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The impact of near-universal insurance coverage on breast and cervical cancer screening: Evidence from Massachusetts

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Abstract

This paper investigates the effect of expansion to near-universal health insurance coverage in Massachusetts on breast and cervical cancer screening. We use data from 2002 to 2010 to compare changes in receipt of mammograms and Pap tests in Massachusetts relative to other New England states. We also consider the effect specifically among low-income women. We find positive effects of Massachusetts health reform on cancer screening, suggesting a 4 to 5% increase in mammograms and 6 to 7% increase in Pap tests annually. Increases in both breast and cervical cancer screening are larger 3 years after the implementation of reform than in the year immediately following, suggesting there may be an adjustment or learning period. Low-income women experience greater increases in breast and cervical cancer screening than the overall population; among women with household income less than 250% of the federal poverty level mammograms increase by approximately 8% and Pap tests by 9%. Overall, Massachusetts health reform appears to have increased breast and cervical cancer screening, particularly among low-income women. Our results suggest reform was successful in promoting preventive care among targeted populations.

Keywords

health insurance; Massachusetts; breast cancer; cervical cancer; screening; prevention

1. Introduction

Morbidity and mortality from both breast and cervical cancer can be reduced through screening, leading to early detection and treatment (Hartmann et al. 2002; Nelson et al. 2009). Breast cancer is the second leading cause of cancer death among US women (Howlader et al. 2012), and cervical cancer is one of the few cancers that could be practically eliminated with screening and early treatment, yet remains prevalent. While mortality rates have fallen over recent decades due to improved screening and treatment, these benefits are not distributed equally across the population. There are substantial disparities in breast and cervical cancer diagnosis, treatment, and outcomes in the US by socioeconomic and insurance status (Ross et al. 2006). One of the primary factors impeding

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access to recommended screening among underserved populations is lack of health insurance coverage (Schueler et al. 2008; Shi et al. 2011). Nonetheless, recent evidence suggests that newly covered low-income women may not make use of their health insurance and may not understand their coverage (Allen et al. 2014). Understanding how insurance coverage affects the use of preventive care services has important implications for coverage expansions under US health reform.

In 2006, the state of Massachusetts passed a comprehensive health reform law, implemented between 2006 and 2008, with the goal of providing health insurance to nearly all state residents. This significant policy change presents an opportunity to examine the effects of a substantial increase in health insurance coverage on important measures of cancer prevention in women. Given that cancer screening rates are lower among women of lower socioeconomic status nationally (CDC 2012) and low-income populations were more likely to gain coverage through health reform, increases in coverage may be expected to increase screening among low-income women. Even among those that had health insurance coverage before reform, the standardization of benefits under reform may increase the use of healthcare services if individuals have more services covered or face lower out of pocket costs post reform. Low-income individuals enrolled in government subsidized plans under the reform receive first dollar coverage for preventive care.¹ Those with private insurance could have copayments for preventive care under Massachusetts reform, but deductibles cannot apply to preventive services post-reform.² These changes along the intensive coverage margin (to more generous benefits) may also improve rates of screening for women in Massachusetts.

This paper contributes to the literature on the effects of Massachusetts health reform on preventive care, and the small literature examining effects of coverage expansions on breast and cervical cancer screening (Busch and Duchovny 2005; Finkelstein et al. 2012; Kolstad and Kowalski 2012; Keating et al. 2013). We consider the effect of health reform in Massachusetts on breast and cervical cancer screening within a quasi-experimental empirical framework, using other New England states as controls. We also consider effects specifically among low-income populations. We find a positive effect of reform on cancer screening, with the largest increases among low-income women, suggesting that coverage expansions can increase important preventive care measures among low-income populations.

2. Background

2.1 Massachusetts health reform

The 2006 Massachusetts Health Care Insurance Reform Law aimed to provide universal health care coverage through a combination of mandates, subsidies, and public insurance expansions (Gruber 2008). Under the law, individuals who do not have health insurance

¹Massachusetts Medicaid did not require any out-of-pocket payment for preventive services before or after implementation of health reform.

²Under the Affordable Care Act most private plans are required to cover breast and cervical cancer screening without cost-sharing. While the law was passed in 2010, these guidelines took effect after our study period and applied to both Massachusetts and control states.

coverage meeting minimum coverage standards and employers who do not provide employee health insurance are subject to tax penalties. In addition, government subsidized insurance, known as the Commonwealth Care Health Insurance Program, provides coverage for adults under 300% of the Federal Poverty Level (FPL) who do not have another source of insurance, including fully subsidized plans for those below 150% FPL. The law also established the Commonwealth Health Connector Authority, a state insurance exchange that offers standardized private health insurance plans. The Massachusetts law served as a model for many of the key provisions of the federal Affordable Care Act (ACA), including insurance exchanges, market reforms, Medicaid expansions, and coverage subsidies.

Health reform in Massachusetts could be expected to increase preventive care since more individuals have insurance coverage for such services. On the other hand, there is concern that constraints on physician capacity may limit access. A survey of physicians in Massachusetts post-expansion identified concerns over increases in patient waiting times for appointments, decreases in the amount of time physicians can spend with patients, and patients' ability to see primary care physicians (SteelFisher et al. 2009). Further, coverage may not guarantee access if the newly insured are not able to navigate the healthcare system (Allen et al. 2014), or if they face other, non-insurance related barriers to access.

