Time Trends, Predictors, and Outcome of Emergency Department Use for Gout: A Nationwide US Study

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ABSTRACT. ***Objective.*** To assess gout-related emergency department (ED) use/charges and discharge disposition.

Methods. We used the US National ED Sample (NEDS) data to examine the time trends in total ED visits and charges and ED-related hospitalizations with gout as the primary diagnosis. We assessed multivariable-adjusted predictors of ED charges and hospitalization for gout-related visits using the 2012 NEDS data.

Results. There were 180,789, 201,044, and 205,152 ED visits in 2009, 2010, and 2012 with gout as the primary diagnosis, with total ED charges of $195 million, $239 million, and $287 million, respectively; these accounted for 0.14%–0.16% of all ED visits. Mean/median 2012 ED charges/visit were $1398/$956. Of all gout-related ED visits, 7.7% were admitted to the hospital in 2012. Mean/median length of hospital stay was 3.9/2.6 days and mean/median inpatient charge/admission with gout as the primary diagnosis was $22,066/$15,912 in 2012. In multivariable-adjusted analyses, these factors were associated with higher ED charges: older age, female sex, highest income quartile, being uninsured, metropolitan residence, Western United States hospital location, heart disease, renal failure, heart failure, hypertension (HTN), diabetes, osteoarthritis (OA), and chronic obstructive pulmonary disease (COPD). These factors were associated with higher odds of hospitalization: older age, Northeast location, metropolitan teaching hospital, higher income quartile, heart disease, renal failure, heart failure, hyperlipidemia, HTN, diabetes, COPD, and OA, whereas self-pay insurance status was associated with lower odds of hospitalization, following an ED visit for gout.

Conclusion. Absolute ED use and charges for gout increased over time, but relative use remained stable. Modifiable comorbidity factors associated with higher gout-related use should be targeted to reduce morbidity and healthcare use. (First Release May 1 2016; J Rheumatol 2016;43:1581–8; doi:10.3899/jrheum.151419)

Key Indexing Terms:

GOUT	EMERGENCY ROOM	CHARGES
HOSPITALIZATION	INPATIENT USE	HEALTHCARE USE

Gout is the most common inflammatory arthritis in adults. The prevalence of gout is increasing in the United States. According to the US National Health and Nutrition Examination Survey 2007–08, 3.9% of the US population reported physician-diagnosed gout[1]. Associated comorbidity burden makes gout a challenging disease to treat, at least partially related to contraindications to the use of gout medications and drug-drug interactions in the presence of renal failure, heart failure, etc.[2] Appropriate treatment can help achieve target serum urate < 6 mg/dl and lead to disease remission (i.e., "cure")[3]. The exact opposite of this excellent outcome is the suboptimal quality of care[4,5] associated with frequent flares with significant decrement in mobility, function, and quality of life[6].

Uncontrolled gout can lead to frequent emergency department (ED) and inpatient visits[7,8,9]. Higher healthcare costs because of ED/inpatient visits compared with lower-cost outpatient visits are undesirable. A single tertiary care center retrospective case-control study (n = 48 each) of recurrent hospital admissions for gout found that medical comorbidity, hyperuricemia, and inadequate allopurinol use were associated with recurrent admissions in unadjusted analyses[10]; this previous study did not examine gout admissions after an ED visit or perform analyses adjusted for potential confounders. In a 2-nation descriptive epidemiology study, Robinson, *et al* reported an increase in hospitalizations with gout as the primary reason/diagnosis over time both in New Zealand and the United Kingdom[11]. Comorbidities were common in these patients, but no analyses were performed to assess whether they predicted ED charges, or the risk of hospitalization[11].

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In a study of the US Nationwide Emergency Department Sample (NEDS; now "National") data from 2006–08, gout accounted for about 0.2% of all ED visits in the United States, with a slight increase in gout-related ED use from 2006 to 2008[7]. The previous study only examined predictors of ED charges and patient characteristics of gout versus non-gout visits[7]; specific comorbidities were not examined as predictors and the study did not examine patient disposition after an ED visit for gout or the predictors of hospitalization after an ED visit for gout[7]. Therefore, it is not known which subgroups of patients with gout should be the highest priority for the reduction of healthcare use for gout in the future. Hospitalization is one of the most expensive types of healthcare treatment in the United States, with only 7% of Americans hospitalized accounting for 29% of all healthcare expenses[12]. To our knowledge, there are no studies of gout-related hospitalization following an ED visit using a representative sample.

