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Changes in Mortality After Massachusetts Health Care Reform

A Quasi-experimental Study

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Background: The Massachusetts 2006 health care reform has been called a model for the Affordable Care Act. The law attained near-universal insurance coverage and increased access to care. Its effect on population health is less clear.

Objective: To determine whether the Massachusetts reform was associated with changes in all-cause mortality and mortality from causes amenable to health care.

Design: Comparison of mortality rates before and after reform in Massachusetts versus a control group with similar demographics and economic conditions.

Setting: Changes in mortality rates for adults in Massachusetts counties from 2001 to 2005 (prereform) and 2007 to 2010 (postreform) were compared with changes in a propensity score–defined control group of counties in other states.

Participants: Adults aged 20 to 64 years in Massachusetts and control group counties.

Measurements: Annual county-level all-cause mortality in age-, sex-, and race-specific cells (n = 146 825) from the Centers for Disease Control and Prevention's Compressed Mortality File. Secondary outcomes were deaths from causes amenable to health care, insurance coverage, access to care, and self-reported health.

Results: Reform in Massachusetts was associated with a significant decrease in all-cause mortality compared with the control group (−2.9%; P = 0.003, or an absolute decrease of 8.2 deaths per 100 000 adults). Deaths from causes amenable to health care also significantly decreased (−4.5%; $P < 0.001$). Changes were larger in counties with lower household incomes and higher prereform uninsured rates. Secondary analyses showed significant gains in coverage, access to care, and self-reported health. The number needed to treat was approximately 830 adults gaining health insurance to prevent 1 death per year.

Limitations: Nonrandomized design subject to unmeasured confounders. Massachusetts results may not generalize to other states.

Conclusion: Health reform in Massachusetts was associated with significant reductions in all-cause mortality and deaths from causes amenable to health care.

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Massachusetts passed comprehensive health care reform in 2006 with the goal of near-universal coverage. The law—which expanded Medicaid, offered subsidized private insurance, and created an individual mandate—was a model for the Affordable Care Act (1). Thus, understanding the effects of the Massachusetts law has important policy implications.

Previous research documents that the Massachusetts reform succeeded in expanding health insurance among adults aged 19 to 64 years by 3 to 8 percentage points (1–5). Studies also indicate improvements in access to care (6–8), self-reported physical and mental health (9), use of preventive services (2, 10), and functional status (1, 11). However, there has been no evidence on the law's effect on mortality. Previous research on the effect of health insurance on mortality is mixed. Some observational studies suggest as much as a 40% increased risk for death for uninsured versus insured adults (12, 13), and an analysis of Medicaid expansion to low-income adults detected a 6% decrease in statewide mortality (14). Other studies, including 2 randomized trials of insurance expansion, found little or no effect on mortality (15–17).

Our study's objective was to examine the changes in mortality associated with the Massachusetts reform. We hypothesized that the reform reduced mortality, particularly from causes potentially treatable with timely care (such as cardiovascular disease, infections, and cancer), and that larger changes occurred among groups likely to benefit from the law—previously uninsured adults and those with higher prereform mortality rates.

Methods

Study Design

Our study used a quasi-experimental pre–post design with a control group and compared average mortality in Massachusetts before and after reform to mortality changes over the same period for similar populations in states without reforms (also known as a "differences-in-differences" analysis [18]). Our preferred specification used propensity score methods to create a control group of counties in nonreform states that best matched the distribution of prereform characteristics in Massachusetts counties (19, 20).

The Massachusetts law had several components: Medicaid expansion starting in July 2006, subsidized private plans for adults with incomes less than 100% of the federal poverty level in October 2006, and expanded coverage subsidies for adults with incomes up to 300% of the federal

See also:

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Context

After passage of a 2006 law that expanded health insurance coverage, studies have found many changes in health and health care, but none has reported changes in mortality.

Contribution

This study found that when Massachusetts counties were compared with similar counties in other states, all-cause and health care–amenable mortality decreased after Massachusetts passed the law.

Caution

The study design cannot rule out the effects of unidentified confounders and thus cannot establish cause and effect.

Implication

The association between more insurance coverage and fewer deaths reported here is consistent with other evidence that expanding insurance coverage can improve health.

—The Editors

poverty level in January 2007. It included an individual mandate effective for the 2007 tax year and "minimum creditable coverage" insurance standards (21). We defined the postreform period as 2007 to 2010, with 2006 omitted as a transitional year (although we included 2006 in sensitivity analyses). The prereform period was 2001 to 2005.