Research has firmly established that the Massachusetts reform expanded coverage to almost all individuals in the state, with coverage increasing from less than 87 percent in 2006 to over 94 percent in 2010 (Long 2009; Long et al. 2012). In addition to increasing rates of coverage (the extensive coverage margin), provisions in the reform mandated that plans meet minimum creditable coverage (MCC) requirements to fulfil the coverage mandate. These requirements included a comprehensive benefit package and a maximum on out-of-pocket spending, as well as specific provisions that preventive care must be covered without being subject to an out-of-pocket deductible (Massachusetts Health Connector, 2008). Surveys of employees in Massachusetts showed significant increases in employee satisfaction with the range of services, choice of doctors, and quality of care available under their employer-sponsored health insurance plans in the years after reform was implemented. This may reflect firms expanding insurance benefit packages to comply with MCC requirements (Long and Stockley 2009). Further, rates of underinsurance (defined based on out-of-pocket healthcare spending as a percentage of family income for an insured individual) fell after reform, particularly among low-income adults (Long 2008). Thus, even among those with insurance before and after reform, there may be improvements in coverage generosity (the intensive coverage margin) due to reform that could impact access to and quality of care. Early research showed improvements in some access measures but persistent reports of difficulty obtaining care because providers would not accept new patients, particularly among low-income individuals (Long and Masi 2009; Long and Stockley 2010). Nonetheless, Kolstad and Kowalski (2012) find evidence of reduced hospitalizations for preventable conditions, and Miller (2012a) finds declines in emergency room visits. Taken together results generally suggest positive effects of reform on primary care and prevention (Miller 2012b).

Only a small number of studies have considered the effect of Massachusetts reform on cancer screening. Clark et al. (2011) compared screening rates before and after health reform

and did not find any change in breast or cervical screening rates. We interpret these results with caution given that the study lacked a comparison group, considerably weakening the possibility of a causal interpretation. Screening rates may have changed relative to the counterfactual of what rates would have been in the absence of health reform. Keating et al. (2013) compare mammography rates before and after Massachusetts reform relative to rates in California and do not find increases in mammography. Their study was limited by the short time period considered pre- and post-reform and the choice of California, which differs from Massachusetts in geography and population demographics, as a control state. Kolstad and Kowalski (2012) also found that Massachusetts health reform had no effect on mammogram use. However, their post-reform two-year time frame may have been too short to observe changes in screening behavior.

Our paper expands existing evidence on the effect of Massachusetts reform on women's cancer screening by considering a longer timeframe (pre- and post-reform), examining both breast and cervical cancer screening, and estimating models for different income groups to investigate whether effects differ for women who were most likely to gain coverage following reform.

2.2 Breast and cervical cancer screening and insurance coverage

Key organizations that issue guidelines on breast and cervical cancer screening include the American Society of Obstetricians and Gynecologists, the American Cancer Society, and the US Preventive Services Task Force. Table 1 presents guidelines from these organizations and shows that for most of our study period, mammograms were generally recommended yearly or every 1 to 2 years and Pap tests were recommended every year to every 3 years. In 2003, major guidelines changed from recommending routine annual cervical cancer screening to suggesting that screening could be less frequent in older women with multiple consecutive negative screening tests. As these guidelines were adopted during our study period we expect a potential decline in annual screening rates across all states. Importantly, it is standard for major insurers, including Medicaid and private insurers, to reimburse for both screenings on an annual basis, despite changes in some guidelines suggesting longer screening intervals³ (United Healthcare 2014; Aetna 2013; Pace et al 2013; Kaiser Family Foundation 2012), providing no incentive for physicians to deviate from annual screening recommendations (Han et al. 2011).

In addition to the potential improvements in health outcomes due to breast and cervical cancer screening, these tests are an important indicator of access to preventive services. Cancer screening may differ from general measures of healthcare access (such as having a usual source of care or a primary care visit) since it requires interaction with the healthcare system that is not precipitated by a health condition. Cancer screening is a key indicator of preventive health care utilization and patient understanding of the healthcare system and insurance, as well as investment in health. Screening may also involve non-monetary costs to the patient (e.g. time away from work when healthy, psychological distress from

³This continued to be the case in 2014 under the Affordable Care Act.

undergoing testing, etc.) that differ from those necessary for care in response to an acute or chronic condition.

Estimating the impact of health reform on breast and cervical cancer screening is also of interest because these services are covered by the National Breast and Cervical Cancer Early Detection Program (NBCCEDP), a targeted public program for individuals at or below 250% FPL who would otherwise not have access to such services. Evidence on the program suggests limited ability to reach the targeted populations. Between 2004 and 2006, fewer than 10% of eligible women received cervical cancer screening through the NBCCEDP nationwide (Tangka et al. 2010). The NBCCEDP is likely to dampen the effect of Massachusetts health reform on breast and cervical cancer screening relative to other measures of preventive care. Evidence of increases on screening despite the existence of the program pre-reform would suggest that near-universal coverage is more effective at increasing utilization of screening services than a stand-alone program with limited resources.

Our study adds to a small number of quasi-experimental or experimental studies from other US states considering the effects of insurance coverage on breast and cervical cancer screening. While cross-sectional studies show that insurance is associated with higher screening rates (Schueler et al. 2008; Shi et al. 2011), they are unable to control for selection into insurance. We know of two studies examining policy changes that exogenously increase health insurance coverage, both of which find significant positive effects of insurance on screening. Research on Medicaid expansions in the 1990's found a positive effect of early eligibility expansions on both breast exams and Pap tests (Busch and Duchovny 2005). The Oregon Medicaid experiment, which randomly assigned low-income adults to Medicaid eligibility, found large and statistically significant increases in both mammograms and Pap tests after one year of coverage (Finkelstein et al. 2012).

3. Methods

We use data from the Behavioral Risk Factor Surveillance System (BRFSS) between 2002 and 2010 to study use of mammograms among women 50 to 64 years of age and Pap tests among women 21 to 64 years of age who have not undergone a hysterectomy. The BRFSS is a cross-sectional telephone survey conducted annually in each state that collects data on demographics, healthcare coverage and access, health behaviors and preventive care. The women's health module, which includes questions on breast and cervical cancer screening, is fielded nationally every two years. Thus, we use data from 2002, 2004, 2006, 2008 and 2010 in our main analyses.⁴ We use data on length of time since last mammogram or Pap test to study changes in breast and cervical cancer screening. In our main analyses we consider whether a woman reports having had a mammogram or Pap test in the past year, since this aligns with most major guidelines in place for the majority of our study period, insurers reimburse for annual screening, recall is better over a shorter time period, and changes in annual screening are easier to detect with a limited post-reform period.

