

# Economic Burden of Cardiometabolic Disorders Among Patients With Asthma

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## BACKGROUND

- Asthma, a chronic disease of the lungs characterized by recurrent episodes of wheezing, breathlessness, and chest tightness, affects approximately 25 million adults in the United States (US).<sup>1</sup>
- Patients with asthma are at an elevated risk of having comorbid conditions due to common inflammatory pathways between asthma and other chronic diseases.<sup>2</sup>
- The prevalence of comorbidities complicate overall asthma management and are associated with poor prognosis, inadequate disease control, and higher health care use.<sup>3</sup>
- Recently, studies have shown that adults with asthma have significantly increased prevalence of cardiovascular disorders such as coronary artery disease, heart failure, and metabolic syndrome including diabetes.<sup>2,4</sup>
- A meta-analysis comparing comorbidities between patients with and without asthma revealed that those with asthma had an elevated risk of cardiometabolic disorders (CMDs).<sup>2</sup>
  - Specifically, patients with asthma were almost twice as likely to have comorbid cardiovascular disease compared with those without asthma (odds ratio [OR]: 1.90; 95% confidence interval [CI]: 1.70-2.14).
  - Similarly, compared with patients without asthma, those with asthma had greater odds of having hypertension (OR: 1.66; 95% CI: 1.44-1.88), diabetes mellitus (OR: 1.25; 95% CI: 1.08-1.44), and other metabolic disorders (OR: 1.40; 95% CI: 1.35-1.45).
- Although evidence exists regarding the impact of comorbidities on health care resource use among adults with asthma,<sup>3,4</sup> to the best of our knowledge, there are no real-world studies examining economic burden due to the presence of CMDs among patients with asthma.

## OBJECTIVES

- To examine the prevalence and incremental economic burden of CMDs in a US asthma cohort.

## METHODS

### Study Design and Data Source

- This study utilized a cross-sectional, retrospective study design, using pooled data from multiple alternate years (2008/2010/2012/2014) of the Medical Expenditure Panel Survey (MEPS).
  - Data from alternate years were used to obtain unique patients as MEPS follows patients for 1 year after cohort entry.
- MEPS is a nationally representative survey of the US civilian noninstitutionalized population that collects personal and household level information on respondents' sociodemographic characteristics, health status, access to care, clinical diagnosis, and related charges and payments.
- Full-year consolidated household, medical conditions, and prescribed medicine event files were used to obtain patient demographics, clinical characteristics, and health care costs.

### Patient Selection and Cohorts of Interest

- Patients with asthma were identified using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis code for asthma (493.xx).
  - The analytic sample for this study included adults (aged  $\geq 22$  years) who were alive during the year they were identified.
- We further divided patients into two cohorts based on the presence of CMDs during the study observation year.
  - CMDs included the following chronic conditions: diabetes, endocrine disorders, hypertension, and heart diseases.
  - These conditions were identified using clinical classification codes (CCC).
  - MEPS validates self-reported conditions through a sample of medical providers and maps these conditions to ICD-9-CM diagnosis codes, which are further aggregated to CCC by researchers.
  - The following combination of codes were used to identify the CMDs:
    - Diabetes (CCC: 49, 50)
    - Endocrine disorders (CCC: 51)
    - Heart disease (CCC: 96, 97, 100 to 108)
    - Hypertension (CCC: 98, 99)
  - Any patient with asthma included in the study sample with at least one of the above mentioned conditions was grouped into the CMD cohort, and other patients were grouped into the "no CMD" cohort.

### Patient Characteristics

- Demographic characteristics consisted of patients' age (in years: 22-49, 50-64,  $\geq 65$ ) gender (male, female), race/ethnicity (white, African American, and others), and metropolitan region (metro, rural, unknown).
- Socioeconomic characteristics included:
  - Education status: Less than high school education, high school education or above, unknown
  - Poverty status: Poor ( $< 100\%$  of federal poverty line [FPL]), low-income ( $100\% \leq \text{FPL} < 200\%$ ), middle-income ( $200\% \leq \text{FPL} < 400\%$ ) and high-income ( $400\%$  of FPL)
- Clinical characteristics included:
  - Health status categorized into three groups (excellent or very good, good, and fair or poor)
  - Polypharmacy (use of 0-5 drug classes,  $\geq 6$  drug classes)
  - Number of chronic conditions excluding CMDs (0, 1,  $\geq 2$ )
- Access to care was measured by health insurance status (private, public, and uninsured).

### Outcome Measure

- Total annual health care costs were calculated by adding costs for hospitalizations, emergency room and outpatient visits, prescription drugs, dental care, and other services during the study year.
- Health care costs were updated to 2014 US dollars using the medical care component of the consumer price index.

