The Effect of Insurance on Outpatient Emergency Room Visits: An Analysis of the 2006 Massachusetts Health Reform

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Abstract

This paper analyzes the impact of a major health reform in Massachusetts on outpatient emergency room (ER) visits. I exploit the variation in ex-ante exposure to the reform generated by the county-level pre-reform uninsurance rate to identify the effect of the reform on ER visits per capita. I find that counties in Massachusetts with high pre-reform uninsurance levels experienced the greatest reductions in outpatient ER usage relative to both counties with similar characteristics in other states and other counties in Massachusetts. The most affected counties saw ER usage decline by about

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4 visits per 100 residents, or .4 visits per one percentage point increase in insurance coverage. I find a significant reduction in preventable, avoidable, and non-urgent ER visits but an *increase* in emergent, unavoidable ER visits and no change in injuries. Using detailed patient-level data on ER visits in Massachusetts, I find a reduction in the probability that ER visits were non-urgent or primary-care treatable, but this reduction is less pronounced for overnight and weekend visits when physician's offices are closed. I conclude that the reform affected ER use by encouraging substitution towards other outpatient care settings.

1 Introduction

Policymakers often cite two goals for health policy: to expand access to healthcare and to control costs. These objectives frequently conflict, as consumers with health insurance use more medical care than those without, improving health outcomes, but also increasing the total amount of resources in the economy devoted to medical services (see Gruber (1997)). However, insurance may also alter the *type* of care purchased by patients. If patients covered by health insurance substitute away from less efficient medical services, such as hospital emergency rooms, and toward primary or preventive care, then expanding insurance coverage may improve the "per dollar" cost of health. This project studies the relationship between insurance and costs by examining how the major health reform in Massachusetts in 2006 affected use of emergency room (ER) care.

It is widely believed that people without health insurance avoid seeking routine care in favor of using outpatient emergency rooms that are legally obligated to treat them. The majority of emergency room visits do not lead to a hospital admission and a sizeable fraction of these are treatable at a physician's office.[1] These outpatient emergency room services are significantly more expensive than a physician's office (Bamezai et al. (2005)) and therefore drive up health costs. Expanding insurance coverage could lower per-capita costs by encouraging consumers to substitute toward more efficient regular places of care. However,

[1] In 2005 and 2006 in Massachusetts, over 80% of ER visits did not lead to an inpatient admission to the hospital. Of these outpatient visits, approximately 40% were classified as primary-care treatable.

by lowering out-of-pocket costs, insurance increases health care usage in general. Unlike outcomes that reflect lifelong health care consumption and behavior, such as the incidence of disease, outpatient ER usage may change immediately following the improvement of available substitutes and decrease in the price of ER care associated with a change in insurance status. Understanding the net effect of insurance on consumers' health care decisions is important for assessing the costs and benefits of public projects designed to expand insurance coverage.

I evaluate the effect on emergency room usage of a near-universal expansion of health insurance coverage by Massachusetts. In 2006, Massachusetts simultaneously mandated that all state residents must have insurance (or pay a sizable non-compliance fee) and introduced a state-run insurance provider that allowed lower- and middle-income families to buy insurance at a subsidized rate. This reform presents an opportunity to study the effect of insurance coverage on emergency department usage, while avoiding the common empirical challenge that emergency room usage is endogenously determined with insurance coverage. Insurance status and ER usage may be correlated because of a causal effect of insurance on behavior or because, for example, poor families forgo insurance because of cost and also face greater exposure to health risks that lead to ER visits. The reform in Massachusetts induced an increase in insurance coverage among people who were otherwise not covered, allowing for the evaluation of a plausibly exogeneous change in the insurance rate on ER use.

I use variation both across states and across counties to analyze the impact of the reform on total ER usage. I compare counties in Massachusetts to those in other states that did not enact a reform. However, I also use a modified difference-in-difference-in-difference model to exploit the variation in the intensity of this reform within Massachusetts. Counties that had high insurance rates prior to the reform did not have their insurance rates impacted as much as counties that had a smaller fraction of their residents insured. Exploiting the variation in treatment intensity allows me to identify the effect of expanding insurance coverage on ER visits in a way that is robust both to Massachusetts-specific time trends or shocks and to changes in ER usage over time that are not correlated with the pre-reform uninsurance rate in the county.

I find that the reform reduced outpatient ER visits per capita, with the most-affected counties experiencing the largest declines in ER usage. In these counties, the reform reduced ER usage by approximately 4 visits per 100 residents. Furthermore, a 1% increase in pre-reform uninsurance rates is associated with a reform-induced decline in ER visits of about 0.4 visits per 100 residents. Under the assumption that the reform only affected ER use through the expansion of insurance coverage, these results imply that insurance reduces a consumer's average ER usage by 0.2 to 0.4 visits per year, a reduction of 34 to 69%.[2]

Although the reform reduced total ER visits per capita, not all ER visits were affected in the same way. Using data on Massachusetts counties, I find the reform had three distinct effects. It reduced non-urgent and primary-care treatable visits, consistent with substitution toward primary care. The reform also reduced visits that are urgent, but can be avoided with routine care, indicating that the reform induced patients to seek more health care in general. However, the reform caused emergent, non-preventable visits (excluding injuries) to *increase* and had no effect on injury visits. By lowering the cost of ER services, the reform increased ER usage for types of visits where primary care is not a good substitute.

I complement the county-level results with analysis of complete patient-level data on *all* outpatient ER visits in Massachusetts from 2005-2008, approximately 9.5 million observations in total, that include patient demographic characteristics and information on diagnosis. I find that, controlling for patient characteristics, the reform reduced the probability that an ER visit is non-urgent or primary-care treatable, and increased the probability that an ER visit is an injury or non-preventable emergency. However, I find that the reduction in non-urgent and primary-care treatable visits is significantly less pronounced for overnight and weekend visits, when physician's offices are generally unavailable.

[2]The reform may have changed patient behavior by, for example, encouraging already-insured residents to purchase more coverage or by expanding dental insurance to Medicaid recipients. If these changes led to a reduction in ER usage, the implied treatment effect is an upper bound for the effect of insurance on ER usage.

2 The Role of Insurance in ER Usage

Emergency rooms are intended to treat acute medical conditions. The federal Emergency Medical Treatment and Active Labor Act, passed in 1986, requires hospitals to treat all patients with medical emergencies regardless of their ability to pay. This mandate does not extend to private physician offices, however, which creates an incentive to use the ER for care that could be provided elsewhere. Indeed, surveys of emergency room patients consistently find that the most common self-reported reason for ER usage is lack of access to primary care (see, e.g., Shesser et al. (1991)). Patients who "lack access" include the insured who are unable to make an appointment with a primary care physician on short notice due to limited primary care office hours and busy physician schedules, and the uninsured, who may have difficulty finding physicians willing to see them outside of the emergency room (O'Brien et al. (1997)). Grumbach et al. (1993) found that 38 percent patients surveyed at the San Francisco General Hospital emergency department expressed willingness to trade their ER visit for an appointment with a physician within 3 days but did not have access to regular care outside of the emergency room.

It is important to understand whether having insurance influences the decision to use the ER or a private physicians office, or to forgo care altogether. Many medical services are less expensive to provide in an office setting than in an ER (Bamezai et al. (2005)). Moreover, treatment quality is likely to be higher when provided by a specialist or in a setting designed for regular care, rather than by providers trained in emergency medicine. Inducing appropriate use of the ER is important for reducing overall health costs and for improving care. Indeed, even private health insurance plans are increasingly more likely to include financial penalties for those who use the ER in non-urgent situations.[3] The provision of insurance to the uninsured is potentially important in this process because it may lead individuals who cannot otherwise pay for care out of pocket to seek care in the most appropriate setting, rather going to the ER simply because they cannot be denied services. For example, evidence in Nawar et al. (2007) indicates that the uninsured who visit the ER

[3]For example, several Aetna small-group HMO plans do not cover emergency room care that is deemed non-urgent. (e.g., Aetna Health, Inc. (2010))

are more likely to be in the lowest-priority triage category, compared to those with insurance who visit the ER.

Understanding the causal effect of insurance coverage on medical use in general, and on ER usage in particular, is complicated by the relationship between insurance status, socioeconomic status, risk preferences, and other characteristics that influence medical care use. For example, being economically disadvantaged is correlated with being uninsured and also correlated with poor health, unhealthy behaviors, and exposure to violence. All of these variables affect ER usage but cannot be perfectly control for in a regression framework. A credible inference about the causal effect of insurance on ER usage requires a source of exogenous variation in insurance that is unrelated to the underlying propensity to use the ER.

Several recent studies use quasi-experimental research designs to generate such exogenous changes in insurance status and find that access to insurance increases individuals' use of medical care services. Finkelstein (2007) finds that the massive expansion of health insurance among the elderly in 1965 when Medicare was introduced significantly affected spending in the hospital sector. Similarly, Card et al. (2007) use the discontinuous increase in insurance coverage at age 65 that is generated by Medicare and also find a significant increase in health care consumption. Dafny and Gruber (2005) analyze the expansion of Medicaid to children that occurred in the early 1990s and find that the program increased hospitalization rates, especially for unavoidable conditions that would not be otherwise treated in an outpatient office visit. These studies indicate that insurance tends to induce people to consume more medical services. By contrast, Anderson, Dobkin, and Gross (2010) examine the effect of children "aging out" (becoming ineligible for coverage) of their parents' health insurance at age 18 and find this reduction in coverage significantly reduces hospital and emergency department use.

Recent research has explored the impact of the Massachusetts reform on other types of medical care. Kolstad and Kowalski (2010) use a difference-in-difference model to examine the impact of the reform on inpatient (overnight) hospital visits, including those originating from the emergency room. The authors find that the overall number of hospital discharges

did not change in Massachusetts relative to other states as a result of the reform, but the percentage of hospital visits originating in the ER declined. They attribute this decline to patients coming to the hospital through the "front door" rather than through the emergency room.

