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Trends in health care utilization for asthma exacerbations among diverse populations with asthma in the United States

Cosby Stone, MD, MPH^a, Tebeb Gebretsadik, MPH^b, Capt Rees L. Lee, MD^c, Amber M. Evans, MPH^d, Tina V. Hartert, MD^a, Edward Mitchel, MS^e, James Morrow^e, Ann C. Wu, MD^f, Carlos Iribarren, MD^g, Melissa G. Butler, PharmD, MPH, PhD^{h,i}, Emma K. Larkin, PhD^a, Kadir N. Turi, PhD^a, and Pingsheng Wu, PhD, MS^{a,b}

^aDepartment of Medicine, Vanderbilt University Medical Center, Nashville, Tenn

^bDepartment of Biostatistics, Vanderbilt University Medical Center, Nashville, Tenn

^cNaval Medical Research Unit Dayton, Wright Patterson AFB, Ohio

^dHealth ResearchTx LLC, Treviso, Pa

^eDepartment of Health Policy, Vanderbilt University Medical Center, Nashville, Tenn

^fDepartment of Population Medicine, Harvard Medical School and Harvard Pilgrim Health Care, Boston, Mass

^gDivision of Research, Kaiser Permanente Northern California, Oakland, Calif

^hCenter for Clinical and Outcomes Research, Kaiser Permanente Georgia, Atlanta, Ga

ⁱRoivant Sciences Ltd., Hamilton, Bermuda

TO THE EDITOR:

Asthma is one of the most common chronic diseases in the United States and around the world. It is also an illness that leads to frequent healthcare utilization.¹ Studies examining trends in asthma health care utilization are conducted mostly from cross-sectional surveys and often lack information on key subpopulations.^{2–5} For example, US health care utilization by asthmatics reported by the Centers for Disease Control and Prevention (CDC) do not differentiate trends occurring in subpopulations defined by geography or insurance source.⁵

Corresponding author: Pingsheng Wu, PhD, MS, Division of Allergy, Pulmonary, and Critical Care Medicine, Department of Medicine, Vanderbilt University School of Medicine, 2525 West End Ave., Suite 1100, Nashville, TN 37203. pingsheng.wu@vanderbilt.edu.

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Disclaimer: Research data derived from an approved Naval Medical Center, Portsmouth, VA IRB protocol (NMCP.2014.0017). The views expressed in this poster are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense or the United States Government. Copyright Notice: CAPT Rees Lee is a military service member. This work was prepared as part of his official duties. Title 17 U.S.C. 105 provides that “Copyright protection under this title is not available for any work of the United States Government.” Title 17 U.S.C. 101 defines a United States Government work as a work prepared by a military service member or employee of the United States Government as part of that person’s official duties.

The goal of this retrospective cohort study was to provide information on trends in health care utilization by asthmatic patients among diverse populations. Such trends help assess where patients are receiving acute and chronic care and help identify areas for focused interventions.

The study population included subjects 4 to 50 years old who were classified as having asthma during 2004 to 2010 and were continuously enrolled for at least 6 months in: (1) the United States Department of Defense Military Health System (MHS), (2) the Tennessee Medicaid program (Medicaid), or (3) 3 large integrated health care delivery systems (IHCDS) of the Population Based Effectiveness in Asthma and Lung Diseases (PEAL) Network. The years 2004-2010 were studied as these represented a timeframe for which there were overlapping data in all 3 health care programs. The 3 PEAL health care plans included Harvard Pilgrim Health Care, Kaiser Permanente Georgia, and Kaiser Permanente Northern California. The institutional review board at each site approved the study (IRB approval: Vanderbilt University IRB #131363 and Naval Medical Center, Portsmouth, VA IRB protocol NMCP.2014.0017). Detailed information on subject entry criteria can be found in this article's Online Repository at www.jaci-inpractice.org.

Asthma-specific health care visits were classified into hospitalization, emergency department (ED), and outpatient visits (OPVs). Yearly rates for each type of asthma-specific health care visit were calculated for the overall populations, by health care systems, age (4-11, 12-17, and 18-50 years), sex, and race groups. Linear trends in rates of health care visits from 2004 to 2010 were estimated using Poisson regression, and rate ratios with 2004 as the reference group were also estimated along with their 95% confidence intervals (CIs).⁶

There were 473,524 subjects with asthma identified: 41.1% (194,512) from the MHS, 10.2% (48,238) from Medicaid, and 48.6% (230,774) from IHCDS. Fifty-three percent were female. Among those whose race data were available ($n = 343,704$), 65% were white, 21% were African American, and 14% were from other racial groups (Table I).

