




Emergency Department Visits and Subsequent Hospital Admission Trends for Patients with Chest Pain and a History of Coronary Artery Disease

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ABSTRACT

Introduction: Hospitalization is the largest component of health care spending in the United States. Most hospitalized patients first visit the emergency department (ED), where hospitalization decisions are made. Optimal utilization of hospital resources is critical for all stakeholders.

Methods: We performed a population-based, cross-sectional study evaluating ED visits and subsequent inpatient admissions for patients with coronary artery disease (CAD) and chest pain (CP) suggestive of CAD from 2006 to 2013 using the Nationwide Emergency Department

Sample database weighted for national estimates. We analyzed trends using a generalized linear regression model with a Poisson distribution and Wald test.

Results: From 2006 to 2013, there was a 15% decrease in ED visits for CAD ($p < 0.01$), while ED visit rates for CP increased 31% ($p < 0.01$). Subsequent inpatient admission rates decreased 18% for CAD ($p < 0.01$) and 33% for CP ($p < 0.01$). Trends were not modified by patient and hospital strata.

Conclusion: ED visits and subsequent inpatient admissions resulting from CAD decreased from 2006 to 2013. Patients with CP had a substantially higher number of ED visits, with a significant decline in inpatient admissions.

Keywords: Chest pain; Coronary artery disease; Emergency department; Hospitalization; United States

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Key Summary Points

Why carry out this study?

Hospitalization accounts for one-third of health care spending in the United States, and identifying trends and tools to reduce avoidable incident and readmission hospitalizations is a key objective of value-based care models.

Cardiovascular conditions are frequent diagnoses associated with hospital admission following visits to the emergency department (ED).

This study evaluated trends in ED visits and subsequent inpatient admissions for patients with coronary artery disease (CAD) and the symptom of chest pain suggestive of CAD.

What was learned from the study?

ED visits and subsequent inpatient admissions for CAD decreased between 2006 and 2013.

The number of ED visits increased over time for patients with chest pain suggestive of CAD, but subsequent inpatient admissions declined over this same period of time.

These trends may be explained, in part, by changes in health care policy and disease management strategies, including formulation of treatment plans and the use of observation units for patient care.

emergency physicians decide whether hospitalization is indicated [2]. Reducing avoidable hospitalizations can be an important step toward decreasing costs while maintaining quality of care. Along these lines, the US health care landscape has been shifting toward value-based models that incentivize quality and penalize poor outcomes, such as excessive hospital readmissions, through a number of alternative payment structures and pay-for-performance measures [3]. However, while quality initiatives can help reduce the rate of hospital readmissions, the net cost of programs varies, and some programs may not provide cost savings [4].

Hospital readmissions that occur soon after discharge are thought to reflect the quality of care transitions from the hospital to outpatient setting [5]. In 2012, the US government mandated a program to reduce the number of hospital readmissions by stipulating that readmissions for a qualifying condition/procedure within 30 days of the initial discharge would lead to reduced payments from Medicare and Medicaid [6, 7]. Outpatient care and observation units are being used more frequently to extend the window for further diagnostic and therapeutic interventions for patients following an ED visit rather than admission or readmission for inpatient care, which has resulted in a declining number of inpatient hospital stays [8]. However, increased use of observation units only partially explains the recent decline in inpatient admissions among Medicare beneficiaries [9].

As of 2014, 60% of adults in the US had a chronic disease and 42% had two or more chronic diseases [10]. Patients with chronic conditions tend to have more ED visits, more inpatient stays, and higher health care spending than patients with no chronic conditions [10]. For patients with chronic diseases, integrated care strategies, such as coordination of care across health and/or social care settings, may reduce the use of health care resources [11]. Cardiovascular disease is one of the most common chronic conditions in the US, affecting an estimated 100 million people in 2015 [12, 13]. Medical costs for managing cardiovascular disease exceed \$300 billion each year, with the