My analysis complements and expands upon their research by looking at outpatient visits; those visits in which patients are treated and released in the same day. Outpatient visits are of particular interest for a few reasons. In Massachusetts, over 80 percent of all ER patients are released the same day they are treated. Moreover, most of the concern about insurance and ER use refers to outpatient visits because less-expensive office-based care is often an appropriate substitute for the ER among this group. A reduction in outpatient visits because of the insurance reform may result from both substitution toward other, more appropriate care and from avoiding medical emergencies in the first place by greater use of preventive services and primary care. Kolstad and Kowalski (2010) indeed find evidence that the Massachusetts reform induced patients to seek more preventive care, implying that a measured short-run change in ER visits may underestimate the long-run decline as regular care continues to prevent medical emergencies.

Finally, Hosseini and Weinberg (2010) compare the change in ER usage in Massachusetts before and after the reform to the change in New York, New Jersey, Connecticut, and Maine using the Community Tracking Household Survey. Due to their limited sample size, however, their results are imprecise cannot rule out large increases or decreases in ER usage.

3 The 2006 Massachusetts Health Reform

In 2006, Massachusetts enacted a major health care reform act aimed at expanding health insurance coverage to nearly all state residents. This act combined an individual mandate to purchase insurance with a major expansion of the Massachusetts Medicaid program and new subsidies for individuals earning up to 300% of the federal poverty line. For a complete review of the reform and its implementation, see Gruber (2008).

Under the new law, all residents are required to purchase health insurance that meets minimum coverage standards as long as affordable coverage is available. Affordability and coverage standards are determined by the Commonwealth Health Insurance Connector Authority, a newly formed independent public authority that also regulates subsidy levels for low income households. Failure to purchase insurance under the new law resulted in loss of the income tax personal exemption, $219 in 2007, with monthly penalties of up to 50 percent the price of the least-costly available insurance plan beginning in 2008. The mandate covers almost all Massachusetts residents, excluding only individuals with religious objections.

In addition to the mandate, Massachusetts dramatically increased free and subsidized coverage to low-income households. The Medicaid program in Massachusetts, called "MassHealth," expanded eligibility for low-income individuals and children, and removed caseload caps on residents with disabilities, people living with HIV, and the long-term unemployed. The reform also restored MassHealth vision and dental benefits that had been cut in 2002. Massachusetts introduced a new program entitled "Commonwealth Care" that provided publicly-subsidized private insurance to individuals who are not eligible for employer-provided coverage or MassHealth, and who earn up to 300 percent of the poverty line (with the level of subsidies based on income). Within the first year, these plans enrolled 122,000 low-income residents (Raymond (2007)).

The Connector Authority also offered special low-cost plans providing minimum coverage for young adults between the ages of 19 and 26. Private health insurance providers were obligated by the law to provide coverage for young adults on their parents' plans for up to two years after they are no longer dependents, or until their 26th birthday.

The reform introduced new employer participation requirements for all employers with 11 or more employees. Such employers must make contributions to their employees' health insurance plan of at least 33 percent of the plan's premium cost and enroll at least 25 percent of full-time employees in the employer's own health plan or pay a yearly "fair share" assessment of up to $295 per uninsured employee. To improve affordability for residents who were not enrolled in group plans and were ineligible for Commonwealth Care subsidies, the reform merged the markets for non-group and small-group insurance plans. This merger

allowed people previously insured through relatively expensive non-group plans to purchase insurance available in the small-group market that previously serviced small firms with fewer than 50 employees.

These combined approaches had a significant impact on insurance coverage in Massachusetts. According to the Current Population Survey, the 2005 uninsurance rate in Massachusetts was about 10.5 percent among the non-elderly population and 9.2 percent for all residents, low relative to the national non-elderly uninsurance rate of 17.2 percent and overall uninsurance rate of 15.3. The Massachusetts Health Insurance Connector Authority (2009) reports that approximately 98 percent of taxpayers were compliant with the new law during its first two years. Long and Phadera (2009) analyze data from the Massachusetts Health Insurance Survey (a survey fielded by the Massachusetts Division of Health Care Policy) and estimate an uninsurance rate of 2.6 percent among all Massachusetts residents, 1.2 percent among children, and 3.7 percent among non-elderly adults. They note that this uninsurance rate is slightly lower than estimates they obtain from the Current Population Survey (5.5 percent uninsurance among the entire population), National Health Interview Survey (3.0 percent), and American Community Survey (4.1 percent). These differences across surveys are due to sampling variation, as well as slight differences in the wording of insurance questions. Other estimates in Long et al. (2009) and Kolstad and Kowalski (2010) are consistent with these post-reform uninsurance rates. It is clear that the uninsurance rate was cut by more than half, but potentially as much as 80 percent.

[Table 1 about here.]

The first row of Table 1 presents estimates from the 2005 Current Population Survey and shows that the 2005 uninsurance rate was 9.2 percent in Massachusetts. The remaining rows of Table 1 present summary statistics on the uninsured population in Massachusetts in 2005, the year prior to the reform, using a complete database on all outpatient emergency room visits in the state from the Emergency Department Database (EDD) provided by the Massachusetts Division of Health Care Finance and Policy. The statistics are based on the approximately 2.3 million patient-level observations for the 2005 fiscal year from the EDD.

Despite being 9.2 percent of the population, the uninsured account for 14.9 percent of ER visits. The uninsured who visit the ER are significantly more likely to be male and non-white than the insured. On average, uninsured ER users are younger than the insured and less likely to visit the ER overnight or on the weekend.

In 2005, there were 339,179 ER visits in Massachusetts by self-pay or free-care[4] patients. According to data from the CPS from that year, the number of uninsured residents in Massachusetts was 583,000, implying a baseline average number of visits for an uninsured resident of 0.58.[5] In the same year there were 1,967,002 insured ER visits and about 5,745,000 insured residents, or a baseline usage rate of 0.34.

Table 1 also provides evidence that the uninsured use the ER in place of office-based care. Twenty-four percent of the ER visits by the uninsured as classified as "non-urgent," compared to 20 percent among the insured. Twenty percent of visits by the uninsured are classified as being emergent, but primary care treatable; this rate is similar, 19 percent, among the insured. 6 percent of visits by both the insured and uninsured are classified as emergent and primary-care preventable. The uninsured are significantly less likely than the insured to be using the ER for unavoidable emergencies and injuries.

4 An introduction to the data and empirical strategy

This analysis uses two types of variation to identify the effect of insurance coverage on emergency room usage. First, I compare ER usage in Massachusetts before and after the reform

[4]Free care refers to patients whose visits are covered by the Massachusetts uncompensated care pool, a public fund designed to partially alleviate hospitals of the bad debt associated with the Emergency Medical Treatment and Active Labor Act mandate. To this end, free care also paid for some visits from under-insured low-income patients whose insurance does not cover emergency room visits. These patients are included in the uninsured category in Table 1.

[5]ER use is dominated by a small subset of the population who use the ER very heavily, while many people never use the ER. So the average number of visits per person is considerably higher than the median. For example, Fuda and Immekus (2006) find that only one percent of all adults in Massachusetts are considered emergency department frequent users, but they account for 18 percent of all visits.

to ER usage in Rhode Island, Vermont, Connecticut and New Jersey. Second, I look at variation in treatment intensity across counties within Massachusetts. Since the reform instituted near-universal coverage throughout the state, counties with high rates of insurance coverage prior to the reform experienced a smaller change in insurance coverage than counties with low pre-reform insurance rates. We should expect to see similar increases in ER use in counties that had relatively high pre-reform insurance rates. My use of multiple sources of variation to measure the causal impact of the reform represents a significant improvement over other studies that rely on a single differences-in-differences comparison between Massachusetts and other states (e.g., Long and Phadera (2009), Hosseini and Weinberg (2010)). By considering the differential impact of the reform across counties, I produce estimates that are robust to Massachusetts-specific shocks and differential trends in ER use between Massachusetts and other states. The purpose of this section is to introduce the data and also shed light on the comparability of Massachusetts to other states.

To measure emergency room usage, I use yearly data on outpatient ER visits from 2005 to 2008. Hospitals in Massachusetts and the comparison states (Rhode Island, Vermont, Connecticut and New Jersey) are all required to report the number of ER visits on an annual basis and I obtain these data directly from each state's department of health. I restrict my attention to outpatient visits, i.e., to visits in which the patient was treated and released on the same day. Data are provided at the hospital level and I aggregate the data to the county-level to match ER usage with county-level uninsurance rates. I generate per-capita emergency room visit rates by dividing ER visits in a county by the Census Bureau's estimated county population.[6] In addition, data on the county unemployment rate comes from the Bureau of Labor Statistics; data on county-level demographic characteristics, such as median income and percent black, come from Small Area Income and Poverty Estimates based on the American Community Survey and the county population estimates from the Census Bureau.[7]

[6]Data on zip code of residence for ER patients is available for Massachusetts ER visits but not comparison states. For models that exclude comparison states, I find qualitatively similar results using patient county of residence, rather than hospital county, to calculate per capita county ER rates.

[7]These data were downloaded from http://www.census.gov/popest/counties/, http://www.bls.gov/lau/ and http://www.census.gov/did/www/saipe/data/statecounty/data/index.html

Data from Vermont and Rhode Island are collected on a calendar year basis, whereas data from Connecticut is collected on a fiscal year basis. New Jersey and Massachusetts ER counts are available by month.[8] Below I present models by fiscal year (excluding Vermont and Rhode Island) and calendar year (excluding Connecticut), and using all states and ignoring the distinction between fiscal and calendar years. The qualitative conclusions are similar for each grouping of states.

