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 pre-reform uninsurance rate across counties to identify the causal effect of the reform on ER visits. My estimates imply that the reform reduced ER usage by between 2 and 8 percent, nearly all of which is accounted for by a reduction in non-urgent visits that could be treated in alternative settings. These estimates are consistent with a large causal effect of insurance on ER usage and imply that expanding insurance coverage could have a substantial impact on the efficiency of health services.

1 Introduction

Two problems have dominated debates over health care policy in the United States: the substantial number of uninsured persons and the rising costs of health care. Recent federal and state health care reform legislation have attempted to address the former problem by expanding publicly-subsidized health insurance coverage. This expansion may exacerbate the problem of rising costs of health care because the insured use more health care than the uninsured. Proponents of health reform counter this by arguing that health insurance may alter the type of care purchased by consumers, for example by increasing primary and preventive care and decreasing the use of the hospital emergency room (ER). As a result, the "per dollar" cost of health may decrease.

Several observations support the idea that expanding insurance coverage will improve the efficiency of health services in general, and ER care in particular. First, the uninsured are more likely than the insured to report that the cost of care has caused them to delay, or fail to obtain, needed care. This may result in them using the emergency room more, although the evidence to support this point is weak (e.g., Blanchard et al. (2003), Zuckerman and Shen (2004)). Second, 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. The uninsured may choose to seek care at the emergency room because, unlike private physician's offices, emergency rooms are legally obligated to treat people, even if they cannot pay for services. For example, in 2005 in Massachusetts, over 80 percent of ER visits did not lead to an inpatient admission to the hospital. Of these outpatient visits, approximately 21 percent were for events classified as non-urgent (e.g., sore throat) and 19 percent were classified as treatable in a primary care setting (e.g., ear infection). Notably, treating non-urgent and primary care preventable illnesses in the emergency room is more expensive than treating these illnesses in the physician's office (Bamezai et al. (2005)). Expanding insurance coverage could reduce emergency room use by preventing true emergencies and by re-directing non-emergent care to the physician's office.

There is voluminous literature to support the argument that expanding publicly-subsdized health insurance leads people to consume more medical care (Newhouse (1993), Card,

Dobkin, and Maestas (2007), Aizer (2007), and others). However, there is little evidence about how insurance influences the place and cost-effectiveness of care, and more specifically, whether outpatient emergency room use is affected. This is an important shortcoming in the literature because part of the support for expanding publicly-subsidized health insurance comes from the belief that it will be cost-reducing and health-improving by increasing access to primary and preventive care services that are more efficient.

In this article, I evaluate the effect of health insurance on use of the emergency room using the near-universal expansion of health insurance coverage in Massachusetts. In 2006, Massachusetts simultaneously mandated that all state residents must have insurance (or pay a sizable non-compliance fee) and introduced a subsidy for low- and middle-income residents to buy insurance.

I use variation both across counties and across states to analyze the impact of the reform on outpatient ER visits. I perform a county-level analysis that exploits the variation in the intensity of the impact of the reform across counties. Prior to the reform, the non-elderly insurance rates across counties in Massachusetts varied from 9.5 percent to 21.3 percent. Counties with relatively higher pre-reform insurance rates experienced a smaller rise in insurance coverage than counties with lower initial insurance rates. I measure whether the change in ER usage was proportionally larger in counties with higher exposure to the law. Additionally, I compare counties in Massachusetts to similar counties in four nearby states (Connecticut, New Jersey, Vermont and Rhode Island). Exploiting the variation in treatment intensity allows me to identify how expanding insurance coverage affected ER visits in a way that is robust to Massachusetts-specific time trends.

I find that the reform had three distinct effects on ER usage. It substantially reduced ER visits for events that can be treated in a physician's office, implying that insurance induces substitution away from hospital ERs and toward more appropriate care settings. Furthermore, the reform reduced emergency visits that can often be avoided with additional routine care (e.g., an asthma attack). This suggests the reform encouraged individuals to obtain more health care in general. Finally, the reform caused emergent, non-preventable visits (e.g., cardiac disrhythmia or stroke) to increase. By lowering the out-of-pocket cost of

ER services for some people, the reform increased ER usage for types of visits where primary care is not a good substitute. The reduction in non-urgent and primary-care treatable visits is largest during regular offices hours when physician's offices are open.

The reform significantly reduced total outpatient ER visits. A one percentage point increase in the pre-reform county uninsurance rate predicts a reduction in ER usage of 0.4 ER visits per 100 residents in the county. Because the reform reduced the uninsurance rate in Massachusetts from about 10.3 percent to between 2.6 and 5.5 percent, my estimates imply that the reform reduced ER usage by between 1.9 and 3.1 visits per 100 residents. Relative to the statewide pre-reform usage rate, which was 46 visits per 100 people per year, this represents a total decline in ER usage of 4.6 to 6.7 percent. Under the assumption that the entire reduction in ER usage is attributable to gaining insurance by those previously uninsured my results imply that insurance reduces an uninsured individual's ER visits by almost 70 percent. I conclude that the reform led to significantly more appropriate use of ER facilities.

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 for those without the means to pay for care 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 (Newton et al. (2008)). 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 likely to include financial penalties for those who use the ER in non-urgent situations.[1] The provision of insurance to the uninsured is important in this process because it may lead individuals who cannot otherwise pay to seek care in the most appropriate setting, rather going to the ER simply because they cannot be denied services. For example, Nawar et al. (2007) find that the uninsured who visit the ER are more likely to be in the lowest-priority triage category than 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 both being uninsured, and with poor health, unhealthy behaviors, and exposure to violence. All of these variables affect ER usage but cannot be perfectly controlled 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.

The RAND Health Insurance experiment (RHIE) is perhaps the most widely cited study of the relationship between level of health insurance coverage. This experiment was conducted in the late 1970s, prior to the introduction of the Emergency Medical Treatment and Active Labor Act that mandated emergency rooms treat patients without regard to their

[1] 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))

ability to pay for services. Results from the RHIE presented in Newhouse (1993) show that more generous health insurance coverage increased use of medical care, including emergency room services.

