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# The Association Between Community-Level Insurance Coverage and Emergency Department Use

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## Abstract

**Background—**Emergency departments (EDs) nationwide are key entry points into the healthcare system, and their use may reflect changes in access and need in their communities. However, no studies to date have empirically and longitudinally studied how changes in a community's level of insurance coverage, a key determinant of access, affect ED utilization.

**Objective—**To determine the effects of changes in a community's rate of insurance coverage on its population's ED use.

**Methods—**We conducted a longitudinal analysis of all California counties between 2005 and 2010 using comprehensive ED visit data from the California Office of Statewide Health Planning and Development. Using Poisson regression with county and year fixed effects, we determined how changes in the rate of insurance coverage within a given county affect ED visits per 1,000 residents.

**Results—**We found that changes in the rate of insurance coverage within a county had a slight but significant inverse relationship with ED visits per 1,000 residents for both adults and children. For example, if a county's rate of insurance coverage among adults jumped from the 10$^{th}$ (73.22%) to the 90$^{th}$ percentile (84.93%), an estimated two fewer ED visits would occur per 1,000 adult residents.

**Conclusions—**As the rate of insurance coverage increased within California counties, overall ED utilization declined only slightly. Thus, expanding insurance coverage may not lead to significant decreases in overall ED use.

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**Keywords**

emergency department; health insurance

## Introduction

In 2014, the Affordable Care Act is set to take effect and significantly increase the number of insured Americans through implementation of health insurance exchanges and Medicaid expansions in many states. There has been hopeful speculation that increased insurance coverage will beget better access to healthcare resources for those patients, including primary and specialty care, leading to fewer emergency department (ED) visits and lower costs. On the other hand, some reports suggest that expanding insurance coverage can increase ED use, as coverage lowers financial barriers to all care including EDs.[1–5] The effect of moving uninsured patients into the insured pool may also vary depending on the type of insurance they receive. As EDs currently struggle to combat crowding, which negatively affects quality of care,[6–9] and stay afloat financially, understanding how changes in community-level insurance coverage affect their patterns of use is essential.

Past studies looking at the effect of insurance coverage on ED use at the population level are limited. National trend analyses have shown that rates of ED use among the uninsured have been stable or dropping, while ED utilization has risen largely due to increases in use by insured patients, particularly Medicaid patients.[10,11] One cross-sectional study in Houston indicated that zip codes with higher rates of uninsurance had higher rates of preventable ED visits.[12] Other studies have attempted to model how decreases in traditional public insurance enrollment would affect ED use; showing drops in use or no effect.[13–15] Analyses of Massachusetts's health reform have presented conflicting evidence on the effects of increased coverage on ED use.[2,16–18] The longest and only annual, ongoing analysis is a telephone survey that showed a slight but significant decrease in ED use four years after Massachusetts healthcare reform implementation.[17] However, the survey had a 39% response rate, only studied self-reported ED visits, and could not isolate the effects of increasing insurance coverage from other aspects of healthcare reform or secular trends.

Our study aims to improve on these efforts by determining how the number of ED visits per 1,000 residents within a community changes as a function of the community's rate of insurance coverage. We address this issue using a unique longitudinal design based on the changes in rates of insurance coverage for children and non-elderly adults within California counties from 2005 to 2010.

## Conceptual Framework

The rate of insurance coverage in a community and the number of ED visits per person in that community could be related for two types of reasons. First, insured and uninsured patients may be expected to use the ED at different static rates, perhaps due to differences in access to preventive care or ability to pay for ED visits. Suppose $ED_u$ is the rate at which uninsured patients use the ED so that each uninsured patient generates on average $ED_u$ visits to the ED each year. Suppose correspondingly that $ED_i$ is the rate for insured patients. In a

community with population P, where i proportion of the population is insured and u=1−i proportion of the population is uninsured, the total number of ED visits will be $ED_u*u*P + ED_i*i*P = ED_u*(1-i)*P + ED_i*i*P = (ED_i - ED_u)*i*P + ED_u*P$. If the rate of insurance coverage increases, therefore, the number of ED visits will also rise if $ED_i > ED_u$, or decrease if vice versa, simply due to differences in the ED use rates.

