

Insurance Impact on Nonurgent and Primary Care–Sensitive Emergency Department Use

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Lack of insurance coverage and the resulting difficulties in accessing basic health services have often been cited as major contributing factors in driving uninsured patients to seek care at hospital emergency departments (EDs).^{1,3} However, recent studies have shown that most of the growth in ED volume has been driven by insured patients, with Medicaid-insured individuals being more likely than other patients to have multiple ED visits.^{4,5} Insured persons (with and without a usual source of medical care) have been found equally likely to have 1 or more ED visits in a 12-month period compared with their uninsured counterparts.^{4,6} In terms of ED misuse, many studies have documented significant nonurgent ED visits by both insured and uninsured patients.⁷⁻⁹

This paper seeks to investigate the relationship between insurance coverage and the likelihood of an ED visit being nonurgent or primary care–sensitive (PCS), using the New York University (NYU) ED Algorithm, a retrospective ED classification system developed by NYU. This computerized classification system has been used to document and track the prevalence and variations of potentially avoidable ED use and has the additional advantage of incorporating empirically verified definitions of nonurgent and PCS ED visits.¹⁰

We constructed a statistical model to examine the effects of insurance type using ED visit records from the 2008 Tennessee Hospital Outpatient Discharge Data Set. We also discussed how a change in insurance mix under national healthcare reform might impact the average likelihood of nonurgent or PCS ED visits and associated ED expenses.

Our paper contributes to the literature in 2 significant ways. First, we modeled the actual ED visit probabilities from the NYU ED Algorithm, whereas most previous studies have used dichotomized nonurgent visits as the dependent variable, ignoring potentially interesting variation in underlying probabilities. Second, while our study was limited to a single state (Tennessee), it provides a timely model that can be used

ABSTRACT

Objectives: To analyze the relationship between insurance and the likelihood of a nonurgent or primary care–sensitive (PCS) emergency department (ED) visit.

Study Design: Retrospective cohort study.

Methods: The probabilities of nonurgent and PCS ED visits were derived on the basis of the New York University ED Classification Algorithm. We constructed a logit quasi-likelihood model to examine the insurance impact using 2008 Tennessee Hospital Outpatient Discharge Data.

Results: Among a total of 2,177,955 ED visits in the analysis, uninsured status was significantly associated with the likelihood that an ED visit was nonurgent or PCS. These associations were different for men and women and across major racial groups. On average, uninsured status was associated with an increased probability of 0.038 of being nonurgent and 0.054 of being PCS, relative to private insurance status. The corresponding numbers for public insurance status were 0.060 and 0.075, respectively. For nonurgent or PCS probabilities that are not close to 0, higher nonurgent or PCS likelihoods corresponded to lower ED cost per visit to third-party insurers and patients.

Conclusions: Lack of insurance was associated with a higher probability of a nonurgent or PCS ED visit when compared with private insurance. When uninsured individuals gain coverage under the Affordable Care Act through either Medicaid expansion (public coverage) or insurance exchanges (private coverage), the average nonurgent or PCS probabilities could change either way given the opposite effects of public and private insurance coverage. If a lower nonurgent or PCS likelihood materialized, it could be associated with higher ED costs.

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by policy makers in other states to gain insights into potential changes in ED use under the Affordable Care Act (ACA).

Take-Away Points

- Lack of insurance was associated with a higher probability of both types of emergency department (ED) visits compared with private insurance.
- Our model can be used by health policy makers in other states to gain insights into potential changes in ED use under the Affordable Care Act.

METHODS

Data Source and Study Variables

Our main data source was the 2008 Tennessee Hospital Discharge Data Set (HDDS). ED visits were identified from outpatient discharge records and included all ED visits from licensed nonfederal, short-term Tennessee hospitals, regardless of whether the visit resulted in hospitalizations later. We also used the Tennessee Joint Annual Report of Hospitals and the Area Resource File to provide information on hospital and county characteristics.