Data

Our data came primarily from the Centers for Disease Control and Prevention's Compressed Mortality File, which provides county-specific annual mortality rates stratified by age, sex, and race (22). For confidentiality, the publicly available data set suppresses death counts for cells with fewer than 10 deaths. We obtained access to the nonsuppressed data set under agreement with the Centers for Disease Control and Prevention. Our sample was adults aged 20 to 64 years, the reform's primary target group (with 19-year-olds excluded because persons aged 15 to 19 years are grouped together in the data set). In addition to age, sex, and race, our estimates were adjusted for year-specific county-level poverty rates, median income, unemployment, and the percentage of Latino persons in the population (all from the Area Resource File [ARF] [23]). Subgroup analyses used prereform county-level uninsured rates from the U.S. Census Bureau's 2005 Small Area Health Insurance Estimates (24).

We also analyzed measures of coverage, health care access, and self-reported health status from 2 nationally representative household surveys: the Centers for Disease Control and Prevention's Behavioral Risk Factor Surveillance System (BRFSS) and the Census Bureau's Current Population Survey (CPS). These data sets have been used previously to examine the effect of the Massachusetts reform on coverage and access (2–4, 8, 9, 25). We present independent estimates using methods analogous to our mortality analysis to provide additional context for our results. For these data sources, we were able to include 19-year-olds, so the sample contains all adults aged 19 to 64 years.

This project used preexisting deidentified data and was deemed exempt from review by the Harvard Institutional Review Board. The project received no external funding.

Outcome Measures

Our primary outcome was all-cause mortality. Our secondary outcome was mortality amenable to health care, adapted from previous research (26–29), to focus on deaths related to conditions that are more likely to be preventable or treatable with timely care, including heart disease, stroke, cancer, infections, and other conditions (30). **Table 1** of the **Supplement** (available at www.annals.org) lists the diagnosis codes from the International Classification of Diseases, 10th Revision, used in this definition and a more restrictive alternate definition tested in a sensitivity analysis.

Additional outcomes were health insurance from the CPS and self-reported health (excellent or very good vs. good, fair, or poor) and access-to-care measures (cost-related delays in care, lack of a usual source of care, and absence of a preventive visit in the past year) from the BRFSS.

Statistical Analysis

Annual county-level death counts based on age, sex, and race were the unit of observation for the mortality analysis. **Table 1** describes the analytic sample, which contains information on the number of counties; states; age-, sex-, and race-specific county-level cells; and population per year.

Our regression models estimated the average annual pre–post change in mortality for age-, sex-, and race-specific cells in Massachusetts counties relative to comparison counties in nonreform states (31). The study contained 5 years of prereform data (2001 to 2005) and 4 years of postreform data (2007 to 2010). Given that our outcome variable is number of deaths in each cell, our multivariate regression analyses fitted a generalized linear model using a negative binomial distribution and log link, with cell population as the exposure variable. We adjusted our analyses for race, sex, age, state, year, and economic factors (unemployment rate, poverty rate, and median income) specific to the county year (**Supplement**).

Robust SEs were clustered at the state level to account for serial autocorrelation and for the state-level nature of the policy intervention (18), which is standard in population-based policy analyses (14, 32–37). Sensitivity analyses included the pooling of annual data into prereform and postreform periods to remove potential autocorrelation, an interrupted time series model, adding 2006 (the implementation year) to our postreform data, and county-level clustering of SEs. We also tested a linear model using death rate per 100 000 adults as the outcome to provide simple estimates of absolute change and results similar to prior research (14). Cells were weighted by population size to yield representative estimates.

Secondary analyses used individual-level information from the BRFSS and CPS on coverage, access, and health status and were adjusted for age, sex, race/ethnicity, employment, household income, year, and state. For these binary outcomes, we used a generalized linear model with a logit link and predicted probabilities to describe the magnitude of absolute changes (38).

Selection of Control Group

For the mortality analysis, we used propensity scores to define a control group of counties in nonreform states that were most similar to prereform Massachusetts counties. We estimated propensity scores with a population-weighted logistic regression model using age distribution, sex, race/ethnicity, poverty rate, median income, unemployment, uninsured rate, and baseline annual mortality as predictors (**Table 2** of the **Supplement**). The quartile of counties with the highest propensity scores, indicating the closest match to the overall population of Massachusetts' 14 counties, was used as the control group in the mortality analysis. This approach yielded excellent balance on key features between Massachusetts and our control group (**Table 2**) and provided adequate sample sizes for subgroup analyses. We also tested a more traditional propensity score–regression adjustment method and a 2:1 nearest-neighbor propensity score–matching approach, which yielded similar overall results (**Supplement**).

