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Longitudinal Patterns of Emergency Department Visits: A Multistate Analysis of Medicaid Beneficiaries

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RESEARCH ARTICLE

Longitudinal Patterns of Emergency Department Visits: A Multistate Analysis of Medicaid Beneficiaries

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Objective. The objective of this study was to examine the longitudinal patterns of emergency department (ED) visits among adult fee-for-service Medicaid.

Data Sources. Data were obtained from the Medicaid analytic eXtract files, Area Health Resource File, and County Health Rankings.

Study Design. A retrospective longitudinal study design, with four observations for each individual was used. The study population consisted of 33,393 Medicaid beneficiaries who met inclusion criteria. ED visits were time-lagged and time-varying patient-level factors were measured for each year. Time-invariant characteristics (gender and race/ethnicity) were measured in 2006. Multivariable hurdle models with logistic (ED use versus no ED use) and negative binomial regressions (ED visits among ED users) were used to analyze the ED visits over time. To account for correlation due to repeated observations, mixed effect models with robust standard errors were performed.

Principal Findings. In both unadjusted and adjusted analysis, the likelihood of ED use did not change from year to year (AOR = 1.00, 95 percent CI: 0.99, 1.01). Among ED users, the estimated number of ED visits increased over time (IRR = 1.01, 95 percent CI: 1.01, 1.03).

Conclusions. Primary care resources should be a major focus to reduce the increased burden on the EDs.

Key Words. Medicaid, time-series analysis, hospitals

During the past two decades, published research has documented a steady increase in emergency department (ED) visits in the United States. ED visits increased by 32 percent (from 90.3 to 119.2 million) from 1996 to 2006 (Pitts et al. 2008). Among older patients, ED visits increased by 25 percent from 2001 to 2009 based on the National Hospital Ambulatory Medical Care Survey (NHAMCS) (Pines et al. 2013). The rising trend in ED visits is not unique to the elderly patients. It is evident from the literature that

ED visits by younger adults, specifically those covered by Medicaid, have also been increasing. Tang et al. (2010) reported that the overall ED visits among those covered by Medicaid increased by 37 percent between 1997 and 2007. Furthermore, Medicaid patients had higher ED visits as compared to those with Medicare, with private insurance, and uninsured (Pitts et al. 2008).

Some of the cited reasons include the lack of primary care access, shortage of primary care providers, increased prevalence of chronic conditions, and patient complexity (Mandelberg, Kuhn, and Kohn 2000; Cunningham 2006; Mortensen and Song 2008; Gawande 2011; Cheung et al. 2012), although a comprehensive and systematic analysis of the reasons for increased ED visits over time is yet not available. For example, it has been reported that Medicaid beneficiaries are more likely to face access barriers to primary care as compared to individuals enrolled in other types of insurance programs and these barriers can lead to higher rates of ED use and higher number of ED visits over time (Cunningham 2006; Cheung et al. 2012). Furthermore, socio-economically disadvantaged and individuals with high medical needs sometimes use the ED repeatedly (Mandelberg, Kuhn, and Kohn 2000; Gawande 2011), as is the case with Medicaid beneficiaries. Mortensen and Song (2008) also reported that poor income, self-reported poor health status, and presence of chronic conditions were the major drivers of ED utilization among Medicaid beneficiaries.

While many studies have documented growth in ED visits over time (Pitts et al. 2008; Tang et al. 2010), these studies have some limitations. Many of these studies examined visit-level data and could not follow individual patients and examine the trajectory of ED visits over time (Tang et al. 2010; Pines et al. 2013). In addition, these studies used only two sources of data that is NHAMCS or Nationwide ED Sample (Skinner, Blanchard, and Elixhauser 2006; Weiss et al. 2006; Pitts et al. 2008). It is important to examine ED visits over time by using patient-level data to capture repeated ED visits made by an individual. As visit-level data do not track ED visits by an individual, these data overestimate the rates of ED use. Furthermore, visit-level data are available for those who

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visited EDs and therefore comparisons cannot be drawn with ED nonusers. Two studies have used patient-level data and these studies have reported increase in the ED visits over time (Xu, Nelson, and Berk 2009; Cheung et al. 2012). However, these studies also have limitations because they combined a series of cross-sectional data over time and did not follow the same individual over time. It is important to understand the ED visits over time at the patient level to identify high-risk individuals and to design policies, programs, and interventions targeting these high-risk individuals.

