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RESEARCH ARTICLE

Effect of Massachusetts Health Reform on Chronic Disease Outcomes

*Tomasz P. Stryjewski, Fang Zhang, Dean Elliott, and
J. Frank Wharam*

Objective. To determine whether Massachusetts Health Reform improved health outcomes in uninsured patients with hyperlipidemia, diabetes, or hypertension.

Data Source. Partners HealthCare Research Patient Data Registry (RPDR).

Study Design. We examined 1,463 patients with hyperlipidemia, diabetes, or hypertension who were uninsured in the 3 years before the 2006 Massachusetts Health Reform implementation. We assessed mean quarterly total cholesterol, glycosylated hemoglobin, and systolic blood pressure in the respective cohorts for five follow-up years compared with 3,448 propensity score-matched controls who remained insured for the full 8-year study period. We used person-level interrupted time series analysis to estimate changes in outcomes adjusting for sex, age, race, estimated household income, and comorbidity. We also analyzed the subgroups of uninsured patients with poorly controlled disease at baseline, no evidence of established primary care in the baseline period, and those who received insurance in the first follow-up year.

Principal Findings. In 5 years after Massachusetts Health Reform, patients who were uninsured at baseline did not experience detectable trend changes in total cholesterol (-0.39 mg/dl per quarter, 95 percent confidence interval $[-1.11$ to $0.33]$), glycosylated hemoglobin (-0.02 percent per quarter $[-0.06$ to $0.03]$), or systolic blood pressure (-0.06 mmHg per quarter $[-0.29$ to $0.18]$). Analyses of uninsured patients with poorly controlled disease, no evidence of established primary care in the baseline period, and those who received insurance in the first follow-up year yielded similar findings.

Conclusions. Massachusetts Health Reform was not associated with improvements in hyperlipidemia, diabetes, or hypertension control after 5 years. Interventions beyond insurance coverage might be needed to improve the health of chronically ill uninsured persons.

Key Words. Health reform, observational data, time series analysis

In 2006, Massachusetts enacted landmark legislation that provided near universal health insurance coverage for residents. The Massachusetts Healthcare Reform (hereafter, “the 2006 reform”) law instituted individual and employer mandates to obtain health insurance, established a new purchasing pool,

expanded Medicaid coverage, and created a subsidized insurance program called Commonwealth Care for households earning less than 300 percent of the Federal Poverty Level (Massachusetts 2006).

Prior to the 2006 reform, health care institutions that provided care to uninsured persons were reimbursed through the state's Uncompensated Care Pool. In the year preceding the 2006 reform, Massachusetts hospitals provided nearly \$663 million (\$212 million inpatient and \$451 million outpatient care) of allowable uncompensated care to the uninsured (Iseline 2007). Community health centers provided an additional \$46 million of uncompensated care. Uncompensated care was classified as full uncompensated care, partial uncompensated care, medical hardship, or emergency bad debt. Eighty-eight percent of inpatient hospitalizations were for emergent or urgent care. Outpatient pharmacy services comprised the largest proportion of outpatient volume (19 percent) and generated 9 percent of the outpatient cost (Iseline 2007). Through these mechanisms, most uninsured adults (61.1 percent) in Massachusetts reported having a usual source of care, excluding emergency department visits, before the 2006 reform (Long and Stockley 2010). Similarly, the 2003 National Health Interview Survey revealed that 93 percent of uninsured persons with diabetes, 82 percent with hypertension, and 80 percent with hyperlipidemia self-reported visiting a health care professional within the prior year (Davidoff and Kenney 2005). The 2006 reform reduced the rate of uninsured Massachusetts residents from an average of 10.3 percent in 2004–2006 to 4.3 percent in 2010–2012 (DeNavas-Walt et al. 2007, 2013).