Our 2 key study variables, the probabilities of nonurgent and PCS ED visits, were based on the NYU ED Algorithm, which was designed to use limited information found in discharge abstracts (primarily diagnosis codes) to classify ED visits. We applied this algorithm to the 2,807,874 ED visits found in the 2008 Tennessee HDDS file to create 9 probabilities that added up to 1 (or 100%) for each ED record. The 9 NYU ED probability categories are: “ne” (non-emergent), “epct” (emergent/primary care treatable), “edcnpa” (emergent/ED care needed/preventable and avoidable), “edcnnpa” (emergent/ED care needed and not preventable/avoidable), “injury” (injury principal diagnoses), “psych” (mental health principal diagnoses), “alcohol” (alcohol-related health principal diagnoses), “drug” (drug-related health principal diagnoses, excluding alcohol), or “unclassified” (not in one of the above categories). The relationship among the categories is depicted in the **Figure**.

The values of the first 4 NYU ED categories were continuous, ranging from 0 to 1, while the other 5 categories were binary, with values of 1 or 0. When an ED visit fell into any of the last 5 ED categories (eg, injury, psych), the value of each of the other 8 categories was 0. The intuition of the NYU ED classification was that for each ED encounter with a valid diagnostic code, the probabilities created represent “the relative percentage of cases for that diagnosis falling into the various classification categories.”¹¹ For example, in the case of urinary tract infections (*International Classification of Diseases, Ninth Revision, Clinical Modification [ICD-9-CM] code 599.0*), each case was designated as “non-emergent” (66%), “emergent/primary care treatable” (17%), and “emergent/ED care needed/preventable and avoidable” (17%).¹¹

We excluded visits made by non-Tennessee residents (6.6% of the total visits) and observations with missing or

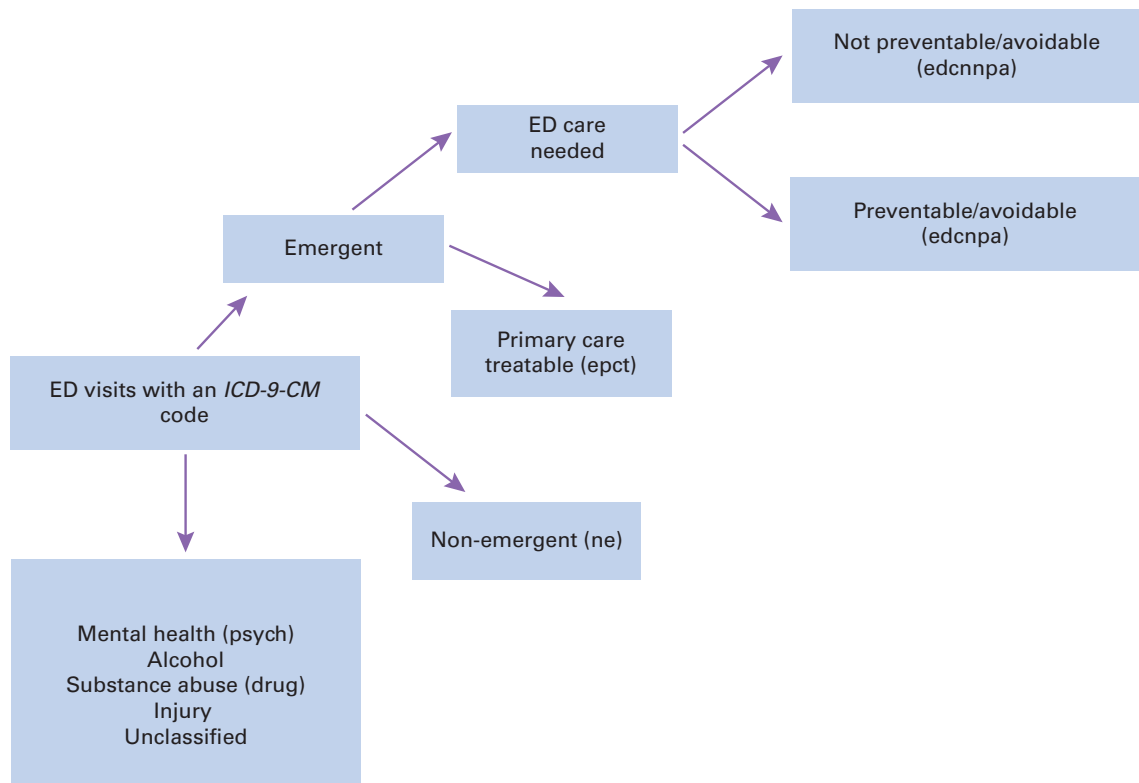
unknown values in explanatory variables (15.8% of the total visits). Our final data set contained 2,177,955 ED visits. The distribution of insurance types among the 15.8% of the sample excluded was similar to that of the remaining sample, so excluding these observations introduced little bias.