The increase in ED visits over time by Medicaid patients is a matter of concern for the policy makers as Medicaid is an important source of health insurance coverage. In 2015, 72 million individuals were enrolled in the Medicaid program (CMS 2015). Under the Patient Protection and Affordable Care Act (ACA), uninsured adults with income up to 138 percent of the federal poverty line can get health insurance coverage through Medicaid (CMS 2012). Such expansion of health insurance coverage through Medicaid may affect the ED utilization. However, the effect of expanded coverage on ED utilization is yet to be determined. Furthermore, it has been documented that many of the patients who visit the ED can be effectively treated in primary care settings. A policy brief from New England Healthcare Institute compared the costs of care in outpatient and ED settings and estimated the cost of ED overuse at $38 billion. EDs are always open and offer high-quality service for acute problems and exacerbations (2010). Health care settings such as urgent care centers may have infrastructure to provide care only for illnesses or injuries that are not life threatening. EDs may be a viable option for Medicaid patients due to long wait time and lack of access to primary care providers. However, for proper management of chronic conditions, long-term follow-up care is needed. Additionally, provision of care in EDs is expensive as compared to other health care settings such as urgent care centers. Therefore, for cost containment purposes it is viable to identify primary care settings that can be used to reduce the number of ED visits.

The objective of the current study is to examine ED use and visits over time after adjusting for patient- and county-level factors that may influence ED use and visits among ED users. For the purposes of the study, longitudinal data of adult fee-for-service (FFS) Medicaid beneficiaries between 2006 and 2010 were used. As ED visits are influenced by both patient- and county-level factors, the current study adjusted for

patient- and county-level factors in multivariable modeling. The patient- and county-level factors were selected based on the widely used Andersen's behavioral model (ABM) in health services research. The ABM model hypothesizes that health care services utilization is a function of predisposing, enabling, need, external environment factors and personal health practices (Andersen 1995).

METHODS

Study Design

This study used a retrospective longitudinal design with observational data from Maryland (MD), Ohio (OH), and West Virginia (WV) for the years 2006–2010; only those patients who were observed for all 4 years were included in the analysis.

Data Sources

Medicaid Analytic eXtract Files. Four different Medicaid analytic eXtract files were used: personal summary, inpatient claims, other therapy claims, and prescription drugs claims file. The personal summary file provided information on demographics, Medicaid eligibility, county federal information processing standard codes, Medicaid managed care enrollment, and Medicare eligibility status. The inpatient claims file provided information on hospital stays, dates of service, Medicaid payment, and the International Classification of Disease, Ninth Revision, Clinical Modification codes (ICD-9-CM) and ICD-9-CM procedure codes. The outpatient claims file provided information on dates of service, types of service, Medicaid payment, ICD-9-CM, and Current Procedural Terminology (CPT) codes. The prescription drugs claims file provided information on the date of prescription filled, days supplied, and national drug code. All these files can be linked using encrypted identification numbers. The current study used data on Medicaid beneficiaries residing in MD, OH, and WV.

Area Health Resources Files. The Area Health Resources File was used to obtain county-level information explained in the Measures section. The file contains

national-, state-, and county-level data on approximately 6,000 variables (HRSA 2015).

County Health Rankings Data. The County Health Rankings data compiled county-level information from 50 different sources on health behaviors, clinical care, social and economic factors, and physical environment (Robert Wood Johnson Foundation 2015).