Several recent studies that used quasi-experimental research designs to estimate the association between health insurance and use of medical care services reach similar conclusions. Finkelstein (2007) finds that the expansion of health insurance among the elderly in 1965 when Medicare was introduced significantly affected spending in the hospital sector. Card, Dobkin, and Maestas (2007) use the discontinuous increase in insurance coverage at age 65 generated by Medicare to identify a significant increase in inpatient use. Similarly, 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. 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. Overall, these studies indicate that insurance tends to induce people to consume more medical services.

Recent research has explored the impact of the Massachusetts reform on 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. They 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 fell. They attribute this decline to a decrease of ER visits that were offset by an increase in non-emergency room admits. They do not, however, observe the 80 percent of ER visits that are conducted entirely on an outpatient basis, which is an important margin for adjustment as it may be affected by substitution towards primary care.[2]

[2]Hosseini and Weinberg (2010) also 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 substantial increases or decreases in ER usage.

My analysis further advances this 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 many 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. A reduction in outpatient visits because of the health reform may result from both substitution toward 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) provide survey evidence that the Massachusetts reform induced more patients to seek preventive care relative to other states. This result implies that a measured short-run change in preventable ER visits may underestimate the long-run decline as regular care continues to prevent medical emergencies.

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 percent of the federal poverty line. See Gruber (2008) for a complete review of the reform and its implementation.

Under the new law, all residents must purchase health insurance that meets minimum coverage standards as long as affordable coverage is available. The Commonwealth Health Insurance Connector Authority determines affordability and coverage standards. This newly formed independent public authority 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 of 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 "MassHealth" Medicaid program 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 also introduced a new program, "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 federal 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.

Prior to the reform, uninsured Massachusetts residents earning under 200 percent of the federal poverty level had necessary hospital care paid for by the Uncompensated Care Pool. The goal of this state-run program was to alleviate hospitals of bad debt resulting from the federal mandate to treat the uninsured and indigent in the emergency room regardless of their ability to pay. Uncompensated care programs are not unique to Massachusetts and similar programs exist in Maine, Rhode Island, Ohio, New Jersey, Washington D.C., and others.[3] Because low-income uninsured Massachusetts residents did not have to pay for emergency room visits, ER usage may have been higher among this group in Massachusetts than in states without uncompensated care pools, although several studies indicate that significant hospital charity care exists in most states, including those without uncompensated care pools (e.g.,Congressional Budget Office (2006), Langland-Orban et al. (2005), and Melnick et al. (1989)). Charity care may be common among emergency room visits because the costs of enforcing payment among low-income uninsured patients exceeds the expected revenue and because these patients cannot be legally turned away even if it is clear they cannot afford services.

[3]Some states do not mandate charity care but do reimburse hospitals for uncompensated care, e.g., Pennsylvania and California.

The 2006 reform replaced the Uncompensated Care Pool with the Health Safety Net program that provided free or subsidized hospital care to those that remained uninsured after the reform. Residents whose ER visits were previously paid for by the Uncompensated Care Pool are eligible for fully subsidized Commonwealth Care if their incomes are less than 100 percent of the federal poverty line and eligible for MassHealth if they meet certain criteria (see Raymond (2007)). Both of these programs carry emergency room copayments of $3 or less. Residents with incomes between 100 and 200 percent of the poverty line and who are ineligible for MassHealth may enroll in partially subsidized Commonwealth Care, which carries a $50 copayment for outpatient ER visits.[4]

The reform introduced new employer participation requirements for all employers with at least 11 full-time employees. Such employers must contribute at least 33 percent of the premium cost to their employees' health insurance plan and enroll at least 25 percent of full-time employees in their 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 served small firms with fewer than 50 employees.

These combined approaches greatly raised insurance coverage in Massachusetts. According to the Current Population Survey, the uninsurance rate in Massachusetts prior to the reform (2004-2006) was about 11.8 percent among the non-elderly population and 10.3 percent for all residents, low relative to the national non-elderly uninsurance rate of 17.3 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

[4]Partially subsidized Commonwealth Care enrollees represented about 23 percent of total Commonwealth Care enrollees in 2007 (Raymond (2007)).

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. Estimates in Long, Stockley, and Yemane (2009) and Kolstad and Kowalski (2010) are consistent with these post-reform uninsurance rates. It is clear that the uninsurance rate was cut by at least half, and potentially by as much as 75 percent.

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. Although only 9.2 percent of the population, the uninsured account for 14.9 percent of ER visits. The uninsured who visit the ER are far 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[5] 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.[6] In the same year there were 1,967,002 insured ER visits and about 5,745,000

[5]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.

[6]ER use is dominated by a small subset of the population who use the ER very heavily, while many people never use the ER. As a result, 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.

insured residents, or a baseline usage rate of 0.34.

Table 1 also provides evidence that the uninsured use the ER in lieu of office-based care. Twenty-four percent of the ER visits by the uninsured are classified as "non-urgent" versus 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 use the ER for unavoidable emergencies and injuries.

4 Introduction to the data and empirical strategy

My analysis uses two types of variation to identify the effect of insurance coverage on emergency room usage. First, I analyze the relative change in ER usage in Massachusetts counties based on their exposure to the reform as measured by the pre-reform uninsurance rate. Because the reform instituted near-universal coverage, counties with high rates of insurance coverage prior to the reform experienced a smaller change in insurance coverage than counties with fewer insured residents. We should expect to see ER usage decline in counties with relatively high pre-reform uninsurance rates relative to less-affected counties. Second, I look at the county-level variation in treatment intensity within Massachusetts and also across the comparison states of Rhode Island, Vermont, Connecticut and New Jersey. 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 to 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. I select these years based on data availability in the comparison states, but in analysis

that excludes comparison states I supplement this data with ER visits from 2002-2004. All hospitals in Massachusetts and the comparison states (Rhode Island, Vermont, Connecticut and New Jersey) must report the number of ER visits on an annual basis. I obtain these data directly from each state's department of health. The choice of comparison states is driven by data availability. I restrict 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.[7] 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.[8]

Data from Vermont and Rhode Island are collected on a calendar year basis, whereas data from Connecticut are collected on a fiscal year basis. New Jersey and Massachusetts ER counts are available by month.[9] 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 state residents 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 8.9 and 9.2 percent respectively, 5.1 and 4.8 percentage points lower than the nation as a whole. Between 1999 and 2005, the uninsurance rate rose nationwide

[7]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.