Table 1. **Analytic Sample**

Variable	Value, *n*
Counties	
Massachusetts	14
Control group	513
United States (non-Massachusetts)	3127
States (including District of Columbia)	
Massachusetts	1
Control group	46
United States (non-Massachusetts)	50
Age-, sex-, and race-specific county-level cells	
Massachusetts	3985
Control group	142 840
United States (non-Massachusetts)	836 413
Average population during study period (persons aged 20 to 64 y)	
Massachusetts	3 900 000
Control group	44 300 000
United States (non-Massachusetts)	173 400 000

Identifying a control group with similar mortality trends in counties not in Massachusetts is the key to our approach (20). We tested for differences in the prereform mortality trends for 2001 to 2006 between Massachusetts and the control group using linear and quadratic time trends interacted with an indicator variable for Massachusetts. We repeated this test for the entire U.S. population.

For the analysis of coverage, access, and self-reported health in the CPS and BRFSS, we compared Massachusetts with the other New England states (Maine, Vermont, New Hampshire, Rhode Island, and Connecticut) before and after reform. These data sets do not contain the county-

Table 2. **Summary Statistics for Study Sample Before Reform**

County-Level Characteristic	Massachusetts, %*	Control Group, %*	*P* Value for Massachusetts vs. Control Group	Rest of United States, %*	*P* Value for Massachusetts vs. Rest of United States
Covariates					
Age					
20–34 y	33.2	33.1	0.95	34.5	0.46
35–44 y	26.3	25.9	0.51	25.3	0.090
45–54 y	24.0	24.3	0.69	23.7	0.68
55–64 y	16.5	16.7	0.79	16.4	0.95
Male	48.9	49.1	0.13	49.6	<0.001
White race	87.4	85.0	0.28	81.0	0.003
Black race	7.0	9.0	0.26	12.8	<0.001
Other race	5.6	6.0	0.62	6.2	0.46
Latino ethnicity	7.6	7.9	0.86	14.0	<0.001
Poverty rate	9.6	10.2	0.55	12.7	0.002
Median household income, $†	62 271	59 124	0.30	52 481	0.001
Unemployment rate	5.0	5.1	0.62	5.4	0.058
Uninsured rate	13.6	14.5	0.18	19.8	<0.001
Outcomes					
All-cause mortality (deaths per 100 000)	283	297	0.26	341	<0.001
Health care–amenable mortality (deaths per 100 000)	185	197	0.11	221	<0.001

* Data are percentages, except for median household incomes and outcomes.
† Median income was inflation-adjusted to 2010 U.S. dollars.

level detail needed for our propensity score method, so we followed previous research in using this control group (2, 3, 11).

Subgroup Analysis

We did prespecified subgroup analyses to test for heterogeneous mortality changes and their effect on disparities. We compared adults aged 20 to 34 years with those aged 35 to 64 years, non-Latino white adults with nonwhite and Latino adults, residents of low-income counties with residents of high-income counties (based on median household income in Massachusetts), and residents of counties with low rates of uninsured adults with those with high rates of uninsured adults (based on median county uninsured rates in Massachusetts before reform). In each analysis, we specified an interaction term between Massachusetts reform and the variable in question to test for significantly different effects across subgroups.

Finally, in a sensitivity analysis, we used elderly adults (aged ≥65 years) as an additional control group. This approach subtracts any secular trend for elderly adults in Massachusetts from the estimated mortality change for nonelderly adults (**Supplement**). Netting out the mortality changes in this group is a conservative approach. Although the Massachusetts reform did not directly affect coverage for most elderly adults, it did expand insurance to the few who did not meet the lifetime earnings requirement for Medicare (2, 39). Thus, it may have had some effect on health in this age group, but one would expect such effects to be much weaker than those on the targeted population of nonelderly adults.

Role of the Funding Source

This study received no funding.

RESULTS

Sample

Table 2 presents descriptive statistics and baseline mortality for counties in Massachusetts, our control group, and all U.S. counties outside Massachusetts. Massachusetts had significantly fewer minorities, more women, lower poverty and uninsured rates, and lower baseline mortality than the rest of the United States. However, there were no statistically significant differences for these outcomes between Massachusetts and the control group, indicating excellent balance from the propensity score approach.