Study Population (N = 33,393)

The study population included FFS Medicaid beneficiaries, aged 22–64 years, with continuous Medicaid enrollment between 2006 and 2010, not eligible for Medicare, and alive during the entire observation period. Pregnant women were excluded from the analysis due to unique prenatal needs. Each of these individuals was followed up for a period of 4 years, resulting in 133,572 person years.

Dependent Variable

Number of ED Visits. ED visits were identified from inpatient and outpatient claims using CPT (99281-85) and revenue codes (450-52, 456, 459, and 981). ED visits were identified in 2007, 2008, 2009, and 2010 — the subsequent year after the measurement of the time-varying patient-level factors.

Independent Variables

Key Independent Variable: Time. Time included 4 years: 2006–2007 (Year 1), 2007–2008 (Year 2), 2008–2009 (Year 3), and 2009–2010 (Year 4). It was used as a continuous variable, and only those patients who were enrolled in all 4 years were included in the analysis.

Other Independent Variables. Other independent variables included both time varying and time invariant factors. Gender and race/ethnicity, and county-level factors were time invariant factors. All other patient-level factors were time variant and were measured each year. These independent variables were measured during the previous year (i.e., time lagged).

Predisposing factors included age (22–34, 35–44, 45–54, 55–64 years), gender (female, male), and race/ethnicity (whites, African Americans,

Hispanics, other races). Enabling factors included patient-level Medicaid eligibility due to cash assistance/poverty (cash eligibility, no cash eligibility), county-level college education rate, primary care use (none, fragmented, continuous), and county-level unemployment rate. The modified continuity index developed by Magill and Senf (1987) was used to measure primary care use.

Need factors included patient-level health status (physical health conditions, mental health conditions, physical and mental health conditions, none), Medicaid eligibility due to medical need/waiver (medical eligibility, no medical eligibility), and poly-pharmacy (Yes, No). Physical and mental health conditions were selected on the priority basis as specified by Health and Human Services Office of the Assistant Secretary of Health (Goodman et al. 2013). Physical health conditions included arthritis, asthma, cardiac arrhythmia, coronary artery disease, cancer, chronic heart failure, chronic kidney disease, chronic obstructive pulmonary disease, dementia, diabetes, hepatitis, hyperlipidemia, human immunodeficiency virus, hypertension, osteoporosis, and stroke. Mental health conditions included anxiety, post-traumatic stress disorder, depression, bipolar disorders, psychosis, schizophrenia, and other mental illness. Presence of both physical and mental health conditions was considered as complex chronic illness using the definition provided by the Agency for Healthcare Research and Quality (NQF 2011). Both physical and mental health conditions were identified: one inpatient or two outpatient claims. Poly-pharmacy was defined as concomitant use of multiple prescription drugs within a 90-day period and was based on number of prescription drugs one standard deviation above the mean (Goldberg et al. 2009).

Personal health practices included patient-level tobacco use (yes tobacco use, no tobacco use) and county-level obesity rates. External environment factors included metropolitan status of the county (metro, nonmetro), health professional shortage area (HPSA - no, partial, and complete shortage areas), number of hospitals with EDs, number of hospitals with psychiatric emergency services, number of rural health clinics, number of federally qualified health centers, number of community mental health centers, and number of urgent care clinics per 100,000 population.

Statistical Analysis

Frequencies and percentages were used to describe the characteristics of the study population in Year 1 through Year 4. As ED visits were measured in four different years—that is, 2006–2007, 2007–2008, 2008–2009, and 2009–2010

—four different observations were available for each subject leading to clustering within subjects. Hurdle models with mixed effects were conducted to test the relationship between ED visits and time after controlling for predisposing, enabling, need, personal health practices, and external environment factors. A hurdle model is "a modified count data model in which the two processes generating the zeros and the positives are not constrained to be the same." (Cameron and Trivedi 1998) The first part of the model determines the occurrence of an outcome (i.e., ED use or no ED use), and the second part models the positive outcomes (i.e., one or more than one ED visit). The hurdle model is a two-part model where the first part is the logit model with binary outcome (i.e., ED use vs. no ED use) and the second part is the negative binomial regression (i.e., ED visits by users). The first part of the model is known as "hurdle at zero," and it examined the relationship between ED use and time after adjusting for all other independent variables. The second part of the hurdle model is known as "above the hurdle," and it examined the association between the number of ED visits by users and time after adjusting for all other independent variables. Mixed effect modeling approach adjusted for random intercepts and correlated error terms for repeated observations. All analyses were conducted using *STATA version 14* (StataCorp, LP College Station, TX, US).

