantly different from zero, p<=.05**Significantly different from zero, p<=.10
! 2021 coefficient significantly different from 2010 coefficient, p<=.05

	2010		2016		2021	
	Coefficient	Standard Error	Coefficient	Standard Error	Coefficient	Standard Error
Female	1229.50*	251.97	1822.97*	300.36	3005.28*	453.11
Race/Ethnicity						
Hispanic	-181.43	309.94	-802.65*	298.79	-1865.09*	700.51
Non- Hispanic Black	75.71	459.66	-1031.50*	429.54	-1359.91**	796.18
Non-Hispanic Other	-1381.82*	282.76	-1018.8*	369.72	-2187.50*	500.99
Age Group						
35-49	-77.08	282.21	287.13	283.38	465.72	574.78
50-64	692.96*	329.75	226.23	366.18	371.18	594.61
Income Percent of Poverty						
100-199%	-319.73	774.75	-645.65	933.79	-263.13	1156.35
200-399%	-780.48	675.39	-1002.66	655.42	592.67	1001.40
400%+	-540.53	664.13	-1058.29**	647.22	1229.00	1040.66
Region						
Midwest	352.87	471.13	-382.34	571.98	-956.94	636.44
South	-652.20**	373.40	-417.04	563.46	-1098.26**	677.45
West	-148.93	345.58	-168.72	546.32	578.72	666.57
Educational Attainment						
High School Graduate	98.76	367.21	514.61	397.53	1182.40	946.98
Some College	126.75	307.74	851.25*	391.75	1290.73	949.90
College Graduate	1084.10*	407.77	1543.22*	391.35	806.47	782.40
Number of Conditions						
1_conditions	2181.47*!	258.58	3039.07*	288.48	4297.81*	618.96
2_conditions	5020.69*	522.97	5828.42*	724.90	8621.15*	1377.82
3_conditions	8337.60*	971.27	11513.75*	2176.11	11901.82*	1633.53
4_conditions	10686.6*	1395.43	14427.03*	2346.19	16182.08*	3479.08
5+conditions	18592.47*	2694.10	24540.49*	4941.41	32946.45*	8892.95
Covid Diagnosis					2276.11*	920.55

Similar results were observed among privately insured adults aged 18-64 (Figure 5). Since the demographic results among this population were similar to those found for all adults, we focus our attention on the impact of patients with one or more chronic conditions in 2010 and changes in spending through 2021. In 2010, spending compared to those with no chronic conditions ranged from $2,181 higher among those with 1 chronic condition to nearly $18,600 higher among those with 5 or more chronic conditions. By 2021, privately insured adults with 5 or more conditions nearly $32,950 more on health care compared to those with no chronic conditions.

Privately insured adults with 1 chronic condition spent over $2,100 more on health care in 2021 compared to the same group

in 2010 (p<.05). While the point estimates increased sharply over time by number of conditions treated the difference over time were not statistically significant.

Finally, we turn to the results for Medicare beneficiaries. There were some differences in the demographic results. There were no significant differences in per capita spending among female and male beneficiaries. Since Medicare covers disabled adults under age 65 health care spending was $5,800 higher for those 35 to 49 compared to those under age 35 and $4,467 higher for those aged 50 to 64 in 2010. These differences were not significant, however, in 2021. The most influential variables were among beneficiaries with one or more chronic condition. Medicare beneficiaries spent between $2,750 more for those

with one condition compared to those with no chronic condition up to over $16,320 more for those with 5 or more conditions.

Of note in the Medicare population were the changes in health care spending over time among those with 5 or more conditions. In 2021, these patients with multiple chronic conditions over $23,840 more on care compared to beneficiaries with no chronic conditions. Moreover, spending among this group increased by over $7,000 in 2021 compared to 2010 (p<=.05).

Other Covariates of Interest

For the Medicare models we also included an indicator of whether the beneficiary was enrolled in fee-for-service or in a Medicare Advantage plan. We estimated models for each year (same variables as displayed in Figure 6) 2010 through 2021. In 2012, 2018 (both years differences p<=.05) and 2021 (p=.065) spending among patients enrolled in a Medicare Advantage plan were lower than found in fee-for-service (2012 and 2018 results not shown). In 2012 spending was $1,276 lower, 2018 spending was $1,534 lower and in 2021 $1,703 lower (p<=.05). The lower level of spending in these years may reflect the different incentives in the two programs. Since Medicare Advantage plans are paid a risk adjusted per capita monthly payment they have incentives to invest in programs to manage chronically ill patients. These programs include medication adherence, and care coordination among others.

Finally, in each of the three models we estimated the incremental effect of COVID-19 on healthcare spending. We use the results presented in Figures 1-3 for the year 2021. In that year, patients diagnosed and treated for COVID-19 incurred significantly higher spending compared to non-COVID patients. Moreover, treatment of COVID-19 added to the growth in per capita spending compared to the pre-pandemic years. Real per capita spending among all adults 18 and over was $3,420 higher compared to non-COVID patients (p<=.05). Among privately insured adults, the treatment of COVID-19 patients was $2,276 higher than non-COVID patients and for Medicare COVID-19 patients per capita spending was $6,620 higher compared to non-COVID-19 patients.