⁴Some states include the women's health module in odd years, when it is not fielded nationally. Among New England states, Rhode Island included these questions in 2001 and Vermont included them in 2003 and 2005. When we include all available data for these states from 2001 – 2010 our results do not change.

We estimate difference-in-difference (DD) models comparing changes in cancer screening in Massachusetts before and after health reform to changes in other New England states. Comparison states include Connecticut, Maine, New Hampshire, Rhode Island, and Vermont, a set of states that are likely to be similar to Massachusetts, facing the same regional shocks, and that have been used as a comparison group in other studies (Zhu et al. 2010).⁵

We estimate DD regressions of the form:

$$Y_{ijt} = \beta_0 + \beta_1 X_{ijt} + \gamma_i + \tau_t + \beta_2 (MASS_j \times REFORM_t) + \beta_3 (MASS_j \times POST_t) + \varepsilon_{ijt},$$

where i indexes individuals, j indexes states, and t indexes years. Y_{ijt} represents a screening outcome of interest. We also estimate DD models with health insurance coverage as the dependent variable to understand the reform driven changes in coverage for each of our samples. $MASS_j$ is a dummy variable that is equal to one for women in Massachusetts; $REFORM_t$ is a dummy variable equal to one for the period from April through December 2006, the period for which we have data from the time health reform was passed in Massachusetts through when major provisions began to be implemented; and $POST_t$ is a dummy variable equal to one for 2008 onwards, after the reform was fully implemented.⁶ The X term represents a vector of demographic covariates, including age, marital status (married vs. not married), education (in six categories ranging from kindergarten or less to college graduate), employment status (employed vs. unemployed or not in the workforce), household income (in eight categories ranging from less than \$10,000 to \$75,000 or more), and race. The term γ_j represents a set of state fixed effects and τ_t represents year fixed effects. The term ε_{ijt} is a random error term. The coefficient of interest is β_3 , the DD estimate. We estimate linear probability models for ease of interpretation and to avoid issues with interaction terms in non-linear models (Ai and Norton 2003). We employ survey weights that account for the BRFSS complex sampling design using survey commands (prefix svy) in Stata for all models.⁷

We also estimate models replacing the $MASS_j \times POST_t$ term with separate interactions of the Massachusetts indicator with indicators for 2008 and 2010. This divides the post-reform period into early and later periods to estimate whether the immediate effects approximately one year after all provisions of reform were fully implemented were different from effects approximately three years after reform was fully implemented.⁸ In addition, we stratify the

⁵In models using all US states as a control group, results are very similar to those based on a control group of New England states. Results available upon request.

⁶We do not use data from 2007, thus it is not assigned to either period. We test alternate implementation periods, since patients and providers may have changed their behavior in anticipation of implementation, though effects were more likely to be seen once implementation began and effects among low-income individuals are more likely to be seen after expansion of coverage to this population. In our baseline analysis we define the implementation period as beginning when reform was passed as this represents a conservative definition of the pre-period that is less likely to be contaminated by anticipation of reform provisions. Results (available upon request) are very similar to baseline findings when we estimate alternate specifications of the implementation period, coding the REFORM variable as July through December 2006, indicating when implementation began as opposed to when the law was passed, and as October through December 2006, indicating when Commonwealth Care began enrollment.

⁷In an alternate sets of models we do not employ survey commands and cluster standard errors at the state level, both with and without person weights specified in the regressions. The coefficients from these models are very similar to the results presented here though the standard errors are smaller suggesting highly statistically significant results across both mammogram and Pap test models. We present the more conservative results using the full set of survey weight variables here.

sample by household income, using four groups defined as a percent of FPL to compare the effect between groups facing different eligibility thresholds both before and after reform. Specifically, we first consider women with income less than 250% FPL (who were eligible for NBCCEDP if they were uninsured or underinsured). We then stratify the entire sample by income according to the provisions of Massachusetts reform, estimating separate models for those with income less than 150% FPL (who qualified for free health insurance after reform), those with income from 150% to 300% FPL (who qualified for subsidized health insurance), and women above 300% FPL (who were subject to mandates and insurance market reforms, but not eligible for subsidized coverage).

We are interested in the overall effect of reform on screening. Therefore, we do not include healthcare access related variables in our primary models because these variables represent mechanisms potentially driving the change we want to estimate. Our core set of models estimate the full effect of Massachusetts health reform, including both the intensive and extensive coverage margins. As a secondary analysis to consider the role of two potentially important mechanisms for improving access to screening under reform, we also estimate models including an indicator for whether the individual reports having insurance⁹ and models with an indicator for when the individual reports having a personal doctor or health care provider.¹⁰ Comparing estimates from models with and without a control for whether the individual has health insurance approximates the relative contribution of changes in having any coverage (the extensive margin) versus changes in the generosity of coverage (the intensive margin) as a result of MCC requirements and other market reforms under the law. Further, improvements in access to preventive care could be driven by patients establishing relationships with primary care providers who recommend such care or could result from more ad hoc encounters with the health care system. We explore this potential mechanism by controlling for whether the individual has a personal doctor.

We estimate alternate models to test the robustness of our results. We consider mammography within the past two years and Pap test within the past three years, consistent with USPSTF guidelines in place for much of our study period. We also run a falsification test to assess whether our results may be driven by preexisting differential trends in Massachusetts and the control states. We estimate models similar to our main specification but restricting the sample to those observations before reform was implemented (years 2002, 2004 and 2006) and replacing the $MASS_j \times REFORM_t$ and $MASS_j \times POST_t$ terms with the variable $MASS_j \times PLACEBO_t$, where $PLACEBO_t$ is a dummy equal to one in 2006, the year before reform was implemented.