RESULTS

The majority of the study population were 45–64 years old (54 percent), females (58.7 percent), and whites (89.3 percent), and resided in a metro county (56.2 percent). Table 1 presents the time-varying characteristics of the study population for each year. More than 90 percent of the study population was eligible for Medicaid due to cash-assistance/poverty in each year. Approximately 70 percent had fragmented primary care use in each year. The prevalence of chronic complex illness (i.e., both physical and mental health conditions) increased from 44.7 percent to 45.1 percent between Year 1 and Year 4. Approximately, 17 percent of the study population had poly-pharmacy in Year 1, and 20.9 percent had poly-pharmacy in Year 4. The eligibility in Medicaid due to medical reasons declined from Year 1 to Year 4 (2.6 percent to 1.4 percent). The prevalence of tobacco use remained almost the same in all the years.

Table 2 summarizes the findings from the hurdle model with mixed effects. In the first model that is "hurdle at zero," no statistically significant relationship was observed between ED use and time after adjusting

Table 1: Description of the Study Population Time-Varying Patient-Level Factors Each Year for Adult Fee-for-Service Medicaid Beneficiaries in Multistate Medicaid Analytical eXtract Files — 2006–2010

	Year 1, N (%)	*Year 2, N (%)*	*Year 3, N (%)*	*Year 4, N (%)*
All	33,393	33,393	33,393	33,393
Enabling factors				
Medicaid eligibility				
Cash eligibility	31,239 (93.6)	31,566 (94.5)	31,561 (94.5)	31,564 (94.5)
No cash eligibility	2,154 (6.5)	1,827 (5.5)	1,832 (5.5)	1,829 (5.5)
Primary care use				
None	6,236 (18.7)	6,187 (18.5)	6,057 (18.1)	5,497 (16.5)
Fragmented	23,747 (71.1)	23,777 (71.2)	23,965 (71.8)	24,623 (73.7)
Continuous	3,410 (10.2)	3,429 (10.3)	3,371 (10.1)	3,273 (9.8)
Need factors				
Complex chronic illness				
Physical health conditions	9,260 (27.7)	9,609 (28.8)	9,805 (29.4)	9,914 (29.7)
Mental health conditions	4,684 (14.0)	4,467 (13.4)	4,366 (13.1)	4,219 (12.6)
Physical and mental health conditions	14,910 (44.7)	14,935 (44.7)	14,979 (44.9)	15,071 (45.1)
None	4,539 (13.6)	4,382 (13.1)	4,243 (12.7)	4,189 (12.5)
Poly-pharmacy				
Yes	5,560 (16.7)	5,980 (17.9)	6,637 (19.9)	6,983 (20.9)
No	27,833 (83.4)	27,413 (82.1)	26,756 (80.1)	26,410 (79.1)
Medicaid medical eligibility				
Medical eligibility	852 (2.6)	745 (2.2)	533 (1.6)	482 (1.4)
No medical eligibility	32,541 (97.5)	32,648 (97.8)	32,860 (98.4)	32,911 (98.6)
Personal health practices				
Tobacco use				
Yes tobacco use	1,825 (5.5)	1,950 (5.8)	1,730 (5.2)	1,886 (5.7)
No tobacco use	31,568 (94.5)	31,443 (94.2)	31,663 (94.8)	31,507 (94.4)