Figure 1 plots estimates of insurance coverage for all persons under age 65 from the Current Population Survey for Massachusetts, an average of the control states, and the entire United States between 1999 and 2008. In 1999, the uninsurance rate in Massachusetts and in the comparison states was 10.2 and 10.4 percent respectively, 3.8 and 3.6 percentage points lower than the nation as a whole. Between 1999 and 2005, the uninsurance rate rose nationwide and in Massachusetts and the comparison states; all appear to follow the same trend. It is clear from Figure 1 that the 2006 reform induced the uninsurance rate in Massachusetts to decline sharply. Prior to the reform (2004-2006), the average uninsurance rate in Massachusetts was 11.8 percent. This fell to around 6 percent in 2007 and 2008.

[Figure 1 about here.]

Table 2 presents descriptive statistics for counties in Massachusetts and the comparison states for the 2005-2006 pre-reform period and the 2007-2008 post-reform period. The unemployment rate, fraction black, and median income in Massachusetts is fairly similar to those in the comparison states. The per capita rate of ER usage in Massachusetts in 2005, prior to the reform, was 0.457, or 457 visits per 1000 residents, and 0.348 in the comparison counties. From 2005 to 2008, the ER rate in Massachusetts rose by 0.016 to 0.473; it increased by 0.027 to 0.375 in the comparison states.

[Table 2 about here.]

[8] About 6 percent of ER visits in New Jersey are recorded with a year, but not a month. I allocate these equally across all months.

Data on the county uninsurance level is from the Small Area Health Insurance Estimates (SAHIE) from the Census Bureau. These are model-based estimates that use data from the Current Population Survey, administrative data from Medicaid, and county demographic characteristics to estimate the uninsurance rate for all counties. Figure 2 displays the 2005 SAHIE uninsurance rate by county for Massachusetts. Although overall insurance coverage in Massachusetts was high in 2005, at 89.5 percent, there was significant variation in coverage by county within Massachusetts. The 2005 uninsurance rates range from under 10 percent in Norfolk and Worcester counties to over 15 percent in the counties of Suffolk, Nantucket and Dukes.

[Figure 2 about here.]

5 The Impact of the 2006 Health Reform on Outpatient Emergency Room Visits per Capita

5.1 State level analysis

I first estimate a model that compares the growth rate in per capita ER visits in Massachusetts counties to the growth rate of per capita ER visits in counties in comparison states. I model per capita ER visits in a county, $PercapER_{ist}$, as

$$PercapER_{ist} = \beta_0 + \beta_1 X_{ist} + \beta_2 MA_{is} + \beta_3 Post_t + \beta_4 MA_{is} * Post_t + \epsilon_{ist}. \quad (1)$$

The variables X_{ist} denote the demographic characteristics of county i in year t (the fraction of the county population that is black, median income, and the county unemployment rate). $MA_{is} = 1$ if county i is in Massachusetts. $Post_t = 1$ for 2007 and 2008, and 0 for 2005 and 2006. The reform was enacted in April of 2006; by counting all of 2006 in the pre-reform period, I likely understate the impact of the reform. The parameter of interest is β_4, which measures how per capita ER visits changed in Massachusetts counties relative to other counties in comparison states. If β_4 is less than zero, then ER use fell, or grew at a slower rate, in Massachusetts counties relative to counties in comparison states.

Table 3 presents the difference-in-difference estimates of equation (1). The first column, in which I exclude the demographic control variables, indicates an average reduction of about 0.9 visit per 100 residents in Massachusetts relative to the comparison states. This effect is not statistically different from zero. The second column includes the demographic control variables and the effect increases to 3.4 visits per 100 residents and is significantly different from zero at the 0.05 level. The second set of columns rely only on Connecticut and New Jersey as comparison states (Connecticut reports data by fiscal year; New Jersey reports data by month); the third set of columns use Rhode Island, Vermont, and New Jersey as comparison states (Rhode Island and Vermont report data by calendar year). The estimated effects in these models are similar, ranging from -0.006 to -0.01 in the models without demographic controls and -0.035 to -0.038 in the models with demographic controls.

To put the size of these estimates in context, the pre-reform ER usage rate in Massachusetts was 0.46 among the whole population and was 0.58 among the uninsured. The estimated effects in columns 1 and 2 of -0.009 to -0.034 in Table 3 represent declines in the overall ER usage rate of 1.96 to 7.39 percent. They represent declines in the usage rate of the uninsured of 1.55 to 5.86 percent.

Although the reduction in ER usage is not statistically different from zero in all models, the estimated effect potentially represents a large impact of insurance on ER use. An estimate of the impact of gaining insurance on ER usage can be formed by the ratio of the impact of the Massachusetts reform on ER usage and the impact of the reform on insurance coverage rates. In Section 4, I reported that the uninsurance rate in Massachusetts prior to the reform (2004-2006) was 11.8 percent. Estimates of the insurance rate after the reform range from 2.6 to 6 percent; i.e., the insurance rate increased by 9.2 to 5.8 percentage points. The estimated coefficients in columns 1 and 2 imply an effect potentially as small as $\frac{-0.010}{0.092} = -0.109$ and as large as $\frac{-0.034}{0.058} = -0.586$. For example, for every 100 people, the reform induced an additional 10 people to gain insurance and also induced 1 fewer ER visit per year. If the entire reduction in ER usage is attributable insurance, these estimates imply that having insurance reduces ER usage by between 0.109 and 0.586 visits per year: a large effect relative to the baseline ER usage rate of 0.58 among the uninsured.

[Table 3 about here.]

5.2 County level analysis

This section uses variation across counties within states to refine my estimates of the impact of the reform on ER use. If insurance coverage causes patients to use the ER less frequently, ER usage should fall the most in counties that experienced the largest increase in insurance coverage. To explore this, I define $Uninsured2005_{ist}$, the uninsurance rate in 2005 among residents under the age of 65 in the county. I include this variable in the model, and fully interact it with MA_{is} and $Post_t$ and estimate

$$\begin{aligned} PercapER_{ist} =& \alpha_0 + \alpha_1 X_{ist} + \alpha_2 MA_{is} + \alpha_3 Uninsured2005_{is} + \alpha_4 Post_t + \alpha_5 MA_{is} * Post_t \\ &+ \alpha_6 Uninsured2005_{is} * Post_t + \alpha_7 Uninsured2005_{is} * MA_{is} \\ &+ \alpha_8 Uninsured2005_{is} * MA_{is} * Post_t + \eta_{ist}. \end{aligned} \tag{2}$$

In this model, α_8 measures the effect of the reform on ER rates for each additional percentage point in the county uninsurance rates. This specification allows the interaction $MA_{is} * Post_t$ to control for any differences in trends in ER usage between Massachusetts and the comparison states that is common to all counties. This specification therefore relies on weaker identification assumptions than the models in Section 5.1.

The results are shown in Table 4 and indicate that each percentage point increase in the 2005 uninsurance rate is associated with a subsequent reduction in ER visits of 0.2 to 0.4 visits per 100 residents, depending on the specification. The first two columns show results that use all comparison states. The third and fourth columns use only Connecticut and New Jersey as comparison states; the final two columns use only Rhode Island, New Jersey, and Vermont. I also show models with and without controlling for the fraction black, median income, and unemployment rate in the county. The standard errors are clustered by county to account for correlation in the error terms within counties over time (Bertrand et al. (2004)). The results across all of the comparison groups are quite similar and, with

one exception, are all statistically different from zero at the five percent level or better.

[Table 4 about here.]

The estimates in Table 4 are slightly larger than those presented in the previous section. Estimates of the decline in the insurance rate in Massachusetts range from 5.8 to 9.2 percentage points. Therefore, the point estimate of 0.004 in column 1 of Table 4 implies that the reform induced between 0.023 ($= 5.8 * 0.004$) and 0.037 ($= 9.2 * 0.004$) fewer ER visits per capita. Recall that the pre-reform ER usage rate in Massachusetts was 0.58 among the uninsured, and thus the estimates in Table 4 represent a decline in the usage rate of 4.0 to 6.4 percent. Finally, the estimates in Table 4 (multiplied by 100) can also be interpreted as the causal effect of insurance on ER usage. Th estimate in column 1 indicates that having insurance reduces ER usage by 0.40 visits per year.

In Table 5 I present results of a model that replaces the continuous measure of county uninsurance rate ($Uninsured2005_{is}$) with a binary indicator for counties that had 2005 uninsurance rates about 12.6 percent (the 75th percentile for Massachusetts according to the 2005 SAHIE). In this triple differences specification, $Treated_{is} = 1$ for counties with the highest uninsurance rates. I estimate

$$\begin{aligned} PercapER_{it} =& \beta_0 + \beta_1 X_{it} + \beta_2 MA_i + \beta_3 Treated_i + \beta_4 Post_t + \beta_5 MA_i * Post_t + \\ & \beta_6 Treated_i * Post_t + \beta_7 Treated_i * MA_i + \beta_8 Treated_i * MA_i * Post_t + \epsilon_{it}, \end{aligned} \tag{3}$$

In this model, β_8 measures the additional change in per capita ER rates in high uninsurance counties in Massachusetts relative to the change in ER rates in high uninsurance counties in the comparison states. Table 5 presents estimates of equation (3). The first two columns show results that use Rhode Island, New Jersey, Connecticut, and Vermont as comparison states. The third and fourth columns use only Connecticut and New Jersey as comparison states; the final two columns use only Rhode Island, New Jersey, and Vermont. I also show models with and without controlling for the fraction black, median income, and unemployment rate in the county. The standard errors are clustered by county to account for correlation in the error terms within counties over time. The estimates are fairly similar

across specifications and show a decline in ER usage of between three and five visits per 100 residents in the high-uninsurance counties. The estimates are all statistically different from zero at the 1 percent or 5 percent level. The coefficient on MA*Post is generally small (ranging from -0.002 to -0.02), indicating that in that counties in Massachusetts with high insurance rates prior to the reform did not experience a meaningful reduction in ER visits relative to similar counties in other states and provides some assurance that the coefficient on $MA_{is} * Post_t * Treated_{is}$ captures the impact of the reform.