### Statistical Analysis

- Descriptive analyses entailed the tabular display of mean values, medians, ranges, and standard deviations (SDs) of continuous variables of interest and frequency distributions for categorical variables.
- T-tests were used to examine unadjusted differences in average annual health care costs by the presence of CMDs.
- Ordinary least squares (OLS) regression on log-transformed health care costs adjusted for demographic, socioeconomic, and clinical characteristics was conducted to estimate the magnitude of excess health care costs associated with CMDs.
- All analyses controlled for the complex sample design of MEPS and were conducted using SAS version 9.4 (Cary, NC: SAS Institute, Inc.; 2011).

## RESULTS

- Overall, 6,726 patients (weighted  $n = 45.7$  million) had asthma during 1 of the 4 years of pooled data (Figure 1).
  - Of these patients, 4,862 (weighted  $n = 32.8$  million) were aged  $\geq 22$  years and were alive during the study year.
- Among adults with asthma, more than half had comorbid CMDs (weighted percentage = 55.1%).

### Demographic and Clinical Characteristics (Table 1)

- Patients with CMDs were older than patients without CMDs (age group  $\geq 65$  years: 83.2% vs. 16.8;  $P < 0.001$ ). Other demographic characteristics such as race and metropolitan region were significantly different between the two study cohorts.
- Socioeconomic characteristics measured by poverty status and education were also different between the two study cohorts. Similarly, the two study cohorts differed on access to health care (i.e., insurance coverage).
- Clinical characteristics significantly differed between the two study cohorts.
  - A greater proportion of patients in the CMD cohort had fair/poor health status compared with those in the "no CMD" cohort (76.2% vs. 23.8%;  $P < 0.001$ ).
  - Similarly, a higher proportion of patients in the CMD cohort had polypharmacy and more chronic conditions than in the "no CMD" cohort.

### Annual All-Cause Health Care Costs (Figure 2)

- Mean (SD) all-cause annual health care costs during the study year were \$15,233 (\$610) among patients with asthma and CMD versus \$5,888 (\$262) among patients with asthma but no CMD ( $P < 0.001$ ).
- Mean (SD) inpatient costs were \$4,303 (\$378) among patients with asthma and CMD versus \$1,123 (\$157) among patients with asthma but no CMD ( $P < 0.001$ ).
  - Annual health care costs for emergency room visits, prescription drugs, and home health services were significantly greater in the CMD cohort than in the "no CMD" cohort.
- Multivariable OLS regression adjusting for patient demographic, socioeconomic, and clinical characteristics indicated that patients with comorbid CMDs had 34% ( $\beta = 0.293$ ;  $\exp[\beta] = 1.34$ ;  $P < 0.001$ ) higher costs than patients without CMDs.

