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25 YEARS

Emergency Department Use in California

Demographics, Trends, and the Impact of the ACA

Technical Appendices

CONTENTS

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Appendix A. Previous Literature

The research literature examining the relationship between ED use and changes in insurance coverage finds mixed evidence on what we might expect from an expansion of coverage. Most research to date has relied on pre-ACA coverage expansions in a few states, or on data from just one year after the coverage expansions (Mazurenko et al. 2018).

Analysis of the effects of Medicaid coverage expansions specifically comes largely from recent work based on an earlier pre-ACA expansion of Oregon's state Medicaid program that included a randomized evaluation to assess the effects of a host of outcomes attributable to the expansion. This Oregon Health Insurance Experiment found that ED visits increased significantly among the group of individuals who gained Medicaid coverage compared to a control group, which remained uninsured despite signing up for a lottery to receive Medicaid (Taubman, 2016). Researchers concluded that rather than Medicaid beneficiaries substituting doctor's office visits for ED visits, Medicaid made it more likely that individuals used more of both types of care (Finkelstein et al., 2017).

Other studies that use various quasi-experimental research designs to study the effects of coverage expansions on ED use have found declines in visits attributable to increased coverage. A study of ED use in Massachusetts found strong evidence that outpatient ED visits significantly declined as the result of major state-level reforms that pre-dated the ACA (Miller, 2012). Other work finds that after ACA dependent coverage expansions went into effect in 2010, ED use among young adults (age 19-26) declined overall – and for patients with behavioral health conditions (Akosa Antwi, et al., 2015; Golberstein et al., 2015; Hernandez-Boussard et.al., 2016).

Evidence is also mixed as to whether the ACA Medicaid expansion that started in 2014 impacted ED use depending on the study design. Pines et al. (2016) find no significant change in ED use across hospitals in states that expanded Medicaid compared to those that did not, and Sommers et al. (2017) report significant reductions in ED use among patients who gained ACA coverage in select states. In contrast, Nikpay et al., 2017 find significantly higher per capita ED rates comparing Medicaid expansion states to states that chose not to expand their Medicaid programs.

There is also growing body of evidence on the effects of the ACA on health care utilization, although much of this work relies on national survey data or self-reported outcomes to assess the impact of expanded coverage (Wherry and Miller, 2016; Sommers et al., 2016). Generally, this work finds that coverage expansions are associated with significant improvements in access to primary care and medications, affordability, preventive visits, screening tests, and self-reported health (Sommers et al. 2017; Miller and Wherry, 2017; Simon et al. 2017). Finally, there is some evidence that ACA coverage expansions may have impacted trends in frequent ED use. In work focused on California, McConville et al. (2018) find that after adjusting for patient mix, insurance coverage, and diagnostic information, the likelihood of frequent ED use was significantly lower in 2014 and 2015 after the Medicaid expansion compared to the two years prior. This study suggests that coverage expansions were successful in reducing the likelihood of frequent ED use.

Appendix B. Data

This study analyzes systematic changes in ED visits across California counties, comparing counties with high rates of uninsured adults to those with lower rates in 2014-2016 as compared to 2011-2013. The approach closely follows that taken in Miller (2012). To estimate the models described in Appendix C and tabulated in Appendix D, we require data on ED visits, population, health insurance coverage rates, demographic, and economic variables. Table B1 summarizes key variables and data sources.

TABLE B1
Summary of variables and data sources

Variable	Notes	Data source
Dependent variables		
Per capita ED visits	Main models use outpatient visits among those age 19-64; some models subset visits by demographic groups and by characteristics of visits	OSHPD discharge data; NIH SEER
Key independent variable		
Percent uninsured, 2013	Among adults age 19-64	Census SAHIE; Census bridged estimates
Other independent variable		
Percent non-Hispanic Black, percent Latinx		NIH SEER; Census bridged estimates
Median family income		Census SAIPE
Employment to population ratio	Total employment to population age 16	Bureau of Labor Statistics, QCEW; NIH SEER
Low-Income Health Program implemented in the county	Flag indicating the quarter a LIHP was implemented.	UCLA Evaluation of LIHP
Per capita ED treatment stations or beds		OSHPD Hospital Annual Utilization
Per capita clinic visits	Total annual clinic visits at community clinics licensed by the state; some county clinics and others are not included	OSHPD Primary Care Clinic Utilization
Per capita FTE clinic providers	Total clinical FTE providers at community clinics licensed by the state; some county clinics and others are not included	OSHPD Primary Care Clinic Utilization

Measures of ED use

A key data source for this research is non-public, visit-level hospital discharge data from California covering the years 2005 through 2016 from the Office of Statewide Health Planning and Development (OSHPD). All licensed hospitals in California, except those that are federally operated, are required to submit discharge abstracts for all inpatient and emergency department visits to OSHPD.

Key outcome variables center on the ratio of ED visits to county population. Using the OSPHD data, we assign visits to counties based on hospital location rather than patient's county of residence, and then aggregate to the county-quarter. Population estimates come from the National Institutes of Health (NIH) National Cancer Institute Surveillance, Epidemiology and End Results (SEER) program. We use the single-year-of-age county-level bridged race population annual estimates to create the detailed population categories that serve as the denominators for our outcomes.