Examination of prereform mortality trends further supports the use of the control group (**Table 3** of the **Supplement**). We found no evidence of divergence between Massachusetts and the control group in linear or quadratic models ($P = 0.120$ and 0.116, respectively). In contrast, the mortality trend in Massachusetts diverged from the rest of the United States before 2006 ($P < 0.001$).

Changes in Mortality

The **Figure** shows the unadjusted annual mortality rates for nonelderly adults in Massachusetts and the control group from 2001 to 2010. All-cause mortality in the 2 groups followed a similar pattern until implementation of the reform in 2006 to 2007, after which mortality in Massachusetts began to decrease relative to the control group. Health care–amenable mortality followed a similar pattern, whereas trends for other causes of death showed minimal changes in Massachusetts and the control group.

Table 3 presents regression estimates for changes in mortality associated with the Massachusetts reform. In our primary specification, adjusted all-cause mortality decreased in Massachusetts after reform by 2.9% ($P = 0.003$) compared with the control group. Mortality amenable to health care decreased by 4.5% ($P < 0.001$). An alternate definition of health care–amenable mortality (28) produced a slightly larger relative reduction (−5.5%; $P = 0.002$), and deaths from nonamenable causes showed no significant decrease (−2.0%; $P = 0.26$) (**Supplement**).

Several sensitivity analyses produced similar results, including those using propensity score regression–adjustment or 2:1 matching approaches, clustering of SEs at the county level, or a linear model with the death rate as the outcome (**Table 4** of the **Supplement**). The relative decrease of 2.9% in all-cause mortality, paired with a baseline mortality in Massachusetts of 283 per 100 000 adults, implies an absolute mortality change of −8.2 per 100 000 adults. This reduction is similar to the linear model estimate of −9.3 per 100 000 adults ($P = 0.014$) reported in the **Supplement**.

Mortality Changes Among Subgroups

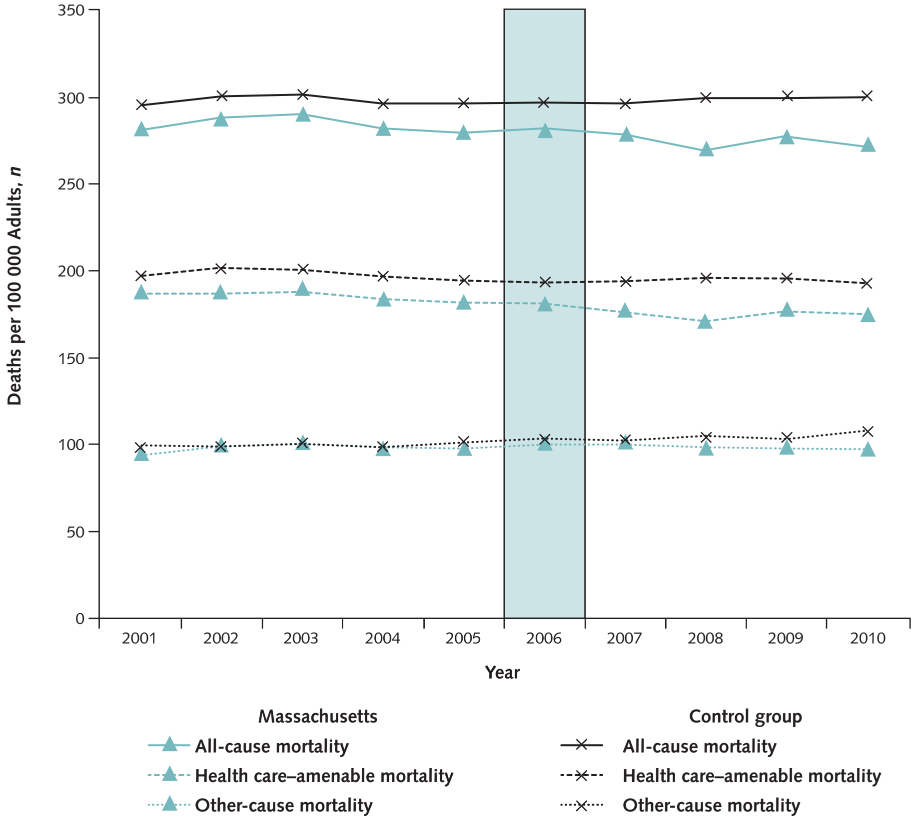
Table 4 presents subgroup analyses. Relative mortality reductions in Massachusetts compared with the control group were significant for white and nonwhite adults, adults aged 20 to 34 and 35 to 64 years, and residents of counties with lower incomes and higher baseline uninsured rates. Although relative mortality changes were larger for Latino and nonwhite adults (−4.6%; $P < 0.001$) than white adults (−2.4%; $P = 0.001$), the between-group difference in these estimates was not significant ($P = 0.062$).