Surveys have found that previously uninsured Massachusetts residents report improved subjective health status and better access to health care providers after the 2006 reform (Maxwell et al. 2011; Pande et al. 2011). Studies using administrative data found that the 2006 reform may have reduced emergency department utilization and increased inpatient surgical procedures among the poor, suggesting improved access patterns (Chen, Scheffler, and

Address correspondence to Tomasz P. Stryjewski, M.D., M.P.P., Department of Medicine, Massachusetts General Hospital, 55 Fruit St., GRB 740, Boston, MA 02114; e-mail: tstryjewski@partners.org. Tomasz P. Stryjewski, M.D., M.P.P., is also with the Department of Medicine, Massachusetts General Hospital, Boston, MA. Fang Zhang, Ph.D., is with the Department of Population Medicine, Harvard Medical School, Boston, MA; Department of Population Medicine, Harvard Pilgrim Health Care Institute, Boston, MA. Dean Elliott, M.D., is with the Departments of Ophthalmology at Massachusetts General Hospital and Massachusetts Eye and Ear Infirmary, Boston, MA. J. Frank Wharam, M.B., B.Ch., B.A.O., M.P.H., is with the Department of Population Medicine, Harvard Medical School, Boston, MA; Department of Population Medicine, Harvard Pilgrim Health Care Institute, Boston, MA; Department of Medicine, Brigham and Women's Hospital, Boston, MA.

Chandra 2011; Smulowitz et al. 2011; Hanchate et al. 2012). However, other studies have questioned the effectiveness of the 2006 reform in improving health outcomes, noting that the 2006 reform has been associated with a low uptake of mammography and addiction treatment services (Capoccia et al. 2012; Keating et al. 2012).

To our knowledge, no studies have examined the impact of the 2006 reform on disease control. Because the leading cost driver of the Massachusetts Uncompensated Care Pool in 2006 was circulatory disease (Iseline 2007), we analyzed whether the 2006 reform affected hyperlipidemia, diabetes, and hypertension disease control in uninsured adults who received care before and in the 5 years after the passage of the 2006 reform.

We hypothesized that uninsured patients, especially those who received insurance in the follow-up period or those with poorly controlled disease at baseline, would experience favorable trends in disease control after the 2006 reform implementation.

METHODS

Study Setting, Study Period, and Data Collection

We examined uninsured and insured patients seen in the Partners HealthCare network, the largest delivery system in Massachusetts. It includes Massachusetts General Hospital (MGH), Brigham and Women's Hospital (BWH), their outpatient departments, and their 20 outpatient community health centers and satellite locations. In 2012, these 22 study sites had approximately 99,000 inpatient admissions, 2.35 million outpatient visits, and 151,000 emergency room visits. In addition, prior to the passage of the 2006 reform, Partners HealthCare (MGH & BWH) was the second largest provider of care to uninsured patients in the state, providing \$245 million worth of total uncompensated care in FY2006 (Iseline 2007). At Partners, patients with no insurance had their hospital and outpatient services billed to the uncompensated care pool and were not required to make copayments. Physicians waived their portion of the total care charges for uncompensated care pool patients on a pro bono basis. Uninsured patients were required to pay a \$1–\$3 monthly copayment for prescription drugs, but a voucher to waive payments was available.

We examined longitudinal patient outcome data from October 1, 2003–December 31, 2011. We defined three periods of interest: baseline, phase-in, and follow-up. We defined the baseline period as October 1, 2003–September 30, 2006. We defined the phase-in period as October 1, 2006–December 31,

2006, because the Commonwealth Care insurance program, a major provider of new health insurance coverage, began enrolling individuals during this period. The follow-up period was January 1, 2007–December 31, 2011.

To determine whether the 2006 reform improved health outcomes in the chronically ill, we included patients with hyperlipidemia, diabetes, or hypertension during the baseline period. We defined these conditions using widely accepted clinical guidelines (Pande et al. 2011; International Expert Committee 2009; Maxwell et al. 2011; Chobanian et al. 2003; National Cholesterol Education Program [NCEP] Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults [Adult Treatment Panel III] 2002): at least one total serum cholesterol level of 200 mg/dl or higher, at least one glycosylated hemoglobin (HbA1c) value of 6.5 percent or higher, and at least two systolic blood pressures of 140 mmHg or higher, respectively.