A second mechanism captures pathways through which changing community rates of insurance coverage affect the baseline $ED_u$ and $ED_i$ rates of use. One such channel involves the effects of the community level of insurance coverage on the structure and functioning of the healthcare system, which affects rates of ED use. For example, low levels of insurance coverage could put financial pressure on community physician practices and affect their ability to care for both insured and uninsured patients, possibly changing $ED_u$ and $ED_i$ by extension. A second pathway concerns changing $ED_u$ and $ED_i$ in response to specific patient population transitions. If the uninsured patients themselves who become insured carry a unique and unchanging ED use rate, their individual switch to insured status could affect $ED_u$ and $ED_i$ depending on their use rate's distance from the mean of each group.

In this study, we examine the correlation between the proportion insured in a given county, i, and the total number of ED visits by patients in the county, which could be related through both mechanisms.

## Methods

### Study Design & Data Sources

To determine how the share of the population of an area that is insured influences the rate of ED use in the population, we conducted a longitudinal analysis of all 58 California counties between 2005 and 2010. We used ED utilization data from the California Office of Statewide Health Planning and Development (OSHPD), which collects information on each patient encounter in all non-federal California hospitals. For our analysis we used the 2005–2010 non-public versions of the Emergency Discharge Data (EDD) for outpatient visits to the ED, and the Patient Discharge Data (PDD) for patients admitted to the hospital from the ED. We excluded all visits with missing age or sex, and within the PDD only included unscheduled admissions through the ED. Our final sample therefore captured demographic and clinical information on every unscheduled ED visit in California. For our analysis, we focused on the patient county of residence, patient age, and ICD-9 diagnosis codes.

To capture the yearly insurance coverage rate by county we used data from the Small Area Health Insurance Estimates (SAHIE) from the United States Census Bureau.[19] Insured patients in our sample included any person who was not uninsured, including those with Medicaid, Medicare, private insurance, and other forms of insurance (e.g., worker's compensation). Specifically, as individuals are known to drop in and out of insurance throughout a year, SAHIE defines someone as "uninsured" if they are not currently covered by any type of health insurance at the time of the interview. Interviews are conducted over the course of the year. We also used California Department of Finance[20] county population data to measure ED visits per 1,000 residents.

Finally, we used the Area Resource Files from the Health Resources and Services Administration to extract the county-level demographic and healthcare access characteristics that we used as covariates in our final model.

## Covariates

To enhance our model, we added covariates for county-level demographic and healthcare supply-related characteristics that could vary differentially by county over time and affect our results. The demographic control variables we used included median household income, unemployment rate, percent of the population with a high school diploma, and percent of the population with a college degree. Further, we included health insurance access metrics for each county, such as the population eligible for Medicaid and the population enrolled in Medicare. Finally, we added measures of healthcare resource concentration, including number of hospitals, hospital beds, doctors, primary care doctors, and federally qualified health centers per 1,000 population.

## Statistical Analysis

We first descriptively analyzed trends in ED utilization, insurance coverage, and population for children (aged <18) and adults (aged 18–64) in the state of California from 2005 to 2010. We also described adults' ED visits over the study period for ambulatory care sensitive conditions (ACSCs) – exacerbations of conditions that could have been prevented or managed in a primary care setting. We categorized adult visits as ambulatory care sensitive by mapping the ICD-9-CM diagnosis codes in the OSHPD data onto the Agency for Healthcare Research and Quality's "Prevention Quality Indicators" (PQIs).[21] These are accepted indicators of preventable hospitalizations, and the categorization has been used widely in past literature to study ACSCs in the ED.[11,22,23] We used the total PQI composite, acute PQI composite, and chronic PQI composite to categorize adult ACSCs (see Supplemental Digital Content Table 1 for details). We did not apply this analysis to children since these particular PQIs apply to adults only.