[Table 5 about here.]

Prior to the reform, the "treated" counties in Massachusetts had an average uninsurance rate of about 18.9 percent. Assuming the uninsurance rate fell by 16.9 percentage points, to two percent, the estimate in column 1 of Table 5 implies an effect of insurance on per capita ER usage of $\frac{-0.004}{16.9} = -0.024$. This effect is in the middle of the range of estimates given in Section 5.1 and slightly smaller than the estimate in Section 5.2.

5.3 Within Massachusetts Analysis

This final subsection uses data only from counties in Massachusetts to measure the impact of the reform on ER usage. One advantage of this approach is that it sets the stage for the analysis of the composition of ER visits that I conduct in the next section. Second, restricting attention to Massachusetts allows me to use data beginning in 2002 to examine trends across counties in ER usage. Figure 3 plots the percentage change in ER visits from 2002 to 2008 in "treated" and "untreated" counties. As in the previous subsection, I define "treated" counties to be those that had an uninsurance rate in 2005 of 12.6 percent or greater. From 2002 to 2006 ER usage in both the treated and untreated counties evolved remarkably similarly. After 2006, however, ER usage in the treated counties (represented by the solid line) declined sharply while usage in the untreated counties (represented by the dashed line) rose sharply. This divergence in ER usage only after the treated group increased its insurance coverage rate adds to the evidence that the reform indeed triggered the change in ER usage.

[Figure 3 about here.]

To measure the effect of the health reform on ER usage in a regression setting, I use data on per capita ER usage in Massachusetts counties from 2005-2008 and estimate a version of equations (2) and (3) removing data and variables associated with the comparison states:

$$PercapER_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Uninsured2005_i + \beta_4 Post_t + \beta_5 Uninsured2005_i * Post_t + \epsilon_{it} \quad (4)$$

$$PercapER_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Treated_i + \beta_4 Post_t + \beta_5 Treated_i * Post_t + \epsilon_{it} \quad (5)$$

Table 6 presents the results of models (5) and (4) with and without additional control variables included. With the continuous measure of treatment intensity, I find that a one percentage point increase in the pre-reform uninsurance level reduces ER usage by 0.49 visits per 100 residents in both models with and without controls; these estimates are statistically different from zero at the 1 percent level. The effects are marginally larger than the measured reduction of 0.44 visits per 100 residents in Table 4 that uses comparison states. In the model that uses a binary "treatment" indicator, with or without controls, the effect of the reform on the treated group is estimated to reduce ER visits by about 5 visits per 100 residents, which is statistically significant at the 1 percent level. This estimate is similar to the larger of the estimates that appear in Table 5 that use comparison states.

[Table 6 about here.]

This analysis indicates that the measured effect of the reform on ER usage is essentially identical whether Massachusetts is compared to comparison states, counties with high uninsurance rates in Massachusetts are compared to similar counties in comparison states, or whether counties within Massachusetts are compared to one another.

5.4 Pre-Reform Trends

In this subsection I assess whether differential trends in ER usage between Massachusetts and the comparison states, or between different counties in Massachusetts, can explain some of the measured effect of the law. The estimates in above are based on a strict "pre-post" design. Differences in trends in ER usages will therefore appear to be differences caused by the reform. I focus my tests on whether the county uninsurance rate in 2005 predicts changes in ER usage in the years prior to the reform.

Table 7 reports results from a regression similar to those reported in Tables 4 and 5, based on equation 3, but with $Post_{ist}$ replaced by indicators for 2006, 2007, and 2008 (2005 is the excluded category). Columns 1, 3, and 5 show estimates that use the continuous measure of the 2005 county uninsurance rate, with different comparison states. Columns 2, 4, and 6 uses the binary treatment indicator that the county had an uninsurance rate greater than 12.6 percent. In all six models I find no evidence of an effect of the law in 2006. I find a statistically significant negative effect in all models for 2007. The estimates for 2008 are uniformly negative, but only statistically different from zero in the models that use the binary treatment indicator.

[Table 7 about here.]

Table 8 repeats this exercise but restricts the sample to Massachusetts counties, and thus is analogous to Table 6. A key advantage of this sample is that data on ER usage in Massachusetts goes back to 2002. These results show very small point estimates that are not statistically different from zero from 2003 to 2006. They show negative and statistically significant effects for 2007 and 2008. For example, the estimates indicate that the reform caused about 0.5 fewer ER visits in 2007 and 2008 for each additional percentage point increase in the 2005 uninsurance rate. The results are similar in the specification with the binary treatment indicator. That ER usage only declined in high uninsurance counties beginning in 2007, but not before, is consistent with a genuine effect of the law, rather than differential trends in usage, driving the estimates.

[Table 8 about here.]

6 Changes in ER Visit Composition

The results in the previous section indicate that the 2006 reform reduced overall ER usage in Massachusetts. This section presents analyses of the types of conditions that were most impacted by the reform. If gaining access to insurance leads people to substitute office-based care for the emergency room, the decrease in ER visits should be concentrated among those conditions that are not urgent and can most easily be treated in an alternative setting. In contrast, some serious medical emergencies cannot be treated in a private physician's office; if substitution is driving the overall reduction in ER care, these types visits should not experience a reduction. This section concludes by examining the impact of the reform on ER visits during regular and off-hours.

The widely-used New York University Emergency Department (NYU ED) visit severity algorithm developed by John Billings and colleagues at New York University (see, e.g., Billings et al. (2000b)) classifies all ER visits into general categories based on the patient's diagnostic code:

1. Non-emergent: Medical care not needed within 12 hours (e.g., sore throats).
2. Emergent/Primary Care Treatable: Medical care needed within 12 hours but safely treatable in a primary care setting (e.g., an ear infection).
3. Emergent/Preventable: ER care needed but the patient could have avoided the medical issue if they had received timely and effective outpatient care (e.g., an asthma attack)
4. Emergent/Not Preventable: ER care needed, not preventable (e.g., a cardiac disrhythmia).
5. Injury (e.g., a broken leg).
6. "Other": Alcohol- and drug-related diagnoses, mental-health related medical problems, and unclassified.

High levels of emergency visits in categories (1) through (3) are symptoms that an individual has limited access to other sources of regular care besides of the emergency room (Billings et al. (2000a)). The prevalence of these types of visits should decrease when a person gains insurance if insurance leads people to seek out a regular source of care or increase their use of preventative care. Categories (4) through (6) could increase as a result of the reform if the uninsured were deterred from using the ER because of costs, though it is also reasonable to presume the prevalence of these categories would not be affected at all.

To examine the relationship between the health reform in Massachusetts and the type of emergency visits experienced at Massachusetts hospitals, I use the Massachuestts Emergency Department Database (EDD), a patient-level dataset on all emergency department visits in Massachusetts from 2005-2008 that is provided by the Massachusetts Division of Health Care Finance and Policy. The EDD also contains information on the diagnostic code, patients' demographic characteristics, such as race and gender, source of payment for the visit, and the visit time and day of the week.

Since it is not possible to ascertain with certainty the degree to which an ER visit was emergent and/or preventable, the typical practice is to assign each visit a probability of being in each of the six categories based on the particular diagnosis code. The probabilities are assigned as in Billings et al. (2000b), using the "Algorithm for Classifying Emergency Department Utilization" provided by the Agency for Healthcare Research and Quality.[9] A sample of these classification probabilities are given in Table 9. Table 1 shows distribution across all six categories. 21 percent of visits in Massachusetts are classified as "Non-urgent," 19 percent are "Emergent/Primary Care Treatable," and 6 percent are "Emergent/Preventable." Thus, roughly 46 percent of visits are in the categories that could potentially be reduced by insurance coverage.

[Table 9 about here.]

[9]The algorithm used to assign emergency department visits to categories is available at http://www.ahrq.gov/data/safetynet/toolsoft.htm

6.1 County-level analysis

I begin by aggregating to the county level the number of Massachusetts ER visits falling into the categories non-urgent, emergent and primary-care treatable, emergent and preventable, emergent and non-preventable[10] and injury (categories (1) through (5)). I divide by county population to arrive at a per capita annual rate for each category. I model the per capita usage rate for visits of type k as

$$PercapType_{kit} = \lambda_0 + \lambda_1 X_{it} + \lambda_2 Post_t + \lambda_3 Uninsured2005_i + \lambda_4 Uninsured2005_i * Post_t + \epsilon_{it} \quad \text{and} \tag{6}$$

$$PercapType_{kit} = \lambda_0 + \lambda_1 X_{it} + \lambda_2 Post_t + \lambda_3 Treated_i + \lambda_4 Treated_i * Post_t + \epsilon_{it}, \tag{7}$$

$Uninsured2005_{it}$ and $Treated_{it}$ are the county uninsurance rate in 2005 and an indicator that the insurance rate in 2005 was higher than 12.6 percent. Similar to the models in Section 5.3, these models identify the effect of the reform by comparing the change in ER usage among Massachusetts counties with relatively high pre-reform uninsurance rates to the change among counties that already had low uninsurance rates.