We used 2 dependent variables in our regressions: likelihood of a nonurgent ED visit and likelihood of a PCS ED visit. We regrouped and combined the first 2 NYU ED categories (“ne” and “epct”) into 1 probability and labeled it “nonurgent” (Figure). These ED visits were made by patients with conditions that could have been adequately treated in a primary care setting and did not need to be seen in a hospital ED; common examples of nonurgent ED visits included sore throat and minor back problems.

Our second dependent variable, the probability of a PCS ED visit, was created by combining the probability of a nonurgent ED case (first dependent variable) with the probability of the third NYU ED category (“edcnpa”), representing the probability of a needed but potentially preventable and avoidable ED visit. These ED visits have been referred to as “primary care-sensitive” ED visits in the literature because they are potentially modifiable by, and therefore sensitive to, the effective delivery of primary care outside the hospital.¹² This term is similar to the term “ambulatory care-sensitive” condition in that both terms emphasize good outpatient care delivered in a timely manner. However, the term “ambulatory care-sensitive” is often used in the context of inpatient hospitalizations, while “primary care-sensitive” is used in the context of ED visits. The latter term also focuses on primary care, a subset of all ambulatory care, as being an important utilization driver. Our use of the term “primary care-sensitive” is consistent with the NYU ED category definitions.

Our primary independent (predictor) variable—insurance type—and other covariates were drawn from 3 major conceptual domains: patient-visit characteristics, hospital characteristics, and the external access-to-care environment. Insurance types from the 2008 Tennessee HDDS included private insurance, Medicaid and Medicare, uninsured, and other insurance (eg, TRICARE and workers’ compensation). Other patient-visit characteristic variables from the 2008 Tennessee HDDS include patient

■ **Figure.** NYU ED Algorithm for Classifying Diagnoses^a



ED indicates emergency department; edcnnpa, emergent/ED care needed and not preventable/avoidable; edcnpa, emergent/ED care needed and preventable/avoidable; epct, emergent/primary care treatable; *ICD-9-CM*, *International Classification of Diseases, Ninth Revision, Clinical Modification*.
^aAdapted from Figure 1 in Ballard et al¹⁰ and from NYU ED Algorithm documentation.¹¹

age, gender, race, and ethnicity, Charlson Comorbidity Index (CCI) (calculated from the patient's *ICD-9-CM* codes and related procedure codes), whether the ED visit was a repeated visit in 2008, and total number of ED visits per patient in 2008.

Hospital characteristics included ownership (public, nonprofit, or for-profit) and medical school affiliation. External access-to-care variables included the following county-level measures: primary care physicians (PCP) per 1000 persons, percent of population 65 years and older, percent of population below the federal poverty line, whether the county was designated a partial or full Health Professional Shortage Area, whether the county was part of a Metropolitan Statistical Area, and whether the county was in the eastern, central, or western section of Tennessee.

To explore the potentially heterogeneous impact of insurance across gender and racial/ethnic groups, we included interaction terms among insurance types, gender, and race.