We obtained data from the Partners Research Patient Data Registry (RPDR), a centralized clinical data warehouse that contains electronic health record data of more than 4.6 million patients seen in the Partners HealthCare Network. We identified patients meeting inclusion criteria using the Partners RPDR Query Tool; The Partners and Harvard Pilgrim Healthcare IRB committees exempted this study from review.

Study Groups

We identified 77,577 patients who met diagnostic criteria for hyperlipidemia, diabetes, or hypertension in the baseline period. For the purposes of our study, we defined uninsured patients as those with all medical or pharmacy encounters billed to the Uncompensated Care Pool (full uncompensated care). Given that our primary analysis was to determine the population-level impact of a policy that applied to the entire Massachusetts population, we included patients who were uninsured at baseline regardless of their insurance status during the follow-up period. We defined the control pool as contemporaneous patients who were fully insured during the entire baseline and follow-up periods. We also required that all patients have a follow-up period measurement at least 1 year after the phase-in period. After applying these criteria, our sample comprised 1,463 uninsured (2 percent) and 67,588 (98 percent) insured adult patients.

For each disease group of interest, we estimated the propensity to be in the uninsured cohort based on age, race, sex, estimated median household income, comorbidity, date of first presentation during the baseline period, and outcome measure level at first presentation. We included the latter two variables to prevent regression to the mean effects that could bias results when

using a nonequivalent control group. We matched uninsured with control patients using 1 : 2 caliper propensity score matching without replacement. Propensity score matching is a well-established method that assists in generating a comparison group with a similar measured characteristics, when subjects have not been randomly allocated into study groups (D'Agostino 1998; Coca-Perraillon 2007; Rubin 2007; Cook and Goldman 2013).

We also identified three subgroups of interest among patients who were uninsured at baseline: (1) those with no evidence of established primary care at baseline; (2) those who received insurance within the first follow-up year; and (3) those with poorly controlled disease at baseline. We defined patients with no established primary care as those who had the majority of their care provided in emergency rooms or urgent care centers, or had one or fewer visits to a primary care physician's office. We defined poorly controlled disease as those in the top quintile of the relevant disease measure at their first appearance in the baseline period.

For sensitivity analyses, we also defined patients with poorly controlled hyperlipidemia, diabetes, and hypertension as those in the top two quintiles of disease severity at entry as well as those who had a measurement of total cholesterol ≥ 240 , HbA1c ≥ 9.0 , or systolic blood pressure ≥ 160 , respectively, at an encounter in the baseline period. We used the same propensity score matching approach described above to develop control groups for all subgroups.

Measures

We assessed quarterly total cholesterol (mg/dl), HbA1c (percent), and systolic blood pressure (mmHg) among patients in the relevant disease cohorts as surrogate outcome measures to monitor disease progression. These measures predict both cardiovascular and all-cause mortality (Amery et al. 1985; Martin et al. 1986; Neaton and Wentworth 1992; Khaw et al. 2004). If a patient had multiple measurements per quarter, we used the mean value for that quarter. For each study group, we calculated the mean of all patient-level outcomes per quarter.

Control Variables

To estimate comorbidity, we applied the Charlson Comorbidity Index, a validated method for estimating mortality risk by classifying comorbid conditions using ICD-9 diagnoses codes, to each patient's baseline period (Charlson et al. 1994). Other variables included median household income from zip

code of residence, age, sex, and self-reported race (Black, White, Hispanic, Asian, Pacific Islander, Native American, other).