Table 10 and Table 11 present estimates of equations (6) and (7). In both specifications, I find that the counties that experienced the largest increase in insurance rates also experienced the largest reductions in visits classified as non-urgent, primary-care treatable and primary-care preventable, and the largest increase in non-preventable emergencies that are not injuries. The first column of Table 10 indicates that a one-percentage point increase in the pre-reform uninsurance rate is associated with a reduction in non-urgent ER visits by 0.3 per 100 residents and a reduction in emergent, primary-care treatable visits by 0.1 per 100 residents. Emergent but preventable visits declined by 0.04 per 100 residents. Emergent but not preventable visits increased by 0.01 per 100 residents. All of these changes are statistically significant at the one-percent level. There is not a statistically significant effect on

[10]For emergencies, I include only diagnoses which always fall in to the "emergent, not preventable/avoidable" category, i.e. "emergent, not preventable/avoidable"=1, in order to avoid ambiguous cases which could be non-emergencies or primary-care treatable and therefore affected by the reform differently.

visits for injuries. Recall from Table that the reform induced a total reduction of 0.5 visits per 100 residents. The results from Table 10 imply that about 60 percent of this decrease is accounted for by a reduction in non-urgent ER visits and the remainder is due to a reduction in emergent, but primary-care treatable or preventable visits. The results in Table 11 show qualitatively similar results for the model that uses a binary indictor for counties with high pre-reform levels of uninsurance.

[Table 10 about here.]

[Table 11 about here.]

The differential impact of the reform across the various types of ER visits suggest indicates that gaining insurance led people to use office-based care instead of the ER for non-urgent and primary-care treatable issues, but encouraged use of the ER for non-preventable emergencies. The reduction in primary-care treatable incidents is also consistent with insurance inducing an increase in primary care services, consistent with findings in Kolstad and Kowalski (2010), though the emergency room data cannot specifically speak to this.

6.2 Regular vs. Off Hours

In this subsection I explore the different impact of the reform on visits that occur during regular office hours and those that occur overnight and on the weekends. If the reform indeed induced people to use office-based care for certain events, we should expect to see a more pronounced decline in ER use during daytime hours when physician offices and clinics are open, and smaller effect on ER visits during off hours.

I use the EDD data and estimate a model at the individual visit level. This allows me to control for the rich individual-level covariates available in the EDD. Each observation in the data refers to a person-visit, so a person may appear in the data multiple times if they visited the ER multiple times (though the data does not contain individual identifiers). I define the dependent variable $Type_{kit}$ to be the probability that a visit to the ER was for

category k, where k indexes the first five categories above, as in Table 9, and estimate

$$Type_{kit} = \lambda_1 + \lambda_2 X_{it} + \lambda_3 Post_t + \lambda_4 Uninsured2005_i + \lambda_4 Uninsured2005_i * Post_t + \quad (8)$$
$$OffHours * (\delta_1 + \delta_2 X_{it} + \delta_3 Post_t + \delta_4 Uninsured2005_i + \delta_5 Uninsured2005_i * Post_t) + \epsilon_{ikt},$$

$$Type_{kit} = \lambda_1 + \lambda_2 X_{it} + \lambda_3 Post_t + \lambda_4 Treated_i + \lambda_4 Treated_i * Post_t + \quad (9)$$
$$OffHours * (\delta_1 + \delta_2 X_{it} + \delta_3 Post_t + \delta_4 Treated_i + \delta_5 Treated_i * Post_t) + \epsilon_{ikt}.$$

where $Uninsured2005_i$ is the 2005 uninsurance rate in the county where the visit occurred and $Treated_i = 1$ if the 2005 uninsurance rate is greater than or equal to 12.6. The individual-level EDD data records the time of each ER visit and I define a visit to be during "regular hours" if it occurs between 7am and 8pm, Monday through Friday; "off hours" visits are those that occur at any other time. I also include control variables, X_{it}, for the patient's race (black, white, asian), gender, age, and whether the patient was known to be homeless. To test whether the reform had a different impact on off-hours visits than on visits during regular hours, I estimate a linear probability model that includes a dummy variable for the visit being during "off hours" and fully interact the other variables with this indicator. The parameters of interest are λ_4, which measures the change in a particular category of visits as a percentage of total ER visits for regular-hour visits, and δ_5, which measures the difference in this effect for off-hours visits.

The results are displayed in Table 12. The first column indicates that a one percentage point increase in insurance rates reduces the probability that an ER visit during regular hours was for a "non-urgent" event by 0.19 percentage points. A one percent increase in insurance coverage rates reduces the probability that an ER visit during off hours was for a non-urgent event by only 0.10 percentage points (i.e. -0.0019 + 0.0009 = -0.0010). The results in the second column indicate that a one percent point increase in insurance rates reduces the probability that a visit during regular hours is for a "emergent, primary care treatable" event by 0.06 percentage points, but has no effect on these types of visits during off hours. Regular hours visits were more likely to be non-preventable emergencies or injuries, as indicated by columns 4 and 5. Off hours visits, by contrast, experienced almost no change in the probability they were in these categories. I find no significant effect on the probability a visit is in the "emergent, primary-care preventable" category. The smaller (and non-existent)

effects during off hours is consistent with insurance inducing people to use alternative places of care when those places are more likely to be open and able to accept a patient on short notice.

[Table 12 about here.]

7 Conclusion

Insurance coverage can impact healthcare usage by both increasing access and improving efficiency. Insurance may induce people to consume more health services, but these health services may occur in more appropriate and lower cost treatment settings than an emergency room. This paper studies the 2006 Massachusetts health insurance reform as means to evaluate the impact of insurance on the use of outpatient emergency room care, a relatively expensive and, in some cases, inefficient source of health services.

In 2006, Massachusetts introduced healthcare reform requiring all state residents to purchase health insurance. I compare changes in ER usage across counties in Massachusetts and between Massachusetts and other states to identify the causal effect of the law. Consistent with expectations, the effect of the law on ER usage increases significantly with the pre-reform county uninsurance rate, a measure of exposure to the law. A one percentage point increase in the pre-reform uninsurance predicts a reduction in ER usage of 0.4 visits per 100 residents. Estimates indicate that the Massachusetts law increased insurance coverage rates by between 6 and 9 percentage points. My estimates therefore imply that the law reduced ER usage by between 2.4 and 3.6 visits per 100 residents. These results imply that ER usage is quite sensitive to insurance status.

I also explore how the law affected ER usage across different types of events. My results are consistent with the three distinct effects of the law: First, insurance reduces the cost of office-based care and led to a reduction in ER usage for non-urgent (e.g. a sore throat) and primary-care treatable (e.g. an ear infection) events. Second, insurance led people to use regular office-based care more often and so ER visits for emergent, but primary-care

preventable events (e.g. an asthma attack) decreased. Finally, by lowering the price of ER visits, the reform increased ER usage for non-preventable emergencies (e.g. a transient ischemic attack or "mini-stroke"). These results are consistent with the idea that insurance induces people to use the medical care system more efficiently by seeking care in more appropriate settings and, consistent with Kolstad and Kowalski's (2010) analysis, increasing their use of primary care.

Finally, Massachusetts ER records indicate the time of day when the visit took place. I find that the law reduced ER visits during the day on weekdays, but had little effect on visits at night or on the weekend. In particular, the law led to a modest reduction in ER usage for non-urgent events during off hours, but had no effect on any type of visit for emergencies.

This project also speaks to the larger issue of the impact of insurance on medical care usage. While an established literature has shown that insurance coverage increases the use of medical services generally, this is the first to provide direct evidence that insurance may also lead consumers to purchase more efficient or appropriate health services. Measuring the causal impact of insurance is notoriously difficult because it requires finding exogenous sources of variation in insurance status. The natural experiment in this paper is a particularly good source of credible exogenous variation to study because it represents the same type of insurance expansion program that recently occurred at the federal level with the Patient Protection and Affordable Care Act.

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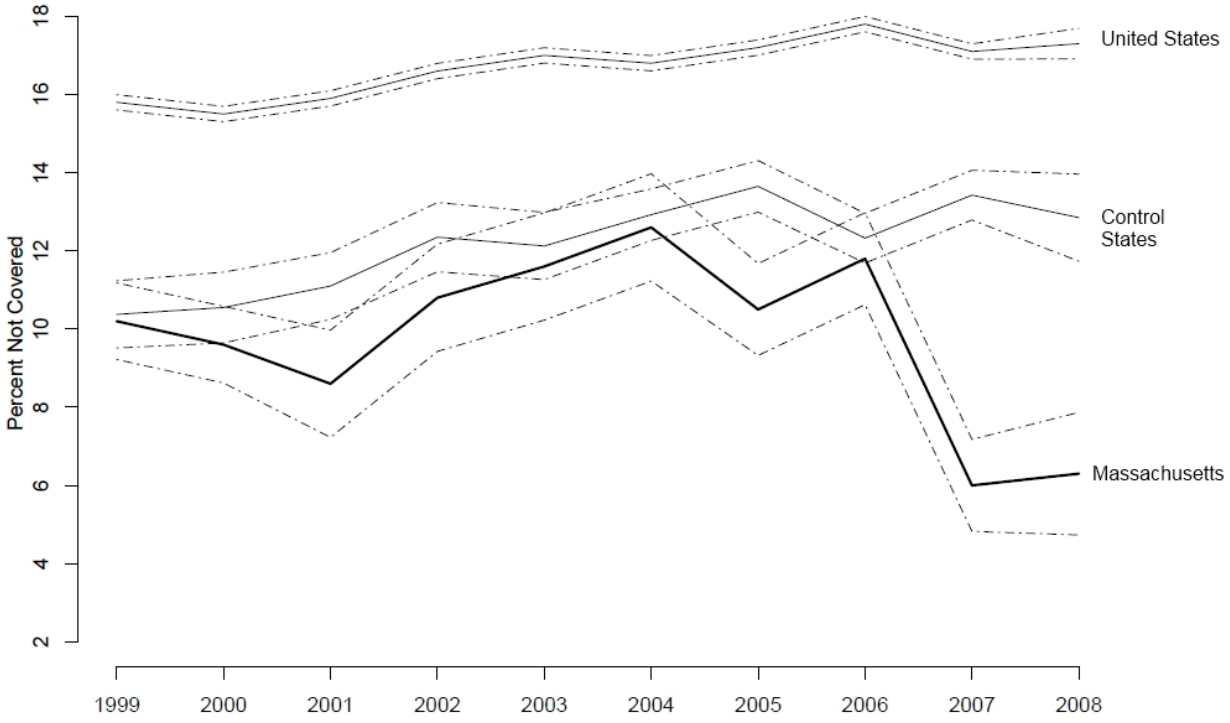
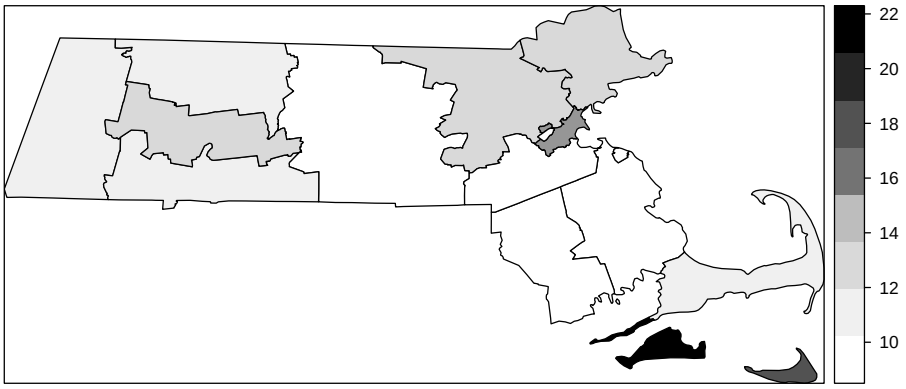
Figure 1: Percentage Uninsured in Massachusetts and Control States