We define subgroups by age, sex, and race/ethnicity as recorded in the OSHPD data. Population denominators are defined to match subgroups in these cases. Other subgroups include visits by primary diagnosis, injury visits, avoidable visits, and by whether the visit resulted in hospital admittance. In these cases population denominators are simply all those age 19-64 in the county-year.

Measure of uninsured rates

The second key data source is estimates of the percent of uninsured adults across county. We use Census Small Area Health Insurance Estimates (SAHIE) estimates of the percent uninsured by county among those age 19-64.

Other covariates

Economy: In our preferred models we include county-level annual household median income estimates drawn from Census Small Area Income and Poverty Estimates (SAIPE) and quarterly employment to population ratios drawn from the Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW) counts and population estimates from NIH SEER data.

Demographics: In our preferred models we include annual estimates of the race/ethnic make-up of the county population, drawn from NIH SEER data.

Health care resources: In our preferred models we include annual measures of clinic and ED capacity by county including per capita ED treatment stations or beds, per capita clinic visits, and per capita FTE clinic providers from OSHPD data. Over our time period, there were likely within county changes to these supply side measures that could impact ED use. And while our models include county fixed effects to account for underlying, *time-invariant* differences across counties – they do not account for within county changes that may have occurred.

LIHP indicators: Some California counties implemented Low-Income Health Programs (LIHPs) prior to 2014 as part of a pre-ACA expansion through an 1115 Medicaid waiver. LIHP programs allowed counties to pull down federal funds for low-income indigent adults -- many of whom were eligible for county based indigent care programs. All but 5 of California's 58 counties implemented some type of LIHP, although eligibility requirements did vary across counties.

While California's pre-expansion of its Medicaid program has been linked to improved access to care, it should be noted that LIHPs were not equivalent to full Medi-Cal coverage. They were required to offer a more extensive set of benefits relative to most county indigent programs; however, LIHPs provided care predominantly through county-based resources rather than operating as an insurance program that would pay for medical services in any location.

In most of our models we include an indicator for whether a LIHP was in effect in the county-quarter to account for the possibility that ED visits were affected after uninsured adults gained additional access to health care through LIHP enrollment.

Appendix C. Methods

We take a quasi-experimental approach, comparing measures of ED use pre-/post-coverage expansions in counties more and less "treated" by the ACA based on their uninsured rates prior to 2014. The identification strategy follows that developed in Miller (2012). As described in Appendix B, our key independent variable is the county population age 19-64 estimated to be uninsured in 2013. In a few models, we use a continuous measure of the county uninsured rate, but in our preferred models we use indicator variables for county uninsured quartiles. Interacting these indicators of coverage in the period immediately before ACA expansions allows us to identify changes in ED use patterns by exploiting the differential effect of the health insurance coverage expansion in counties with higher versus lower shares of their population uninsured. In essence, we categorize counties as "treated" based on having high or low pre-ACA coverage rates.

Such difference-in-difference approaches typically use variation in the *timing* of the treatment and/or the number of places treated rather than the *intensity* of the treatment to identify post-policy change effects. That is, geographic locations – most often states – are used as controls for themselves, and the change in outcomes post policy implementation is compared to the change in states that did not (or had not yet) made the policy change. However in the case of the ACA, all counties in California were treated at the same time, invalidating this approach. But there is variation in the treatment across counties. Further, the ACA was a federal policy change, meaning it was not driven by particular county residents' intensity of need for insurance. Therefore, we treat county uninsured rates in 2013 as an exogenous factor.

With this assumption, we employ a difference-in-differences (DD) approach. Equation 1 illustrates the approach, where the dependent variable (Y) measures per-capita ED visits and varies by county c and quarter t. The vector of control variables, X, varies either by county-quarter or county-year. Models include indicator variables for county, quarter, and quarter interacted with county quartile of non-elderly adult uninsured in 2013. Our key independent variable γ_4 is the interaction between an indicator variable for being in the top quartile of counties and an indicator for the post-reform period (2014-2016). We allow effects to vary by the top, second and third quartiles of uninsured across counties with the first quartile – counties with the lowest pre-ACA uninsured rate serving as the comparison (omitted category).[1]

$$(1)\ Y_{ct} = \beta_0 + \gamma_4 uninsured2013_{\text{quartile4}} * postACA + \gamma_3 uninsured2013_{\text{quartile3}} * postACA + \gamma_2 uninsured2013_{\text{quartile2}} * postACA + \gamma_1 postACA + \boldsymbol{X_{ct}}\beta + \boldsymbol{county_c} + \boldsymbol{quarter_i} + \boldsymbol{quarter_i} * uninsured2013_{\text{quartile4}} + \epsilon_{ct}$$

Our key outcome variables are county-level measures of per capita ED use among non-elderly adults, age 19 to 64. For the visit measure, we examine multiple constructs including outpatient visits, and ED visits categorized by primary diagnosis. We also analyze these outcome measures for defined demographic subgroups.