INTRODUCTION

Acute-care hospitalization is the largest component of health care spending in the United States (US), accounting for ~ 33% of all health care expenditures in 2017, totaling \$1.1 trillion [1]. Most hospitalized patients are first seen in the emergency department (ED), where

majority of these costs attributable to hospitalization [12]. In particular, coronary artery disease (CAD) is among the most frequently admitted conditions following ED visits; approximately 80% of ED visits for coronary atherosclerosis and other heart disease were found to result in hospital admission, compared with ~ 20% for all conditions combined [14]. Observation units may play a growing role in cardiovascular care for patients seen in the ED; for example, in 2008, chest pain was the most frequent reason for an ED visit resulting in observation unit care, and accounted for nearly 20% of visits to those units [15]. In light of the aging population and longer life expectancy, the prevalence of CAD is expected to increase substantially over the next 20 years, which will place a growing burden on the health care system. The changing health care and disease management landscapes could also impact overall health care resource use.

In addition to better disease management, it is important to understand the trends in CAD care to identify potential strategies to offset resource utilization and lower costs. Therefore, the objective of the current study was to better understand trends in ED visits and subsequent inpatient admissions for patients with CAD and the related symptom of chest pain (CP) suggestive of CAD.

METHODS

Analysis Set

We used the Nationwide Emergency Department Sample (NEDS) for our analysis. The NEDS database is sponsored by the Healthcare Cost and Utilization Project (HCUP) of the Agency for Healthcare Research and Quality (AHRQ) in the US (<http://www.hcup-us.ahrq.gov/>) [16]. Data records are de-identified for public use and are protected through data use agreements.

The NEDS is composed of 30 million ED visits at more than 900 hospitals, representing a sample of approximately 20% of the data from all US hospital-based EDs, and includes individuals covered by Medicare, Medicaid, or private insurance, as well as those who are

uninsured. The sample is selected per the strata of geographic region, trauma center designation, urban/rural location, and hospital ownership/control [17]. Weights are available to reflect national estimates pertaining to 135 million ED visits in 2013. Drawn from statewide data, the NEDS provides ED visits that may or may not have resulted in hospital admission. This database contains several types of information that are useful for research applications, including geographic, hospital, and patient characteristics, and the nature of visits. The NEDS designates patients as inpatient or outpatient after ED care, but does not distinguish whether outpatients were discharged home or receive hospital-based outpatient care in observation status, such as in an observation unit.

Study Population

This population-based, cross-sectional study assessed US ED visits and subsequent inpatient admissions for patients with CAD and CP from 2006 through 2013. We defined CAD by the primary *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* diagnosis codes 410 to 414. We defined CP by a primary diagnosis code of 786.5, with CAD as a secondary diagnosis, but no diagnosis for other serious conditions (e.g., aortic dissection) that might also be linked to the symptom and influence the decision to hospitalize. We did not use the *International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM)* diagnosis codes, as they were adopted by the NEDS subsequent to our study end date.

Statistical Methods

We categorized patients with clinical and symptomatic conditions according to patient demographics and hospital characteristics for the years 2006, 2010, and 2013. Our outcome measures included the annual number of ED visits and the annual number of subsequent inpatient admissions at the encounter level that reflect national estimates from 2006 to 2013. We performed a trend analysis for ED visits and

subsequent admissions over time using a generalized linear regression model with a Poisson distribution and a Wald test. We also calculated a Quan–Charlson comorbidity index (CCI) based on secondary discharge diagnoses [18].

We evaluated variation in subsequent admission rates using a hospital-based risk-standardized admission ratio (RSAR), which was calculated as the ratio of the number of predicted admissions to the number of expected admissions at a given hospital for each clinical outcome or symptom (i.e., 75th over 25th percentile hospitals). In this analysis, we estimated the RSAR for each hospital using a generalized linear mixed model that accounted for correlations among hospital encounters. We adjusted the analytical model for age, sex, household income, insurance status, and patient comorbidities. We also determined the coefficient of variation as the ratio of the standard deviation to the mean.

Compliance with Ethic Guidelines

Our study is based on de-identified data collected from a publicly available health care database and does not contain any experimental data with human or animal participants; our analysis was deemed exempt from institutional review board oversight, and we did not obtain informed consent.