[8]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

[9]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.

and in Massachusetts and the comparison states; all appear to follow the same trend. Figure 1 reveals that the 2006 reform caused the uninsurance rate in Massachusetts to decline sharply. Prior to the reform (2004-2006), the average uninsurance rate in Massachusetts was 10.3 percent. This fell to around 5.5 percent in 2007 and 2008.

Table 2 presents unweighted 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 are 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.

Data on the county non-elderly uninsurance rate 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 people under 65 in all counties. Figure 2 displays the 2005 SAHIE uninsurance rate by county for Massachusetts. Although overall insurance coverage in Massachusetts was high in 2005, 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.

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

5.1 Within Massachusetts Analysis

I first analyze the effect of the reform by comparing ER trends across Massachusetts counties. If insurance coverage causes patients to use the ER less frequently, ER usage should fall in

counties that experienced larger increases in insurance coverage relative to other counties. To explore this, I model per capita ER visits in county i and year t ($PercapER_{it}$) as

$$\begin{aligned} PercapER_{it} =& \alpha_0 + \alpha_1 X_{it} + \alpha_2 Uninsured2005_i + \alpha_3 Post_t \\ &+ \alpha_4 Uninsured2005_i * Post_t + \eta_{it}. \end{aligned} \tag{1}$$

The variable $Uninsured2005_i$ indicates the 2005 uninsurance rate of county i. The variables X_{it} denote the demographic characteristics of the county in year t (the fraction of the county that is black, median income, and the county unemployment rate). $Post_t = 1$ for 2007 and 2008, and 0 for 2005 and 2006. The reform was enacted in April of 2006 and continued to be implemented throughout 2007; by counting all of 2006 in the pre-reform period and all of 2007 in the post-reform period, I likely underestimate the impact of the reform. The parameter of interest is α_4, which measures how exposure to the reform, as described by the pre-reform uninsurance rate, affected per capita ER visits. If α_4 is less than zero, then the increase in insurance coverage associated with the reform resulted in a relative reduction in ER use.

Columns 1 and 2 of Table 3 present the results. The first column shows results that control for county demographic characteristics. The second column presents the effect of the reform without these controls. The standard errors are clustered by county to account for correlation in the error terms within counties over time (Bertrand, Duflo, and Mullainathan (2004)).

Both specifications indicate that each percentage point increase in the 2005 uninsurance rate is associated with a subsequent reduction in ER visits of approximately 0.5 visits per 100 residents. This effect is statistically significant at the one percent level. Estimates of the decline in the insurance rate in Massachusetts range from 4.8 to 7.7 percentage points. Therefore, the point estimate of 0.005 in Table 3 implies that the reform induced between 0.024 ($= 4.8 * 0.005$) and 0.0385 ($= 7.7 * 0.005$) fewer ER visits per capita. Recall that the pre-reform ER usage rate in Massachusetts was 0.46. Therefore the estimates in Table 3 represent a reduction in the number of ER visits per capita of 5.2 to 8.4 percent. Finally, the estimates in Table 3 (multiplied by 100) can be interpreted as the causal effect of insurance on ER usage. The estimate in column 1 indicates that having insurance reduces ER usage

by 0.50 visits per year, a reduction of over 85 percent from the baseline ER usage among the uninsured of 0.58.

Table 3 also presents results of a traditional difference-in-difference model that replaces the continuous measure of county uninsurance rate ($Uninsured2005_{is}$) with a binary indicator for counties that had 2005 uninsurance rates above 12.6 percent (the 75th percentile for Massachusetts according to the 2005 SAHIE). In this difference-in-difference specification, $Treated_i = 1$ for counties with the highest uninsurance rates. I estimate

$$PercapER_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Treated_i + \beta_3 Post_t + \beta_4 Treated_i * Post_t + \epsilon_{it}. \quad (2)$$

In this model, β_4 measures how per capita ER usage in the most-affected counties in Massachusetts changed relative to ER rates in less-affected counties. This model assumes that the relative reduction in ER usage in counties with low 2005 uninsurance rates ($Treated_i = 0$) captures the Massachusetts-specific trend. Columns 2 and 3 of Table 3 present the results. I find that the reform caused ER usage to fall in the high uninsurance counties by almost 0.5 visits per 100 residents relative to the low uninsurance counties. This effect is statistically significant at the one percent level.

The average insurance rate in the "treated" counties was approximately 18.9 in 2005; in the "untreated" counties, it was about 10.9. Assuming a fixed non-compliance rate, the relative reduction in percent of the population that is uninsured is therefore about 8 percentage points. A back of the envelope calculation of the treatment effect is therefore approximately a reduction of 0.60 visits per year ($-0.048/0.08$), approximately equal to the usage rate among the uninsured.[10]

5.2 Robustness to Pre-Reform Trends

In this subsection I assess whether differential trends in ER usage between more- and less-affected counties in Massachusetts can explain some of the measured effect of the law. The

[10] One explanation for the unusually large treatment effect may be that counties with high uninsurance rates followed a different trend than the low uninsurance rate counties after the reform. I control for these trends in Section 5.3 using comparison states and do indeed estimate a smaller treatment effect.

estimates 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 test on whether the county uninsurance rate in 2005 predicts a decrease in ER usage only beginning in 2007.

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) continued to grow. This divergence adds to the evidence that the reform indeed changed trends in ER usage because the reduction occurred only after the treated group increased its insurance coverage rate.