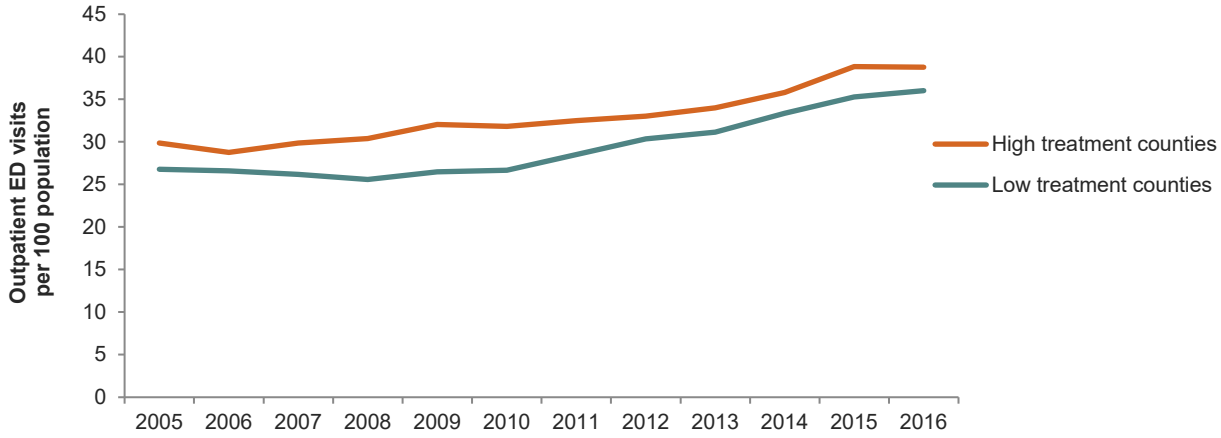
We include additional controls ($\boldsymbol{X_{ct}}$) for time varying factors within counties that likely shape patterns of insurance coverage and ED use. As described in Appendix B, these controls for economic indicators and demographic characteristics include county-level quarterly employment-to-population ratios, annual median household incomes, and the racial/ethnic composition of the county. The inclusion of current and lagged economic indicators help to disentangle the effects of the Great Recession from coverage expansions (Klerman and Danielson, 2016). The controls also include measures of health care supply including numbers of ED beds and clinic capacity.

[1] In a few models we interact the continuous percent uninsured with years; however, in our main models we focus on quartiles of uninsured rates rather than assuming a linear relationship between uninsured prior to 2014 and change in ED use after the coverage expansions.

For the DD approach to be valid, trends in per capita ED use prior to the ACA coverage across our high-treatment and low-treatment counties should be parallel. Figure C1 displays the descriptive trends in per capita outpatient ED visits for our county groups classified as high and low treatment based on their 2013 uninsured rate. Over the entire time period, we do see some divergence in per capita ED trends centered around the years during the Great Recession. The trends do appear to move more in line starting in about 2011. As a result, we restrict our main analysis to the time period between 2011 (3 years prior to ACA) and 2016 (3 years post-ACA).

FIGURE C1

Descriptive trends in ED use between high treatment and low treatment counties



SOURCE: Authors calculations from OSHPD discharge data, SAHIE county uninsured rates

NOTE: Trends show per capita trends in ED visits for two county groups—high treatment counties (75th percentile and higher, 2013 adult uninsured rates) and low treatment counties (25th percentile and lower).

As is standard in the literature, throughout we cluster standard errors by unit of geography (county) to correct for the auto-correlation of the time series. California has 58 counties, and we use quarterly data over the period 2011-2016, or 6 years. This translates into 1,392 observations for our models: 24 quarters of observations and 58 counties. Three very small counties have no ED visits in the data, but are included in the analysis with 0s for the outcomes. For some of our subgroup and diagnosis analysis, additional counties have some quarters with no visits and again we include them with 0s for the outcomes.

Scaling the coefficients

To provide a sense of how large the key estimate shown in the Appendix D tables are, in Figure 9 we scale the interactions of the dummy variables for top quartile uninsured and post-ACA implementation by multiplying the coefficients by 4 (recall that ED visit rates are quarterly) and then dividing by statewide per capita ED visits prior to the ACA (2011-2013 average). Table C1 provides the per capita visit rates we use as denominators.

TABLE C1

Average ED visit rates pre-ACA (2011-2013)

Adults, age 19 - 64	Adults, age 35-44	Adults, age 45-54	Non-Hispanic whites, 19-64
27	25	26	28

NOTE: Visit rates are multiplied by 100 and represent the number of ED outpatient visits divided the number in the population in the indicated age or age and race/ethnic group.

Appendix D. Detailed Regression Results

This appendix presents regression coefficients from our main models, as well as subgroup analyses.

Per capita outpatient ED visits

In this section we present regression results for models that include year of observation as well as year of observation interacted with the continuous measure of the county uninsured rate in 2013 for non-elderly adults (Table D1). Finding no evidence of an effect of the ACA coverage expansions on visits prior to 2014-2016, and no effect of a growing effect of the ACA coverage expansions across the years 2014-2016, we then strip down the number of variables to focus on the combined years 2014-2016 interacted with an indicator for whether the county was in the top 25 percent of counties in terms of uninsured adults in 2013 (Tables D2-D5).

We first discuss the common trends in ED visits. Before controlling for demographic and macroeconomic changes, Table D1 shows no clear common trend across California counties over the period 2011-2016 (columns 1, 3 and 5). This is true of outpatient visits, all visits, and visits that resulted in a hospital admission. Once we account for demographics and the economy (columns 2, 4 and 6), we see a clear positive trend in the main year effects for outpatient and all visits, but not for visits that resulted in an hospital admittance.