For our analytical model, given our small data set and our choice of fixed effects, we used Poisson regression to determine the effect of change in rate of insurance coverage on the number of ED visits per 1,000 residents. Our model used county fixed effects to isolate within county effects and eliminate the impact of regional differences, and fixed effects for year to account for secular trends over that time period. A population offset was used to ensure results reflected changes of an ED visit rate. We also used several covariates described above to control for relevant county demographic characteristics and availability of healthcare resources (means and standard deviations of these covariates are presented in Supplemental Digital Content Table 2).

Our basic model was:

$$\ln(\text{ed\_ visit\_ }\mathbf{number_{c,t}}) = \beta_0 + \beta_1(\text{insurance\_ }\mathbf{rate_{c,t}}) + \beta_2(\text{year\_ }\mathbf{dummy_t}) + \beta_3(\text{county\_ }\mathbf{dummy_c}) + \boldsymbol{\beta_4}(\mathbf{covariate}) + \ln(\mathbf{population_{c,t}}) + \varepsilon$$

where subscripts *c* and *t* denote counties and years, and $\beta_1$ was the outcome of interest. We estimated the main model separately among adults aged 18 – 64, and children under 18. We further conducted the same analysis using a negative binomial model as a sensitivity analysis.

## Results

We analyzed a final sample of almost 52 million emergency department visits across 58 counties in California between 2005 and 2010 (Table 1). Among children, the statewide rate of insurance coverage fluctuated from 87.2% – 91.9% over the study period, while among adults it ranged from 76.0% – 78.1%. The overall ED visit rate among children rose from 237 to 263 visits per 1,000 residents, while among adults it rose from 243 to 263 visits per 1,000.

To provide a better sense of county variation, Table 2 shows the range of insurance coverage and ED visit rates across counties for our study period. Across all 58 California counties, for adults, the ED visit rate varied from 69 to 596 visits per 1,000 residents, and the percentage of adult county residents with insurance ranged from 70% to 90%. The change in the rate of ED visits by adults within a county between 2005–2010 varied dramatically; in one county it dropped by 128 visits per 1,000 residents, and in another it rose by 168 visits per 1,000 residents. Similarly, the percent of the adult population with insurance coverage dropped by as much as 8.6% in one county and rose by 9.7% in another between 2005 and 2010. There was similar variation in these metrics for children across counties.

In our primary model, we found that for both children and adults, as the rate of insurance coverage increased, the number of ED visits per person in that county slightly declined (Table 3). For children, if a county's rate of insurance coverage were to increase from the median (91.46%) to the 90$^{th}$ percentile (93.88%), the ED visit rate would decrease slightly, by 0.8 visits per 1,000 children ($p<0.01$). For adults, we found a very similar pattern. An increase from the median county rate of insurance coverage (78.80%), to the 90$^{th}$ percentile (84.93%) was associated with a decrease of one visit per 1,000 adult residents ($p<0.01$). For the average California county with an adult population of 411,000, this would translate to 411 fewer annual ED visits.

The rate of insurance coverage in a county was also inversely related to the rate of visits for overall ACSCs among adults (Table 4). For example, a shift from the 10$^{th}$ percentile of counties' adult insurance coverage (73.22%) to the median (78.80%) was associated with 0.1 fewer ED visits per 1,000 residents ($p<0.05$). When stratified further, that same shift in a county's rate of insurance coverage among adults was associated with 0.2 fewer ED visits ($p<0.01$) for acute ACSCs per 1,000 adult residents, such as bacterial pneumonia or urinary tract infections. This increase in the rate of insurance coverage was also associated with a small but statistically significant increase in the rate of ED visits for chronic ACSCs, such as diabetes complications, hypertension, and heart failure.