A rapidly increasing prevalence of gout in the United States[1] raises the question of whether gout-related use is also increasing rapidly over time. Given the knowledge gap in this area, a contemporary analysis of gout-related ED and inpatient use is needed. Knowledge of modifiable factors associated with hospitalization after an ED visit can allow us to potentially develop interventions to reduce it in the future. Our objective was to use contemporary US NEDS data to perform a comprehensive study to (1) determine whether specific comorbidities were associated with ED charges for gout, (2) assess the predictors of inpatient admission, including specific comorbidities, among patients presenting to ED with gout, and (3) obtain updated estimates of ED visits and ED charges because of gout.

MATERIALS AND METHODS

Data source and study population. We used the discharge data from the NEDS, Healthcare Cost and Utilization Project (HCUP), Agency for Healthcare Research and Quality for the years 2009, 2010, and 2012 (2011 data were not available at the time of study conduct because of data duplication issues)[13]. The NEDS describes ED visits in the United States and produces national estimates about ED visits across the country. NEDS is the largest publicly available all-payer US ED database that contains a 20% stratified sample of ED visits from across the United States[13]. Weights are used to calculate national estimates. For example, 31 million ED visits were weighted to calculate the national estimates related to 134 million ED visits in 2012 in the United States[13]. The representativeness of NEDS makes it a great resource for conducting health services and outcomes research.

NEDS was constructed using the HCUP State Emergency Department Databases (SEDD) and the State Inpatient Databases (SID)[13]. Among 24 states in 2006 and 30 states in 2012, contributed data included 950 US hospitals. The SEDD identify discharge information on ED visits that do not result in a hospital admission, and the SID have information on patients initially seen in ED and then admitted to the same hospital[13]. NEDS contains event-level data but not unique identifiers so that individuals may be represented by multiple visits in any given year. The Institutional Review Board at the University of Alabama at Birmingham approved the study.

For our study, we limited major analyses to ED visits with gout as the primary diagnosis, using the International Classification of Diseases-9-Clinical Modification (ICD-9-CM) code of 274.xx, a validated approach to identify a gout ED visit[14]. In addition, we estimated inpatient and total charges for admissions for visits with gout as primary or secondary diagnosis to assess the overall burden of gout.

Covariates. In addition to providing information related to the reasons for ED visit (diagnoses and procedures performed), NEDS includes several other important patient and hospital characteristics. Patient variables include age, sex, insurance status, residence (urban vs rural), and annual median household income estimated using residential zip code. Hospital characteristics include geographical region, metropolitan or non-metropolitan, and whether teaching versus nonteaching hospital. For each visit in NEDS, up to 15 ICD-9-CM diagnostic codes, 9 ICD-9-CM procedures, and 15 additional procedures coded using Current Procedural Terminology are provided.

Outcomes of interest. We examined predictors of 2 outcomes of interest: ED charges and ED discharge to inpatient setting, i.e., hospitalization (reference, discharge to home, or other) with gout as the primary diagnosis. Also assessed were time trends in ED use and ED charges for ED visits, and inpatient and total (ED + hospital) charges for hospitalizations because of gout as the primary diagnosis after an ED visit for gout.

Statistical analysis. We calculated weighted national frequency of gout visits for each study year (2009, 2010, and 2012) with gout as the primary diagnosis. We also examined summary statistics for gout-visit ED charges (absolute and proportion of all ED charges).

We undertook analyses of factors associated with outcomes of gout-related ED visits (charges, disposition) using data from NEDS 2012, i.e., the most recent year. We included patient and hospital characteristics as potential predictors of outcomes in these 2 groups of patients presenting with gout as the primary diagnosis for their ED visit. We performed multivariable-adjusted logistic regression (disposition) or linear regression (charges, length of stay) using SAS version 9.3 (SAS Corp.).