Analysis

Because our dependent variables were continuous but bounded—taking on any value between 0 and 1, including 0 and 1—standard linear regression models were not appropriate because a) the resulting predicted values could not be guaranteed to lie between 0 and 1; and b) their variance would not be constant (a violation of the standard regression models).^{13,14} Previous studies have dealt with these problems by dichotomizing the outcome; for example, defining a visit to be nonurgent or PCS if the relevant probability was above a predetermined cutoff. However, this approach loses the substantial, potentially interesting information captured in the relative probability levels. Therefore, we used the actual probabilities generated by the NYU ED Algorithm, and modeled them using an econometric method developed for fractional or proportional dependent variables by Papke and Wooldridge.¹³

We modeled our outcomes using a logit quasi-likelihood model. Independent variables included patient-

visit characteristics, hospital characteristics, neighborhood characteristics, and interaction terms among insurance types, race, and gender to explore the potentially heterogeneous impact of these variables. Quasi-likelihood estimation was performed in STATA 12 (College Station, Texas), with error terms clustered at the patient level. Adjustment for patient-level clustering was necessary because we observed a large number of repeated ED visits.

To illustrate the policy relevance of our regression results, we also produced evidence on how nonurgent and PCS probabilities were associated with costs of ED services to third-party insurers and patients. ED costs were estimated by applying hospital-specific revenue-to-charge ratios to billed ED charges. We then arrayed nonurgent and PCS probabilities of patients in the sample from low to high based on their quintiles, and examined the pattern of average ED costs corresponding to the probabilities in each quintile.

RESULTS

Descriptive statistics for our final sample are presented in **Table 1**. In 2008, ED visits in Tennessee had average probabilities of being nonurgent and PCS of 0.515 and 0.587, respectively. For comparison, we also included statewide population averages for certain key variables (last column). It is important to keep in mind that our primary data represented visits, while our comparison data were population-based. To the extent that visits represented unique individuals, however, this comparison provides some insight regarding differences between the population seeking care at EDs and the overall Tennessee population.

Among the 2,177,955 ED visits in our analysis, public insurance (Medicaid and Medicare) was the largest payer for Tennessee residents (52%); this percentage was significantly higher than the proportion of Tennesseans enrolled in these public programs in 2008 (31%). In contrast, 17% of ED visits were made by uninsured patients, while only 15% of Tennesseans were uninsured in 2008.

Table 2 presents results from our 2 predictive equations (probabilities of an ED visit being nonurgent and PCS, respectively). Chi-square statistics for both equations ($P < .001$) suggest overall significance of the models.

The key independent variable of interest, “uninsured” (patient was uninsured at the time of the ED visit), was associated with higher likelihood of an ED visit being nonurgent or PCS. Public insurance had similar effects. The “other insurance,” however, was negatively related to nonurgent or PCS likelihoods.

Among other significant predictors, the CCI for comorbidity was negatively related to nonurgent likelihood and positively related to PCS likelihood. Demographic variables such as age, gender, and race were all statistically significant. Among the interaction terms, those significant in both regressions were female interacted with race and insurance types, and black interacted with insurance types. The variable for repeated visits in 2008 (equals 1 if the patient already had a prior ED visit in 2008) was associated with a higher likelihood of the visit being nonurgent or PCS; the total number of ED visits in 2008 was also significant in both regressions, with an odds ratio slightly higher than 1. Hospital characteristics had odds ratios close to 1 in both regressions.

In terms of county characteristics, a higher density of PCPs and a higher proportions of the population over 65 years were associated with a higher likelihood that visits were nonurgent or PCS. Partial Health Professional Shortage Areas were negatively associated with nonurgent and PCS visits, and whole Health Professional Shortage Areas were negatively associated with PCS visits (effect on nonurgent likelihood not significant). The percent of the population with income below the federal poverty line was positively related to nonurgent probability but had no significant effect on PCS likelihood. The location of residence (metro/non-metro) had mixed effects on nonurgent and PCS likelihoods; residence in central Tennessee was associated with the highest likelihood of an ED visit being nonurgent, followed by eastern and western Tennessee. PCS ED visits were less likely for residents of central and western Tennessee compared with residents of eastern Tennessee.