For our sensitivity analysis using negative binomial regression, we found the results to be generally larger in effect size with attenuated significance (results in Supplemental Digital

Content Table 3). This is likely because negative binomial models require an additional estimating parameter and may be less appropriate for our small, county-level dataset.

## Discussion

Our results show a statistically significant inverse relationship between the rate of insurance coverage in California counties and the number of ED visits per capita. Controlling for regional differences and secular trends, we find that between 2005 and 2010, as county rates of insurance coverage increased, overall visits to the emergency department by both adults and children slightly decreased. When we further restricted the analysis to visits for ambulatory care sensitive conditions, increasing insurance coverage among adults was associated with a slight decrease in the rate of visits for acute ACSCs, and a small increase in the rate of visits for chronic ACSCs.

Our study evaluates the overall community effects of increased insurance coverage on a broad population over a relatively longer timeframe compared with other literature, and therefore contributes to the existing knowledge regarding the association of insurance and ED use. The fact that increases in insurance coverage are associated with small decreases in total visits suggests that the rate of ED visits per uninsured person is higher than the rate of visits per insured person, so that moving people from the uninsured to insured groups has a net decrease in visits. Previous literature provides supporting evidence for this assumption, assuming that the privately insured make up the majority of the insured population pool.[11]

These results do not tell us whether changes in the rate of community insurance coverage affect the underlying rates of ED use by insured and uninsured patients specifically. Though we cannot reliably parse out the effects of changes in the community level insurance coverage on ED use by insured and uninsured patients separately, there is precedent in the literature to hypothesize these effects could be taking place and affecting our overall results. For instance, past literature has shown that the uninsured more often report difficulty accessing care or delaying needed care in communities with high levels of uninsurance than in those with low levels of uninsurance.[24] With fewer demands on limited resources such as safety-net primary care, those who remain uninsured as overall rates of insurance coverage increase may have less need to seek care in the ED.[25–27]

Further, the underlying rate of use by insured patients could change if the population of a county moving into the insured pool changes the overall distribution of the types of insurance coverage. Though uninsured patients are more likely than the overall pool of patients with insurance to report the ED as their usual source of care or the site of their last outpatient visit,[28] it is well-documented that Medicaid patients have the highest rates of ED use, above the uninsured[29] and privately insured.[11,30,31] Given recent evidence from the Oregon experiment showing that Medicaid coverage increases ED utilization,[1] any preferential movement towards public insurance programs in the overall insured pool could raise the rate of ED use among the insured.[30,32]

The final finding that increases in insurance coverage may be associated with a decline in acute ACSCs that are counterbalanced by increases in chronic ACSCs is concerning,

suggesting that individuals may tradeoff seeking care for acute conditions for chronic and more expensive conditions.[33] In general, however, previous literature showing that insurance provides better access to preventive care[34] that should reduce the need for ambulatory care sensitive ED use,[35] provides support for the inverse association between ED visits for all ACSCs and insurance coverage rates that we observe.

Exposing these connections provides important data for hospitals, patients, and policy-makers as the proportion of non-elderly Americans who are insured is projected to rise from roughly 80% to 90% of the population by 2022 as a result of the Affordable Care Act (ACA).[36] Though our model used retrospective data, and was not designed to predict the impact of ACA-specific changes in insurance coverage, our findings do shed light on what past experience can show us about how changing community rates of insurance coverage affect EDs. By demonstrating that past increases in rates of insurance coverage have resulted in only slight decreases in ED use, our results provide some insight that the imminent policy changes in access to care may not lead to an expected decrease in demand for ED care. Because data on the actual policy-induced shifts in insurance coverage will not be available for years after the fact, our results will be valuable especially as this process begins.