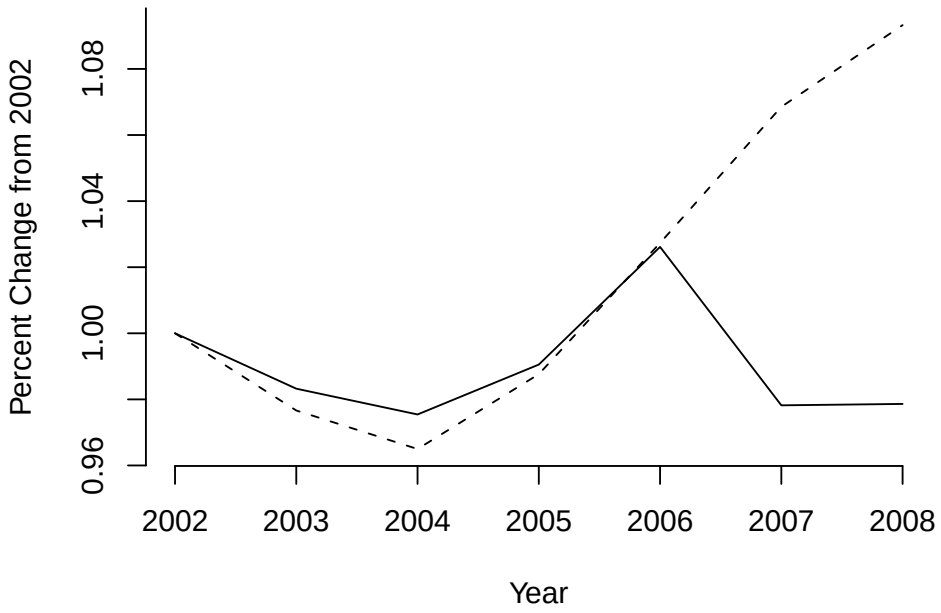
Source: Current Population Survey (CPS) estimates of uninsurance rate for all persons under the age of 65. Standard errors provided by the CPS. Available here: http://www.census.gov/hhes/www/hlthins/data/historical/index.html

Figure 2: Percentage Uninsured in Massachusetts by County, 2005



Source: Small Area Health Insurance Estimates, U.S. Census

Figure 3: Growth in ER visits from 2002, treated (solid) and untreated (dashed) Massachusetts counties



Source: Author's own calculations based on the Massachusetts Emergency Department Database, provided by the Massachusetts Division of Health Care Finance and Policy

Table 1: Characteristics of 2005 Outpatient Emergency Room Visits and Patients in Massachusetts

	All Visits	Uninsured	Insured
Percentage of Total Population[1]	–	9.2 (0.60)	90.8 (0.60)
Percentage of Outpatient ER Visits	100.00	14.90 (0.00)	85.10 (0.00)
Average Age	35.94 (0.00)	31.53 (0.02)	36.70 (0.02)
Fraction Female	0.51 (0.00)	0.42 (0.00)	0.53 (0.00)
Fraction Non-White	0.27 (0.00)	0.40 (0.00)	0.24 (0.00)
Fraction of Visits that are:			
Non-Urgent	0.21 (0.00)	0.24 (0.00)	0.20 (0.00)
Emergent, Primary Care Treatable	0.19 (0.00)	0.20 (0.00)	0.19 (0.00)
Emergent, Primary Care Preventable	0.06 (0.00)	0.06 (0.00)	0.06 (0.00)
Emergent, Not Preventable/Avoidable	0.09 (0.00)	0.08 (0.00)	0.10 (0.00)
Injuries	0.32 (0.00)	0.28 (0.00)	0.32 (0.00)
Other	0.13 (0.00)	0.14 (0.00)	0.13 (0.00)
Overnight or weekend	0.49 (0.00)	0.47 (0.00)	0.50 (0.00)

Source: Author's own calculations based on data the Emergency Department Database provided by the Massachusetts Division of Health Care Finance and Policy

1. Source: Current Population Survey insurance coverage estimates

Table 2: Descriptive Statistics of Counties
Mean (Standard Deviation)

	Massachusetts		Control States	
	Pre-Reform	Post-Reform	Pre-Reform	Post-Reform
Per capita ER Visits	0.457 (0.23)	0.473 (0.21)	0.319 (0.14)	0.343 (0.15)
Unemployment Rate	4.579 (0.92)	4.718 (1.02)	4.415 (0.87)	4.985 (1.15)
Median Income (In $1000s)	55.50 (9.19)	60.66 (10.44)	57.33 (13.56)	62.05 (14.95)
Percent Black	0.066 (0.059)	0.067 (0.057)	0.078 (0.087)	0.080 (0.087)

Source: Author's own calculations based on data from Massachusetts, Rhode Island, Connecticut, Vermont, and New Jersey Departments of Health, American Communities Survey, Bureau of Labor Statistics Local Area Unemployment Statistics, U.S. Census

Table 3: Dependent Variable: Per capita ER rates

	RI, NJ, CT, and VT as controls		CT, NJ as Controls		RI, NJ, and VT as controls	
	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)
(Intercept)	0.752 (0.15)***	0.319 (0.02)***	1.280 (0.27)***	0.329 (0.02)***	0.789 (0.15)***	0.35 (0.02) ***
MA*Post	**-0.034 (0.02)****	**-0.010 (0.01)**	**-0.038 (0.01)****	**-0.010 (0.01)**	**-0.035 (0.02)****	**-0.006 (0.01)**
MA	0.151 (0.06)***	0.138 (0.06)**	0.084 (0.04)*	0.129 (0.06)**	0.167 (0.06)***	0.146 (0.06)**
Post	0.077 (0.02)***	0.024 (0.00)***	0.108 (0.02)***	0.025 (0.00)***	0.075 (0.02)***	0.016 (0.00)***
Fraction Black	0.765 (0.22)***	–	0.486 (0.22)**	–	0.827 (0.23)***	–
Median Income (In $1000s)	-0.004 (0.00)***	–	-0.008 (0.00)***	–	-0.004 (0.00)***	–
Unemp. Rate	-0.060 (0.02)**	–	-0.105 (0.04)***	–	-0.066 (0.03)***	–
No. obs:	248		172		200	

Significance Levels: * = 10%, ** = 5%, *** = 1%. Standard errors clustered by county.

Data source: MA, CT, VT, NJ, and RI Departments of Health, U.S. Census American Community Survey, U.S. Census Small Area Health Insurance Estimates, U.S. Census Population Estimates, Bureau of Labor Statistics Local Area Unemployment Statistics

Table 4: Dependent Variable: Per capita ER rates

	RI, NJ, CT, and VT as controls		CT, NJ as Controls		RI, NJ, and VT as controls	
	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)
(Intercept)	0.779 (0.13)***	0.405 (0.08)***	1.045 (0.20)***	0.368 (0.07)***	0.766 (0.13)***	0.370 (0.09)***
Post*Uninsured2005*MA	**-0.004 (0.001)****	**-0.004 (0.002)****	**-0.004 (0.001)*****	**-0.004 (0.002)****	**-0.002 (0.002)**	**-0.003 (0.002)***
MA	-0.670 (0.135)***	-0.649 (0.13)***	-0.635 (0.12)***	-0.613 (0.12)***	-0.619 (0.15)***	-0.609 (0.14)***
Post	0.079 (0.02)***	0.044 (0.01)***	0.103 (0.02)***	0.047 (0.01)***	0.061 (0.03)***	0.045 (0.01)***
Uninsured2005	-0.016 (0.01)**	-0.006 (0.01)	-0.012 (0.00)***	-0.003 (0.00)	-0.013 (0.01)*	-0.004 (0.01)
MA*Post	0.025 (0.02)	0.04 (0.02)*	0.019 (0.02)	0.037 (0.02)	0.007 (0.02)	0.031 (0.03)
MA*Uninsured2005	0.063 (0.01)***	0.062 (0.01)***	0.057 (0.01)***	0.058 (0.01)***	0.060 (0.01)***	0.059 (0.01)***
Post*Uninsured2005	-0.002 (0.00)**	-0.001 (0.00)*	-0.002 (0.00)**	-0.002 (0.00)**	-0.003 (0.00)***	-0.002 (0.00)**
Fraction Black	0.771 (0.25)***	–	0.509 (0.27)*	–	0.787 (0.26)***	–
MedIncome	-0.003 (0.00)***	–	-0.006 (0.00)***	–	-0.004 (0.00)***	–
Unemp. Rate	-0.026 (0.02)	–	-0.050 (0.03)*	–	-0.029 (0.02)	–
No. obs:	248		172		216	