Most importantly for our analysis, across all columns of the table, the interactions between percent uninsured adults in 2013 and the year indicators are insignificant, even at the 10 percent level for outpatient and all ED visits. Across columns 1, 3 and 5 of the table, we see some evidence of a growing, positive trend from 2014-2016 before including the control variables. However, after including controls, point estimates turn negative for outpatient and all ED visits, although they remain insignificant.

TABLE D1

Interactions of percent uninsured with year fixed effects

	(1)	(2)	(3)	(4)	(5)	(6)
	Outpatient ED visits	**Outpatient ED visits**	**All ED visits**	**All ED visits**	**Admittance ED visits**	**Admittance ED visits**
2011	-0.00606*	-0.0152***	-0.00614*	-0.0150***	-0.000111	0.000118
2012	-0.00108	-0.00673**	-0.00112	-0.00679**	-0.000172	-0.000193
2013	Omitted					
2014	0.00476	0.00857**	0.00507	0.00877**	.0000108	-.0000750
2015	0.00772	0.0146***	0.00745	0.0142***	-0.000211	-0.000346
2016	0.0168	0.0245***	0.0168	0.0240***	-0.000373	-0.000766
2011 x % pre-reform uninsured	0.00622	0.0471**	0.00780	0.0481**	0.00122	0.000522
2012 x % uninsured	-0.00368	0.0227	-0.00271	0.0238*	0.00121	0.00119
2013 x % uninsured	Omitted					
2014 x % uninsured	0.00280	-0.0147	0.00113	-0.0157	-0.000648	-.0000633
2015 x % uninsured	0.0194	-0.0147	0.0201	-0.0130	0.000586	0.00150
2016 x % uninsured	-0.0110	-0.0444	-0.0107	-0.0414	0.00183	0.00422
Visit quarter dummies	X	X	X	X	X	X
Uninsured x quarter dummies	X	X	X	X	X	X
County dummies	X	X	X	X	X	X
Demographic variables		X		X		X
Economic variables, including lagged employment		X		X		X
LIHP implemented		X		X		X
Health care supply variables		X		X		X
Observations	1392	1392	1392	1392	1392	1392
R-squared	0.953	0.961	0.956	0.963	0.964	0.965

*** p<0.01, ** p<0.05, * p<0.1

NOTES: Robust standard errors in parentheses. All outcome variables are the ratio of quarterly visits in the county among those age 19-64 divided by the estimated population age 19-64 in the county.

Examining only outpatient visits and focusing on the interaction between the top quartile of "treated" counties – those that were in the 75th percentile or above based on the pre-ACA uninsured rate – and the post-reform years 2014-2016, we see negative point estimates once we add in demographic, macroeconomic, and health care supply variables (Table D2 – columns 3 and 4). In other words, per capita outpatient ED visits dropped in these treated counties relative to the counties with the lowest pre-ACA uninsured rates (first quartile) after the ACA coverage expansions. These point estimates range between -0.0067 and -0.00739. The middle two quartile of counties have smaller, and insignificant coefficients relative to the lowest quartile.

Column 1 of the table includes no time-varying controls, and columns 2-4 step in first indicators for a LIPH being in place in the county and then demographic and economic controls, and finally measures of health care supply in the county. All models include year, county, and visit quarter fixed effects. The interaction of 2014 and later years with the top quartile uninsured in 2013 is significant at the 5 percent level in column 3 and 4 when all demographic and economic controls are added. Below, we use the model with all controls (Column 4) as our preferred model for the analysis of subgroups.

TABLE D2

Outpatient ED visits, adults age 19–64

	(1)	(2)	(3)	(4)
Post-ACA x top quartile uninsured (high treatment)	-0.00153	-0.00162	-0.00671**	-0.00739**
Post-coverage expansion x 2nd quartile uninsured	0.00277	0.00263	-0.00198	-0.00150
Post-coverage expansion x 3rd quartile uninsured	-0.000722	-0.000980	-0.00302	-0.00358
County covariates				
LIHP implemented		0.00353***	0.00103	-.0000101
Demographic/Economic				
% Latinx			0.417***	0.456***
% Non-Hispanic black			0.699	0.559
Employment to population ratio			0.0821	0.0700
Lagged one quarter			-0.00813	-0.00982
Lagged two quarters			0.0452	0.0441
Lagged three quarters			-0.0108	-0.0119
Lagged four quarters			0.0257	0.0354
Median household income			-.0000412*	-.0000417*
Health care supply				
Per capita ED beds				47.60*
Per capita clinic visits				-0.0106
Per capita clinic FTE providers				22.35***
Observations	1,392	1,392	1,392	1,392
R-squared	0.948	0.949	0.957	0.959

*** p<0.01, ** p<0.05, * p<0.1

NOTES: All outcome variables are the ratio of quarterly visits in the county among those age 19-64 divided by the estimated population age 19-64 in the county. All regressions include fixed effects for counties, quarter of visit, and quarter of visit interacted with the indicator for top quartile (75th percentile) uninsured rate.