RESULTS

Summary Statistics for Distribution of Patient and Hospital Characteristics in Patients with CAD

Characteristics and distribution by respective characteristics were generally similar among patients with CAD for ED visits and subsequent inpatient admissions over the three selected years (2006, 2010, and 2013; Table 1). Mean subject age was 66 years, and approximately 60% of patients were male. More than half of the population had Medicare as their primary payer, which is consistent with the age range of this population. The percentage of patients with

ED visits was inversely related to household income, with numerically higher numbers of ED visits among patients from low-income households. Most patients with CAD with ED visits were subsequently admitted as inpatients (87.1%, 86.8%, and 83.7% in 2006, 2010, and 2013, respectively), with a similar average length of stay over time (4.2, 4.0, and 4.0 days, respectively; Table 2). CCI scores increased over time for both ED visits and subsequent inpatient admissions. No substantial changes were observed for other encounters or hospital characteristics.

Trend Analysis of ED Visits and Subsequent Inpatient Admissions for Patients with CAD

We have assessed the trend of ED visits and subsequent inpatient admissions among patients with CAD from 2006 to 2013. ED visits for patients with a primary discharge diagnosis of CAD decreased by 15% (11.5 vs. 9.8×10^5) visits, respectively; $p < 0.01$) and the number of subsequent inpatient admissions for CAD decreased by 18% (10.1 vs. 8.2×10^5 admissions, respectively; $p < 0.01$; Fig. 1a).

Summary Statistics for Distribution of Patient and Hospital Characteristics in Patients with CP

Characteristics and distribution by respective characteristics were generally similar among patients with CP for ED visits and subsequent inpatient admissions over the three selected years (2006, 2010, and 2013; Table 3). Mean subject age was 63 years, and approximately 60% of patients were male. Medicare was the most common primary payer for both ED visits and inpatient admissions, and the proportion of ED visits covered by Medicaid increased over time. ED visits were inversely related to household income, with numerically higher percentages of ED visits among patients from low-income households. We observed a numerical increase in CCI score over time for both ED visits and admissions (Tables 3 and 4). There

Table 1 Selected baseline demographic and clinical characteristics in patients with ED visits for CAD in 2006, 2010, and 2013 ($\times 10^5$ visits)

	NEDS		
	2006	2010	2013
Total (national estimates) [<i>n</i> (%)]	11.54 (100.0)	10.39 (100.0)	9.81 (100.0)
Age, years, mean \pm SE	66.1 \pm 0.1	66.0 \pm 0.1	66.1 \pm 0.1
Female [<i>n</i> (%)]	4.75 (41.2)	4.18 (40.2)	3.83 (39.0)
Primary payer [<i>n</i> (%)] ^a			
Insured	10.47 (90.8)	9.27 (89.2)	8.72 (88.9)
Private insurance	3.40 (29.4)	2.78 (26.8)	2.42 (24.7)
Medicare	6.38 (55.3)	5.67 (54.6)	5.54 (56.5)
Medicaid	0.69 (6.0)	0.82 (7.9)	0.76 (7.7)
Uninsured	1.05 (9.1)	1.10 (10.6)	1.08 (11.0)
Median household income [<i>n</i> (%)] ^a			
1st quarter (\$1–\$37,999/year)	3.19 (27.6)	2.94 (28.3)	3.01 (30.7)
2nd quarter (\$38,000–\$47,999/year)	3.01 (26.1)	2.93 (28.2)	2.72 (27.7)
3rd quarter (\$48,000–\$63,999/year)	2.78 (24.1)	2.33 (22.4)	2.18 (22.2)
4th quarter (\$64,000+/year)	2.32 (20.1)	1.94 (18.7)	1.66 (16.9)
CCI score, mean \pm SE	1.3 \pm 0.01	1.5 \pm 0.01	1.5 \pm 0.01
Safety net [<i>n</i> (%)]	3.07 (26.6)	2.70 (25.9)	2.51 (25.6)

CAD coronary artery disease, ED emergency department, NEDS Nationwide Emergency Department Sample, SE standard error, CCI Quan–Charlson comorbidity index

^a Percentages may not sum to 100.0% due to missing values or unreported categories

were no substantial changes observed for other encounter or hospital characteristics.