⁸While we consider 2008 to be the first year that reform was fully implemented, Commonwealth Care began enrolling individuals with income below 300% FPL in October 2006, allowing a longer time period for lower-income individuals to respond to coverage.

⁹BRFSS asks respondents whether they have any kind of health care coverage, but does not distinguish between different types of coverage or ask about changes in coverage over the previous year. Thus we are able to control for whether the person has any coverage at the time of the interview but cannot account for changes in coverage or type of coverage.

¹⁰In addition, we consider 2-stage least squares (2SLS) instrumental variables (IV) models using the interaction terms $MASS_j \times REFORM_t$ and $MASS_j \times POST_t$ as instruments for having insurance coverage. This analysis estimates the impact of the extensive margin of having any insurance coverage on screening, using changes in state policy to identify exogenous changes in coverage. For the IV analysis to be unbiased, the Massachusetts reform must be correlated with coverage, but not correlated with the error term (e.g. not affect screening except through coverage changes). We do not present these results here since our main results suggest that changes in screening are not driven entirely by changes in the extensive coverage margin.

4. Results

4.1 Descriptive statistics

Table 2 reports survey-weighted descriptive statistics. Panel A summarizes outcomes and demographics among mammography eligible women. The annual and biennial mammography rates in Massachusetts increase by 2.0 percentage points ($p = 0.11$) and 0.7 percentage points ($p = 0.44$), respectively, but neither increase is statistically significant. In contrast, both annual and biennial screening rates decrease slightly in control states, and again the differences are not statistically significant. Turning to the sample demographics, the average age of women in the sample was 56 years. Across states and time periods, more than 60% of women are married, two-thirds to three quarters are employed, about a quarter are high school graduates with no college, another quarter have some college, and approximately 45% are college graduates. Between 14 and 18% of women in each sample come from households with annual income less than \$25,000. The vast majority of women in each category are white.

Panel B presents outcomes and demographics for Pap test eligible women. Annual Pap test rates decrease for both the Massachusetts and control samples, with a decline of 1.5 percentage points ($p = 0.08$) in Massachusetts and 6.3 percentage points ($p < 0.001$) in other New England states. The 3 year screening rate does not change significantly in Massachusetts post-reform but declines in control states by 1.4 percentage points ($p < 0.001$). On average women in the sample are approximately 40 years of age. Across states and time periods, more than half are married and more than 70% are employed. Education, income and race distributions are similar to those for the mammography sample.

4.2 Regression estimates of insurance coverage changes

Table 3 presents results from DD regressions with an indicator of whether the respondent reported having any insurance coverage as the outcome. We estimate this model for both the mammogram and Pap test eligible samples, overall and stratified by income. Columns (1) and (4) show that there were significant increases in coverage overall, representing about a 4.6% increase in coverage over baseline Massachusetts rates (reported in Table 3) for the older women in the mammography sample and a 3.1% increase for the younger women in the Pap test sample. Increases are highest for the group with income under 150% FPL, who were substantially less likely to have coverage before and qualified for fully subsidized public coverage after the reform. The low income groups experienced 25.7% and 12.2% increases in coverage due to reform for the mammogram and Pap test samples, respectively. We also see increases in coverage for the low-income group earlier, during the reform implementation period, likely due to the fact that the enrollment of individuals with incomes below 300% FPL in Commonwealth Care began in October 2006 before many other provisions of the reform.

4.3 Full sample screening regression results

Table 4 presents estimates of the effect of reform on cancer screening, including DD estimates for receipt of mammograms and Pap tests in the past year. The mammography DD estimate, MA*post in column (1), is positive and marginally statistically significant ($p =$

0.105). The specification in column (2) includes separate terms for the year 2008 (immediately following full implementation of reform) and the year 2010 (approximately 3 years post reform). Both coefficients are positive. The effect immediately following reform is small and insignificant, while in 2010 we see a larger and statistically significant increase in mammography, with rates approximately 4 percentage points higher in 2010 than before reform. This implies approximately a 5% increase in mammography in Massachusetts in 2010 relative to pre-reform rates.

Results for Pap tests in the past year are presented in columns (3) and (4) of Table 4. The overall DD estimate in column (3) suggests a statistically significant increase in annual Pap tests of approximately 5 percentage points. The coefficient implies that the rate of annual Pap tests increased by over 6% relative to pre-reform rates in Massachusetts. In column (4) we see statistically significant increases both immediately following reform and in 2010. The point estimate suggests the increase is larger in the latter period, but the coefficients on the two years are not statistically significantly different from each other.

4.4 Results by income level

Panel A of table 5 reports estimates from models of mammography use in the past year similar to column (1) in Table 4, but by household income as a percentage of FPL. We first consider women with household incomes less than 250% FPL, which is the income threshold for NBCCEDP screening eligibility. Compared to women of the same income group in other New England states, women in Massachusetts with income less than 250% FPL experienced an increase in mammography of approximately 6 percentage points ($p = 0.092$). Among women with income less than 150% FPL (who qualified for free health insurance after reform) and women above 300% FPL (who were subject to mandates and insurance market reforms, but not eligible for subsidized coverage) we do not see an increase in screening. The increase in mammography is driven by those with incomes 150% to 300% FPL (who qualified for subsidized health insurance after reform), for whom the effect of reform is a 7 percentage point increase ($p = 0.060$) in mammography.

Panel B reports estimates from models using the same income groups for the cervical cancer screening sample. There are significant increases in Pap tests across all income groups, with the largest increase among lower-income groups. Among women with income less than 250% FPL, rates of cervical cancer screening increased 6 percentage points ($p = 0.007$). When we stratify by income, women who qualified for free or subsidized coverage under health reform experienced larger increases (6 percentage points) than those who were not eligible for subsidized coverage (4 to 5 percentage points).