I formalize the results of Figure 3 with regression analysis. Table 4 reports results from a regression similar to those reported in Table 3, based on equations (1) and (2), but with $Post_{it}$ replaced by indicator variables for the years 2003-2008 (2002 is the excluded category). Column 1 shows estimates that use the continuous measure of the 2005 county uninsurance rate. The regression estimates reported in Column 2 use the binary treatment indicator that the county had an uninsurance rate greater than 12.6 percent as the measure of exposure to the reform. In both models I find no evidence of an effect for 2003 to 2006, prior to the introduction of the law. I find a statistically significant negative effect in both models for 2007 and 2008. This result provides some evidence that prior to the law, Massachusetts counties with high uninsurance rates were not growing at a different rate than other counties in Massachusetts, suggesting that the results in the previous section are attributable to the change in the law rather than a differential trend.

5.3 Across State and Across County Analysis

The "within Massachusetts" analysis is not robust to shocks that only affect high-uninsurance counties or are correlated with the 2005 uninsurance rate. In this section, I expand upon the

previous analysis by adding comparison states. This addition allows me to control for both Massachusetts-specific trends as well as unrelated contemporaneous changes in ER usage among counties with high 2005 uninsurance rates. If the reform reduced ER usage, ER rates should fall in Massachusetts counties relative to those in comparison states, with the most pronounced reductions occurring in counties that experienced the largest increase in insurance coverage.

I model per capita ER rates in county i, in state s, and during year t ($Percap_{ist}$) as

$$\begin{aligned} PercapER_{ist} =& \alpha_0 + \alpha_s + \alpha_1 X_{ist} + \alpha_2 MA_{is} + \alpha_3 Uninsured2005_{is} + \alpha_4 Post_t \\ &+ \alpha_5 MA_{is} * Post_t + \alpha_6 Uninsured2005_{is} * Post_t \\ &+ \alpha_7 Uninsured2005_{is} * MA_{is} + \alpha_8 Uninsured2005_{is} * MA_{is} * Post_t + \eta_{ist}. \end{aligned} \tag{3}$$

In this model, α_8 measures the effect of the reform on ER rates for each additional percentage point in the county uninsurance rates. The variable MA_{is} equals 1 for counties in Massachusetts. I also include state fixed effects, α_s. In this specification, the interaction term $MA_{is} * Post_t$ controls for any difference in trends in ER usage between Massachusetts and the comparison states that are common to all Massachusetts counties and $Uninsured2005_{is} * Post_t$ controls for trends associated with the 2005 uninsurance rate. This specification therefore relies on weaker identification assumptions than the models in Section 5.1.

Table 5 presents the results. They 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 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.

Because the reform induced an increase in insurance coverage of between 4.8 to 7.7

percentage points, the point estimate of 0.004 in column 1 of Table 5 implies that the reform induced between 0.019 ($= 4.8 * 0.004$) and 0.031 ($= 7.7 * 0.004$) fewer ER visits per capita, a decline in the ER usage rate of between 4.1 to 6.7 percent from pre-reform levels. This result is slightly smaller than the 5.2 to 8.4 percent reduction estimated using only the Massachusetts counties. Furthermore, the estimate in column 1 indicates that having insurance reduces an individual's ER usage by 0.40 visits per year on average, or 69 percent from the baseline ER usage among the uninsured.

Table 6 presents results of a model that uses the binary indicator that a county that had 2005 uninsurance rates above 12.6 percent (the 75th percentile for Massachusetts) rather than the continuous variable. In this triple differences specification, $Treated_{is} = 1$ for counties with the highest uninsurance rates. I estimate

$$\begin{aligned} PercapER_{it} =& \beta_0 + \beta_s + \beta_1 X_{it} + \beta_2 MA_i + \beta_3 Treated_i + \beta_4 Post_t + \beta_5 MA_i * Post_t \\ &+ \beta_6 Treated_i * Post_t + \beta_7 Treated_i * MA_i + \beta_8 Treated_i * MA_i * Post_t + \epsilon_{it}. \end{aligned} \tag{4}$$

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. This model assumes that the relative reduction in ER usage in counties with low 2005 uninsurance rates ($Treated_i = 0$) reflects the Massachusetts-specific trend. If ER use in these less-affected counties were also reduced by the health legislation, β_8 is overly conservative in capturing the entire effect.

Table 6 presents estimates of equation (4). 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 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 negative (ranging from -0.002 to -0.02), indicating that

counties in Massachusetts with high insurance rates prior to the reform did experience a small reduction in ER visits relative to similar counties in other states. However, the effect in these counties is generally small, which provides some assurance that the coefficient on $MA_{is} * Post_t * Treated_{is}$ largely captures the impact of the reform.

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 half, the estimate in column 1 of Table 5 implies an effect of insurance on per capita ER usage of $\frac{-0.043}{0.0945} = -0.455$. This effect is similar to the treatment effect estimated in Section 5.1. My 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 The Effect of the Reform on Visits of the Elderly Patients

In this section I analyze how the reform affected the ER usage patterns of people over the age of 65. This is an interesting subpopulation to study because most elderly residents are eligible for health insurance coverage through Medicare and so the 2006 law had, if anything, a small effect on their insurance status. Estimates from the Current Population Survey indicate there were about 9000 uninsured elderly in 2005 in Massachusetts, which represents about one percent of the population over age 65. Ninety-five percent of the elderly population received coverage through Medicare; most of the remainder have Medicaid. The uninsured elderly are largely composed of recent immigrants who do not qualify for Medicare and natives who are eligible for Medicaid but have not signed up for it (Mold et al. (2004)). Despite the near universal insurance, the 2006 law potentially could have increased the insurance rate among the elderly by encouraging some of the uninsured to enroll in Medicaid or Commonwealth Care. Estimates from the Current Population Survey indicate that the number of elderly who were uninsured decreased from 9000 in 2005 to 6000 in 2007, though the 90 percent confidence interval for this change ranges from a decrease of 10,000 to an increase of 4000.