CONCLUSION, LIMITATIONS AND RECOMMENDATIONS

The analysis highlights the key role that patients with multiple chronic health conditions play in adding to annual health care spending as well as the growth in spending over time. Among all adults over 18, patients with 5 or more chronic conditions added over $26,600 to annual per capita spending in 2021. In that same year, the treatment of COVID-19 patients added an additional $3,420 in per capita health care spending.

After controlling for inflation, per capita spending among patients with 5 or more chronic conditions was nearly $9,000 higher in 2021 than estimated in 2010. Even larger increases

Figure 6: Factors Associated with Medicare Health Care Spending per Beneficiary, 2010-2021, Marginal Effects
SOURCE: MEPS 2010-2021
*Significantly different from zero, p<=.05
** Significantly different from zero, P<=.10
! 2021 coefficient significantly different from 2010 coefficient, p<=.05

	2010		**2016**		**2021**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Female	-415.36	683.56	1186.97	687.93	44.92	1026.32
Race/Ethnicity						
Hispanic	1006.01	1144.18	-512.84	867.94	-3734.30	1079.71
Non-Hispanic Black	1142.84	1117.97	-154.43	944.08	-850.11	2264.70
Non-Hispanic Other	-278.48	1209.54	-3319.55	974.10	-3723.45	1005.47
Age Group						
35-49	5828.48*	2632.06	1231.49	4310.55	-1670.57	6290.53
50-64	4466.84*	2077.11	-1497.60	2972.55	1586.75	6128.89
65+	439.75	1652.31	-5277.44	2746.07	-4594.63	6013.65
Income As Percent Poverty						
100-199	-173.45	1223.97	-1076.95	1279.36	-1785.72	1747.32
200-399%	-1205.06	1037.99	-2806.62	1149.36	-505.78	2032.60
400%+	-859.56	1273.16	-1284.81	1284.45	-2543.22	1938.41
Region						
Midwest	683.86	841.62	-718.17	1681.39	523.57	1553.91
South	-389.85	884.38	-1091.43	1662.85	-863.49	376.83
West	401.38	910.79	-1086.54	1630.99	-1123.35	1193.15
Educational Attainment						
High School Graduate	1436.69**	862.81	25.57	879.62	743.39	1424.22
Some College	1268.56	897.37	1001.01	1373.21	801.99	1578.83
College Graduate	1982.99	1244.84	1833.83	1174.33	633.67	1385.76
Number of Conditions						
1_conditions	2750.01*	1035.41	2608.28*	796.07	4367.88*	993.53

2_conditions	4861.78*	846.07	5555.29*	904.45	9849.93*	1776.71
3_conditions	7887.90*	1048.48	8634.44*	1138.76	11591.08*	1298.57
4_conditions	11916.49*	1320.13	15800.47*	1626.24	16358.36*	1713.11
5+conditions	16320.91*!	1255.38	21899.24*	2567.88	23840.42*	2094.09
Enrolled in Medicare Advantage	207.32	702.91	-779.59	735.91	1703.16	918.99
Covid Diagnosis					6620.05*	3215.48

were observed among privately insured adults with 5 or more chronic conditions over time. In 2021, per capita spending among these patients were nearly $33,000 higher than adults with no chronic conditions. Between 2010 and 2021, per capita spending among these patients were over $14,000 higher in the most recent year estimated.

Finally, we found similar results among Medicare patients. Per capita spending among those with 5 or more conditions were nearly $24,000 higher compared to patients with no chronic conditions. Among these most chronically ill, per capita spending increased by over $7,500 between 2010 and 2021.

The treatment of Covid-19 patients also added to the higher 2021 per capita spending levels, ranging from over $6,600 among Medicare patients to $2,276 for privately insured adults.

The results highlight key areas for health plans, employers, and the Medicare program to focus their efforts to reduce the level and growth in per capita health care spending. First, finding effective approaches for preventing the number and growth in chronic conditions through diet, exercise, nutrition and weight loss are key priorities. These tools could include lifestyle modification programs like the diabetes prevention program and expanded use of the growing number of semaglutide products coming to market.

Given the financial importance of patients with multiple chronic conditions, new approaches for coordinating care including medication adherence programs seems essential. Patients with multiple chronic conditions face a wide range of health challenges including mental disorders, and a variety of cardiovascular related conditions. This diversity places a premium on developing effective team- based care including providers that collaborate on whole-person care, and not individually diseased focus. Slowing the growth in spending will necessitate the evolution of more effective team-based care models.

FUNDING

REFERENCES

1. Holman HR. The Relation of the Chronic Disease Epidemic to the Health Care Crisis. ACR Open Rheumatol. 2020; 2: 167-173.

2. Thorpe KE, Allen L, Joski P. The Role of Chronic Disease, Obesity and Improved Treatment and Detection in Accounting for the Rise in Healthcare Spending between 1987 and 2011. Appl Health Econ Health Policy. 2015; 13: 381-387