The overall rates per thousand asthmatics for asthma hospitalization, ED, and OPVs during the study period were 0.32, 3.91, and 9.40, respectively. Rates varied by encounter type, over time, and across health care systems.

Over the study period, population rates of asthma hospitalization decreased by 49% in the pooled study population from 0.45 to 0.23 per thousand (rate ratio [RR]: 0.51, 95% CI: 0.47, 0.55) (Figure E1, available in this article's Online Repository at www.jaci-inpractice.org). Examined separately, Medicaid showed the greatest decrease in hospitalizations for asthma, a 64% decrease from 1.28 per thousand to 0.46 (RR: 0.36, 95% CI: 0.30, 0.46; linear trend β : -0.15 , $P < .001$). The MHS decreased by 49% from 0.39 per thousand in 2004 to 0.20 in 2010 (RR: 0.51, 95% CI: 0.45, 0.59; linear trend β : -0.12 , $P < .001$), and the IHCDS decreased 27% from 0.33 per thousand to 0.24 (RR: 0.60, 95% CI: 0.52, 0.68; linear trend β : -0.09 , $P < .001$) (Figure 1).

ED visit rates were relatively stable during the observation period across all 3 health care systems with no changes reaching statistical significance. Compared with 2004, there was a 25% decline in the MHS (RR: 0.75, 95% CI: 0.73, 0.78; linear trend β : -0.03 , $P = .07$) and

an 11% decline in Medicaid (RR: 0.89, 95% CI: 0.85, 0.93; linear trend b : -0.01 , $P = .62$) in 2010, respectively. ED visits increased 25% in the IHCDS cohort from 2.60 per thousand to 3.24 (RR: 1.25, 95% CI: 1.20, 1.30; linear trend β : 0.05 , $P = .12$) (Figure 1).

Change in rates for OPVs over the study period varied by the health care system. Rate ratios from 2004 to 2010 indicated a 43% decline in the MHS cohort from 13.70 per thousand to 7.79 (RR: 0.57, 95% CI: 0.56, 0.58; linear trend β : -0.11 , $P < .001$) and a 7% decline in the IHCDS cohort from 9.60 per thousand to 8.93 (RR: 0.93, 95% CI: 0.91, 0.95; linear trend β : -0.03 , $P = .01$); during this same timeframe there was a 1.84-fold increase in OPVs among Medicaid beneficiaries with asthma, from 5.65 per thousand to 10.37 (RR: 1.84, 95% CI: 1.74, 1.94; linear trend β : 0.08 , $P < .001$) (Figure 1). The observed trends in health care encounters were similar across age groups (4-11, 12-17, and 18-50 years), sex, and race (Online Repository at www.jaci-inpractice.org).

We observed a significant and consistent decline in asthma hospitalizations from 2004 to 2010 across 3 health care systems covering demographically, socioeconomically, and geographically diverse populations. This decline in asthma hospitalizations was consistent in all age groups, and by race and sex. The largest decline in hospitalizations was observed for the Medicaid cohort, which provides care primarily to low-income pregnant women, children, and individuals with a disability. The decline of asthma hospitalizations in this Medicaid cohort was accompanied by a concurrent increase in OPVs. In contrast, OPVs declined in both MHS and IHCDS populations. The decline in asthma hospitalizations differs from the stable rate reported by the CDC during the same time period; the discrepancy between our results and those of the CDC may be due to our focus on health care utilization within select insurance-source-based subpopulations.⁵ On the other hand, the Healthcare Cost and Utilization Project (HCUP) conducted by the Agency for Healthcare Quality and Research reported a consistent decrease in asthma hospitalizations in the pediatric population during the same time period.⁷ However, asthma hospitalizations remained stable in the adult population of the HCUP report; again the discrepancy may be related to our subpopulation focus.⁷ The varying rates in OPVs across health care systems observed in our study might also explain the stable trend reported by the CDC.⁵

Asthma hospitalization is the most salient and costly manifestation from loss of asthma control. The consistent decline in hospitalization rates is encouraging and may be indicative of improved asthma care, or a transition of acute care to another setting. The corresponding increase in OPVs in Medicaid may represent improved care or disease management. Consistent with the CDC report,⁵ we failed to observe a decrease in the ED visit rate, as would be expected if the changes were reflective of improved disease control and increased reliance on primary care management.

Strengths of this study are inclusion of large and diverse populations and multilevel health care encounter events for asthma. Limitations include the ecological design of the cohort, which does not allow us to determine the reasons for the decline in hospitalization rates. We were unable to measure asthma health care utilization of uninsured persons, who would be expected to utilize the ED and hospital at higher rates.