Notes. Based on 33,393 adult Medicaid fee-for-service beneficiaries aged 22–64 years, who are continuously enrolled, who are not Medicare and Medicaid eligible, and who are alive and non-pregnant for the years 2006–2010. County-level variables were extracted from the Area Health Resource Files and county health ranking data. Information on time-varying baseline characteristics was extracted from the base period of the panels; that is, Year 1: 2006 in 2006–2007 panel; Year 2: 2007 in 2007–2008 panel, Year 3: 2008 in 2008–2009 panel, and Year 4: 2009 in 2009–2010 panel.

for predisposing, enabling, need, personal health practices, and external environment factors. In the second model that is above the hurdle, as time increased, there was a 1 percent increase in the number of ED visits after adjusting for predisposing, enabling, need, personal health practices, and external environment factors. Sensitivity analysis was conducted by analyzing data for each state separately. Similar results were observed for each state.

Table 2: Parameter Estimates from Adjusted Mixed-Effects Hurdle Models of Emergency Department Use and Emergency Department Visits for Adult Fee-for-Service Medicaid Beneficiaries (N = 133,572) in Multistate Medicaid Analytical eXtract Files — 2006–2010

	AOR (95% CI)	*Sig*	*IRR (95% CI)*	*Sig*
Time	1.00 (0.98, 1.01)		1.01 (1.01, 1.02)	***
Predisposing factors				
Age				
22–34 years				
35–44 years	1.10 (1.03, 1.17)	*	0.97 (0.94, 0.99)	*
45–54 years	0.83 (0.78, 0.89)	***	0.90 (0.88, 0.93)	***
55–64 years	0.73 (0.68, 0.78)	***	0.88 (0.85, 0.90)	***
Gender				
Female	1.27 (1.21, 1.33)	***	1.03 (1.01, 1.05)	*
Male				
Race				
White				
African Americans	1.40 (1.29, 1.51)	***	1.14 (1.10, 1.18)	***
Hispanics	1.77 (1.24, 1.54)	**	1.11 (0.92, 1.35)	
Other races	1.58 (1.04, 2.41)	*	1.31 (1.05, 1.64)	*
Enabling factors				
Medicaid eligibility				
Cash eligibility	1.14 (1.08, 1.49)	*	1.03 (0.99, 1.07)	
No cash eligibility				
County-level education				
Percent with college education	0.99 (0.98, 1.00)		1.00 (1.00, 1.01)	
County-level unemployment				
Percent unemployed	0.90 (0.88, 0.92)	***	0.99 (0.98, 0.99)	**
Primary care use				
None	0.93 (0.87, 0.98)	*	0.99 (0.96, 1.02)	
Fragmented	1.17 (1.11, 1.23)	***	1.04 (1.01, 1.06)	**
Need factors				
Medical eligibility				
Medical eligibility	1.27 (1.08, 1.49)	**	1.05 (0.98, 1.13)	
No medical eligibility				
Complex chronic illness				
Physical health conditions	1.43 (1.34, 1.52)	***	1.15 (1.12, 1.18)	***
Mental health conditions	1.41 (1.32, 1.52)	***	1.13 (1.09, 1.16)	***
Physical and mental health conditions	2.13 (1.99, 2.27)	***	1.33 (1.29, 1.37)	***
None				
Poly-pharmacy				
Yes	1.76 (1.67, 1.84)	***	1.22 (1.20, 1.25)	***
No				