RESULTS

Gout-related ED visits: Patient characteristics, burden, time trends, and outcomes. In 2009, 2010, and 2012, gout was responsible for 0.14%, 0.16%, and 0.15% of all ED visits (Table 1); the total numbers of ED visits in those years were 130 million, 130 million, and 134 million, respectively. Characteristics were similar across various years for people with ED visits with gout as the primary diagnosis (Table 1). Mean age was 55 years, 23% were women, 75% were seen at a metropolitan area hospital, and 14% were in the highest quartile of household income. We did not note any time trends in patient characteristics, except the proportion seen at teaching hospitals, which increased from 25% in 2009 to 39% in 2012.

There were 180,789, 201,044, and 205,152 ED visits in 2009, 2010, and 2012 with gout as the primary diagnosis, respectively (Table 2). Total ED charges for gout were $195 million in 2009 and $287 million in 2012. For ED visits with gout as the primary diagnosis that resulted in inpatient admission, total charges were $299 million in 2009 and $350 million in 2012 (Table 3). Total (ED + hospital) charges for patients admitted to the hospital with gout as primary or secondary diagnosis after an ED visit were $14.1 billion in 2009 and $18.3 billion in 2012 (Table 3).

Of the ED visits with gout as the primary diagnosis in 2012, 91.3% resulted in discharge to home and 7.7% in hospital admissions. Mean and median 2012 ED

Table 1. ED visits for gout as the primary diagnosis in years 2009, 2010, and 2012. Values are n (%) unless otherwise specified.

Variables	2009 NEDS	2010 NEDS	2012 NEDS
ED visits for gout, % of all ED visits	180,789 (0.14)	201,044 (0.16)	205,152 (0.15)
Age, yrs			
Mean (SD)	55.35 (68.06)	55.35 (71.74)	55.44 (72.47)
Median (IQR)	53.50 (42.68–66.73)	53.61 (42.84–66.53)	53.71 (43.31–66.27)
Sex			
Female	41,543 (23.00)	46,213 (22.99)	46,839 (22.83)
Patient location, residence			
Micropolitan/not metro	45,778 (25.51)	50,593 (25.32)	47,371 (23.19)
Metropolitan, large or small	135,683 (74.49)	151,287 (74.68)	158,918 (76.81)
Median household income			
1st quartile	65,831 (37.46)	79,371 (40.55)	81,588 (40.71)
2nd quartile	49,752 (28.31)	50,845 (25.97)	48,791 (24.35)
3rd quartile	34,935 (19.88)	37,055 (18.93)	40,462 (20.19)
4th quartile	25,208 (14.34)	28,487 (14.55)	29,554 (14.75)
Primary payer			
Medicare	62,176 (34.5)	69,960 (34.92)	72,568 (35.41)
Medicaid	19,605 (10.89)	23,724 (11.84)	27,556 (13.45)
Private insurance	55,803 (31)	57,115 (28.51)	51,329 (25.05)
Self-pay	35,608 (19.78)	42,116 (21.03)	44,042 (21.49)
Uninsured/no charge	1654 (0.92)	1525 (0.76)	1199 (0.58)
Other	5175 (2.87)	5872 (2.93)	8254 (4.03)
Hospital region			
Northeast	31,220 (17.27)	34,870 (17.34)	35,976 (17.54)
Midwest	35,146 (19.44)	39,931 (19.86)	40,729 (19.85)
South	87,427 (48.36)	98,323 (48.91)	97,904 (47.72)
West	26,997 (14.93)	27,919 (13.89)	30,543 (14.89)
Teaching status of hospital			
Metropolitan nonteaching or nonmetro	123,559 (74.77)	124,746 (64.19)	125,106 (60.98)
Metropolitan teaching	57,230 (25.23)	71,997 (35.81)	80,047 (39.02)

ED: emergency department; NEDS: US National ED Sample; IQR: interquartile range.

Table 2. ED charges for the ED visits with gout as the primary diagnosis and ED disposition.