In summary, there has been a significant and consistent decline in asthma hospitalizations from 2004 to 2010 across the diverse health care systems studied; trends are also consistent by sex, age, and race. Trends in asthma-specific acute OPVs varied across health care systems, and only in the Medicaid population were decreases in asthma hospitalizations accompanied by increases in OPVs. The stable rate of ED visits indicates a continued reliance in the United States on ED treatment for acute asthma management and represents an area of potential focus for public health initiatives.

ONLINE REPOSITORY METHODS

Study population

Our study population included 4- to 50-year-old subjects who were classified as having asthma during 2004 to 2010 and were continuously enrolled for at least 6 months in one of the 3 health care systems studied. Subjects were classified as having asthma if they experienced at least 1 episode of an asthma-related exacerbation and/or had at least 2 separate dispensing events of asthma-specific medications within a 6-month period.^{E1,E2} An asthma-related exacerbation was defined by (1) a hospitalization or emergency department (ED) visit with a primary diagnosis of 493.xx; (2) a hospitalization or ED visit with a nonprimary diagnosis of asthma along with other respiratory diagnosis (Table E1); (3) an outpatient visit with a diagnosis of asthma requiring at least a 3-day supply of rescue corticosteroids; (4) an outpatient visit with asthma-specific exacerbation ICD9 (International Classification of Diseases, Ninth Revision) code 493.92. Asthma-specific medications included inhaled corticosteroids (ICS), long-acting β -agonists (LABA), combination of ICS plus LABA (ICS/LABA), leukotriene receptor antagonists, and at least a 5-day supply of corticosteroids. Subjects who have the following chronic lung diseases were excluded: congenital heart disease (ICD9 codes 428 and 429), bronchopulmonary dysplasia (ICD9 code 770.7), chronic obstructive pulmonary disease (ICD9 codes 496, 518.83, 786.05, 786.09, 799.02), congenital anomaly (ICD9 codes 740-759), chronic bronchitis and emphysema (ICD9 codes 490, 491, 492, 518.1, and 518.2), bronchiectasis (ICD9 codes 494 and 748.61), cystic fibrosis (ICD9 code 277), pulmonary hypertension (ICD9 codes 416, 415.0, 417.8, and 417.9), immunodeficiency (ICD9 code 279), and neurological disorders (ICD9 codes 343 and 359).

RESULTS

We examined rates of health care encounters within 3 age groups: 4-11 years, 12-17 years, and 18-50 years. Children 4 to 11 years had higher rates of asthma hospitalization, ED, and outpatient visit (OPV) events over time and across health care systems. Except for rate differences among age groups, the pattern of trends in asthma hospitalization, ED, and OPVs during the study periods in the 3 age groups was consistent when the age groups were combined, showing decreasing hospitalizations, stable ED visits, and decreasing OPVs in the MHS and IHCDs with increasing OPVs in Medicaid across the 3 age groups from 2004 to 2010 (Figure E2).

We also examined whether trends of asthma-specific health care encounters varied by sex across 3 health care systems. In all 3 health care systems, we observed a consistent decline

in asthma hospitalizations in both sex groups. Rates for asthma OPVs increased in both male and female groups in the Medicaid cohort (Figure E3).

Finally, we examined whether trends of asthma-specific health care encounters varied by race across the 3 health care systems. Consistent with other published findings, we noted higher rates of all types of asthma-specific health care visits for nonwhite racial groups,^{E3-E5} with narrowing of differences over the course of the study period. Trends in visits across racial groups, however, were similar when accounting for the health care system (Figure E4).

DISCUSSION

Asthma care and management during the last decade has been significantly different than in previous decades, emphasizing a stepwise approach to medication titration,^{E6} and relatively new treatment modalities. Leukotriene receptor antagonists and combination inhaled corticosteroids/long-acting bronchodilators are now commonly prescribed. Although our data suggest decreased asthma morbidity based on decreases in asthma hospitalizations, this study could not determine the reasons for these decreases. Possible explanations, such as health care systems providing improved asthma care in the outpatient system, as suggested by the Medicaid data, or perhaps through other disease management programs, cannot be ascertained from this study. Furthermore, trends toward decreased reimbursement for short hospitalizations may also influence the decision to admit and utilize higher level care.^{E7,E8} The trends observed in our study are likely to be cost-effective shifts in care given the very high costs of hospital care.

We observed a consistent higher rate of health care utilization in African Americans and other racial groups compared with whites, even in systems where comprehensive health care is available and cost for care is less of a consideration. This racial discrepancy in asthma health care utilization may be due to socioeconomic status, habituated preference in care location-seeking transmitted amongst family groups, or due to other unknown reasons, presenting a need for further investigation.