The Massachusetts EDD indicate that emergency room visits among the uninsured elderly fell from 4470 visits in 2005 to 3167 visits in 2007, a decrease of about 30 percent. The decline in ER usage among the elderly could signal that insurance rates did, in fact, rise among this group, even though the rise is not detectable in the Current Population Survey. Unfortunately, data are not available on uninsurance rates at the county level and so I cannot perform the same exercise for the elderly as I did in Section 5.1 for the total population. However, if ER usage among the elderly is as responsive to gaining insurance coverage as usage among the total population, I can use my prior estimates to gauge how many elderly would have had to gain insurance to generate a 1300 visit reduction in ER visits. In particular, my earlier estimates indicated that gaining insurance reduced the ER usage rate by 0.4 visits per person per year. To generate a decline in 1300 ER visits in a year, about 3260 elderly people would have to gain insurance. This is slightly larger than the estimated change in elderly uninsured residents in the state, but within the confidence interval for the change.

I have run models of elderly ER usage by year and county as a function of the uninsurance rate of the non-elderly, similar to models in Section 5.1. These estimates (which are available upon request) indicate that ER usage among the elderly declined in counties that had the largest pre-reform uninsurance rate. This is consistent with the idea that these counties also had relatively higher rates of uninsurance among the elderly and therefore saw the largest declines in ER usage among the elderly. However, without better data on uninsurance rates among the elder, it is difficult to be more precise about how the reform affected this group.

6 Did the Reform Cause a Change in the Composition of ER Visits?

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-urgent: 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 preventive 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 patient-level data in the Massachusetts EDD. 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.[11] A sample of these classification probabilities are given in Table 7. 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.

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[12] 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

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

[12] 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.

usage rate for visits of type k as

$$PercapType_{kit} = \lambda_0 + \lambda_1 X_{it} + \lambda_2 Post_t + \lambda_3 Uninsured2005_i + \lambda_4 Uninsured2005_i * Post_t + \epsilon_{it} \quad \text{and} \tag{5}$$

$$PercapType_{kit} = \lambda_0 + \lambda_1 X_{it} + \lambda_2 Post_t + \lambda_3 Treated_i + \lambda_4 Treated_i * Post_t + \epsilon_{it}, \tag{6}$$

$Uninsured2005_{it}$ 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 8 and Table 9 present estimates of equations (5) and (6). 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 8 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 visits for injuries. Recall from Table 3 that the reform induced a total reduction of 0.5 visits per 100 residents. The results from Table 8 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 9 show qualitatively similar results for the model that uses a binary indictor for counties with high pre-reform levels of uninsurance.

The differential impact of the reform across the various types of ER visits 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 reduction in non-urgent 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 to 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 7, and estimate

$$Type_{kit} = \lambda_1 + \lambda_2 X_{it} + \lambda_3 Post_t + \lambda_4 Uninsured2005_i + \lambda_4 Uninsured2005_i * Post_t + \tag{7}$$
$$OffHours * (\delta_1 + \delta_2 X_{it} + \delta_3 Post_t + \delta_4 Uninsured2005_i + \delta_5 Uninsured2005_i * Post_t) + \epsilon_{it},$$

$$Type_{kit} = \lambda_1 + \lambda_2 X_{it} + \lambda_3 Post_t + \lambda_4 Treated_i + \lambda_4 Treated_i * Post_t + \tag{8}$$
$$OffHours * (\delta_1 + \delta_2 X_{it} + \delta_3 Post_t + \delta_4 Treated_i + \delta_5 Treated_i * Post_t) + \epsilon_{it}.$$

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. 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 estimates of equations (7) and (8) are displayed in Tables 10 and 11. The first column of Table 10 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.

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 legislation requiring all state residents to purchase

health insurance. I compare changes in ER usage both 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 reform. A one percentage point increase in the pre-reform uninsurance rate 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 4.8 and 7.7 percentage points. My estimates therefore imply that the law reduced ER usage by between 1.9 and 3.1 visits per 100 residents. These results imply that ER usage is quite sensitive to insurance status.

I explore how the law affected ER usage across different types of events. My results are consistent with 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 increases their use of primary care.

Finally, Massachusetts ER records indicate the time of day when the visit took place. If the decrease in non-urgent visits is indeed driven by substitution towards primary or regular care, the reduction should be most pronounced during office hours when physician's offices are generally open. Consistent with this hypothesis, I find that the law reduced non-urgent 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 significant 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 study provides 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 relevant 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. By analyzing the impact of the Massachusetts health reform on utilization, this research contributes to the ongoing debate about the role of health insurance subsidies and individual mandates in public policy.