Table 3 shows the marginal impacts of different insurance types on the probability of an ED visit being nonurgent or PCS. These marginal impacts were estimated using the differences in the average predicted nonurgent or PCS probabilities when we change the individual insurance from the reference type (private insurance or uninsured) to any of the 3 other types. Private insurance was associated with a decreased probability of 0.038 of an ED visit being nonurgent and 0.054 of the ED visit being PCS, relative to uninsured status (lower part of Table 3). Again, using uninsured status as the reference group, public insurance was associated with an increased probability of 0.021 (nonurgent) and 0.022 (PCS).

Table 4 summarizes the relationship between nonurgent and PCS probabilities in quintiles and average ED costs corresponding to those probabilities in each quintile. Nonurgent and PCS probabilities in the first few

■ **Table 1.** Descriptive Statistics (N = 2,177,955)

Variable	Mean	SD	TN Population Average ^a
Dependent variables			
Nonurgent	0.515	0.398	
Primary care-sensitive	0.587	0.429	
Patient visit characteristics			
Charlson Comorbidity Index	0.158	0.567	
Age	34.232	21.931	
Female	0.574	0.494	0.52
Black	0.218	0.413	0.2
Hispanic	0.036	0.185	0.07
White (reference)			
Other race	0.092	0.289	0.03
Uninsured	0.172	0.377	0.15
Medicaid/Medicare	0.519	0.500	0.31
Private insurance (reference)			
Other insurance	0.051	0.220	0.02
Revisit	0.443	0.497	
No. visits	4.103	7.118	
Hospital characteristics			
Medical school	0.315	0.465	
Public hospital	0.205	0.404	0.15
For-profit hospital (reference)			
Nonprofit hospital	0.509	0.500	0.43
County characteristics			
Primary care providers per 1000 population	1.273	0.684	2.25
Percent 65 years or older	0.137	0.030	0.14
Health Professional Shortage Area, part	0.444	0.497	
Health Professional Shortage Area, whole	0.165	0.371	
Not a Health Professional Shortage Area			
% annual income <FPL	0.159	0.036	0.2
Metropolitan statistical area	0.681	0.466	
East TN	0.409	0.492	
Central TN (reference)			
West TN	0.233	0.423	

FPL indicates federal poverty line.

^aThe last column presents the mean values of the general population in Tennessee in 2008.

The data came primarily from the Kaiser Family Foundation Facts website and were supplemented by data from such sources as the US Department of Agriculture and the Census Bureau.

quintiles were close to 0 because a large number of injury cases were included here (recall that when injury = 1, all other probabilities were 0). When the nonurgent or PCS probabilities moved away from 0 (starting from the third quintile of nonurgent and second quintile of PCS probabilities), expenses showed a decreasing trend. The average

ED visit cost was \$833 in the third quintile of nonurgent probabilities and dropped to \$315 in the fifth quintile. Similarly, the average ED cost continued to decline from the second to the last quintile of PCS probabilities (differences between the average values of adjacent quintiles were all significant, $P = .000$).