Continued

Table 2 *Continued*

	AOR (95% CI)	*Sig*	*IRR (95% CI)*	*Sig*
Personal health practices				
Tobacco use				
Yes tobacco use	1.39 (1.30, 1.49)	***	1.10 (1.07, 1.13)	***
No tobacco use				
County-level obesity				
Obesity rate	0.98 (0.97, 0.99)	**	0.99 (0.98, 0.99)	***
County-level external environment factors				
Health professional shortage area				
No shortage	1.05 (0.98, 1.13)		0.97 (0.94, 1.00)	
Part county shortage	1.16 (1.10, 1.22)	***	1.00 (0.98, 1.02)	
Whole county shortage				
Metro				
Metro				
Nonmetro	0.99 (0.93, 1.05)		0.97 (0.95, 0.99)	*
Emergency departments				
Number of EDs/100,000 population	1.08 (1.07, 1.10)	***	1.01 (1.00, 1.01)	
Psychiatric emergency departments				
Number of psychiatric EDs/ 100,000 population	1.08 (1.04, 1.11)	***	1.03 (1.02, 1.04)	***
Rural health centers				
Number of rural health centers/ 100,000 population	1.00 (0.99, 1.00)		1.00 (1.00, 1.00)	
Urgent care centers				
Number of urgent care centers/ 100,000 population	0.94 (0.92, 0.95)	***	0.99 (0.98, 0.99)	***
FQHC				
Number of FQHCs/100,000 population	1.00 (1.00, 1.01)		1.00 (1.00, 1.00)	
Community mental health centers				
Number of community mental health centers/100,000 population	1.07 (0.99, 1.15)		1.01 (0.98, 1.05)	

Notes. Based on 133,572 person years of adult Medicaid fee-for-service beneficiaries aged 22–64 years and who are continuously enrolled, who are not Medicare and Medicaid eligible, who are alive, nonpregnant, and are ED users for the years 2006–2010. County-level variables were extracted from the Area Health Resource Files and county health ranking data.
***$p < .001$; **$.001 < p < .01$; *$.01 < p < .05$.
AOR, adjusted odds ratio; CI, confidence interval; ED, emergency department; FQHC, federally qualified health center; IRR, incidence rate ratio; Sig, significance.

Further analyses were conducted for each subgroup of the study population. In the first model that is "hurdle at zero," individuals aged 35–44 years were more likely to use ED as compared to those aged 22–34 years (AOR = 1.10; 95 percent CI = 1.03, 1.17). Similar results were observed for the following subgroups of the study population: females, African Americans,

Hispanics, other races, cash-eligibility, fragmented primary care use, medical eligibility, physical health conditions, mental health conditions, physical and mental health conditions, poly-pharmacy, tobacco use, part county health professional shortage area, number of EDs/100,000 population, and number of psychiatric EDs/100,000 population. As compared to those aged 22–34 years, individuals aged 45–54 years were less likely to use ED (AOR = 0.83; 95 percent CI = 0.78, 0.89). Similar results were observed for the following subgroups of the study population: 55–64 years old, percent with college education, percent unemployed, no primary care use, county-level obesity rate, and urgent care centers/100,000 population.

In the second model that is "above the hurdle" following subgroups of the study population had higher number of ED visits: females, African Americans, Hispanics, other races, fragmented primary care use, presence of physical health conditions, presence of mental health conditions, presence of both physical and mental health conditions, poly-pharmacy, tobacco use, and number of hospitals with psychiatric emergency services/100,000 population. Following subgroups of the study population had lower number of ED visits: 35–64 years old, county-level percent unemployed, county-level obesity rate, nonmetro counties, and number of urgent care centers/100,000 population.

DISCUSSION

In the current study, the use and number of ED visits over time were analyzed. This study provided the pre-ACA estimates of ED use and number of ED visits for adult FFS Medicaid beneficiaries who were followed up for a period of 4 years. The percentage of ED users did not increase over time. The stability of ED use over time was an unexpected finding because published studies that have evaluated ED use longitudinally using patient-level data reported an increase in ED use over time (Xu, Nelson, and Berk 2009). It is noteworthy that Xu et al. did not follow individual patient's overtime because the author pooled cross-sectional Medical Expenditure Panel data. However, the author concluded that the ED users increased from 34.2 to 40.8 million. The difference in findings could be due to the study design (longitudinal vs. pooled cross-sectional data over a number of years). Additionally, differences in study findings may also be due to differences in the study periods. The findings from the current study suggest that identifying and profiling individuals using an indicator that is presence or absence of ED use may not provide a complete picture of ED use over time.