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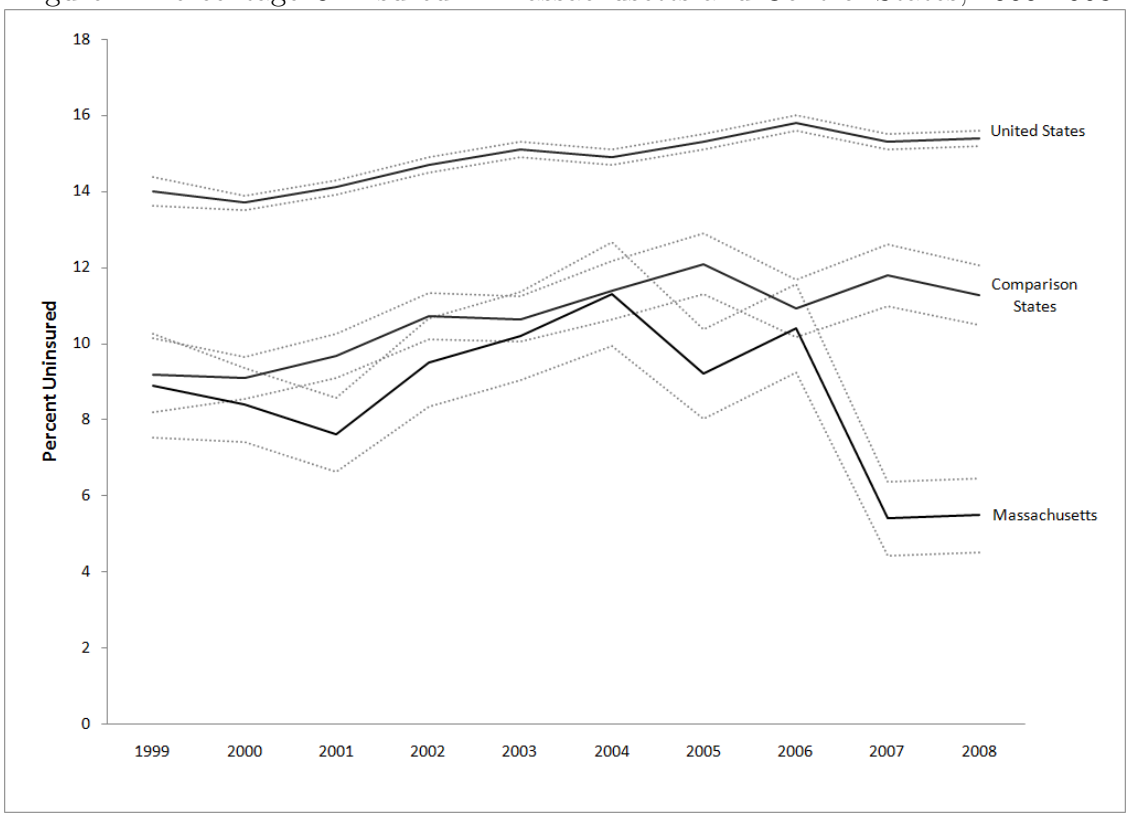
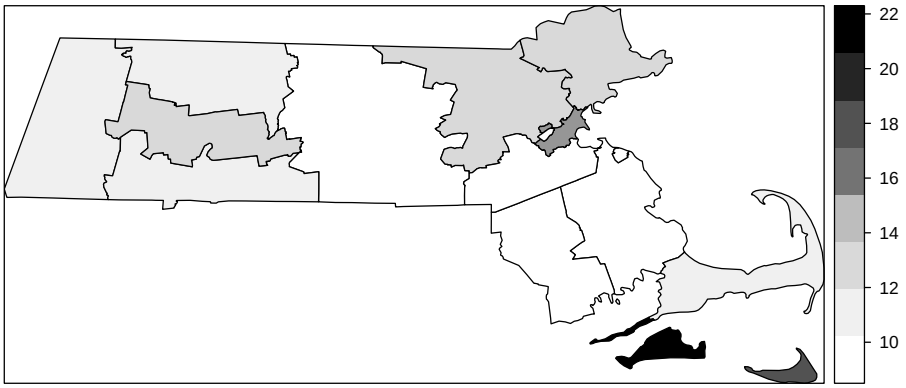
Figure 1: Percentage Uninsured in Massachusetts and Control States, 1999-2008



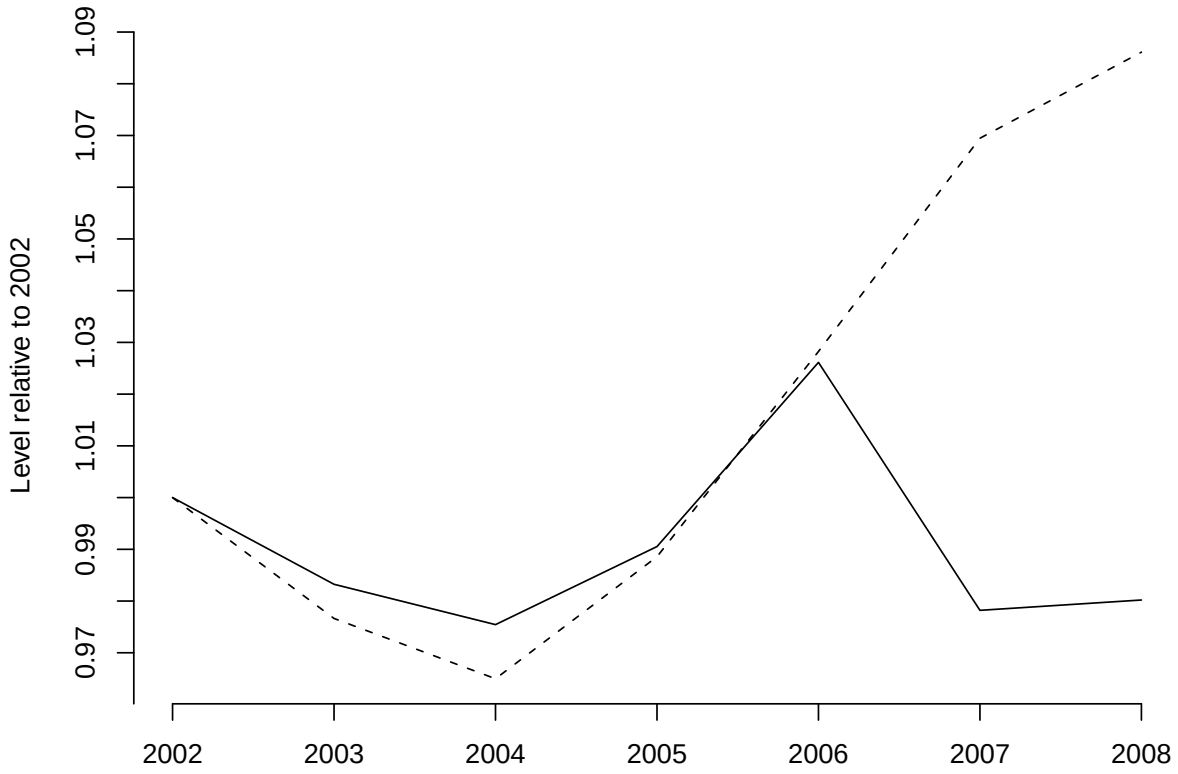
Source: Current Population Survey (CPS) estimates of uninsurance rate. Available here: http://www.census.gov/hhes/www/hlthins/data/historical/index.html

Figure 2: Uninsurance Rate in Massachusetts by County, 2005



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

Figure 3: Growth in ER visits 2002 to 2008, 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 the Massachusetts Population and Outpatient Emergency Room Visits, 2005

	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)

Standard errors in parentheses.

Source: Author's own calculations based on data from the 2005 Emergency Department Database provided by the Massachusetts Division of Health Care Finance and Policy; sample size is 2306181

1. Source: Current Population Survey insurance coverage estimates

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

	Massachusetts		Comparison 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)

Pre-reform years are 2005 and 2006. Post-reform years are 2007 and 2008.