Demographic subgroups

Examining subgroups, we find evidence that outpatient visits declined among adults age 34-44 and 45-54—prime expansion groups for the ACA (Table D3). Point estimates range from -0.00916 to -0.0121 and are significant at the 5 percent level or better. We do not find evidence that these declines are concentrated among males – females age 34 to 64 also experienced significant declines (Table D4). Table D5 provides evidence of a decline in ED outpatient visits among non-Hispanic whites. The point estimate is in the same range (-0.012) and is significant at the 5 percent level.

TABLE D3

Outpatient visits by age groups

	(1)	(2)	(3)	(4)	(5)
	Outpatient visits, age 19-26	Outpatient visits, age 27-34	Outpatient visits, age 35-44	Outpatient visits, age 45-54	Outpatient visits, age 55-64
Post-ACA x top quartile uninsured (high treatment)	-0.00528	-0.00505	-0.0121***	-0.00916***	-0.00484
Post-coverage expansion x 2nd quartile uninsured	-0.00101	0.00113	-0.00330	-0.00149	-0.00143
Post-coverage expansion x 3rd quartile uninsured	-0.00172	-0.00451	-0.00513	-0.00320	-0.00213
County covariates					
LIHP implemented	-0.00212	0.000885	-0.000654	0.000439	0.000674
Demographic/Economic					
% Latinx	0.263	0.327*	0.592***	0.516***	0.532***
% Non-Hispanic black	0.570	1.387**	0.413	0.376	0.177
Employment to pop ratio	0.116	0.0942	0.0570	0.0544	0.0439
Lagged one quarter	-0.0328	-0.00854	-0.00501	-0.0120	0.00251
Lagged two quarters	0.0357	0.0398	0.0314	0.0461	0.0602
Lagged three quarters	0.000476	-0.0175	-0.0136	-0.0100	-0.0156
Lagged four quarters	0.0550	0.0281	0.0367	0.0340	0.0315
Median household income	-5.25e-07	-4.32e-07	-3.54e-07*	-3.89e-07**	-3.56e-07*
Health care supply					
Per capita ED beds	60.23**	59.25*	43.63	56.53**	33.14
Per capita clinic visits	1.93e-05	-0.0329	-0.00207	0.00162	-0.00825
Per capita clinic FTE providers	0.389	47.85***	12.33	20.24**	26.69**
Observations	1,392	1,392	1,392	1,392	1392
R-squared	0.935	0.944	0.947	0.957	0.940

*** p<0.01, ** p<0.05, * p<0.1

NOTES: All outcome variables are the ratio of quarterly visits in the subgroup divided by the estimated county population in the subgroup. All regressions include fixed effects for counties, quarter of visit, and quarter of visit interacted with the indicator for top quartile uninsurance rate.

TABLE D4

Outpatient visits by age groups and sex

	(1)	(2)	(3)	(4)
	Outpatient visits, males 19-34	**Outpatient visits, males 35-64**	**Outpatient visits, females 19-34**	**Outpatient visits, females 35-64**
Post-ACA x top quartile uninsured (high treatment)	-0.00294	-0.00742***	-0.00830	-0.00905**
Post-coverage expansion x 2nd quartile uninsured	0.00341	0.000278	-0.00496	-0.00440
Post-coverage expansion x 3rd quartile uninsured	-0.00160	-0.00179	-0.00725	-0.00505
County covariates				
LIHP implemented	-0.000482	0.000208	-0.000565	-9.25e-06
Demographic/Economic				
% Latinx	0.200	0.423***	0.395**	0.643***
% Non-Hispanic black	1.089**	0.250	0.902	0.500
Employment to population ratio	0.107	0.0503	0.103	0.0528
Lagged one quarter	-0.0235	-0.00745	-0.0174	-0.00204
Lagged two quarters	0.0300	0.0450	0.0447	0.0484
Lagged three quarters	-0.0158	-0.0139	0.000871	-0.0132
Lagged four quarters	0.0463	0.0385*	0.0317	0.0270
Median household income	-2.59e-07	-2.91e-07*	-7.88e-07**	-4.14e-07**
Health care supply				
Per capita ED beds	39.49*	32.11	76.67**	55.72*
Per capita clinic visits	-0.0128	0.00465	-0.0303	-0.0145
Per capita clinic FTE providers	24.64**	17.81**	27.19*	22.91***
Observations	1,392	1,392	1,392	1,392
R-squared	0.919	0.948	0.959	0.964

*** p<0.01, ** p<0.05, * p<0.1

NOTES: All outcome variables are the ratio of quarterly visits in the subgroup divided by the estimated county population in the subgroup. All regressions include fixed effects for counties, quarter of visit, and quarter of visit interacted with the indicator for top quartile uninsurance rate.