Variables	2009	2010	2012
All gout ED visits with gout as the primary diagnosis, n (% of total ED visits)	180,789 (0.14)	201,044 (0.16)	205,152 (0.15)
Total ED charges, US$	195,460,027	239,407,216	286,714,281
ED charges** per ED visit, US$			
Mean (SD)	1081 (5324)	1190.82 (5013)	1398 (6482)
Median (IQR)	749 (428–1275)	844 (505–1191)	956 (572–1063)
ED disposition, n (%)			
Discharged, routine*	163,432 (90.40)	181,781 (90.42)	187,315 (91.31)
Admitted	15,287 (8.46)	17,422 (8.67)	15,870 (7.74)
Transferred	1051 (0.58)	847 (0.42)	978 (0.47)
Home healthcare	459 (0.25)	207 (0.10)	375 (0.18)
Against medical advice	428 (0.24)	422 (0.21)	533 (0.26)
Unknown	133 (0.07)	364 (0.18)	82 (0.04)

* Routine discharge indicates discharge from the ED to home. ** Numbers were rounded to the nearest whole digit. ED: emergency department; IQR: interquartile range.

charges/inpatient visit were $1398 and $956, respectively (Table 2). For gout-related hospitalization after ED visit, the median length of hospital stay was 2.6 days [interquartile range (IQR) 1.46–4.24, mean 3.9 days] and median total hospital charges were $15,912 in 2012 (IQR 9655–26,764, mean $22,066; Table 3).

Predictors of gout-related ED charges. In multivariable-adjusted analyses, these factors were associated with

Table 3. Charges and characteristics of inpatient admission for gout as primary diagnosis after an ED visit and charges for inpatient admission with gout as primary or secondary diagnosis.

Variables	2009 NEDS	2010 NEDS	2012 NEDS
Gout as the primary diagnosis for hospitalization after an ED visit			
All gout inpatient admissions with gout as primary diagnosis* for those with ED visits	15,287	17,422	15,870
Total inpatient charges, US$	264,984,858	321,435,900	313,448,370
Length of hospital stay, days			
Mean (SD)	4.15 (4.42)	4.00 (4.13)	3.86 (3.38)
Median (IQR)	2.82 (1.65–4.89)	2.75 (1.53–4.53)	2.58 (1.46–4.24)
Total charges, ED and inpatient, for admitted patients, US$	299,472,330	357,098,734	350,187,420
Total charges**, ED and inpatient, per visit for admitted patients, US$			
Mean (SD)	19,590 (35,000)	20,497 (38,073)	22,066 (17,070)
Median (IQR)	13,609 (8093–23,246)	14,862 (8888–24,429)	15,912 (9655–26,764)
Gout as primary or secondary diagnosis for hospitalization after an ED visit			
All gout inpatient admissions with gout in any position, primary or secondary, after an ED visit	445,934	472,470	498,296
Total inpatient charges, US$	12,671,214,610	13,896,287,640	16,118,879,008
Length of hospital stay, days, mean (SE)	4.96 (14.93)	4.81 (12.29)	4.69 (15.78)
Total charges for ED and inpatient services, US$	14,150,823,622	15,375,118,740	18,314,869,480

* Gout International Classification of Diseases-9-Clinical Modification code 274.xx listed as the primary diagnosis. ** Numbers were rounded to the nearest whole digit. ED: emergency department; NEDS: US National ED Sample; IQR: interquartile range; SE: standard error.

higher ED charges: older age, female sex, highest quartile of household income, uninsured/no charge insurance status, metropolitan area patient residence, and hospital location in the western United States (Table 4). The following comorbidities were associated with higher ED charges, ranging $117–$196 more for each comorbidity: the presence of heart disease, heart failure, hypertension (HTN), diabetes, or chronic obstructive pulmonary disease (COPD), but not hyperlipidemia. Renal failure in patients with gout was associated with $647 higher and osteoarthritis (OA) with $551 higher ED charges, compared with their absence, for gout-related ED visits (Table 4).

Predictors of hospital admission with gout as the primary diagnosis. In univariate analyses, various sociodemographic and comorbidity factors were associated with a higher risk of hospital admission among patients with gout-related ED visits: older age, female sex, higher household income, Medicare insurance status, patient residence in a metropolitan area, hospital location in the Northeast region or status as a metropolitan teaching hospital, and presence of chronic conditions (Table 5).