The **Figure** of the **Supplement** shows unadjusted mortality trends for elderly adults, with no apparent divergence between Massachusetts and the control group before or after reform. A model using elderly adults as an additional within-state control group (**Table 5** of the **Supplement**) showed a 3.3% decrease in all-cause mortality ($P = 0.066$) for nonelderly adults and a 0.1% increase for elderly adults ($P = 0.93$) in Massachusetts after reform. This model also showed a 4.9% decrease in health care–amenable mortality ($P < 0.001$) for nonelderly adults and a 0.2% increase for elderly adults ($P = 0.90$).

Coverage, Access to Care, and Health

Table 5 shows changes in coverage, access to care, and self-reported health. Compared with other New England states, reform in Massachusetts was associated with significant reductions in the uninsured rate (change in predicted probability, −6.8 percentage points, a 57% relative de-

Figure. **Unadjusted mortality rates for adults aged 20 to 64 years in Massachusetts versus control group (2001–2010).**



The shaded band designates the beginning of the Massachusetts state health care reform that was implemented starting in July 2006. "Health care–amenable mortality" is as defined in **Table 1** of the **Supplement** (available at www.annals.org). "Other-cause mortality" contains all other causes of death not included in that definition.

crease from baseline); cost-related delays in care (−2.0 percentage points, a 22% relative decrease); lacking a usual source of care (−1.9 percentage points, a 13% relative decrease); having no preventive visit in the last year (−4.0 percentage points, a 13% relative decrease); and reporting good, fair, or poor health (−1.8 percentage points, a 5% relative decrease) (all changes, $P < 0.001$). Results were nearly identical with linear probability models or without state clustering of SEs (**Table 6** of the **Supplement**).

Estimated Mortality Effect

To assess the plausibility of our estimated decrease in mortality, we compared it with the coverage gains we detected (**Table 7** of the **Supplement**). In absolute terms, we

Table 3. **Mortality Before and After Massachusetts Health Care Reform Among Adults Aged 20 to 64 Years (2001–2010)***

Outcome	Unadjusted Mortality per 100 000 Adults		Unadjusted Relative Change		Adjusted Relative Change	
	Prereform	Postreform	Difference (95% CI), %	*P* Value	Difference (95% CI), %	*P* Value
All-cause mortality						
Massachusetts	283	274	−4.2 (−8.0 to −0.4)	0.032	−2.9 (−4.8 to −1.0)	0.003
Control group	297	299				
Health care–amenable mortality						
Massachusetts	185	175	−4.3 (−7.2 to −1.5)	0.003	−4.5 (−6.2 to −2.7)	<0.001
Control group	197	195				

* Relative changes estimated by using negative binomial generalized linear models with log link. Adjusted model controlled for age, sex, race/ethnicity, poverty rate, median income, unemployment rate, and state of residence.

Table 4. **Subgroup Analyses of Changes in All-Cause Mortality After Massachusetts Health Care Reform Among Adults Aged 20 to 64 Years (2001–2010)***

Subgroup	Unadjusted Mortality in Massachusetts Before Reform per 100 000 Adults	Adjusted Relative Change, Massachusetts vs. Control Group (95% CI), %	*P* Value		Absolute Change in Predicted Mortality per 100 000 Adults†
			Subgroup	Between-Group Difference	
Full sample	283	−2.9 (−4.8 to −1.0)	0.003	–	−8.2
Race/ethnicity					
Non-Latino white‡	295	−2.4 (−3.8 to −1.0)	0.001	0.062	−7.1
Latino or nonwhite‡	231	−4.6 (−6.3 to −2.8)	<0.001		−10.6
Age					
20–34 y	77	−3.6 (−6.9 to −0.4)	0.030	0.38	−2.8
35–64 y	386	−2.2 (−3.8 to −0.6)	0.008		−8.5
County median income					
Low income	312	−3.0 (−4.6 to −1.3)	<0.001	0.33	−9.4
High income	257	−1.8 (−4.0 to 0.5)	0.120		−4.6
County prereform uninsured rate					
Low uninsured	295	−1.7 (−3.8 to 0.4)	0.118	0.41	−5.0
High uninsured	273	−3.3 (−6.0 to −0.6)	0.015		−9.0