TABLE D5

Outpatient visits by race/ethnic groups

	(1)	(2)	(3)	(4)
	Outpatient visits, non-Hispanic whites 19-64	**Outpatient visits, non-Hispanic blacks 19-64**	**Outpatient visits, Latinx 19-64**	**Outpatient visits, non-Hispanic Asian/Pacific Islander 19-64**
Post-ACA x top quartile uninsured (high treatment)	-0.0129**	-0.00484	-0.00463	-0.000449
Post-coverage expansion x 2nd quartile uninsured	-0.00479	0.00623	0.00269	0.00555
Post-coverage expansion x 3rd quartile uninsured	-0.00633	-0.000846	0.000837	-0.00138
County covariates				
LIHP implemented	0.00102	0.00190	-0.000520	-0.00115
Demographic/Economic				
% Latinx	0.363**	0.176	0.422**	0.212
% Non-Hispanic black	1.367*	1.187	-0.162	1.251
Employment to pop ratio	0.101	0.106	0.0299	0.0700
Lagged one quarter	-0.0183	0.0295*	0.0213**	-0.0383
Lagged two quarters	0.0507	0.0512	0.0307	0.0362
Lagged three quarters	-0.0233	0.0142	0.0211**	-0.0186
Lagged four quarters	0.00548	0.000272	0.0424**	0.0501
Median household income	-6.42e-07**	1.53e-07	1.11e-07	-9.80e-08
Health care supply				
Per capita ED beds	61.51**	20.70	52.65***	66.66***
Per capita clinic visits	-0.0301*	-0.0502	-0.00768	0.0122
Per capita clinic FTE providers	33.24***	18.62	12.82	28.47*
Observations	1,392	1,392	1,392	1,392
R-squared	0.940	0.925	0.941	0.802

*** p<0.01, ** p<0.05, * p<0.1

NOTES: All outcome variables are the ratio of quarterly visits in the county among those age 19-64 divided by the estimated population age 19-64 in the county. All regressions include fixed effects for counties, quarter of visit, and quarter of visit interacted with the indicator for top quartile uninsurance rate.

Diagnostic category subgroups

Turning to subgroups of ED visits defined by primary diagnoses, we find no evidence that outpatient ED visits classified as avoidable, nor those related to chronic conditions or pain (abdominal, chest, or headache) saw any decline. Surprisingly, we do see a decline, significant at the 5 percent level, in injury visits—a category of visit that we would not expect to be affected by the coverage expansions. Note that the denominators for these dependent variables are all adults in the county, implying that we would expect smaller point estimates than for demographic subgroups.

TABLE D6

Visits by primary diagnoses

	(1)	(2)	(3)	(4)
	Outpatient visits, avoidable 19-64	**Outpatient visits, chronic 19-64**	**Outpatient visits, pain-related 19-64**	**Outpatient visits, injury 19-64**
Post-ACA x top quartile uninsured (high treatment)	-0.000893	-0.000462	-0.000569	-0.00162**
Post-coverage expansion x 2nd quartile uninsured	0.000202	-0.000273	-0.00108**	-0.000234
Post-coverage expansion x 3rd quartile uninsured	-9.47e-05	-0.000188	-0.000792	-0.000373
County covariates				
LIHP implemented	0.000306	0.000307*	0.000233	0.000120
Demographic/Economic				
% Latinx	0.0552*	0.0483**	0.0207	0.0569*
% Non-Hispanic black	0.0672	0.135	-0.0332	0.0104
Employment to population ratio	0.00979**	0.00562**	0.00486*	0.0457
Lagged one quarter	-0.00210	-0.000818	0.000547	-0.0297
Lagged two quarters	0.00432	0.00266	-0.000554	0.0127
Lagged three quarters	0.00180	0.000154	0.00124	-0.0146
Lagged four quarters	-0.00290	-0.000593	-0.00243	0.00803
Median household income	-2.27e-08	-6.61e-09	-5.25e-08*	-1.49e-07**
Health care supply				
Per capita ED beds	1.439	4.924***	0.142	-0.974
Per capita clinic visits	-0.000787	0.00135	-0.00240	-0.00208
Per capita clinic FTE providers	2.186	1.382	0.0851	2.728
Observations	1,102	1,102	1,102	1,102
R-squared	0.935	0.951	0.929	0.899

*** p<0.01, ** p<0.05, * p<0.1

NOTES: Counties that had no visits reported for any given category are included with 0 as the outcome. Due to the change from ICD9 codes to ICD10 codes in October 2015, we only include through quarter 3 of 2015 in all models of diagnoses. All outcome variables are the ratio of quarterly visits in the subgroup divided by the estimated county population age 19-64. All regressions include fixed effects for counties, quarter of visit, and quarter of visit interacted with the indicator for top quartile uninsurance rate.

Appendix E. Sensitivity Tests

We ran a number of alternate model specifications in order to assess the robustness of our main results. In this appendix, we discuss those findings.

Using patient county of residence

In our main analysis, the county to which ED visits are assigned is based on the hospital county. The OSHPD discharge data also contains information on the patient county of residence, although about 7% of all ED visits have missing information on patient county. We construct alternate measures of our outcome variables of per capita ED use based on patient county (and use hospital county only for those with missing patient county).

Table E1 presents the results from these models for several of our outcomes of interest. In general, the results are consistent with our main findings, although the point estimates become less precise and in some cases do not reach the level of statistical significance we use to determine if the coefficients are different from 0.