Trend Analysis of ED Visits and Subsequent Inpatient Admissions for Patients with CP

When assessing the trend of ED visits and subsequent inpatient admissions among patients with CAD from 2006 to 2013, we found that ED visits for CP increased by 31% (5.9 vs. 7.7×10^5 visits, respectively; unadjusted $p < 0.01$), while subsequent inpatient admissions decreased by 33% ($2.7\text{--}1.8 \times 10^5$ admissions, respectively; unadjusted $p < 0.01$; Fig. 1b).

Hospital-based RSAR

We calculated hospital-based RSAR for hospitals that had ≥ 25 ED visits for each condition. A total of 799 and 761 hospitals met this criterion for CAD and CP, respectively (Fig. 2). For CAD, we observed a RSAR of 1.15 for the 75th over 25th percentile hospitals, and the coefficient of variation was 0.15. For CP, we observed an RSAR of 2.47 for 75th over 25th percentile hospitals, with a coefficient of variation of 0.63.

DISCUSSION

Data from the NEDS showed that ED visits and subsequent inpatient admissions resulting from

Table 2 Selected baseline demographic and clinical characteristics in patients with subsequent inpatient admissions for CAD in 2006, 2010, and 2013 ($\times 10^5$ visits)

	NEDS		
	2006	2010	2013
Total (national estimates) [<i>n</i> (%)]	10.05 (100.0)	9.02 (100)	8.22 (100)
Age, years, mean \pm SE	66.5 \pm 0.1	66.4 \pm 0.1	66.5 \pm 0.1
Female, <i>n</i> (%)	4.13 (41.1)	3.62 (40.1)	3.18 (38.7)
Primary payer type [<i>n</i> (%)] ^a			
Insured	9.16 (91.2)	8.08 (89.6)	7.32 (89.1)
Private insurance	2.92 (29.0)	2.36 (26.2)	2.00 (24.3)
Medicare	5.65 (56.3)	5.02 (55.6)	4.71 (57.3)
Medicaid	0.59 (5.9)	0.70 (7.8)	0.62 (7.5)
Uninsured	0.87 (8.7)	0.93 (10.3)	0.88 (10.8)
Median household income [<i>n</i> (%)] ^a			
1st quarter (\$1–\$37,999/year)	2.73 (27.2)	2.50 (27.7)	2.48 (30.2)
2nd quarter (\$38,000–\$47,999/year)	2.60 (25.8)	2.52 (27.9)	2.27 (27.6)
3rd quarter (\$48,000–\$63,999/year)	2.45 (24.4)	2.04 (22.6)	1.83 (22.2)
4th quarter (\$64,000+/year)	2.07 (20.6)	1.74 (19.3)	1.44 (17.5)
CCI score, mean \pm SE	1.4 \pm 0.01	1.6 \pm 0.01	1.6 \pm 0.01
Length of stay, mean \pm SE (day)	4.2 \pm 0.0	4.0 \pm 0.0	4.0 \pm 0.0

CAD coronary artery disease, NEDS Nationwide Emergency Department Sample, SE standard error, CCI Quan-Charlson comorbidity index

^a Percentages may not sum to 100.0% due to missing values or unreported categories

CAD decreased linearly from 2006 through 2013. ED visits in patients with CP increased over time, yet subsequent inpatient admissions for these patients decreased significantly. Variation in ED admission rates among studied hospitals was small for patients with a primary diagnosis of CAD. In contrast, there was substantial hospital-level variation in the use of inpatient care for patients presenting to the ED with CP.

These trends in ED visits and subsequent inpatient admissions for cardiovascular conditions may be impacted, in part, by the Affordable Care Act (ACA) legislation, which was signed in 2010 to expand health care coverage for more Americans and to lower health care costs [19]. In the current study, there was a

consistent numerical trend for increased ED visits for CAD and CP for patients with lower income, suggesting that despite its intentions, the ACA may not have eliminated health care access challenges. The NEDS data showed that between 2006 and 2013, ED visits for CP increased, but inpatient admissions for CP decreased. Of note, inpatient admissions for CP decreased less for lower-income patients than for higher-income patients, suggesting that outpatient care may be considered less safe for low-income patients. A separate study showed a similar trend of overall decreased inpatient admissions for CP between 2006 and 2012 [20].