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Clinical Implications

- Asthma hospitalization rates decreased from 2004 to 2010 despite stable and high rates of emergency department visits for asthma exacerbations. This study supports continued opportunities for targeted prevention efforts for patients with suboptimal control.

Healthcare Utilization for Asthma Exacerbations Among Asthmatics from 2004-2010

FIGURE 1.

Trends in asthma-related healthcare visits (hospitalization, emergency department visits [ED], and outpatient visits) from 2004 to 2010 in subjects with asthma enrolled in the Military Health Systems (MHS), Tennessee Medicaid program (Medicaid), and large integrated health care delivery systems (IHCDS).

FIGURE E1.

Pooled trends in health care utilization using all 3 health care systems for outpatient visits (blue), emergency department visits (red) in the upper panel, and hospitalizations (yellow) in the lower panel.

FIGURE E2.

Trends in asthma-related health care visits (hospitalization, emergency department visits [ED], and outpatient visits) in persons with asthma aged 4-11 years, 12-17 years, and 18-50 years and enrolled in the Military Health Systems (MHS), Tennessee Medicaid program (Medicaid), and large integrated health care delivery systems (IHCDS).

FIGURE E3.

Trends in asthma-related health care visits (hospitalization, emergency department visits [ED], and outpatient visits) in persons with asthma, stratified by sex who were enrolled in the Military Health Systems (MHS), Tennessee Medicaid program (Medicaid), and large integrated health care delivery systems (IHCD).

FIGURE E4.

Trends in asthma-related health care visits (hospitalization, emergency department visits [ED], and outpatient visits) in persons with asthma, stratified by race. Data were from 343,704 patients for whom race data were available, compared with 473,524 overall. Subjects were enrolled in the Military Health Systems (MHS), Tennessee Medicaid program (Medicaid), and large integrated health care delivery systems (IHCD).

TABLE I.

Characteristics of subjects with asthma by the health care system

Characteristics	MHS (n = 194,512)	Medicaid (n = 48,238)	IHCDS (n = 230,774)
Birth year			
1954-1970	24,001 (12.3%)	2,252 (4.7%)	60,972 (26.4%)
1971-1990	71,357 (36.7%)	10,005 (20.7%)	75,351 (32.6%)
1991-2006	99,154 (51%)	35,981 (74.6%)	94,451 (40.9%)
Race (n = 343,704) *			
White	102,475 (62.7%)	27,404 (58.0%)	93,828 (70.5%)
African American	35,950 (22.0%)	16,653 (35.3%)	19,489 (14.6%)
Other	24,930 (15.3%)	3,156 (6.7%)	19,819 (14.9%)
Sex			
Female	103,695 (54%)	24,094 (50%)	121,725 (53%)
Male	90,817 (47%)	24,144 (50%)	109,041 (47%)
How subjects met asthma entry criteria			
Health care visit for asthma exacerbation only	32,461 (17%)	6,600 (14%)	32,617 (14%)
Asthma medication fill only	100,926 (52%)	19,193 (40%)	120,182 (52%)
Both health care visit for asthma exacerbation and medication fill	77,975 (34%)	22,445 (47%)	77,975 (34%)
Comorbidities			
Diabetes	5,692 (2.9%)	1,146 (2.4%)	6,469 (2.8%)
Malignancy	2,585 (1.33%)	331 (0.69%)	1,936 (0.84%)
Cardiovascular or peripheral vascular disease	2,517 (1.29%)	289 (0.60%)	1,105 (0.48%)

IHCDS, Integrated health care delivery systems; *MHS*, Military Health Systems.

* Race information was not available for 31,157 (16.0%) of MHS, 1,025 (2.1%) of Medicaid, and 97,638 (42.3%) of IHCDS subjects, respectively.

TABLE E1.

Respiratory diagnoses used to define acute asthma exacerbations when 493.xx was listed as a secondary code

Respiratory diagnosis	ICD-9 code
Pneumonia	480-486.99
Influenza with pneumonia or other respiratory manifestations	487.0, 487.1
Bronchitis	490-490.99
Acute upper respiratory infection	465-465.99
Acute bronchitis and bronchiolitis	466-466.99
Pulmonary collapse	518.0
Respiratory failure	518.81
Other pulmonary insufficiency	518.82
Pneumothorax	512-512.99
Perinatal chronic respiratory disease	770.7
Viral infection, excluding:	079-079.99
Human papilloma virus	
Retrovirus	
Retrovirus NOS	
HTLV I	
HTLV II	
HIV 2	
Retrovirus NEC	

HTLV, Human T-lymphotropic virus; *ICD-9*, International Classification of Diseases, Ninth Revision; *NEC*, not elsewhere classified; *NOS*, not otherwise specified.