4.5 Potential mechanisms

Table 6 reports estimates from models of mammography or Pap test in the past year for the full sample and by income group, including an indicator for whether the individual reports having insurance coverage in one set of models and an indicator for when the individual reports having a personal doctor or health care provider in another. Panel A reports results for mammography. When we include a control for health insurance (column 1) or a personal doctor (column 6), the effect of each of these variables is large and statistically significant.

When controlling for insurance, the coefficient on $MASS_j \times POST_t$ (the DD estimate) remains positive, is smaller than in column (1) of Table 4 and is insignificant. Controlling for whether the individual has a personal doctor does not substantially change the coefficient for the full sample. In general coefficients remain positive, but statistically insignificant, with the exception of the 150 to 300% FPL group, for which we continue to see a marginally significant increase in mammography of approximately 6 percentage points even after controlling for insurance coverage.

Panel B presents similar models for the cervical cancer screening samples. When we control for health insurance in the full sample (column 1), the DD estimate is reduced somewhat, but there remains a statistically significant 4 percentage point increase in screening. Among low-income women (columns 2 and 3) the DD estimates are reduced when we control for insurance coverage. As with mammography, controlling for whether the individual has a personal doctor does not appreciably change the DD estimates.

Comparing the estimates in Table 6 that control for whether the individual reports having health insurance coverage to estimates from Tables 4 and 5 that do not control for insurance (and estimate the overall effect of reform on screening) may shed light on the role of coverage increases under the reform. First, the results imply that the extensive coverage margin is more important for lower income populations than for higher income populations that were more likely to have insurance before reform. For example, considering the Pap test DD estimates, comparing the coefficients from models with and without a control for insurance suggests that in the overall population the extensive margin explains approximately 12% ($1 - 0.0414/0.0472$) of the overall effect of reform, while the corresponding figure is 31% ($1 - 0.0449/0.0647$) for those under 150% FPL and only 3% ($1 - 0.0423/0.0438$) for those over 300% FPL. Second, the extensive margin explains a relatively small proportion of the overall effect.

4.6 Robustness checks

We also consider mammography within the past two years and Pap test within the past three years, consistent with alternate sets of guidelines.¹¹ Results for both remain positive, but statistical significance of some results is reduced (appendix tables A1 and A2). We continue to see a significant increase in cervical cancer screening in the full sample after reform when using the alternate time interval.

When we test for differences in pre-trends by replacing our DD coefficients with a placebo term testing for differences in Massachusetts in 2006 versus earlier years, coefficients on the $MASS_j \times PLACEBO_t$ term are small and insignificant. This falsification test result is consistent for receipt of mammography at 1 and 2 year intervals and Pap tests at 1 and 3 year interval (see appendix Table A3). These results indicate that the increase in screening in Massachusetts post-reform does not appear to be driven by differential trends before reform.

¹¹Note that for multiple year screening intervals the reference periods can overlap the pre-period or implementation period depending on the year and outcome. For example, for the outcome Pap test in the past three years, women surveyed in 2008 are reporting on a period spanning 2005-2008, most of which fell during the pre-period or implementation period.

5. Discussion

Massachusetts health reform represented a landmark state effort to increase health insurance coverage and improve the health of state residents. While the reform was successful in substantially increasing health insurance coverage, evidence on the effects of this coverage expansion is still accumulating. We consider the effect of Massachusetts reform on two key measures of women's preventive health care: breast and cervical cancer screening. Earlier studies based on simple pre- and post-reform comparisons or using fewer years of data did not find evidence of increased rates of screening (Clark et al. 2011; Kolstad and Kowalski 2012; Keating et al. 2013). In contrast, we use a longer post-period in a quasi-experimental framework and find evidence of increases in screening. This is especially true of cervical cancer screening, which has only been examined in the context of Massachusetts reform in one prior study (Clark et al. 2011). We also find some evidence of increased breast cancer screening. We find evidence of significant increases in annual mammography in 2010, after reform had been fully implemented for approximately three years, and marginally significant increases for some groups of low-income women who were more likely to face barriers to screening pre-reform.

We find a larger increase in cervical cancer screening than breast cancer screening, perhaps reflecting differences in the complexity of the test or the populations recommended to receive each. The difference across the two outcomes may also be due to differences in the process for accessing the two services: cervical cancer screening can be done as part of a routine visit, while mammography is likely to require a referral and separate appointment.¹² We also find that for annual breast and cervical cancer screening, the effect is stronger approximately 3 years after the implementation of reform than in the year immediately following, with estimates suggesting a 5% increase in breast cancer screening and 7% increase in cervical cancer screening in 2010 relative to pre-reform. This suggests there may have been a period of adjustment or learning among individuals who are newly covered or have had changes to their health insurance as they establish contact with providers and a regular care routine, or there may have been a wait time to see providers that led to a lag in the effect of reform on preventive care.

The effect of reform on screening is largest among low-income women, suggesting that reform is improving prevention among this underserved population that was more likely to be uninsured before the implementation of health reform. We see statistically significant positive effects of reform even among those women in the income eligibility range for the NBCCEDP, suggesting that near-universal coverage may be more effective at promoting preventive care than a targeted program specific to two types of cancer screening in a limited population. When we account for potential mechanisms we find that the extensive insurance coverage margin plays the largest role for low-income populations, though explains a relatively small proportion of our overall estimates of the effect of reform on

¹²We attempt to examine this by controlling for whether a woman reports having a regular personal doctor, and this does not affect our DD estimates for either breast or cervical cancer screening. A more appropriate indicator might be whether the woman had a routine well-visit in the previous year; unfortunately this variable is not available in the BRFSS for most of our pre-period.

cancer screening. We do not find evidence that having a personal doctor is an important mechanism driving screening behavior.