TABLE E1

Visits classified by patient county of residence

	(1)	(2)	(3)		
	Outpatient visits, all adults 19-64	Outpatient visits, age 35 - 44	Outpatient visits, age 45-54	Outpatient visits, male 35-64	Outpatient visits, female 35-64
Post-ACA x top quartile uninsured (high treatment)	-0.00459	-0.00857*	-0.00759**	-0.00507*	-0.00653*
Post-coverage expansion x 2nd quartile uninsured	-0.00113	-0.00192	-0.00165	0.000866	-0.00454
Post-coverage expansion x 3rd quartile uninsured	-0.00365	-0.00383	-0.00519*	-0.00236	-0.00519
County covariates					
LIHP implemented	-0.000136	-0.00120	0.000693	0.000732	2.48e-05
Demographic/Economic					
% Latinx	0.588***	0.744***	0.625***	0.491***	0.804***
% Non-Hispanic black	0.708	0.363	0.684	0.463	0.764
Employment to population ratio	0.0674***	0.0621***	0.00135	0.0103	0.0124
Lagged one quarter	-0.0127	-0.0187	0.00992	0.000982	0.0153**
Lagged two quarters	0.0508***	0.0372***	0.0299***	0.0281**	0.0207**
Lagged three quarters	-0.0159	0.0173	0.0106	0.00761	0.00846
Lagged four quarters	0.0303	-0.0303	0.0256***	0.0305**	0.00490
Median household income	-3.34e-07**	-1.40e-07	-2.65e-07**	-1.37e-07	-2.04e-07
Health care supply					
Per capita ED beds	20.13	26.16	33.53**	16.77	28.56
Per capita clinic visits	-0.0224*	-0.0148	-0.0146	-0.00337	-0.0287*
Per capita clinic FTE providers	15.75*	2.178	19.58***	12.28*	19.87**
Observations	1,392	1,392	1,392	1,392	1,392
R-squared	0.958	0.924	0.943	0.935	0.956

Adjusting for county population/Large county analysis

In our main analysis, all counties are included regardless of their population size. To further probe our results, we also conducted our analysis on subsets of counties based on their total population. Below we present detailed results for counties with 100,000+ populations and 500,000+.

Table E2 compares model coefficients across two specifications: one that interacts the post reform dummy with each county quartile of the 2013 uninsured rate, omitting the first quartile as we do in our main analysis (panel A), and one that interacts the post reform dummy with only the fourth (top) quartile of uninsured. In other words, the top quartile of counties is compared to the bottom 3 quartiles (panel B).

Results are consistent across the specifications for the 58 county analysis and the 35 county analysis. In particular, the interactions with the middle two quartile of counties have small and statistically insignificant coefficients, while the coefficients on both the top and bottom quartiles are significant and are of opposite sign: the top quartile is negative and the bottom quartile is positive. When we collapse the comparison to the top as compared with the bottom three quartiles, estimates are smaller, but remain significant and opposite signed.

Looking only at the 16 largest counties, the coefficient on the post-ACA interaction with the top quartile of counties has a positive and significant coefficient—comparing to the bottom quartile, which is insignificant. The bottom quartile counties in this large county group are all in the Bay Area. Note that the coefficients on the middle two quartiles are positive and of nearly the same size in most cases. However, when we combine the bottom three quartiles and compare with the top quartile, we obtain no significance.

TABLE E2

Outpatient visits, large counties

	All counties			35 counties with population 100,000 and above			16 counties with population 500,000 and above		
	Adults 19-64	Adults 35-44	Adults 45-54	Adults 19-64	Adults 35-44	Adults 45-54	Adults 19-64	Adults 35-44	Adults 45-54
A. Interactions with quartile of uninsured									
Post-coverage expansion x top quartile uninsured	-0.00739**	-0.0121***	-0.00916***	-0.000871	-0.000719	-0.00285	0.00556**	0.00498**	0.00645**
	(0.0032)	(0.0043)	(0.0032)	(0.0028)	(0.0026)	(0.0033)	(0.0023)	(0.0021)	(0.0023)
Post-coverage expansion x 2nd quartile uninsured	-0.0015	-0.0033	-0.00149	0.00328	0.00238	0.00168	0.00545	0.00478*	0.00474
	(0.0031)	(0.0036)	(0.0030)	(0.0034)	(0.0029)	(0.0038)	(0.0035)	(0.0026)	(0.0032)
Post-coverage expansion x 3rd quartile uninsured	-0.00358	-0.00513	-0.0032	0.000794	0.00128	-3.01E-05	0.00456	0.00394	0.00613**
	(0.0032)	(0.0036)	(0.0030)	(0.0032)	(0.0035)	(0.0032)	(0.0027)	(0.0023)	(0.0026)
Post ACA expansions	0.00826***	0.00875***	0.00764***	0.00372	0.00344	0.00381	0.000709	0.000657	-0.000647
	(0.0024)	(0.0027)	(0.0023)	(0.0023)	(0.0023)	(0.0026)	(0.0020)	(0.0017)	(0.0019)
Observations	1,392	1,392	1,392	840	840	840	384	384	384
R-squared	0.959	0.947	0.957	0.971	0.968	0.965	0.976	0.977	0.973
B. Interaction with top quartile of uninsured									
Post-coverage expansion x top quartile uninsured	-0.00552**	-0.00886***	-0.00742***	-0.00244	-0.00213	-0.00348	0.00102	0.00102	0.00134
	(0.0022)	(0.0033)	(0.0022)	(0.0024)	(0.0022)	(0.0024)	(0.0018)	(0.0015)	(0.0019)
Post ACA expansions	0.00648***	0.00580***	0.00600***	0.00484***	0.00454***	0.00421***	0.00424***	0.00373***	0.00322***
	(0.0014)	(0.0016)	(0.0013)	(0.0013)	(0.0015)	(0.0013)	(0.0011)	(0.0008)	(0.0011)
Observations	1,392	1,392	1,392	840	840	840	384	384	384
R-squared	0.959	0.946	0.956	0.97	0.968	0.965	0.974	0.975	0.971