The increase in ED visits for CP may also be linked to a lack of programs for disease management education or support, as well as

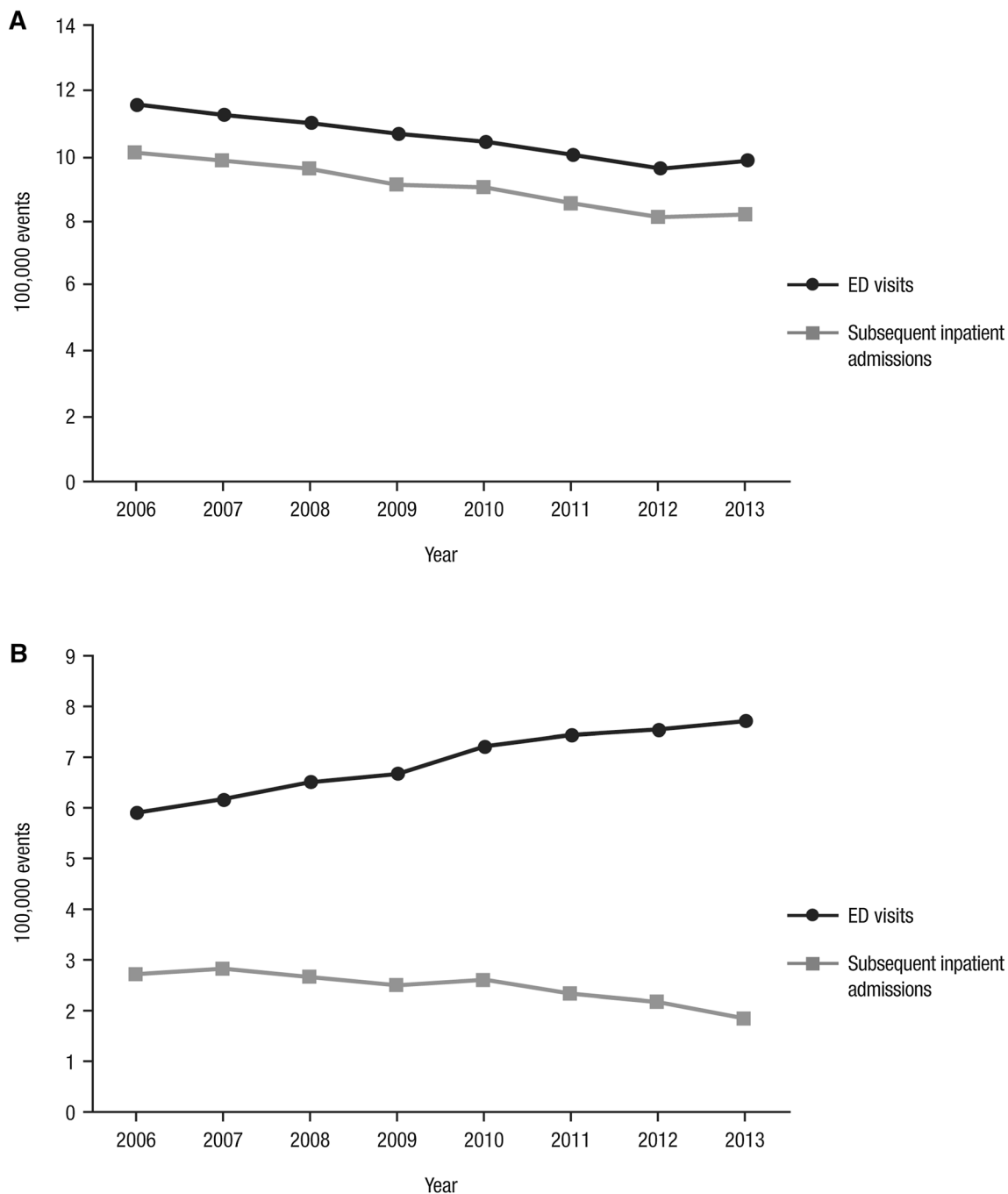


Fig. 1 National estimates of ED visits and subsequent inpatient admissions for patients with **a** CAD and **b** CP (2006–2013). *ED* emergency department, *CAD* coronary artery disease, *CP* chest pain