Figure 1. Patient Selection Criteria

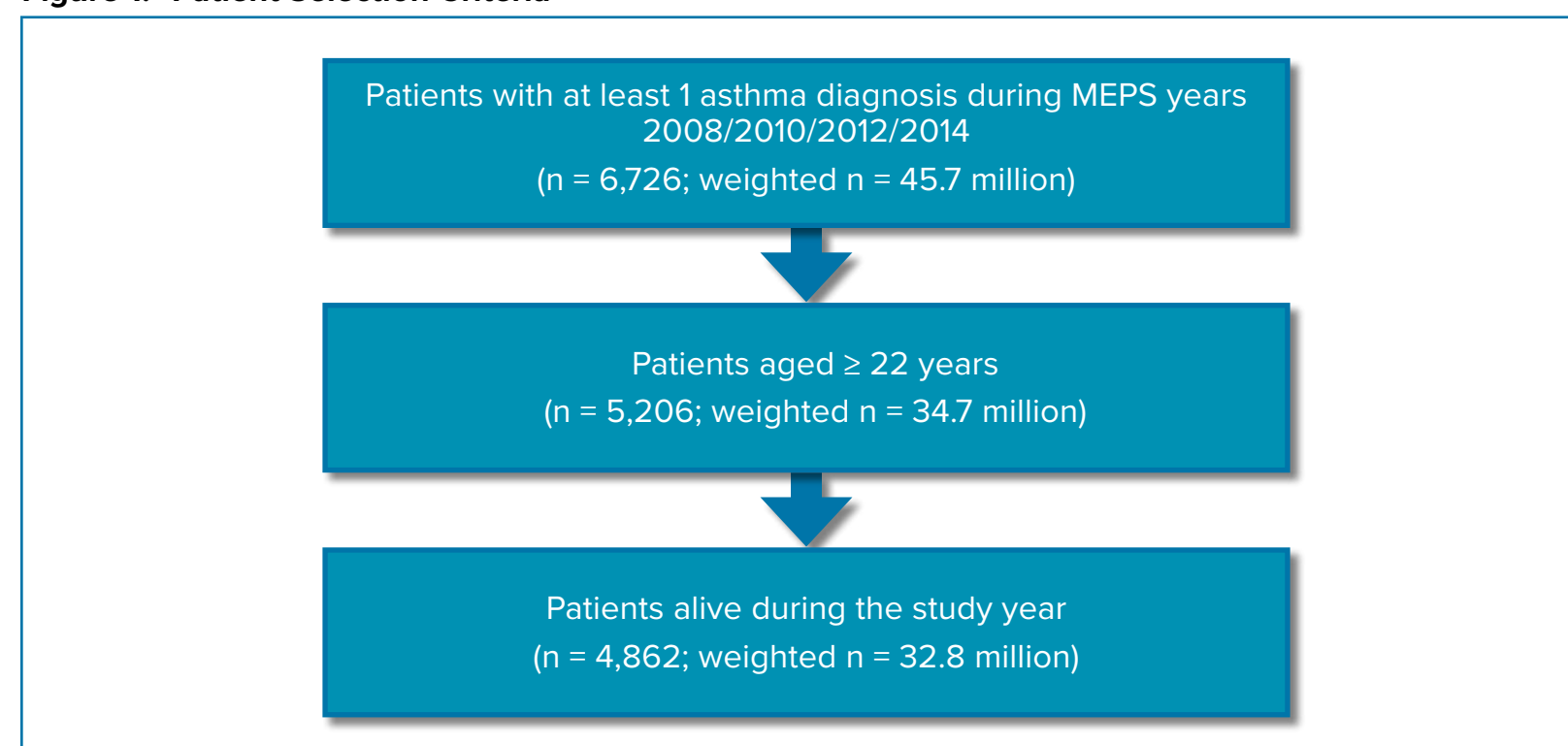


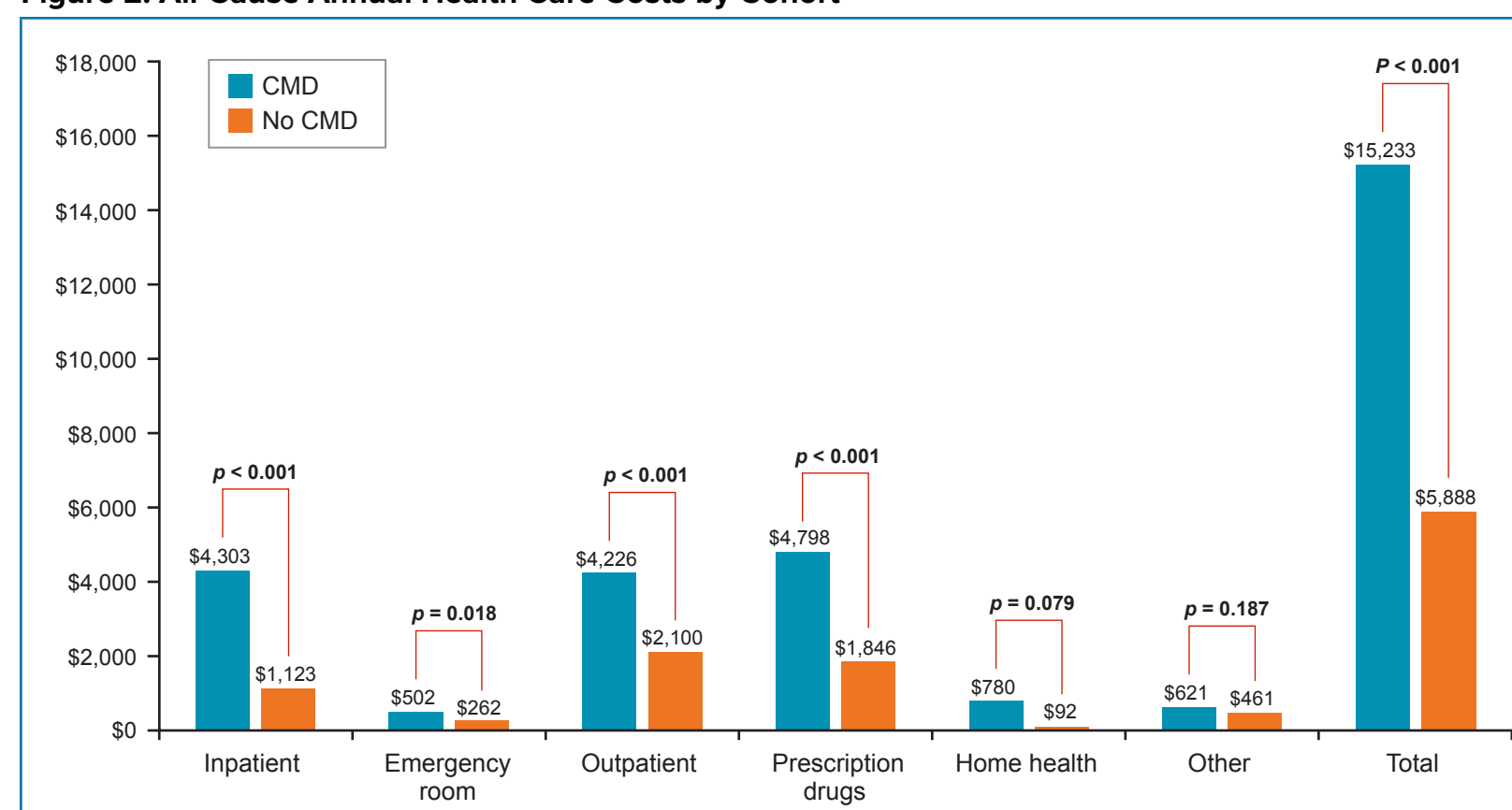
Table 1. Demographics and Clinical Characteristics by Cohort