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

Table 3: Difference-in-difference regression estimates of the effect of the Massachusetts reform on per capita emergency room usage, subset of counties in Massachusetts

Dependent Variable: Per capita ER usage

	Continuous Treatment Measure		Difference-in-Difference	
	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)
(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: Massachusetts Division of Health Care Finance and Policy, U.S. Census Small Area Income and Poverty Estimates, U.S. Census Small Area Health Insurance Estimates, U.S. Census Population Estimates, Bureau of Labor Statistics Local Area Unemployment Statistics

Table 4: Regression evaluation of pre-reform trends in per capita ER usage: Massachusetts counties
Dependent Variable: Per capita ER usage

	Continuous Measure of Treatment Intensity	Difference-in-Difference
	Estimate (S.E.)	Estimate (S.E.)
Intercept	-0.2440 (0.1082)***	0.3567 (0.0296)***
PercUninsured2005	0.0552 (0.0083)***	–
Treated=1	–	0.4533 (0.1268)***
Year=2003	0.0032 (0.0206)	-0.0083 (0.0031)***
Year=2004	0.0036 (0.0358)	-0.0125 (0.0050)**
Year=2005	0.0038 (0.0231)	-0.0044 (0.0065)
Year=2006	-0.0048 (0.0237)	0.0098 (0.0057)*
Year=2007	0.0769 (0.0204)***	0.0244 (0.0068)***
Year=2008	0.0895 (0.0272)***	0.0304 (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	–	-0.0464 (0.0180)**
Uninsured2005*Year=2003	-0.0010 (0.0018)	–
Uninsured2005*Year=2004	-0.0014 (0.0032)	–
Uninsured2005*Year=2005	-0.0007 (0.0018)	–
Uninsured2005*Year=2006	0.0013 (0.0019)	–
Uninsured2005*Year=2007	-0.0049 (0.0014)***	–
Uninsured2005*Year=2008	-0.0055 (0.0020)***	–
No. obs:	98	98

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

Table 5: Triple difference regression estimates of the effect of the Massachusetts reform on per capita emergency room usage with continuous third difference
Dependent Variable: Per capita ER usage

	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)	0.862 (0.19)***	0.361 (0.12)***	1.015 (0.22)***	0.307 (0.10)***	0.872 (0.20)***	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	-0.629 (0.148)***	-0.605 (0.13)***	-0.613 (0.14)***	-0.552 (0.14)***	-0.616 (0.15)***	-0.609 (0.14)***
Post	0.091 (0.03)***	0.044 (0.01)***	0.102 (0.02)***	0.047 (0.01)***	0.‘0 (0.03)***	0.045 (0.01)***
Uninsured2005	-0.016 (0.01)**	-0.007 (0.01)	-0.011 (0.01)	0.001 (0.00)	-0.013 (0.01)*	-0.004 (0.01)
MA*Post	0.020 (0.02)	0.040 (0.02)	0.019 (0.02)	0.037 (0.02)	0.007 (0.02)	0.031 (0.03)
MA*Uninsured2005	0.063 (0.01)***	0.063 (0.01)***	0.056 (0.01)***	0.055 (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	0.604 (0.29)***	–	0.516 (0.28)*	–	0.787 (0.26)***	–
MedIncome	-0.005 (0.00)***	–	-0.006 (0.00)***	–	-0.004 (0.00)***	–
Unemp. Rate	-0.032 (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. Includes state fixed effects.
Data source: MA, CT, VT, NJ, and RI Departments of Health, U.S. Census Small Area Income and Poverty Estimates, U.S. Census Small Area Health Insurance Estimates, U.S. Census Population Estimates, Bureau of Labor Statistics Local Area Unemployment Statistics

Table 6: Triple difference regression estimates of the effect of the Massachusetts reform on per capita emergency room usage with binary third difference
Dependent Variable: Per capita ER usage

	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)	0.771 (0.18)***	0.284 (0.07)***	0.956 (0.20)***	0.312 (0.04)***	0.797 (0.19)***	0.288 (0.07)***
Post*Treated*MA	**-0.043 (0.01)*** **	**-0.042 (0.02)*** **	**-0.046 (0.01)*** **	**-0.041 (0.02)** **	**-0.032 (0.01)*** **	**-0.036 (0.02)** **
MA*Post	-0.020 (0.01)*	-0.003 (0.01)	-0.020 (0.01)**	-0.004 (0.01)	-0.024 (0.01)*	-0.002 (0.01)
MA	0.059 (0.07)	0.075 (0.08)	0.018 (0.05)	0.047 (0.05)	0.061 (0.07)	0.076 (0.08)
Post	0.077 (0.02)***	0.028 (0.00)***	0.084 (0.02)***	0.029 (0.01)***	0.077 (0.02)***	0.021 (0.01)***
Treated	-0.056 (0.04)	-0.053 (0.04)	-0.018 (0.04)	0.005 (0.05)	-0.059 (0.04)	-0.053 (0.05)
MA*Treated	0.425 (0.14)***	0.510 (0.13)***	0.369 (0.13)***	0.452 (0.13)***	0.423 (0.14)***	0.508 (0.13)***
Post*Treated	-0.008 (0.01)	-0.007 (0.01)	-0.008 (0.01)	-0.007 (0.01)	-0.016 (0.01)*	-0.009 (0.01)
Fraction Black	0.365 (0.30)	–	0.303 (0.29)	–	0.365 (0.33)	–
MedIncome	-0.005 (0.00)***	–	-0.006 (0.00)***	–	-0.005 (0.00)***	–
Unemp. Rate	-0.043 (0.02)*	–	-0.061 (0.03)**	–	-0.045 (0.02)*	–
No. obs:	248		172		216	