* Relative changes were estimated by using negative binomial generalized linear models with log link. The model was adjusted for age, sex, race/ethnicity, poverty rate, median income, unemployment rate, and state of residence.
† Calculated by using adjusted relative change multiplied by baseline subgroup-specific mortality for Massachusetts.
‡ Although unadjusted mortality was higher for non-Latino white adults than for Latino or nonwhite adults, this is primarily due to the different age distributions of the groups. After adjustment for age by standardization to the age distribution of white adults, baseline mortality for Latino or nonwhite adults was significantly higher (312 per 100 000 adults) than for non-Latino white adults (295 per 100 000 adults). This model omits from the sample any deaths with "unknown" ethnicity because the data set has no corresponding population denominator for that group necessary to calculate a death rate.

found a decrease in mortality of 0.0082 percentage points (8.2 per 100 000 adults) concurrent with an increase in coverage of 6.8 percentage points, which implies that for approximately every 830 adults who gained insurance, there was 1 fewer death per year.

DISCUSSION

The Massachusetts 2006 health care reform was associated with significant reductions in all-cause mortality over 4 years of follow-up relative to a control group of similar counties in states without reform. Reductions were concentrated in causes of death that were more plausibly amenable to health care and in populations most likely to benefit from expanded access, particularly residents of counties with lower incomes and higher prereform uninsured rates.

Compared with the control group, overall mortality in Massachusetts decreased by 2.9%. This relative decrease in mortality is smaller than the 6.1% decrease in mortality associated with several states' Medicaid expansions (14), which is consistent with the fact that Massachusetts began its expansion from a much higher baseline rate of insurance

Table 5. **Changes in Coverage, Access to Care, and Self-Reported Health After Massachusetts Health Care Reform Among Adults Aged 19 to 64 Years (2001–2010)***

Outcome	Unadjusted Population Mean in Massachusetts Before Reform, %	Adjusted Odds Ratio After Reform (95% CI)	*P* Value	Absolute Change in Predicted Probability, *percentage points*†
Uninsured (*n* = 99 661)	11.9	0.43 (0.41–0.45)	<0.001	−6.8
Delayed care due to cost in the past year (*n* = 215 365)	9.0	0.78 (0.70–0.86)	<0.001	−2.0
No usual source of care (*n* = 262 761)	14.7	0.84 (0.78–0.89)	<0.001	−1.9
No preventive physician's visit in the past year (*n* = 166 642)	30.5	0.82 (0.79–0.85)	<0.001	−4.0
Worse self-reported health (*n* = 214 510)‡	34.7	0.92 (0.88–0.95)	<0.001	−1.8

* All analyses compare pre–post changes in the outcomes for Massachusetts vs. other New England states for the years 2001–2005 and 2007–2010. Data are from the Current Population Survey for the uninsured and the Behavioral Risk Factor and Surveillance System (BRFSS) for the remaining measures. Sample sizes for BRFSS items differ primarily because of changes in the survey year in which each item was queried and small differences in item nonresponse. The model was adjusted for age, sex, race/ethnicity, household income (as a percentage of the federal poverty level), employment status, year, and state of residence.
† Calculated by using change in predicted probability.
‡ Good, fair, or poor vs. excellent or very good self-reported health.

coverage. However, 2 recent experimental studies of insurance have shown neither a mortality benefit of insurance (16, 17) nor statistically significant changes in blood pressure or glycated hemoglobin levels (40), although both found major gains in self-reported health and access to recommended care. The latter studies have the advantages of a randomized design and individual-level data. However, they have much smaller sample sizes (for example, 916 persons gaining coverage in 1 study [17] and roughly 10 000 newly insured in another [40] vs. approximately 270 000 adults gaining coverage in our study) and shorter follow-up (16, 40) than is possible using statewide population data, giving our study far greater statistical power for small absolute changes, such as those detected here.