Our study is limited in that it is restricted to California, and albeit a large and diverse state, our results cannot be generalized to the entire nation. In addition, our rates of insurance coverage and county populations are estimates drawn from surveys and inter-census projections. Therefore any inaccuracy on their part could affect our results. We also do not take into account what insurance types the uninsured move into or out of, which could change over time differentially across counties, possibly distorting our findings. Further, we use county as the geographic delineation of insurance rates and visits, which, while a relevant political geography, does not necessarily delineate boundaries of ED use patterns. Because patients may cross county lines when seeking emergency medical care, the rate of insurance coverage coupled with their ED visit in our analysis may not correspond to the patient's actual community. In addition, they may not be counted in the uninsured and insured populations used in the denominators of the county's ED visit rates. However, we feel that there is no better measure that we could have used to accurately encompass both ED use and insurance coverage. Finally, although our model controls for time-invariant regional differences across counties and a number of demographic and healthcare-related covariates, it is possible that unobservable factors varied differentially across counties over time, and could confound our findings.

Further research is needed to discern the differential effects of change in community rates of insurance coverage on ED utilization in different neighborhoods and hospitals within counties, particularly how it affects the safety net that typically serves the uninsured. Moreover, a more detailed analysis of how changes in specific types of insurance coverage affect ED use could provide more relevant insights to how policy and demographic shifts could affect ED visit rates at the community level. Finally, as these real-time changes occur in the US as a result of the ACA, strong research efforts should be devoted to examining the effect of rising insurance coverage on emergency departments across the nation.

### Conclusions

In California from 2005–2010, a county's rate of insurance coverage had a small but significant inverse relationship to its per capita number of ED visits for both adults and children. These findings suggest that the net effect of expanding insurance coverage may not lead to anticipated significant declines in ED visits.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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**Table 1**

Statewide characteristics of California ED visits and rates of insurance coverage, 2005–2010

| **Children** | | | | | | |
|---|---|---|---|---|---|---|
| | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
| ED Visits | 2,484,380 | 2,445,406 | 2,556,244 | 2,607,144 | 3,013,225 | 2,791,731 |
| Population | 10,493,468 | 10,543,944 | 10,584,055 | 10,611,615 | 10,616,624 | 10,613,742 |
| Rate of Insurance | 91.9% | 87.2% | 88.6% | 90.3% | 90.8% | 91.3% |
| ED visit rate* | 237 | 232 | 242 | 246 | 284 | 263 |

| **Adults** | | | | | | |
|---|---|---|---|---|---|---|
| | **2005** | **2006** | **2007** | **2008** | **2009** | **2010** |
| ED Visits | 5,587,549 | 5,654,673 | 5,852,952 | 6,044,783 | 6,447,006 | 6,514,140 |
| Population | 23,038,741 | 23,373,770 | 23,705,768 | 24,044,666 | 24,394,369 | 24,734,149 |
| Rate of Insurance | 76.9% | 76.0% | 77.4% | 78.1% | 77.0% | 76.1% |
| ED visit rate* | 243 | 242 | 247 | 251 | 264 | 263 |
| ACSC visits | 413,819 | 416,585 | 426,816 | 442,853 | 476,491 | 475,989 |
| ACSC visit rate* | 18 | 18 | 18 | 18 | 20 | 19 |

* per 1,000 residents

## Table 2

Distribution of county rates of ED visits and insurance coverage among adults and children, 2005–2010