Weighting by county population

A recent study (Duggan et al, 2019) also examines the relationship between the ACA coverage expansions and ED use at California hospitals. Their main analyses of ED visits was conducted at the individual level and focused on California adults near the age of 65 (just before and just after eligibility for Medicare begins). As a robustness test of their main finding—that the ACA expansions of health insurance coverage options increased ED visits for this specific age group—the authors also conducted aggregated analyses of Hospital Service Area ED visits divided by the under 65 population. Their auxiliary analysis, akin to the approach we take in the main analyses presented in this report, employed weighted least squares (WLS), weighting by HSA population, and found significant, positive coefficients on interactions of 2014-2016 year dummies and a continuous variable for share of the under 65 population living under 125 percent of the federal poverty level. Apart from using poverty rates rather than uninsured rates to identify the effect of the ACA on ED use and conducting their analysis at the Hospital Service Area (HSA) level rather than at the county-level, another noteworthy difference from our analysis is that Duggan et al. drop pregnancy-related visits from their counts.

While we did not conduct an exhaustive comparison of their findings and ours, it does appear that the results presented in this report differ from the auxiliary findings of Duggan et al. primarily due to the choice of estimating the models using OLS or WLS. WLS is typically employed to improve the efficiency of OLS estimates using aggregated data (e.g., means and proportions) by placing greater weight on observations measured with greater precision. While we considered using WLS, we decided against doing so because WLS "introduce[s] considerable heteroscedasticity, produce[s] inefficient parameter estimates and biased estimates of the standard errors" if the observations that make up the group – in our case, ED visits—are not independent (Dickins 1990). Because the unit of observation is a visit, and a minority of individual make up a majority of visits, ED visits in a county or HSA are clearly not independent draws.

We tested the assumption directly by regressing the squared residuals from a WLS model on county population. If WLS removed heteroscedascity, we expect an insignificant coefficient on the population variable (Dickins 1990). In the case of our analysis, the parameter estimate was significant and therefore we decided against using WLS.

We note that the Miller study (2012) on which we base our analytic strategy included WLS as an alternative model specification and found similar results between the OLS and WLS specifications. Conversely, we find slightly different results comparing our OLS and WLS estimates on the effect of insurance expansion on ED use. This could be driven by the fact that California has many more counties – and substantially more variance in the size of county populations compared to Massachusetts.

Using the Elderly as a Control Group

In this section we discuss the potential for using the elderly as a control group in our analyses—an approach that we considered, but ultimately rejected.

Equation 2 illustrates a representative difference-in-difference-in-differences (DDD) models where the subscript a indicates that observations vary by age groups (19-64 vs. 65+) to control for trends affecting ED use within a county over time (but identically across non-elderly and 65+ patients).

$$(2)\ Y_{act} = \beta_0 + uninsured2013_c + visitsage1964 + uninsured2013_c * \text{postACA} + uninsured2013_c * \text{visits}age1964 * \text{postACA} + g(county, quarter) + \epsilon_{act}$$

In equation 2, the key coefficient of interest is the coefficient on the three-way interaction between insurance status, age group, and post-ACA expansion years.

However, for this approach to be valid, the elderly must be a valid within-county control group for non-elderly adults. The elderly are an attractive control group because they were not directly affected by the coverage expansions because they had access to Medicare both before and after 2014. At the same time, the ACA was a complex piece of legislation that aimed to change the behavior of health systems, including incentives to hospitals to reduce re-admittances, which could have affected the elderly as their rates of ED and hospital use are the highest among all age groups.

In fact, when we examine ED visit rates among the elderly using the same set-up as in Appendix D, we see a very similar pattern of a significant decline in ED visits among those age 65+ in the top quartile of counties in 2014 and after (Table E4). This suggests to us that the elderly were affected by the ACA—albeit not by the coverage expansions—and are therefore not a suitable control group for non-elderly adults.

TABLE E3

Outpatient visits, age 65+

	(1)
Post-coverage expansion x top quartile uninsured	-0.00796***
Post-coverage expansion x 2nd quartile uninsured	-0.00281
Post-coverage expansion x 3rd quartile uninsured	-0.000802
% Latinx	0.636***
% non-Hispanic black	-0.298
Employment to population ratio	0.0434**
Lagged one quarter	-0.0735***
Lagged two quarters	0.0881
Lagged three quarters	-0.0769**
Lagged four quarters	0.0325**
Median household income	1.52e-07
LIHP implemented	-0.00182
Observations	1,317
R-squared	0.911

*** p<0.01, ** p<0.05, * p<0.1

NOTES: Robust standard errors in parentheses. Observations reflect 24 quarters of observations on 54 counties and 21 quarters for one county. Counties excluded had no ED visits in the quarter. All outcome variables are the ratio of quarterly visits in the county among those age 19-64 divided by the estimated population age 19-64 in the county. All regressions include fixed effects for counties, quarter of visit, and quarter of visit interacted with the indicator for top quartile uninsurance rate.

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