Significance Levels: * = 10%, ** = 5%, *** = 1%. Standard errors clustered by county.
Data source: MA, CT, VT, NJ, and RI Departments of Health, U.S. Census American Community Survey, U.S. Census Small Area Health Insurance Estimates, U.S. Census Population Estimates, Bureau of Labor Statistics Local Area Unemployment Statistics

Table 5: Dependent Variable: Per capita ER rates

	RI, NJ, CT, and VT as controls		CT, NJ as Controls		RI, NJ, and VT as controls	
	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)
(Intercept)	0.605 (0.11)***	0.341 (0.02)***	0.993 (0.20)***	0.343 (0.03)***	0.629 (0.12)***	0.333 (0.03)***
Post*Treated*MA	**-0.042 (0.01)*** **	**-0.042 (0.02)*** **	**-0.046 (0.01)*** **	**-0.041 (0.02)** **	**-0.033 (0.02)** **	**-0.036 (0.02)** **
MA*Post	-0.016 (0.01)	-0.003 (0.01)	-0.020 (0.01)**	-0.004 (0.01)	-0.020 (0.01)	-0.002 (0.01)
MA	0.035 (0.04)	0.018 (0.03)	-0.009 (0.04)	0.016 (0.04)	0.056 (0.04)	-0.002 (0.01)
Post	0.059 (0.01)***	0.028 (0.00)***	0.085 (0.02)***	0.029 (0.01)***	0.060 (0.02) ***	0.021 (0.01)***
Treated	-0.06 (0.04)	-0.043 (0.04)	-0.039 (0.04)	-0.023 (0.04)	-0.041 (0.05)	-0.030 (0.04)
MA*Treated	0.431 (0.15)***	0.500 (0.13)***	0.393 (0.13)***	0.479 (0.13)***	0.402 (0.15)***	0.486 (0.13)***
Post*Treated	-0.008 (0.01)	-0.007 (0.01)	-0.008 (0.01)	-0.007 (0.01)	-0.015 (0.01)*	-0.009 (0.01)
Fraction Black	0.585 (0.24)**	–	0.272 (0.29)	–	0.608 (0.25)**	–
MedIncome	-0.003 (0.00)**	–	-0.006 (0.00)***	–	-0.003 (0.00)***	–
Unemp. Rate	-0.031 (0.02)	–	-0.06 (0.03)**	–	-0.035 (0.02)*	–
No. obs:	248		172		200	

Significance Levels: * = 10%, ** = 5%, *** = 1%. Standard errors clustered by county.

Data source: MA, CT, VT, NJ, and RI Departments of Health, U.S. Census American Community Survey, U.S. Census Small Area Health Insurance Estimates, U.S. Census Population Estimates, Bureau of Labor Statistics Local Area Unemployment Statistics

Table 6: Dependent Variable: Per capita ER rates
Massachusetts Counties Only, 2005-2008

	Continuous Treatment Measure		Difference-in-Difference	
	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)
(Intercept)	-0.027 (0.43)	-0.245 (0.10)**	0.595 (0.32)*	0.36 (0.03)***
Post*Uninsured2005	**-0.005 (0.00)*** **	**-0.005 (0.00)*** **	–	–
Post*Treated	–	–	**-0.049 (0.01)*** **	**-0.048 (0.01)*** **
Post	0.100 (0.03)***	0.084 (0.02)***	0.043 (0.02)*	0.025 (0.01)***
Uninsured2005	0.056 (0.01)***	0.056 (0.01)***	–	–
Treated	–	–	0.578 (0.10)***	0.457 (0.12)***
Fraction Black	-0.272 (0.36)	–	-1.60 (0.568)***	–
MedIncome	-0.003 (0.003)	–	-0.003 (0.00)	–
Unemp. Rate	-0.002 (0.04)	–	0.004(0.05)	–
No. obs:	56		56	

Significance Levels: * = 10%, ** = 5%, *** = 1%. Standard errors clustered by county.
Data source: MA, CT, VT, NJ, and RI Departments of Health, U.S. Census American Community Survey, U.S. Census Small Area Health Insurance Estimates, U.S. Census Population Estimates, Bureau of Labor Statistics Local Area Unemployment Statistics

Table 7: Pre-reform Trends: All Counties
Dependent Variable: Per capita ER rates

	CT, NJ as Controls		RI, NJ, and VT as controls		RI, NJ, CT, and VT as controls	
	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)
Intercept	0.3654 (0.0724)***	0.3328 (0.0286)***	0.3539 (0.0867)***	0.3144 (0.0283)***	0.3958 (0.0794)***	0.3276 (0.0225)***
MA	-0.6056 (0.1133)***	0.0196 (0.0380)	-0.5990 (0.1245)***	0.0392 (0.0379)	-0.6370 (0.1201)***	0.0024 (0.0345)
Year=2006	0.0057 (0.0190)	0.0205 (0.0087)**	0.0317 (0.0162)*	0.0380 (0.0065)***	0.0184 (0.0148)	0.0271 (0.0060)***
Year=2007	0.0335 (0.0200)*	0.0410 (0.0080)***	0.0389 (0.0191)**	0.0389 (0.0074)***	0.0335 (0.0172)*	0.0401 (0.0062)***
Year=2008	0.0658 (0.0199)***	0.0375 (0.0091)***	0.0832 (0.0220)***	0.0416 (0.0096)***	0.0729 (0.0196)***	0.0428 (0.0078)***
MA * Year=2006	-0.0144 (0.0428)	-0.0063 (0.0093)	-0.0203 (0.0424)	-0.0176 (0.0077)**	-0.0270 (0.0411)	-0.0130 (0.0069)*
MA * Year=2007	0.0396 (0.0264)	-0.0122 (0.0099)	0.0408 (0.0247)*	-0.0116 (0.0093)	0.0396 (0.0244)	-0.0113 (0.0085)
MA * Year=2008	0.0199 (0.0268)	-0.0027 (0.0119)	0.0002 (0.0278)	-0.0100 (0.0121)	0.0164 (0.0271)	-0.0051 (0.0111)
PercUninsured2005	-0.0066 (0.0059)	–	-0.0041 (0.0061)	–	-0.0027 (0.0040)	–
MA * PercUninsured2005	0.0612 (0.0090)***	–	0.0592 (0.0092)***	–	0.0572 (0.0080)	–
Year=2006 * PercUninsured2005	0.0008 (0.0009)	–	0.0007 (0.0010)	–	0.0014 (0.0008)	–
Year=2007 * PercUninsured2005	0.0008 (0.0012)	–	0.0004 (0.0012)	–	0.0015 (0.0011)	–
Year=2008 * PercUninsured2005	-0.0028 (0.0036)**	–	-0.0039 (0.0013)***	–	-0.0025 (0.0012)	–
Treated=1	–	-0.0318 (0.0432)	–	-0.0331 (0.0420)	–	-0.0456 (0.0372)
MA * Treated = 1	–	0.4816 (0.1240)***	–	0.4866 (0.1261)***	–	0.4956 (0.1223)***
Year=2006 * Treated=1	–	0.0180 (0.0099)*	–	0.0059 (0.0085)	–	0.0057 (0.0074)
Year=2007 * Treated=1	–	0.0164 (0.0109)	–	0.0106 (0.0100)	–	0.0079 (0.0092)
Year=2008 * Treated=1	–	-0.0126 (0.0108)	–	-0.0233 (0.0111)**	–	-0.0153 (0.0097)
MA * Year=2006 * PercUninsured2005	**0.0012 (0.0036)**	–	**0.0001 (0.0036)**	–	**0.0007 (0.0036)**	–
MA * Year=2007 * PercUninsured2005	**-0.0049 (0.0016)*** **	–	**-0.0053 (0.0015)*** **	–	**-0.0057 (0.0015) *** **	–
MA * Year=2008 * PercUninsured2005	**-0.0021 (0.0016)**	–	**-0.0010 (0.0016)**	–	**-0.0024 (0.0016)**	–
MA * Year=2006 * Treated=1	–	**-0.0033 (0.0291)**	–	**-0.0013 (0.0283)**	–	**0.0090 (0.0284)**
MA * Year=2007 * Treated=1	–	**-0.0552 (0.0146)*** **	–	**-0.0539 (0.0139)*** **	–	**-0.0467 (0.0133)*** **
MA * Year=2008 * Treated=1	–	**-0.0305 (0.0139)** **	–	**-0.0193 (0.0142)**	–	**-0.0320 (0.0129)** **
No. obs:	172		216		248	

Significance Levels: * = 10%, ** = 5%, *** = 1%. Standard errors clustered by county.
Data source: MA, CT, VT, NJ, and RI Departments of Health, U.S. Census American Community Survey, U.S. Census Small Area Health Insurance Estimates, U.S. Census Population Estimates, Bureau of Labor Statistics Local Area Unemployment Statistics

Table 8: Falsification test: Massachusetts counties only
Dependent Variable: Per Capita ER Usage