Multivariable-adjusted analyses showed that compared to age < 50 years, older age was associated with increasingly higher odds of hospitalization, while sex was no longer associated. Compared to Medicare coverage, self-pay status was associated with lower odds of hospitalization. Location of hospital in regions other than Northeast United States was associated with lower odds of hospitalization, whereas metropolitan teaching hospital status and higher income quartile were associated with higher odds (Table 5). The presence of coronary heart disease, hyperlipidemia, heart failure, HTN, diabetes, and COPD were each associated with 1.38–2.41 times higher odds of hospitalization in those presenting to the ED with gout as the primary diagnosis. The presence of renal failure was associated with 8 times higher odds of hospitalization and OA was associated with 4.25 times higher odds of hospitalization for gout (Table 5).

DISCUSSION

We used 2009–2012 NEDS data to study time trends in ED and inpatient charges/use because of gout and assessed whether specific comorbidities predicted ED charges and hospitalization using the 2012 NEDS data. To our knowledge, our study is the first to provide US national estimates of overall charges for gout care in non-outpatient settings (not just ED charges) and the first study to examine the predictors of inpatient use for gout after an ED visit using a representative US sample. Specific comorbidities were examined as potential predictors of ED use and charges. We updated the estimates of gout-related ED use and charges from 2008 to the current time[7]. Our current study fills several knowledge gaps. Several study findings regarding gout-related use of healthcare services in a US national sample merit further discussion.

A novel study observation was the identification of factors predictive of hospitalization after an ED visit for gout as the primary diagnosis in a national US representative cohort. Other single-center or multicenter studies have shown that more frequent gout attacks, higher serum urate level, higher nonemergent gout-related use, and heart disease were associated with higher gout-related emergency/urgent care visits[8,9,15]. However, these studies did not include a representative sample. In addition, they were focused on time trends in hospitalization[11] or recurrent gout hospitalizations

Table 4. Predictors of ED hospital charges among patients presenting to ER with gout using linear regression.

Variables	Univariate β Estimate* (95% CI)	p	Multivariable-adjusted β Estimate* (95% CI)	p
Age, yrs				
< 50	Ref		Ref	
50 to < 65	**135.32 (91.77–178.87)**	**< 0.0001**	34.96 (–7.66 to 77.58)	0.1077
65 to < 80	**432.69 (373.31–492.06)**	**< 0.0001**	**194.44 (126.28–262.59)**	**< 0.0001**
≥ 80	**629.29 (529.00–729.59)**	**< 0.0001**	**297.27 (190.66–403.88)**	**< 0.0001**
Sex				
Female, ref	Ref		Ref	
Male	**–189.66 (–233.35 to –145.97)**	**< 0.0001**	**–47.91 (–93.72 to –2.10)**	**0.0404**
Median household annual income				
Lowest quartile, < $38,999	Ref		Ref	
2nd quartile, $39,000 to $47,999	15.52 (–59.21 to 90.25)	0.6836	–10.64 (–82.12 to 60.85)	0.7703
3rd quartile, $48,000 to $62,999	**161.60 (47.12–276.08)**	**0.0057**	61.75 (–38.56 to 162.06)	0.2272
Highest quartile, $63,000 or more	**326.75 (175.69–477.82)**	**< 0.0001**	**163.24 (20.22–306.26)**	**0.0253**
Primary payer				
Medicare, ref	Ref		Ref	
Medicaid	**–287.55 (–355.54 to –219.56)**	**< 0.0001**	–38.93 (–111.09 to 33.24)	0.29
Private insurance	**–288.14 (–353.26 to –223.02)**	**< 0.0001**	–36.32 (–101.06 to 28.43)	0.2712
Self-pay	**–407.62 (–466.61 to –348.63)**	**< 0.0001**	–64.21 (–135.71 to 7.29)	0.0783
Uninsured/no charge	41.58 (–231.89 to 315.06)	0.7654	**331.83 (48.95–614.72)**	**0.0216**
Other	**–445.00 (–542.37 to –347.64)**	**< 0.0001**	**–182.50 (–284.05 to –80.95)**	**0.0004**
Patient residence				
Micropolitan/not metro	Ref		Ref	
Metro, large or small	**399.80 (302.92–496.69)**	**< 0.0001**	**297.62 (195.46–399.79)**	**< 0.0001**
Hospital region				
Northeast	Ref		Ref	
Midwest	–152.64 (–359.63 to 54.35)	0.1481	–67.25 (–266.14 to 131.65)	0.507
South	–164.93 (–358.25 to 28.40)	0.0944	–25.11 (–218.92 to 168.69)	0.7993
West	**207.08 (16.56–397.60)**	**0.0332**	**456.24 (263.16–649.31)**	**< 0.0001**
Teaching status of hospital				
Metropolitan nonteaching or nonmetro	Ref		Ref	
Metropolitan teaching	**265.81 (130.46–401.15)**	**0.0001**	120.67 (–25.82 to 267.16)	0.1063
Comorbidities, ref: no				
Coronary heart disease	**612.59 (490.46–734.73)**	**< 0.0001**	**187.85 (64.28–311.42)**	**0.0029**
Hyperlipidemia	**476.23 (383.64–568.82)**	**< 0.0001**	79.03 (–8.63 to 166.70)	0.0771
Renal failure	**1038.97 (871.53–1206.40)**	**< 0.0001**	**646.76 (484.36–809.16)**	**< 0.0001**
Heart failure	**602.79 (480.09–725.49)**	**< 0.0001**	**116.96 (2.97–230.95)**	**0.0443**
Hypertension	**380.15 (320.33–439.97)**	**< 0.0001**	**121.65 (65.82–177.48)**	**< 0.0001**
Diabetes	**466.90 (384.78–549.03)**	**< 0.0001**	**196.34 (120.43–272.25)**	**< 0.0001**
COPD	**571.87 (414.57–729.16)**	**< 0.0001**	**164.54 (10.59–318.50)**	**0.0362**
Osteoarthritis	**901.13 (723.85–1078.41)**	**< 0.0001**	**551.31 (384.74–717.89)**	**< 0.0001**