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

Table 7: Sample NYU ED Classifications

Clinical Classification Software (CCS) Designation	Non-Urgent	Emergent, Primary Care Treatable	Emergent, Primary Care Preventable	Emergent, ER Care Needed, Not Preventable/Avoidable	Injury	Other
Urinary tract infections	0.46	0.30	0.24	0	0	0
Spondylosis, intervertebral disc disorders, other back problems	0.74	0.15	0	0.11	0	0
Acute myocardial infarction	0	0	0	1	0	0
Pancreatic disorders (not diabetes)	0	0	0	1	0	0
Superficial injury, contusion	0	0	0	0	1	0
Cardiac dysrhythmias	0	0	0	1	0	0
Acute and chronic tonsilitis	0.66	0.28	0.06	0	0	0
Joint disorders and dislocations, trauma-related	0	0	0	0	1	0
Disorders of teeth and jaw	0.90	0.10	0	0	0	0
Asthma	0	0.01	0.98	0	0	0
Fever of unknown origin	0.43	0.37	0	0.20	0	0
Otitis media and related conditions	0.37	0.59	0.038	0	0	0
Alcohol-related mental disorders	0	0	0	0	0	1
Anxiety, somatoform, dissociative, and personality	0	0	0	0	0	1

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

Table 8: Regression estimates of the effect of the Massachusetts reform on ER visits by type, continuous treatment measure

Dependent Variable: Per capita ER usage by type

	Non-Urgent		Emergent, Primary Care Treatable		Emergent, Primary Care Preventable		Emergent, Not Preventable		Injury	
	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E)
Intercept	-0.0287 (0.094)	-0.0863 (0.031)***	-0.0379 (0.083)	-0.0678 (0.021)***	-0.0087 (0.025)	-0.0192 (0.005)***	0.0015 (0.007)	-0.0037 (0.002)**	0.0262 (0.148)	-0.0605 (0.040)
Post*Uninsured2005	**-0.0029 (0.000)*** **	**-0.0029 (0.000)*** **	**-0.0012 (0.000)*** **	**-0.0013 (0.000)*** **	**-0.0004 (0.000)*** **	**-0.0004 (0.000)*** **	**0.0001 (0.000)*** **	**0.0001 (0.000)*** **	**-0.2366 (0.140)**	**-0.0012 (0.001)**
Post	0.0408 (0.008)***	0.0372 (0.005)***	0.0225 (0.007)***	0.0203 (0.003)***	0.0060 (0.002)***	0.0052 (0.002)	-0.0010 (0.001)*	-0.0014 (0.001)***	0.0199 (0.014)	0.0138 (0.011)
Uninsured2005	0.0142 (0.003)***	0.0148 (0.003)***	0.0130 (0.002)***	0.0126 (0.002)***	0.0039 (0.000)***	0.0037 (0.000)	0.0009 (0.000)***	0.0008 (0.000)***	0.0164 (0.004)***	0.0161 (0.003)***
PercBlack	0.0109 (0.106)	–	-0.0816 (0.081)	–	-0.0396 (0.018)**	–	-0.0208 (0.003)***	–	0.0000 (0.000)*	–
MedIncome	0.0000 (0.000)	–	0.0000 (0.000)	–	0.0000 (0.000)	–	0.0000 (0.000)*	–	-0.0041 (0.015)	–
PctUnemp	-0.0027 (0.011)	–	0.0012 (0.009)	–	0.0009 (0.002)	–	0.0001 (0.001)	–	-0.0012 (0.001)	–
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 9: Difference-in-difference estimates of the effect of the Massachusetts reform on ER visits by type

Dependent Variable: Per capita ER usage by type

	Non-Urgent		Emergent, Primary Care Treatable		Emergent, Primary Care Preventable		Emergent, Not Preventable		Injury	
	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E)
Intercept	0.1323 (0.070)*	0.0746 (0.006)***	0.1118 (0.063)*	0.0699 (0.005)***	0.0352 (0.019)*	0.0209 (0.002)***	0.0115 (0.005)**	0.0054 (0.001)***	0.2071 (0.112)*	0.1162 (0.009)***
Post * Treated	-0.0245 (0.006)***	-0.0240 (0.006)***	-0.0114 (0.002)***	-0.0114 (0.003)***	-0.0035 (0.001)***	-0.0037 (0.001)***	0.0007 (0.001)	0.0007 (0.001)	-0.0130 (0.007)*	-0.0119 (0.007)*
Post	0.0092 (0.005)*	0.0051 (0.002)***	0.0094 (0.005)**	0.0060 (0.001)***	0.0018 (0.001)	0.0005 (0.000)	0.0006 (0.000)**	0.0001 (0.000)	0.0079 (0.007)	0.0017 (0.001)
Treated	0.1446 (0.028)***	0.1239 (0.033)***	0.1326 (0.020)***	0.1022 (0.029)***	0.0405 (0.005)***	0.0295 (0.008)***	0.0099 (0.001)***	0.0064 (0.002)***	0.1729 (0.037)***	0.1270 (0.050)**
PercBlack	-0.3052 (0.166)*	–	-0.3821 (0.128)***	–	-0.1325 (0.031)***	–	-0.0457 (0.007)***	–	-0.6387 (0.206)***	0.0000
MedIncome	-0.0006 (0.001)	–	-0.0006 (0.001)	–	-0.0003 (0.000)	–	0.0008 (0.001)*	–	0.0009 (0.001)	–
PctUnemp	-0.0016 (0.010)	–	0.0019 (0.008)	–	0.0013 (0.002)	–	0.0002 (0.001)	–	-0.0020 (0.013)	–
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 10: Regression estimates of the effects of the Massachusetts reform on off hours vs. regular hours ER visits
Dependent Variable: The probability a visit is in each category

Dependent Variable:	Non-Urgent	Emergent, Primary Care Treatable	Emergent, Primary Care Preventable/Avoidable	Emergent, Not Preventable	Injury
	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)
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)***
No. obs:	9671933	9671933	9671933	9671933	9671933

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

Table 11: Difference-in-difference regression estimates of the effect of the Massachusetts reform on off hours vs. regular hours ER visits

Dependent Variable: The probability a visit is in each category

Dependent Variable:	Non-Urgent	Emergent, Primary Care Treatable	Emergent, Primary Care Preventable/Avoidable	Emergent, Not Preventable	Injury
	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)	Estimate (S.E.)
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

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