	Asthma and CMD		Asthma and No CMD		P Value
	n	Wt. Col. %	n	Wt. Col. %	
<b>Age groups</b>					
22-49 years	764	32.1	1,389	67.9	< 0.001
50-64 years	1,089	65.2	518	34.8	
$\geq 65$ years	938	83.2	164	16.8	
<b>Gender</b>					
Female	1,957	55.4	1,410	44.6	0.513
Male	834	54.3	661	45.7	
<b>Race</b>					
White	1,401	54.7	1,112	45.3	0.012
African American	731	60.5	395	39.5	
Other	659	52.1	564	47.9	
<b>Metropolitan region</b>					
Metro	1,656	52.4	1,359	47.6	0.002
Rural	368	62.4	189	37.6	
Unknown	767	57.3	523	42.7	
<b>Education</b>					
Less than high school	500	70	197	30	< 0.001
High school or above	472	57.6	341	42.4	
Unknown	1,819	52.4	1,533	47.6	
<b>Poverty status</b>					
Poor	775	65.4	398	34.6	< 0.001
Low-income	670	62.5	413	37.5	
Middle-income	702	53.7	597	46.3	
High-income	644	47.6	663	52.4	
<b>Insurance coverage</b>					
Private	1,281	47.4	1,343	52.6	< 0.001
Public	1,326	73.8	507	26.2	
Uninsured	184	48.6	221	51.4	
<b>Health status</b>					
Excellent/very good	566	36.9	948	63.1	< 0.001
Good	889	54.6	681	45.4	
Fair/poor	1,336	76.2	442	23.8	
<b>Polypharmacy</b>					
< 6 drug classes	1,103	36.4	1,754	63.6	< 0.001
$\geq 6$ drug classes	1,688	81.7	317	18.3	
<b>Number of chronic condition excluding CMDs</b>					
0	702	35.1	1,214	64.9	< 0.001
1	1,262	62.4	684	37.6	
$\geq 2$	827	80.2	173	19.8	

Col = column; Wt. = weighted.

The n's represented in the above table are unweighted; however, the column percentages are weighted and are nationally representative.

Figure 2. All-Cause Annual Health Care Costs by Cohort



## DISCUSSION

- The current study used nationally representative survey data to highlight the elevated prevalence of CMDs among patients with asthma.
- Patients with asthma and CMD had statistically significantly greater annual total health care costs compared with patients with asthma but no CMDs.
- It is plausible that increased costs were observed among patients with CMDs because they had poorer general health status, greater polypharmacy, and an increased number of other chronic conditions compared with those without CMDs.
- Key limitations included the following:
  - Several important clinical characteristics such as asthma severity and laboratory values, which may have confounded the relationship between presence of CMDs and increased health care costs, were not available in the study database.
  - Inherent limitations associated with survey databases such as recall bias and inaccuracy of self-reported measures such as prescription drug use may have impacted study results.
- Health care providers treating patients with asthma should consider the potential burden of comorbid CMDs and implement effective methods for the comanagement of chronic conditions in patients with asthma.
- Further research is needed to understand the reasons behind increased health care costs among patients with asthma with comorbid CMDs.

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