| | ED visits per 1,000 residents | Change in ED visits per 1,000 2005–2010 | Percent of county residents with insurance | Change in insured rate 2005–2010 |
|---|---|---|---|---|
| **Children** | | | | |
| **N** | 58 | 58 | 58 | 58 |
| **Mean** | 310 | 21 | 91.45% | 0.04% |
| **SD** | 94 | 55 | 1.74% | 1.91% |
| **Minimum** | 67 | −211 | 87.46% | −3.62% |
| **p5** | 199 | −49 | 88.59% | −2.56% |
| **p10** | 209 | −26 | 89.30% | −2.23% |
| **p25** | 235 | 3 | 90.24% | −1.10% |
| **p50** | 304 | 16 | 91.46% | −0.25% |
| **p75** | 359 | 37 | 92.75% | 1.28% |
| **p90** | 436 | 75 | 93.88% | 2.36% |
| **p95** | 501 | 139 | 94.33% | 2.85% |
| **Max** | 544 | 204 | 94.75% | 7.51% |
| **Adults** | | | | |
| **N** | 58 | 58 | 58 | 58 |
| **Mean** | 306 | 14 | 79.01% | −0.03% |
| **SD** | 89 | 40 | 4.44% | 3.08% |
| **Minimum** | 69 | −128 | 69.81% | −8.55% |
| **p5** | 203 | −34 | 71.90% | −5.51% |
| **p10** | 218 | −20 | 73.22% | −4.02% |
| **p25** | 243 | −7 | 75.81% | −2.02% |
| **p50** | 297 | 11 | 78.80% | 0.07% |
| **p75** | 350 | 35 | 82.39% | 1.56% |
| **p90** | 418 | 46 | 84.93% | 3.88% |
| **p95** | 461 | 83 | 85.81% | 4.29% |
| **Max** | 596 | 168 | 89.97% | 9.65% |

Legend: pX – Xth percentile (e.g. p10 – tenth percentile).

## Table 3

Predicted changes in ED visits per 1,000 county residents based on changes in insurance coverage

| **Children** | | |
|---|---|---|
| Change in ED visits per 1,000 if insurance coverage rose from the 10th percentile of CA counties (89.30%) to the . . . | | 95% CI of estimate |
| . . . median insurance rate (91.46%) | **−0.7**[+] | (−1.1, −0.3) |
| . . . 90th percentile insurance (93.88%) | **−1.5**[+] | (−2.4, −0.6) |
| **Adults** | | |
| Change in ED visits per 1,000 if insurance coverage rose from the 10th percentile of CA counties (73.22%) to the . . . | | 95% CI of estimate |
| . . . median insurance rate (78.80%) | **−0.9**[+] | (−1.4, −0.5) |
| . . . 90th percentile insurance (84.93%) | **−2.0**[+] | (−2.9, −1.1) |

[*] $p<0.05$

[+] $p<0.01$

## Table 4

Predicted changes in adult visits for ACSCs per 1,000 adult county residents based on changes in insurance coverage

| **Ambulatory care sensitive conditions**° | | |
|---|---|---|
| Change in ED visits for PQIs per 1,000 if insurance coverage rose from the 10th percentile of CA counties (73.22%) to the . . . | | 95% CI of estimate |
| . . . median insurance rate (78.80%) | **−0.1*** | (−0.2, −0.01) |
| . . . 90th percentile insurance (84.93%) | **−0.3*** | (−0.5, −0.03) |
| **Ambulatory care sensitive conditions - acute**° | | |
| Change in ED visits for PQIs per 1,000 if insurance coverage rose from the 10th percentile of CA counties (73.22%) to the . . . | | 95% CI of estimate |
| . . . median insurance rate (78.80%) | **−0.2**+ | (−0.3, −0.1) |
| . . . 90th percentile insurance (84.93%) | **−0.4**+ | (−0.6, −0.3) |
| **Ambulatory care sensitive conditions - chronic**° | | |
| Change in ED visits for PQIs per 1,000 if insurance coverage rose from the 10th percentile of CA counties (73.22%) to the . . . | | 95% CI of estimate |
| . . . median insurance rate (78.80%) | **0.1*** | (0.003, 0.2) |
| . . . 90th percentile insurance (84.93%) | **0.2*** | (0.01, 0.3) |

° classified according to the Agency for Healthcare Research and Quality's Prevention Quality Indicators (PQI) – adults only

* $p<0.05$

+ $p<0.01$