patients’ comfort with performing self-care and notifying their health care teams of exacerbation of symptoms once they have been discharged [21]. Among patients with cardiovascular disease, those who have better

communication with their health care provider have fewer ED visits and hospitalizations, and lower annual out-of-pocket costs [22]. Although disease management through clinical care is provided through Medicaid and Medicare, these

Table 3 Selected baseline demographic and clinical characteristics in patients with ED visits for CP in 2006, 2010, and 2013 ($\times 10^5$ visits)

	NEDS		
	2006	2010	2013
Total (national estimates) [<i>n</i> (%)]	5.89 (100.0)	7.22 (100.0)	7.73 (100.0)
Age, years, mean \pm SE	63.3 \pm 0.1	62.9 \pm 0.2	63.2 \pm 0.2
Female [<i>n</i> (%)]	2.68 (45.5)	3.23 (44.7)	3.37 (43.6)
Primary payer type [<i>n</i> (%)] ^a			
Insured	5.25 (89.1)	6.35 (88.0)	6.79 (87.9)
Private insurance	1.52 (25.9)	1.68 (23.2)	1.54 (19.9)
Medicare	3.13 (53.2)	3.78 (52.3)	4.27 (55.2)
Medicaid	0.59 (10.0)	0.90 (12.5)	0.99 (12.8)
Uninsured	0.63 (10.7)	0.85 (11.8)	0.93 (12.0)
Median household income [<i>n</i> (%)] ^a			
1st quarter (\$1–\$37,999/year)	1.76 (29.9)	2.30 (31.9)	2.75 (35.5)
2nd quarter (\$38,000–\$47,999/year)	1.63 (27.7)	2.09 (29.0)	2.20 (28.4)
3rd quarter (\$48,000–\$63,999/year)	1.38 (23.4)	1.54 (21.3)	1.59 (20.5)
4th quarter (\$64,000+/year)	0.99 (16.7)	1.10 (15.2)	1.00 (13.0)
CCI score, mean \pm SE	1.2 \pm 0.01	1.3 \pm 0.01	1.4 \pm 0.01
Safety net [<i>n</i> (%)]	1.65 (28.0)	2.18 (30.2)	2.21 (28.6)

CP chest pain, ED emergency department, NEDS Nationwide Emergency Department Sample, SE standard error, CCI Quan-Charlson comorbidity index

^a Percentages may not sum to 100.0% due to missing values or unreported categories

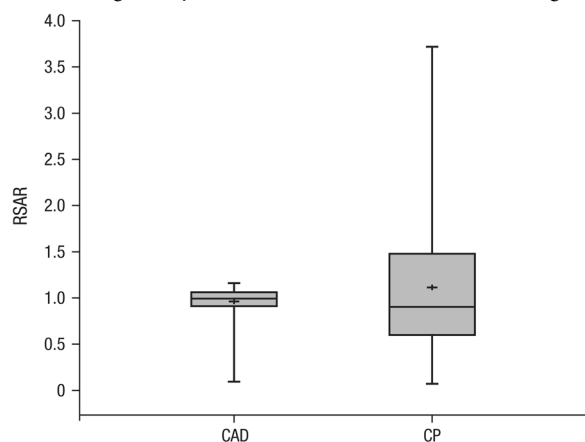


Fig. 2 Hospital-based ED RSARs for patients with CAD and CP (2006–2013). ED emergency department, RSAR risk-standardized admission ratio, CAD coronary artery disease, CP chest pain

services are not available to all patients. The decision to implement Medicaid care management programs is made on a state-by-state basis, and, as of 2008, only half of states had done so [23]. Disease management through Medicare Part B consists of clinical care management but not patient self-management. In addition, eligibility to participate is currently limited to patients with two or more chronic conditions that are at more severe stages [24].