Our results are in line with earlier research that found positive effects of Medicaid insurance expansions on breast and cervical cancer screening in other contexts. Research on Medicaid expansions in the 1990's found that a 10 percentage point increase in Medicaid eligibility led to a 0.54 percentage point increase in Pap test rates, which implies that about 29% of the target population received a Pap test as a result of expansions. Results are similar for breast exams, though we do not examine that particular outcome (Busch and Duchovny 2005). Results from the first year of the Oregon Medicaid experiment showed a 45% increase in the probability of having a Pap test within the last year and a 60% increase in the probability of having a mammogram within the past year (for women age 40 and over) (Finkelstein et al. 2012). While we are unable to isolate the effect among those newly gaining coverage in order to directly compare our estimates, we see large increases in screening relative to the magnitude of coverage increases across income groups. For example, we estimate a 2.9 percentage point increase in coverage and a 4.7 percentage point increase in cervical cancer screening overall, with the largest effects for both among low income women. For women with income less than 150% FPL we estimate a 9.8 percentage point increase in coverage and a 6.5 percentage point increase in screening.

This study faces a few limitations. First, while self-reported measures of women's cancer screening in the BRFSS have been validated (Zapka et al. 1996; Caplan et al. 2003) there is still likely to be some error in recall, particularly with periods beyond one year. In addition, the BRFSS does not include information on type of health insurance coverage, only whether the individual had any coverage, precluding analyses of particular insurance types. Further, BRFSS response rates vary across states and are low for some states and years. Finally, the experience in Massachusetts may not be generalizable to insurance expansions in other states. Yet, a finding of increased screening in a state with high baseline rates of coverage and screening suggests the potential for a similar or larger impact in states with lower baseline rates.

Our results also offer lessons for the ACA. Our findings suggest that expanding health insurance coverage through a combination of market reforms and subsidies may lead to improved preventive care for women, though the effects may not be seen immediately. We find an effect that builds over time, potentially due to learning or to waiting periods for care. Future research should examine whether the effect continues to increase, since the data we use cover only three years after the full implementation of reform. An additional avenue for future research is to explore the effects of reform on related health outcomes, including stage at cancer diagnosis and incidence of advanced stage cancers. Increases in screening should detect disease at earlier stages, leading to improvements in health outcomes and potential cost savings. Our results suggest that universal coverage has a positive effect on preventive healthcare for women and is effective at increasing cancer screening and targeting populations that have traditionally been underserved.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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The Virginia Commonwealth University IRB determined that this study qualified for exemption.

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Table 1

Screening mammography and Pap test guidelines, 2002-2010

A. Mammography Guidelines		
Organization	Years	Mammography Guidelines
American College of Obstetrics and Gynecologists	2003 - 2011	<ul style="list-style-type: none"> • Women ages 40-49 should have screening mammography every 1-2 years • Women ages 50 years and older should have annual screening mammography
	2002 - 2003	<ul style="list-style-type: none"> • Mammography should be performed every 1-2 years for women ages 40-49 years and then annually thereafter
American Cancer Society	2003 onward	<ul style="list-style-type: none"> • Yearly mammograms starting at age 40, continuing as long as a woman is in good health
	2002 - 2003	<ul style="list-style-type: none"> • Yearly mammograms starting at age 40
US Preventive Services Task Force	2009 onward	<ul style="list-style-type: none"> • Mammograms every 2 years for women ages 50-74 • Decision to get regular mammograms before 50 should be based on a personal assessment of harms and benefits
	2002 - 2009	<ul style="list-style-type: none"> • Women ages 40 and over get routine screening for breast cancer every 1 to 2 years
B. Pap Test Guidelines		
Organization	Years	Pap Test Guidelines
American College of Obstetrics and Gynecologists	2009 - 2012	<ul style="list-style-type: none"> • Screening should begin at age 21 regardless of age at onset of sexual activity • Screening from ages 21-29 is recommended every 2 years • Women ages 30 years and older who have had 3 consecutive negative screens and are low-risk may be tested every 3 years
	2003 - 2009	<ul style="list-style-type: none"> • Annual cervical cytology screening should begin approximately 3 years after initiation of sexual intercourse, but no later than 21 years • Women ages 30 years and older who have had 3 consecutive negative cervical cytology screening test results and are low-risk may extend the interval between screenings to every 2-3 years
	2002 - 2003	<ul style="list-style-type: none"> • Yearly Pap test for women who are sexually active or who are 18 years of age • After 3 or more consecutive, satisfactory annual cytologic exams, Pap test may be performed less frequently on low-risk women at the discretion of her physician
American Cancer Society	2003 - 2012	<ul style="list-style-type: none"> • Yearly Pap test for those 21 and over or within 3 years after first intercourse (or every 2 years with liquid-based test) • Age 30 and over, screening can be every 2 to 3 years after 3 consecutive normal results
	2002 - 2003	<ul style="list-style-type: none"> • Yearly Pap test for women age 18 and over or sexually active • Less frequently at discretion of doctor after 3 consecutive normal exams
US Preventive Services Task Force	2003 - 2012	<ul style="list-style-type: none"> • Begin screening within 3 years of onset of sexual activity or age 21 years (whichever comes first) and screening at least every 3 years
	2002 - 2003	<ul style="list-style-type: none"> • Begin screening with the onset of sexual activity and screening at least every 3 years