How does insurance expansion reduce population mortality? Our secondary outcomes trace a plausible causal pathway: Eligibility leads to increased coverage, and such coverage leads to better access and more utilization of clinical services, including office visits, with resulting gains in self-reported health status (a strong predictor of mortality [41, 42]). This potential pathway of coverage leading to health gains through access to clinicians and high-quality care is consistent with Eisenberg and Power's seminal 2000 article (43), which outlines a framework for understanding challenges to improving care for patients in the U.S. health care system.

Our results are consistent with the bulk of previous research on the Massachusetts reform, which demonstrates gains in coverage, access to care, and self-reported health among Massachusetts residents after reform (1, 2, 8, 10, 11). Mortality reductions were concentrated in conditions most likely to be amenable to health care, such as cancer (which can sometimes be prevented with earlier screening or treated more successfully with early detection), infections (treatable with early detection and preventable or less likely to be fatal with better long-term disease management), and cardiovascular disease (treatable in the short term with early detection and partially preventable with risk factor modification). This is consistent with research showing a decline in potentially avoidable hospitalizations after the Massachusetts reform and other insurance expansions (2, 44). Although research on breast cancer did not find a significant effect of the Massachusetts reform (25), our use of a more comprehensive health outcome may have given us greater power to detect changes than analysis of a single diagnosis.

Our number needed to treat was 830 adults gaining insurance to prevent 1 death per year. This estimated coverage-to-mortality effect would be consistent with a 30% relative reduction in individual-level mortality for persons gaining insurance (compared with an estimated 25% relative reduction in mortality from insurance cited by the Institute of Medicine [13] and the 40% relative reduction found by Wilper and colleagues [12]) if overall baseline mortality for these uninsured individuals were 400 per 100 000 adults (**Table** 7 of the **Supplement**). This baseline mortality rate would be roughly 1.5 times that of our overall sample, which is consistent with prior research on elevated mortality risks for the uninsured (12, 15). In addition, research suggests that insurance expansion disproportionately enrolls persons in worse health (14, 45) and components of the Massachusetts expansion preferentially targeted adults with disabilities or HIV/AIDS (21). These illustrative calculations assume that mortality reductions occurred only for those obtaining insurance under reform, which may be conservative because the law also expanded benefits (including preventive care and prescription drugs) for many persons who already had insurance.

Reductions in mortality were largest in Massachusetts counties with lower incomes and lower insurance coverage before reform—areas likely to have had the greatest increase in access to care under reform. Mortality reductions were nearly twice as large for minority as for white adults, although this between-group difference was not statistically significant. These results provide useful additional information compared with previous research suggesting that racial/ethnic disparities in coverage and access may not have narrowed after the Massachusetts reform (3, 4).

Our analysis has several limitations. First, we do not have individual-level insurance information and thus cannot directly link mortality changes to persons gaining insurance coverage. Second, defining mortality from causes amenable to health care is somewhat subjective. We built on methods used in prior research (27–29) and tested 2 definitions that provided similar results. Future research distinguishing between treatable and curable conditions would also be worthwhile.

Most important, our quasi-experimental approach cannot definitively demonstrate a causal relationship underlying the association between the Massachusetts reform and the state's declining mortality relative to other states. It is possible that the postreform reduction in mortality in Massachusetts was due to other factors that differentially affected Massachusetts, such as the recession. However, our analysis controlled for several distinct time- and county-specific economic measures. We also found no evidence of a similar decline in mortality among elderly adults in Massachusetts that would suggest a secular trend. Although we cannot rule out unmeasured confounders, it is challenging to identify factors other than health care reform that might have produced this pattern of results: a declining mortality rate in Massachusetts since 2007 not present in similar counties elsewhere in the country, primarily for health care–amenable causes of death in adults aged 20 to 64 years (but not elderly adults), concentrated among poor and uninsured areas and not explained by changes in poverty or unemployment rates.

In conclusion, we find a significant reduction in mortality among nonelderly adults in Massachusetts since its 2006 reform relative to a control group of similar counties in states without such reforms. Although this analysis cannot demonstrate causality, the results offer suggestive evidence that the Affordable Care Act—modeled after the Massachusetts law—may impact not only coverage and access but also mortality. However, it is critical to note the many dimensions in which Massachusetts differs from the rest of the nation, including lower mortality, higher income and baseline insurance coverage rates, fewer minorities, and the most per capita physicians in the country (46). The extent to which our results generalize to the United States as a whole is therefore unclear, which underscores the need to monitor closely the Affordable Care Act's effect on coverage, access, and population health across all states.

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