Significant β estimates and p values are in bold face. Dollars are US. ED: emergency department; ER: emergency room; ref: reference; COPD: chronic obstructive pulmonary disease.

at a tertiary care center[10]. Our study showed that compared to age < 50, older age was associated with higher odds, while self-pay, location of hospital in a region other than Northeast United States, and metropolitan teaching hospital status were each associated with lower odds of hospitalization. Presence of heart disease, hyperlipidemia, heart failure, HTN, diabetes, COPD, renal failure, and OA were each significantly associated with the risk of hospitalization, but sex was not.

Thus, our study identified several new correlates of gout-related hospitalization after an ED visit for gout. Of note, renal failure was associated with 8 times, OA with 4.25 times, and heart disease and other comorbidities with 1.5–2.5 times higher odds of gout-related hospitalization after an ED visit for gout. The risk imparted by renal failure of 8 times the odds for gout hospitalization after an ED visit for gout in 2012 was much higher than the 3.1 times higher odds of hospital admission after an ED visit because of renal failure in COPD visits in 2012 using the same set of covariates in multivariable models[16]. This finding identifies renal failure as a highly significant comorbidity in patients with gout, and establishes its association with healthcare use related to gout ED visits and subsequent healthcare use. The associations of comorbidities with hospitalization are novel findings, and illustrate that not all comorbidities are created equal when it comes to hospitalization risk in patients with gout. This finding can also allow for the identification of groups at the

Table 5. Predictors of hospital admission among patients presenting to ER with primary diagnosis of gout using logistic regression (reference, discharge to home).