Table 2. Estimation of the Nonurgent and Primary Care–Sensitive Equations

	Nonurgent			Primary Care–Sensitive		
	Odds Ratio		Robust SE ^a	Odds Ratio		Robust SE ^a
Patient visit characteristics						
Charlson Comorbidity Index	0.926	***	0.002	1.352	***	0.005
Age	0.993	***	0.000	0.991	***	0.000
Female	1.483	***	0.007	1.528	***	0.008
Black	1.452	***	0.011	1.622	***	0.013
Hispanic	1.139	***	0.017	1.159	***	0.019
White (reference)						
Other race	1.088	***	0.011	1.085	***	0.012
Uninsured	1.179	***	0.008	1.240	***	0.009
Medicaid/Medicare	1.409	***	0.007	1.515	***	0.009
Private insurance (reference)						
Other insurance	0.640	***	0.007	0.624	***	0.007
Revisit	1.172	***	0.004	1.221	***	0.004
No. visit	1.010	***	0.001	1.008	***	0.001
Black*female	1.018	***	0.007	0.971	***	0.007
Hispanic*female	0.963	***	0.013	0.947	***	0.014
Other race*female	0.995		0.009	1.002		0.010
Uninsured*female	1.023	***	0.008	1.062	***	0.009
Medicaid/care*female	0.891	***	0.005	0.884	***	0.006
Other insurance*female	1.128	***	0.015	1.114	***	0.015
Uninsured*black	0.927	***	0.009	0.926	***	0.010
Uninsured*Hispanic	1.016		0.021	0.998		0.022
Uninsured*other race	0.949	***	0.012	0.943	***	0.014
Medicaid/care*black	0.852	***	0.006	0.864	***	0.007
Medicaid/care*Hispanic	1.106	***	0.018	1.156	***	0.020
Medicaid/care*other race	0.988		0.010	0.991		0.011
Other insurance*black	0.683	***	0.011	0.638	***	0.011
Other insurance*Hispanic	0.689	***	0.029	0.663	***	0.029
Other insurance*other race	0.697	***	0.019	0.683	***	0.019
Hospital characteristics						
Medical school	1.010	***	0.003	0.994	*	0.003
Public hospital	0.995		0.004	0.965	***	0.004
For-profit hospital (reference)						
Nonprofit hospital	1.054	***	0.004	1.058	***	0.004
County characteristics						
Primary care providers ^b	1.032	***	0.003	1.041	***	0.003
% 65+	3.514	***	0.240	1.762	***	0.135
HPSA, part	0.975	***	0.004	0.960	***	0.004
HPSA, whole	1.004		0.004	0.986	***	0.005
No HPSA (reference)						
% Income <FPL	1.275	***	0.064	0.953		0.053
Metropolitan statistical area	1.014	***	0.004	0.973	***	0.005
East TN	0.979	***	0.004	1.011	**	0.005
West TN	0.940	***	0.004	1.001		0.004
Central TN (reference)						

FPL indicates federal poverty line; HPSA, Health Professional Shortage Area.

^aStandard errors are adjusted for 1,268,695 clusters in patient ID.

^bPrimary care providers are per 1000 population.

Number of observations in both equations is 2,177,955.

The symbols ***, **, and * indicate that the coefficient is statistically significantly different from 0 at the 1, 5, and 10% levels ($P = .01, .05, \text{ and } .10$), respectively.

■ **Table 3.** Marginal Impact of Various Types of Insurance on Probability That an ED Visit Is Nonurgent or Primary Care–Sensitive

Probability	Private Insurance Reference Group		
	Marginal Impact of Uninsured	Marginal Impact of Public Insurance	Marginal Impact of Other Insurance
ED visit is nonurgent	0.038	0.060	–0.119
ED visit is PCS	0.054	0.075	–0.133
Probability	Uninsured Reference Group		
	Marginal Impact of Private Insurance	Marginal Impact of Public Insurance	Marginal Impact of Other Insurance
ED visit is nonurgent	–0.038	0.021	–0.158
ED visit is PCS	–0.054	0.022	–0.187

ED indicates emergency department; PCS, primary care–sensitive.

■ **Table 4.** Mean and Standard Deviation of ED Expenses^a by Nonurgent and Primary Care–Sensitive Quintiles

Quintiles	Nonurgent	Expenses (\$)ᵇ: Mean	Expenses (\$)ᵇ: SD	PCS	Expenses (\$)ᵇ: Mean	Expenses (\$)ᵇ: SD
1	0-0	505.629	772.651	0-0	500.674	768.460
2	0.019-0.019	531.807	583.848	0.059-0.200	1289.551	1020.518
3	0.040-0.670	833.169	899.161	0.231-0.870	745.587	840.165
4	0.750-0.882	433.491	499.120	0.875-1	379.402	556.715
5	0.885-1	314.716	567.633			

ED indicates emergency department; PCS, primary care–sensitive.
^aED expenses are measured by hospital revenues (billed ED charges multiplied by hospital-specific revenue-to-charge ratio), and are in 2008 dollars.
^bFor each nonurgent and PCS quintile, the costs mean is significantly different from the costs mean of the next adjacent quintile, with $P = 0$ (t test).