Table 2

Descriptive statistics for mammogram and Pap test samples

Panel A. Mammography sample				
	Massachusetts		New England control states	
	Pre-reform and implementation	Post-reform	Pre-reform and implementation	Post-reform
Unweighted N	3,527	5,984	10,534	11,443
Weighted N	1,350,617	1,064,416	1,727,512	1,400,908
<u>Outcomes</u>				
Mammogram in past year	75.8%	77.8%	72.7%	72.1%
Mammogram in past two years	88.6%	89.3%	86.0%	85.8%
<u>Basic demographics</u>				
Age	56.1 (0.10)	56.1 (0.08)	56.1 (0.05)	56.2 (0.06)
Married	64.2%	67.02%	66.4%	69.2%
Employed	68.6%	73.50%	70.4%	71.0%
Insured	93.8%	96.87%	92.8%	92.5%
<u>Education</u>				
Less than 1st grade	0.0%	0.1%	0.1%	0.0%
Less than 9th grade	2.0%	1.7%	1.3%	0.7%
Some high school	3.7%	2.6%	3.2%	2.4%
High school grad	24.0%	20.0%	28.7%	25.1%
Some college	24.9%	25.4%	26.0%	25.6%
College grad	45.2%	50.2%	40.8%	46.2%
<u>Household Income</u>				
Less than \$10,000	4.2%	2.8%	3.5%	2.8%
\$10,000-\$14,999	3.8%	2.8%	3.2%	2.7%
\$15,000-\$19,999	3.7%	3.7%	4.6%	3.6%
\$20,000-\$24,999	5.9%	5.8%	6.1%	5.0%
\$25,000-\$34,999	8.7%	7.5%	10.9%	7.8%
\$35,000-\$49,999	15.0%	12.1%	16.5%	13.8%
\$50,000-\$74,999	21.2%	17.5%	22.0%	20.3%
\$75,000 or more	37.6%	47.8%	33.3%	44.1%
<u>Race/Ethnicity</u>				
White, non-Hispanic	92.5%	87.4%	93.6%	92.7%
Black, non-Hispanic	1.9%	4.0%	2.2%	2.4%
Asian, non-Hispanic	0.5%	1.2%	0.4%	0.8%
Hawaiian or Pacific Islander, non-Hispanic	0.0%	0.1%	0.0%	0.1%
American Indian or Alaskan Native, non-Hispanic	0.4%	0.5%	0.6%	0.5%

Panel A. Mammography sample				
	Massachusetts		New England control states	
	Pre-reform and implementation	Post-reform	Pre-reform and implementation	Post-reform
Other, non-Hispanic	0.5%	1.3%	0.3%	0.4%
Multiracial, non-Hispanic	0.7%	0.6%	0.5%	0.6%
Hispanic	3.5%	5.1%	2.5%	2.6%
Panel B. Pap test sample				
	Massachusetts		New England control states	
	Pre-reform and implementation	Post-reform	Pre-reform and implementation	Post-reform
Unweighted N	9,514	11,483	25,360	19,535
Weighted N	4,479,356	3,071,763	5,308,530	3,597,204
<u>Outcomes</u>				
Pap test in past year	76.6%	75.1%	75.8%	69.5%
Pap test in past three years	93.2%	93.3%	92.9%	91.5%
<u>Basic demographics</u>				
Age	40.1 (0.18)	41.9 (0.17)	40.5 (0.10)	42.1 (0.15)
Married	60.8%	64.7%	62.2%	66.6%
Employed	71.7%	75.6%	73.9%	73.4%
Insured	93.1%	96.5%	90.3%	91.3%
<u>Education</u>				
Less than 1st grade	0.1%	0.1%	0.1%	0.0%
Less than 9th grade	1.5%	1.2%	0.8%	0.7%
Some high school	3.3%	2.8%	3.0%	2.7%
High school grad	19.6%	17.4%	24.7%	20.9%
Some college	24.9%	23.8%	27.1%	25.6%
College grad	50.7%	54.7%	44.3%	50.1%
<u>Household Income</u>				
Less than \$10,000	3.8%	2.7%	3.0%	3.0%
\$10,000-\$14,999	3.4%	2.3%	3.1%	2.8%
\$15,000-\$19,999	4.5%	4.2%	4.9%	3.9%
\$20,000-\$24,999	6.0%	6.2%	6.7%	5.4%
\$25,000-\$34,999	8.6%	6.8%	10.7%	7.6%
\$35,000-\$49,999	13.8%	11.3%	16.4%	12.9%
\$50,000-\$74,999	21.3%	17.1%	21.0%	19.4%
\$75,000 or more	38.7%	49.5%	34.1%	45.1%
<u>Race/Ethnicity</u>				
White, non-Hispanic	85.3%	80.6%	88.1%	87.2%
Black, non-Hispanic	3.3%	4.5%	3.5%	2.7%

Panel B. Pap test sample				
	Massachusetts		New England control states	
	Pre-reform and implementation	Post-reform	Pre-reform and implementation	Post-reform
Asian, non-Hispanic	2.5%	2.9%	1.4%	2.3%
Hawaiian or Pacific Islander, non-Hispanic	0.1%	0.2%	0.1%	0.1%
American Indian or Alaskan Native, non-Hispanic	0.3%	0.6%	0.6%	0.4%
Other, non-Hispanic	0.8%	1.8%	0.6%	0.6%
Multiracial, non-Hispanic	0.6%	1.0%	0.6%	0.9%
Hispanic	7.1%	8.6%	5.2%	5.8%

Notes: All figures represent weighted percentages or means with linearized standard errors in parentheses for continuous variables.

Table 3

Regression results for health insurance coverage by income group

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Full sample	Mammogram sample <150fpl	150-300fpl	>=300fpl	Full sample	Pap test sample <150fpl	150-300fpl	>=300fpl
* Mass reform	0.0158 (0.0120)	0.157*** (0.0582)	0.00607 (0.0325)	-0.00838 (0.0102)	0.00464 (0.00881)	0.0132 (0.0342)	0.0142 (0.0219)	0.000373 (0.00783)
* Mass post	0.0435*** (0.00866)	0.201*** (0.0472)	0.0322 (0.0216)	0.0145** (0.00640)	0.0292*** (0.00669)	0.0984*** (0.0277)	0.0228 (0.0141)	0.00672 (0.00541)
Mass baseline coverage rate	93.8%	78.3%	90.5%	97.5%	93.1%	80.5%	90.6%	97.1%
Observations	31488	4512	8219	18757	65892	11329	18516	36047

Notes: Survey-weighted standard errors in parentheses. All models also include year and state dummies, individual demographic controls, and a constant (not shown). Mass = Massachusetts.

p<0.01

**

p<0.05

*

p<0.1.