Variables	Univariate OR (95% CI)	p	Multivariable-adjusted OR (95% CI)	p
Age, yrs				
< 50	Ref		Ref	
50 to < 65	**2.30 (2.02–2.62)**	**< 0.0001**	**1.25 (1.08–1.44)**	**< 0.0001**
65 to < 80	**4.69 (4.16–5.29)**	**< 0.0001**	**1.40 (1.19–1.64)**	**< 0.0001**
≥ 80	**9.25 (7.99–10.73)**	**< 0.0001**	**2.26 (1.87–2.72)**	**< 0.0001**
Sex				
Female	Ref		Ref	
Male	**0.61 (0.56–0.66)**	**< 0.0001**	0.99 (0.90–1.10)	0.8514
Median household annual income				
Lowest quartile, < $38,999	Ref		Ref	
2nd quartile, $39,000 to $47,999	1.17 (0.99–1.38)	0.0698	**1.20 (1.01–1.43)**	**0.0351**
3rd quartile, $48,000 to $62,999	**1.36 (1.14–1.62)**	**0.0007**	1.19 (0.99–1.43)	0.0584
Highest quartile, $63,000 or more	**1.88 (1.54–2.31)**	**< 0.0001**	1.22 (0.96–1.54)	0.0982
Primary payer				
Medicare	Ref		Ref	
Medicaid	**0.44 (0.36–0.53)**	**< 0.0001**	1.01 (0.84–1.23)	0.8844
Private insurance	**0.34 (0.30–0.38)**	**< 0.0001**	0.87 (0.75–1.00)	0.0574
Self-pay	**0.16 (0.14–0.20)**	**< 0.0001**	**0.72 (0.59–0.87)**	**0.0007**
Uninsured/no charge	**0.31 (0.20–0.48)**	**< 0.0001**	1.41 (0.88–2.25)	0.1515
Other	**0.38 (0.29–0.50)**	**< 0.0001**	1.07 (0.77–1.49)	0.686
Patient location, residence				
Micropolitan/not metro	Ref		Ref	
Metro, large or small	**2.46 (2.08–2.91)**	**< 0.0001**	**1.60 (1.32–1.95)**	**< 0.0001**
Hospital region				
Northeast	Ref		Ref	
Midwest	**0.60 (0.45–0.78)**	**0.0002**	**0.49 (0.38–0.63)**	**< 0.0001**
South	**0.42 (0.33–0.55)**	**< 0.0001**	**0.47 (0.36–0.60)**	**< 0.0001**
West	**0.50 (0.38–0.65)**	**< 0.0001**	**0.33 (0.21–0.52)**	**< 0.0001**
Hospital: teaching status and location				
Metropolitan nonteaching or nonmetro	Ref		Ref	
Metropolitan teaching	**2.26 (1.88–2.72)**	**< 0.0001**	**1.41 (1.15–1.73)**	**0.0008**
Comorbidities				
CHD, ref: no	**6.81 (6.08–7.64)**	**< 0.0001**	**1.89 (1.65–2.16)**	**< 0.0001**
Hyperlipidemia, ref: no	**5.98 (5.33–6.70)**	**< 0.0001**	**1.82 (1.59–2.08)**	**< 0.0001**
Renal failure, ref: no	**21.51 (18.34–25.22)**	**< 0.0001**	**8.00 (6.82–9.38)**	**< 0.0001**
Heart failure, ref: no	**8.50 (7.43–9.72)**	**< 0.0001**	**2.28 (1.95–2.65)**	**< 0.0001**
Hypertension, ref: no	**6.45 (5.75–7.24)**	**< 0.0001**	**2.41 (2.11–2.75)**	**< 0.0001**
Diabetes, ref: no	**3.87 (3.53–4.24)**	**< 0.0001**	**1.38 (1.23–1.55)**	**< 0.0001**
COPD, ref: no	**6.40 (5.48–7.47)**	**< 0.0001**	**2.34 (1.93–2.85)**	**< 0.0001**
Osteoarthritis, ref: no	**8.38 (7.16–9.81)**	**< 0.0001**	**4.25 (3.43–5.26)**	**< 0.0001**

Significant OR and p values are in bold face. Dollars are US. ER: emergency room; ref: reference; CHD: coronary heart disease; COPD: chronic obstructive pulmonary disease.

highest risk of hospitalization for gout. This information can be used in 2 ways.

This new knowledge may allow risk prediction and prognostication for clinical care and healthcare policy and planning. Policy makers can use this information for resource allocation and quality improvement. Additionally, researchers can use this information to develop interventions targeting modifiable factors, such as comorbidities, to reduce healthcare use in patients with gout. It remains to be seen whether optimization of treatment of specific comorbidities such as renal failure, OA, COPD, etc. in the outpatient settings can reduce gout-related ED use. Several factors associated with a higher risk of hospitalization and ED charges, such as age, sex, residence, and the type of hospital where patients are seen, are not modifiable; however, knowledge of these associations adds to the current knowledge and our understanding of gout-related ED and subsequent inpatient use. Our study extends a similar finding of association of comorbidities with higher hospitalization risk after ED visits for other conditions[17,18] to ED visits for gout.