DISCUSSION

Our purpose was to investigate the impact of insurance coverage on nonurgent and PCS ED visits. Our results suggest that being uninsured was associated with a higher probability that an ED visit would be nonurgent or PCS compared with having private insurance. These effects were different for men and women and across major racial groups.

Our marginal effects analysis suggests that a conversion of insurance status from uninsured to publicly insured could be associated with an increase in the likelihood of both nonurgent and PCS ED visits, while a conversion to private insurance status could be associated with a decrease. A recent study using Oregon's Medicaid data found similar results: Medicaid coverage increased ED visits, including visits for conditions most readily treatable in primary care settings.¹⁵ Given these different and opposite effects of public and private insurance coverage, it is unclear how nonurgent or PCS probabilities would change when the uninsured individuals gained coverage under ACA through either Medicaid expansion or insurance exchanges. Tennessee has not accepted Medicaid expansion, electing instead to negotiate with federal health

officials hoping to leverage federal dollars to purchase private health insurance for Tennesseans who would not otherwise have access to coverage.¹⁶ If Tennessee's uninsured would be covered by private insurance, our models predict that these ED visits would less likely be nonurgent or PCS. This outcome could be associated with higher average ED cost due to the negative relationship between nonurgent and PCS probabilities and ED costs. Conversely, if Tennessee's uninsured were covered through public insurance, our models predict these ED visits would more likely be nonurgent or PCS and associated with lower average ED costs.

It is important to point out that these predictions assume that there is no selection associated with type of insurance (uninsured, public, private) and that the likelihood of an ED visit being nonurgent or PCS is driven entirely by the insurance benefit design of the private versus public plans. If instead there are consistent (unmeasured) differences in the individuals who tend to be covered in private versus public plans (ie, selection bias), simply switching the benefit designs may not produce the results our equations predict. While we tried to include measures of demographics and healthcare needs in our equations to capture population differences, it is possible we have not captured all

of the important differences driving ED use. To the extent that our predictions about the impact of public and private insurance reflect underlying population characteristics more than insurance benefit design, it becomes important to understand whether the newly insured populations under ACA are more like the current publicly insured or the currently privately insured populations. This will allow us to better assess the impact of ACA on the likelihood of ED visits being nonurgent or PCS.

In the empirical results, the CCI had odds ratios below 1 for the nonurgent regression and above 1 for the PCS regression. The former agrees with prior expectations that sicker ED patients are less likely to present with nonurgent symptoms. The latter, however, suggests that high comorbidity increases the likelihood of an (urgent) primary care-preventable ED visit.

One puzzling result was the positive relationship between PCP density and nonurgent/PCS likelihoods. A previous study found that persons with nonurgent ED visits also had a higher number of physician office visits (non-ED setting).⁶ Other explanations might be that density of PCPs was associated with unmeasured factors in the model, or potential reverse causality problems. A recent paper¹⁷ found that frequent ED users have substantial burden of disease and a high rate of primary care use. Future studies may consider further controlling for these potential problems.

CONCLUSIONS

Our findings provide an in-depth look at the relationship between type of insurance and nonurgent and PCS ED visits. We were able to expand the nonurgent ED literature to model predictors of nonurgent and PCS ED visits using the NYU ED Algorithm. Although we use new definitions and empirical approaches, our results generally mirror those found in the literature, adding to our understanding of nonurgent and PCS ED visits. Modeling the continuous values of the probabilities generated by the NYU ED Algorithm using an econometric method developed for fractional or proportional dependent variables by Papke and Wooldridge also serves as a useful model for future studies of this type.

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