In the current study, it was observed that the number of ED visits increased over time among ED users. The findings of the current study are consistent with the study conducted by Tang et al. (2010) that reported an increase in the rate of ED visits among Medicaid patients over time using visit-level data. It was also observed that the counties with higher number of urgent care centers per 100,000 population had lower number of ED visits. Additionally, it was observed in the current study that those with fragmented primary care use were more likely to be ED users and had a higher number of ED visits. Taken together, these findings suggest that the increase in the intensity of ED use may be due to increasing complexity and lack of access to primary care for extended periods of time.

Previous literature suggests that Medicaid beneficiaries face many barriers that include access to primary care providers, limited physician office hours, increased wait time, limited availability of immediate diagnostic services, lack of transportation, and usual source of care (Pitts et al. 2008; Gindi, Cohen, and Kirzinger 2012). To mitigate the effect of these barriers, it is important to explore ways to triage patients with nonemergent care needs to other health care settings (e.g., primary care doctors, clinics, and urgent care facilities). Given that a majority of ED visits occur after business hours (Pitts et al. 2010), improving the infrastructure to provide after-hour care, extended primary care office hours, and increasing the supply of urgent care centers can go a long way in reducing the frequency of ED visits (Mason 2014). In fact, almost 30 percent of all ED visits can be managed at urgent care centers and other health care settings (Weinick, Burns, and Mehrotra 2010). Additionally, when patients received proper guidance about the appropriate settings for health care through public education, ED visits have declined with consequent annualized cost-savings of approximately $31 million (Kellermann and Weinick 2012; Busch 2014).

It is documented in the literature that the factors such as access to primary care providers and patient complexity accounted for higher number of ED visits (Cunningham 2006; Mortensen and Song 2008). The current study had findings consistent with the previous literature. Individuals with fragmented primary care use and complex health care needs were more likely to use ED and had higher number of ED visits. It was observed that the percentage of individuals with complex chronic illness increased from 44.7 percent in 2006 to 45.1 percent in 2009; similarly, the rates of polypharmacy also increased from 16.7 percent in 2006 to 20.9 percent in 2009. These findings highlight the role of patient complexity in increased visits to the ED over time. Therefore, health care providers may adopt interventions and treatment

strategies designed to provide better management of the patient complexities. In Washington State by formulating a policy named "ER is for Emergencies" of tracking the ED use of Medicaid beneficiaries over a period of time, the policy makers were able to identify high-risk adults, target interventions for these individuals, and reduce ED use, which resulted in cost savings (Kellermann and Weinick 2012; Busch 2014).

The current study was conducted on alive, adult FFS Medicaid beneficiaries, aged 22–64 years old, continuously enrolled, not dually eligible, and residing in MD, OH, and WV from 2006 to 2010. The results of this study are not generalizable to Medicaid population of other states because wide difference exist across states in terms of the geographic population, policy, and resources. Due to the exclusion of the managed care population from the study population, there is a possibility of selection bias. Due to limited sample size, the study could not control for alcohol consumption and drug abuse. Use of administrative claims data may result in misclassification of diagnosis. The study did not control for unobserved differences that may affect ED visits over time. These differences may be due to factors such as patient's preferences and knowledge, perceived health status of the patient, and disease severity.

Despite the limitations, the current study has several strengths. A comprehensive list of patient- and county-level factors were used from different data sources to perform longitudinal analysis. By relying on health care encounter data, the current study was able to capture services received from multiple providers, health care settings, and geographical areas. Information on clinical diagnosis, prescription drugs, and other health care services use were captured from claims data and do not have the shortcomings of self-reported data. The current study used patient-level data and was able to track repeated ED visits made by the same patient.

To conclude, ED use among Medicaid patients remained stable; however, the intensity of ED use, measured by the number of ED visits, increased over time. These findings suggest that increase in ED visits is not a short-term phenomenon. We speculate that if proper primary care management programs and settings are not initiated, increase in ED visits will remain even after implementation of ACA. Provision of health insurance coverage alone without corresponding improvements in primary care access may increase the burden on EDs and escalate costs. A multipronged approach with both infrastructure improvements and public education may be necessary to reduce the burden on EDs.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.