We found that ED charges for gout increased from $195 million in 2009 to $287 million in 2012; a previous study using the same dataset reported ED charges of $128 million

in 2006 for gout[7]. Thus, total ED visit charges for gout in the United States have increased 47% and 124% over the last 4 and 7 years, respectively. This important finding indicates an increasing public health burden of gout. This increase may be attributable to a higher gout medication cost[19], a higher cost of ED services[20,21], and/or a higher complexity of patients[22] over the study period. The median charges/ED visit increased from $749 in 2009 to $956 in 2012, a 28% increase in 4 years. Similarly, hospital charges for those admitted with gout as primary diagnosis increased from $13,609 to $15,912, a 17% increase from 2009 to 2012. The total charges for patients who were admitted with gout (primary or secondary diagnosis) were $14.1 billion in 2009 and $18.3 billion in 2012, a 30% increase. Thus, our findings in conjunction with the earlier NEDS study[7] provide an analysis of time trends in gout-related ED and inpatient use, and charges in the United States. Gout-related ED visits accounted for 0.14% of all ED visits, which mirrors the earlier NEDS data from 2006–2008[7].

Another novel finding from our study was that all comorbidities except hyperlipidemia predicted higher ED charges for ED visits because of gout. Specifically, the presence of heart disease, heart failure, COPD, renal failure, HTN, diabetes, and OA each predicted higher ED charges in patients with gout. The increase in adjusted ED charges ranged from $117 for heart failure to $647 for renal failure, demonstrating the differential effect of various comorbidities on ED charges and the risk of hospitalization in patients presenting to ED with gout as the primary diagnosis. This has a practical implication, i.e., with limited resources, one can focus on comorbidities that are the costliest and/or associated with the highest risk. We also confirmed previously noted findings that western US location, metropolitan hospital, female sex, and older age were associated with higher ED charges in patients with gout[7].

Our study has several limitations, which must be considered while interpreting findings. NEDS counts visits, not people; therefore some patients may have had more than 1 visit, and repeat ED visits are of great interest from clinical and policy perspective but cannot be studied using NEDS because the data are visit-based and not patient-based. Important gout-related disease severity variables and serum urate were not available in NEDS to adjust in the analyses, which may have led to residual confounding. NEDS does not have medication data or link to outpatient records. Therefore, it was not possible to conduct medication-related analyses that could have provided valuable insight, or assess outpatient treatment of gout or the number of outpatient diagnoses to better understand their relationship to ED visits. Generalizability to other countries may not be possible, because healthcare settings might differ.

Our study estimated the total charges secondary to ED visits and hospitalizations, not the actual healthcare costs. It is likely the charges are inflated and the actual costs are lower. We did not adjust charges for inflation because of a short study period, because inflation was historically low during the course of this study period; however, we recognize this as a potential limitation. One would expect the charges to be higher with comorbidities, because comorbidities may be associated with a poorer health status and/or contraindications to certain treatments for gout. However, we were interested in assessing the effect of specific comorbidities and noted that the adjusted ED charges varied from an additional $116 for heart failure to $647 for renal failure in patients with gout. Our study findings cannot be generalized to hospitalizations because of gout that occurs from non-ED settings and NEDS does not identify these data. These hospitalizations may differ in outcomes from hospitalizations after an ED visit for gout that we studied. Study of non-gout ED visits was not an objective, and therefore detailed comparisons to other types of visits could not be made; separate publications provide similar analyses for COPD[16] and for gout versus non-gout ED visits[7].

Our study has several strengths. NEDS is the largest and most representative US sample of ED visits, and therefore the findings are applicable to Americans with gout. We adjusted for several patient, healthcare access, and hospital characteristics including comorbidities common in patients with gout (important covariates and confounders) to obtain unbiased estimates.

In our study of 2009–2012 NEDS data, we estimated the ED and inpatient healthcare burden of gout in the US general population. We described new correlations of ED-to-hospital admission and ED charges for patients with gout. Gout-related ED and inpatient charges have increased dramatically in the last few years in absolute terms. The number of ED visits with gout as the primary diagnosis increased 13% in the last 4 years, though it was stable as a proportion of all ED visits (0.14% across yrs). The total hospital charges for gout as the primary diagnosis were $350 million in 2012, and $18.3 billion for gout as primary or secondary diagnosis in 2012. Future studies need to determine which aspects of comorbidity management are associated with higher charges and higher risk of hospitalization in patients with gout. This will allow us to develop interventions to target this high-risk group.

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