Table 4

Regression results for mammogram or Pap test in the past year

	(1)	(2)	(3)	(4)
	Mammogram		Pap test	
Mass * reform	-0.00395 (0.0226)	-0.00395 (0.0226)	-0.00982 (0.0149)	-0.00982 (0.0149)
Mass * post	0.0269 (0.0166)		0.0472 *** (0.0115)	
Mass * 2008		0.0146 (0.0189)		0.0409 *** (0.0136)
Mass * 2010		0.0391 ** (0.0197)		0.0535 *** (0.0147)
Mass baseline screening rate	75.8%	75.8%	76.6%	76.6%
N (unweighted)	31488	31488	65892	65892

Notes: Survey-weighted standard errors in parentheses. All models also include year and state dummies, individual demographic controls, and a constant (not shown). Mass = Massachusetts.

p<0.01

**
p<0.05

*
p<0.1.

Table 5

Regression results for screening in past year by income as a percent of federal poverty

	(1) <250% FPL	(2) <150% FPL	(3) 150-300% FPL	(4) >=300% FPL
Panel A. Mammography sample				
Mass [*] reform	0.0447 (0.0454)	-0.0475 (0.0592)	0.0779 (0.0539)	-0.0187 (0.0271)
Mass [*] post	0.0563 [*] (0.0334)	-0.0289 (0.0471)	0.0709 [*] (0.0376)	0.0192 (0.0200)
Mass baseline screening rate	69.2%	71.3%	69.6%	78.2%
N (unweighted)	9795	4512	8219	18757
Panel B. Pap test sample				
Mass [*] reform	-0.00933 (0.0297)	-0.0172 (0.0388)	-0.0225 (0.0384)	-0.00623 (0.0172)
Mass [*] post	0.0610 ^{***} (0.0226)	0.0647 ^{**} (0.0327)	0.0494 ^{**} (0.0234)	0.0438 ^{***} (0.0141)
Mass baseline screening rate	71.0%	70.6%	72.9%	79.4%
N (unweighted)	22901	11329	18516	36047

Notes: Survey-weighted standard errors in parentheses. All models also include year and state dummies, individual demographic controls, and a constant (coefficients not shown). Mass = Massachusetts.

p<0.01

**
p<0.05

*
p<0.1

Table 6

Regression results for screening in the past year controlling for insurance and personal doctor

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			<u>Controlling for insurance coverage</u>					<u>Controlling for personal doctor</u>		
	Full sample	<250fpl	<150fpl	150-300fpl	>=300fpl	Full sample	<250fpl	<150fpl	150-300fpl	>=300fpl
Panel A. Mammography sample										
* Mass reform	-0.00743 (0.0226)	0.0238 (0.0454)	-0.0763 (0.0593)	0.0765 (0.0537)	-0.0167 (0.0272)	-0.0117 (0.0224)	0.0227 (0.0454)	-0.0680 (0.0600)	0.0582 (0.0527)	-0.0210 (0.0268)
* Mass post	0.0173 (0.0165)	0.0295 (0.0331)	-0.0658 (0.0466)	0.0632* (0.0370)	0.0157 (0.0199)	0.0205 (0.0164)	0.0433 (0.0327)	-0.0338 (0.0474)	0.0552 (0.0357)	0.0155 (0.0198)
Insurance coverage	0.220*** (0.0171)	0.215*** (0.0212)	0.184*** (0.0290)	0.238*** (0.0251)	0.243*** (0.0338)					
Personal doctor						0.342*** (0.0193)	0.333*** (0.0268)	0.248*** (0.0338)	0.436*** (0.0310)	0.337*** (0.0299)
Mass baseline screening rate	75.8%	69.2%	71.3%	69.6%	78.2%	75.8%	69.2%	71.3%	69.6%	78.2%
N (unweighted)	31488	9795	4512	8219	18757	31488	9795	4512	8219	18757
Panel B. Pap test sample										
* Mass reform	-0.0107 (0.0148)	-0.0143 (0.0293)	-0.0199 (0.0376)	-0.0249 (0.0386)	-0.00632 (0.0170)	-0.0113 (0.0146)	-0.0149 (0.0293)	-0.0201 (0.0382)	-0.0231 (0.0355)	-0.00684 (0.0171)
* Mass post	0.0414*** (0.0114)	0.0465*** (0.0223)	0.0449 (0.0316)	0.0454* (0.0235)	0.0423*** (0.0140)	0.0471*** (0.0114)	0.0602*** (0.0222)	0.0635** (0.0318)	0.0526** (0.0233)	0.0440*** (0.0140)
Insurance coverage	0.198*** (0.0117)	0.197*** (0.0144)	0.201*** (0.0198)	0.172*** (0.0178)	0.218*** (0.0233)					
Personal doctor						0.224*** (0.0115)	0.246*** (0.0166)	0.236*** (0.0220)	0.266*** (0.0214)	0.192*** (0.0165)
Mass baseline screening rate	76.6%	71.0%	70.6%	72.9%	79.4%	76.6%	71.0%	70.6%	72.9%	79.4%
N (unweighted)	65892	22901	11329	18516	36047	65892	22901	11329	18516	36047

Notes: Survey-weighted standard errors in parentheses. All models also include year and state dummies, individual demographic controls, and a constant (coefficients not shown). Mass = Massachusetts.

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