Another possible explanation for these observations is the relative ease of formulating a treatment plan for patients who present to the ED with diagnosed CAD, which may reduce the need for hospitalization. It is especially helpful when physicians have access to patient data via electronic health records to inform these

Table 4 Selected baseline demographic and clinical characteristics in patients with subsequent inpatient admissions for CP in 2006, 2010, and 2013 ($\times 10^5$ visits)

	NEDS		
	2006	2010	2013
Total (national estimates) [<i>n</i> (%)]	2.70 (100.0)	2.61 (100.0)	1.82 (100.0)
Age, years, mean \pm SE	64.1 \pm 0.2	64.1 \pm 0.2	63.9 \pm 0.2
Female [<i>n</i> (%)]	1.26 (46.7)	1.18 (45.1)	0.79 (43.1)
Primary payer type [<i>n</i> (%)]			
Insured	2.44 (90.2)	2.32 (88.9)	1.61 (88.2)
Private insurance	0.69 (25.4)	0.54 (20.8)	0.33 (18.3)
Medicare	1.49 (54.9)	1.46 (55.8)	1.02 (56.2)
Medicaid	0.27 (9.9)	0.32 (12.3)	0.25 (13.7)
Uninsured	0.26 (9.6)	0.28 (10.9)	0.21 (11.7)
Median household income [<i>n</i> (%)] ^a			
1st quarter (\$1–\$37,999/year)	0.81 (30.0)	0.82 (31.5)	0.63 (34.7)
2nd quarter (\$38,000–\$47,999/year)	0.70 (25.9)	0.72 (27.7)	0.50 (27.5)
3rd quarter (\$48,000–\$63,999/year)	0.63 (23.4)	0.55 (21.0)	0.36 (19.8)
4th quarter (\$64,000+/year)	0.50 (18.5)	0.44 (16.7)	0.27 (14.9)
CCI score, mean \pm SE	1.4 \pm 0.01	1.6 \pm 0.01	1.7 \pm 0.02
Length of stay, mean \pm SE (day)	2.0 \pm 0.0	2.0 \pm 0.0	2.0 \pm 0.0

CP chest pain, NEDS Nationwide Emergency Department Sample, SE standard error, CCI Quan-Charlson comorbidity index

^a Percentages may not sum to 100.0% due to missing values or unreported categories

decisions in the ED [25, 26]. Patients who present to the ED with nonspecific cardiovascular symptoms like CP receive comprehensive cardiac evaluations that can include an electrocardiogram, physical examination, and cardiac biomarkers, all of which can be performed within the time frame of an ED visit [27]. Using these results, physicians can perform risk stratification, such as a calculation of a HEART (History, ECG, Age, Risk factors, and Troponin) risk score, a measure designed to predict whether patients who present in the ED with CP are at high risk of an adverse event [28]. Increased use of the HEART score, which was introduced in 2008, may explain some of the decrease in inpatient admissions for CP seen in this study.

The declining rate of inpatient admissions over time may also be linked to greater use of observation status, which is billed as an outpatient service even though patients are often treated in the same medical wards, have similar medical needs, and receive similar clinical services as patients who are hospitalized as short-stay inpatients [5]. Between 2009 and 2011, the proportion of Medicare patients with CP who were initially admitted as inpatients decreased, while the proportion who were first admitted to the ED remained steady; during this time, an increasing proportion of Medicare patients with CP were designated as observation status [29]. Observation units are dedicated areas in the hospital where patients in observation status are housed. The shift to observation units allows

physicians to maintain oversight of patient care in a lower cost environment by housing patients in one location and using condition-specific protocols to reduce unwarranted variations in care, which could provide major cost savings, and reflects the value-based environment of the current health care landscape in the US [30].