	Continuous Measure of Treatment Intensity	Triple Difference
	Estimate (Std. Error)	Estimate (Std. Error)
Intercept	-0.2450 (0.1082)***	0.3564 (0.0296)***
PercUninsured2005	0.0553 (0.0083)***	–
Treated=1	–	0.4533 (0.1268)***
Year=2003	0.0032 (0.0206)	-0.0083 (0.0031)***
Year=2004	0.0035 (0.0358)	-0.0125 (0.0051)**
Year=2005	0.0037 (0.0231)	-0.0044 (0.0065)
Year=2006	-0.0049 (0.0237)	0.0097 (0.0057)*
Year=2007	0.0769 (0.0204)***	0.0244 (0.0068)***
Year=2008	0.0931 (0.0272)***	0.0332 (0.0084)***
Treated=1*Year=2003	–	-0.0052 (0.0161)
Treated=1*Year=2004	–	-0.0074 (0.0262)
Treated=1*Year=2005	–	-0.0033 (0.0155)
Treated=1*Year=2006	–	0.0114 (0.0148)
Treated=1*Year=2007	–	-0.0421 (0.0151)***
Treated=1*Year=2008	–	-0.0506 (0.0174)***
PercUninsured2005*Year=2003	-0.0010 (0.0018)	–
PercUninsured2005*Year=2004	-0.0014 (0.0032)	–
PercUninsured2005*Year=2005	-0.0007 (0.0018)	–
PercUninsured2005*Year=2006	0.0014 (0.0019)	–
PercUninsured2005*Year=2007	-0.0049 (0.0014)***	–
PercUninsured2005*Year=2008	-0.0056 (0.0020)***	–
No. obs:	98	98

Significance Levels: * = 10%, ** = 5%, *** = 1%. Standard errors clustered by hospital.
Data source: Emergency Department Database, Massachusetts Division of Health Care Finance and Policy

Table 9: NYU ED Classification Algorithm: Examples

Clinical Classification Software (CCS) Designation	Non-Emergent	Emergent, Primary Care Treatable	Emergent, Primary Care Preventable	Emergent, ER Care Needed, Not Preventable/Avoidable	Injury	Mental Health Related	Alcohol Related	Drug Related	Unclassified
Urinary tract infections	0.46	0.30	0.24	0	0	0	0	0	0
Spondylosis, intervertebral disc disorders, other back problems	0.74	0.15	0	0.11	0	0	0	0	0
Acute myocardial infarction	0	0	0	1	0	0	0	0	0
Superficial injury, contusion	0	0	0	0	1	0	0	0	0
Cardiac dysrhythmias	0	0	0	1	0	0	0	0	0
Acute and chronic tonsilitis	0.66	0.28	0.06	0	0	0	0	0	0
Joint disorders and dislocations, trauma-related	0	0	0	0	1	0	0	0	0
Disorders of teeth and jaw	0.90	0.10	0	0	0	0	0	0	0

Source: Example Classifications by Billings Algorithm with associated Clinical Classification Software designation

Table 10: Dependent Variable: Per capita ER rates by Type, Continuous Treatment Measure

	Non-Urgent		Emergent, Primary Care Treatable		Emergent, Primary Care Preventable		Emergent, Not Preventable		Injury	
	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)
Intercept	-0.0287 (0.0939)	-0.0863 (0.0313)***	-0.0379 (0.0834)	-0.0678 (0.0210)***	-0.0087 (0.0251)	-0.0192 (0.0051)***	0.0015 (0.0071)	-0.0037 (0.0015)**	0.0262 (0.1480)	-0.0605 (0.0396)
Post*Uninsured2005	**-0.0029 (0.0004)*** **	**-0.0029 (0.0003)*** **	**-0.0012 (0.0003)*** **	**-0.0013 (0.0002)*** **	**-0.0004 (0.0001)*** **	**-0.0004 (0.0001)*** **	**0.0001 (0.0000)*** **	**0.0001 (0.0000)*** **	**-0.2366 (0.1397)**	**-0.0012 (0.0009)**
Post	0.0408 (0.0078)***	0.0372 (0.0048)***	0.0225 (0.0065)***	0.0203 (0.0034)***	0.0060 (0.0020)***	0.0052 (0.0016)	-0.0010 (0.0006)*	-0.0014 (0.0005)***	0.0199 (0.0138)	0.0138 (0.0108)
Uninsured2005	0.0142 (0.0027)***	0.0148 (0.0027)***	0.0130 (0.0020)***	0.0126 (0.0017)***	0.0039 (0.0004)***	0.0037 (0.0003)	0.0009 (0.0001)***	0.0008 (0.0001)***	0.0164 (0.0036)***	0.0161 (0.0033)***
PercBlack	0.0109 (0.1056)	–	-0.0816 (0.0805)	–	-0.0396 (0.0184)**	–	-0.0208 (0.0034)***	–	0.0000 (0.0000)*	–
MedIncome	0.0000 (0.0000)	–	0.0000 (0.0000)	–	0.0000 (0.0000)	–	0.0000 (0.0000)*	–	-0.0041 (0.0149)	–
PctUnemp	-0.0027 (0.0106)	–	0.0012 (0.0085)	–	0.0009 (0.0023)	–	0.0001 (0.0006)	–	-0.0012 (0.0010)	–
County-year obs:	56		56		56		56		56	

Significance Levels: * = 10%, ** = 5%, *** = 1%. Standard errors clustered by county.

Data source: Massachusetts DHCFP Emergency Department Database, U.S. Census American Community Survey, U.S. Census Small Area Health Insurance Estimates, U.S. Census Population Estimates, Bureau of Labor Statistics Local Area Unemployment Statistics

Table 11: Dependent Variable: Per capita ER rates by Type, Difference-in-Difference Estimates

	Non-Urgent		Emergent, Primary Care Treatable		Emergent, Primary Care Preventable		Emergent, Not Preventable		Injury	
	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)				
Intercept	0.1323 (0.0699)*	0.0746 (0.0060)***	0.1118 (0.0632)*	0.0699 (0.0054)***	0.0352 (0.0186)*	0.0209 (0.0017)***	0.0115 (0.0052)**	0.0054 (0.0006)***	0.2071 (0.1115)*	0.1162 (0.0087)***
Post * Treated	-0.0245 (0.0056)***	-0.0240 (0.0062)***	-0.0114 (0.0023)***	-0.0114 (0.0025)***	-0.0035 (0.0010)***	-0.0037 (0.0012)***	0.0007 (0.0008)	0.0007 (0.0007)	-0.0130 (0.0070)*	-0.0119 (0.0069)*
Post	0.0092 (0.0049)*	0.0051 (0.0015)***	0.0094 (0.0045)**	0.0060 (0.0012)***	0.0018 (0.0013)	0.0005 (0.0003)	0.0006 (0.0003)**	0.0001 (0.0001)	0.0079 (0.0072)	0.0017 (0.0012)
Treated	0.1446 (0.0280)***	0.1239 (0.0326)***	0.1326 (0.0204)***	0.1022 (0.0287)***	0.0405 (0.0045)***	0.0295 (0.0083)***	0.0099 (0.0013)***	0.0064 (0.0021)***	0.1729 (0.0368)***	0.1270 (0.0495)**
PercBlack	-0.3052 (0.1663)*	–	-0.3821 (0.1278)***	–	-0.1325 (0.0308)***	–	-0.0457 (0.0067)***	–	-0.6387 (0.2062)***	0.0000
MedIncome	-0.0006 (0.0007)	–	-0.0006 (0.0007)	–	-0.0003 (0.0002)	–	0.0008 (0.0005)*	–	0.0009 (0.0011)	–
PctUnemp	-0.0016 (0.0096)	–	0.0019 (0.0076)	–	0.0013 (0.0020)	–	0.0002 (0.0006)	–	-0.0020 (0.0132)	–
County-year obs:	56		56		56		56		56	

Significance Levels: * = 10%, ** = 5%, *** = 1%. Standard errors clustered by county.

Data source: Massachusetts DHCFP Emergency Department Database, U.S. Census American Community Survey, U.S. Census Small Area Health Insurance Estimates, U.S. Census Population Estimates, Bureau of Labor Statistics Local Area Unemployment Statistics

Table 12: Off Hours vs. Regular Hours: Percentage of Visits Non-Urgent, Primary-Care Treatable

Dependent Variable:	Non-Urgent		Emergent, Primary Care Treatable		Primary Care Preventable/Avoidable		Emergent, Not Preventable		Injury	
	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)	Estimate (Std. Error)
Post*Uninsured2005	-0.0019 (0.0003)***	–	-0.0006 (0.0002)**	–	0.0000 (0.0002)	–	0.0003 (0.0002)*	–	0.0014 (0.0004)***	–
Post*Uninsured2005*OffHours	0.0009 (0.0003)***	–	0.0006 (0.0003)*	–	0.0000 (0.0002)	–	-0.0001 (0.0001)	–	-0.0013 (0.0003)***	–
Post*Treated	–	-0.0107 (0.0020)***	–	-0.0039 (0.0007)***	–	-0.0000 (0.0007)	–	0.0015 (0.0001)*	–	0.0083 (0.0028)**
Post*Treated*OffHours	–	0.0048 (0.0010)***	–	0.0047 (0.0005)***	–	0.0006 (0.0004)	–	-0.0008 (0.0004)*	–	-0.0079 (0.0011)***
No. obs:	9671933	9671933	9671933	9671933	9671933	9671933	9671933	9671933	9671933	9671933

Significance Levels: * = 10%, ** = 5%, *** = 1%. Standard errors clustered by hospital.
Models include control variables for patient's race, age, gender, and an indicator that
the patient is known to be homeless fully interacted with the binary indicator that the visit occurred outside normal office hours
Data source: Emergency Department Database, Massachusetts Division of Health Care Finance and Policy