Hospital admission rates can vary for a number of reasons, including patient- and hospital-specific factors such as differences in geographic location, level of ED training, hospital teaching status, local expectations of staff physicians, payment variation, and hospital type; however, even when adjusting for these characteristics, some variations in hospital admission rates have been observed [31, 32]. In this study, the variation in hospital-based RSARs for CAD were low, which may suggest that hospitals are comfortable following established protocols for patients with a known history of CAD. In contrast, there was significant variation in hospital-based RSARs for CP, as might be expected given its potential association with a variety of conditions. More data are needed on the association between nonspecific symptoms such as CP in order to develop recommendations for reducing the hospital-based variability in inpatient admissions for patients presenting with these symptoms.

Emerging technologies like the currently available Patient Activation Model can be used to predict which patients are at risk of avoidable hospitalization [33]. In the future, additional technologies such as artificial intelligence and predictive analytics will be used to predict diagnoses and identify patients at high risk of other costly complications, including prolonged hospitalization, readmission, and mortality [34, 35]. The use of technology to identify patients with a high risk of costly outcomes will help physicians and other decision makers focus appropriate time and resources on preventing outcomes in these patients that may not be immediately apparent from their health records, such as providing additional information and follow-up care to prevent hospital readmissions.

Moving forward, efforts to increase access to disease management education and support at

the primary care level may reduce the trend of increased ED visits for certain symptoms. Future research is warranted to examine possible reasons underlying the different ED admission rates between hospitals for symptoms associated with major diseases, such as CAD. These include the expansion of Medicaid services as part of the implementation of the ACA, and the growing presence and potential increased utilization of urgent care clinics.

The current study has several limitations. First, there may be coding bias, misclassification of diagnosis codes, variation in the use of diagnosis codes, and similar issues in this type of database. ICD-10-CM codes, introduced in 2015, were not available at the time of this study, so future studies of ED admission rates for diseases like CAD may be able to provide more detailed information, though there is likely to be an increased risk for coding bias. Also, the NEDS database captured data at the encounter level rather than at the patient level; therefore, multiple visits by the same patient cannot be identified. The NEDS also does not distinguish between patients who are immediately discharged to their homes and those who are managed in the hospital under observation status before being discharged, and does not contain the clinical information necessary to assess the cause of subsequent hospitalization. Lastly, the trend test was conducted without adjusting for potential confounding factors.

CONCLUSIONS

Based on data from the NEDS from 2006 to 2013, the number of ED visits and admissions for CAD decreased over time, and there was a trend for increased number of ED visits and decreased number of subsequent inpatient admissions over time for patients with CP. Adoption of new clinical tools and policy changes during the study period may have influenced disposition decisions, and subsequent study is warranted to investigate whether admission rates also fell for similar conditions during the study time frame.

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Authorship Contributions. All authors meet the International Committee of Medical Journal Editors (ICMJE) criteria for authorship for this article, take responsibility for the integrity of the work as a whole, and have given their approval for this version to be published. CE, AP, ZD, CDP, JHL, and CWB were involved in study design. CE, AP, ZD, CDP, JHL, and CWB were involved in the interpretation of the results. ZD and JHL were responsible for the statistical analyses.

Prior Presentation. A portion of these results were originally presented at the Council on Quality of Care and Outcomes Research (QCOR) Scientific Sessions on April 3, 2017, in Arlington, VA and at the Annual Meeting of the Society for Academic Emergency Medicine (SAEM) on May 19, 2017, in Orlando, FL.

Disclosures. CE, AP, ZD, CDP, and JHL are employees of Janssen Scientific Affairs, LLC (a Johnson & Johnson company) and hold stock in Johnson & Johnson. CWB has worked as a consultant and advisory board member for Janssen Pharmaceuticals and Salix Pharmaceuticals, has previously received research funding from Janssen Pharmaceuticals and Boehringer Ingelheim, and has also served as an advisory board member and as a paid speaker for Roche Diagnostics.

Compliance with Ethics Guidelines. Our study is based on de-identified data collected from a publicly available health care database and does not contain any experimental data with human or animal participants; our analysis

was deemed exempt from institutional review board oversight, and we did not obtain informed consent.

Data Availability. The NEDS data analyzed during the current study are available at the Healthcare Cost and Utilization Project website (https://www.hcup-us.ahrq.gov/news/exhibit_booth/neds_brochure.jsp). The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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