Statistical Analysis

We compared baseline characteristics of the uninsured and insured study groups using chi-square tests. After seasonal adjustment, we plotted quarterly rates of mean total serum cholesterol, HbA1c, and systolic blood pressure before and after the phase-in period in the uninsured and insured groups. To model level and trend changes in measures from before to after the phase-in period in the uninsured relative to the insured group, we used patient-level interrupted time series regression. We tested the statistical significance of level and trend changes using one-part generalized estimating equations specified with a normal variance function. We estimated the variance using the empirical sandwich estimator. The primary independent variables in the model were *time* (quarters from the start of the baseline through the follow-up period), *policy* (denoting whether a given quarter was before or after the phase-in period), and *time after policy* (time in quarters after the phase-in period). To calculate the differential level and trend changes in measures between the study groups, we examined interactions between study group and the primary independent variables above. These terms provide estimates of absolute effects per quarter after controlling for covariates.

We used the same methods to conduct subgroup analyses among patients with poorly controlled disease at baseline, those with no evidence of established primary care, and those patients who became insured during the first year of the follow-up period. We performed further sensitivity analyses using 1 : 1 and 1 : 3 propensity score matching.

RESULTS

Baseline Characteristics of Patients

Our final study cohort included 1,463 uninsured patients and 3,448 matched insured controls. Nine hundred and forty-five uninsured patients and 1,890 matched controls had hyperlipidemia (Table 1). The two groups had similar baseline distributions of sex (41–41 percent men, $p = .87$), age (31–27 percent age 50–60, $p = .08$), median household income ($p = .50$), comorbidity (58–61 percent Charlson Comorbidity Index Score 0, $p = .12$), and disease severity ($p = .41$).

Table 1: Baseline Characteristics of Uninsured and Insured Chronically Ill Patients by Presenting Clinical Sign

Variable	Hypertipidemia				Diabetes				Hypertension						
	Uninsured (n = 945)	%	Insured (n = 1,890)	%	p	Uninsured (n = 263)	%	Insured (n = 526)	%	p	Uninsured (n = 560)	%	Insured (n = 1,120)	%	p
Male	388	41	782	41	.87	146	56	281	53	.58	208	37	429	38	.63
Age at index date															
18-49	436	46	942	50	.08	110	42	221	42	.85	190	34	393	35	.4
50-59	295	31	517	27		81	31	153	29		181	32	326	29	
≥60	214	23	431	23		72	27	152	29		189	34	400	36	
White race	333	35	1,163	62	<.01	98	37	293	56	<.01	197	35	630	56	<.01
Median household income by zip code															
\$0-\$44,999	303	32	567	30	.5	93	35	176	33	.87	178	32	353	32	.95
\$45,000-\$59,999	273	29	573	30		76	29	156	30		183	33	374	33	
≥\$60,000	369	39	750	40		94	36	194	37		199	36	392	35	
Comorbidity index															
0	546	58	1,160	61	.12	14	5	19	4	.51	238	43	503	45	.25
1	226	24	392	21		135	51	270	51		146	26	251	22	
>1	173	18	338	18		114	43	237	45		176	31	365	33	
Disease severity at initial presentation*															
1 (best control)	132	14	256	14	.41	27	10	52	10	.99	122	22	248	22	.34
2	199	21	392	21		43	16	88	17		119	21	231	21	
3	187	20	331	18		44	17	82	16		107	19	229	20	
4	201	21	454	24		46	17	91	17		123	22	204	18	
5 (most poorly controlled)	226	24	457	24		103	39	213	40		89	16	207	18	

Note. Probability values calculated using the chi-square test.
*Disease severity is defined as the quintile of the outcome measure at first presentation.

Figure 1: Outcomes of Patients with (a) Hyperlipidemia, (b) Diabetes, or (c) Hypertension

Note.[†]Level changes represent the estimated absolute change in outcome units (HbA1C percent, mmHg, or mg/dl) from immediately before to immediately after the phase-in period in the uninsured group relative to the insured group. [‡]Trend changes represent the estimated slope of the follow-up trend in the uninsured group relative to the insured group as measured by outcome units (HbA1C percent, mmHg, or mg/dl) per quarter. *Uninsured is defined as uninsured in the baseline and either being insured or uninsured in the follow-up period. Insured is defined as having health insurance over the entire study period.

Our diabetes cohort comprised 263 uninsured patients and 526 controls. The groups again had similar baseline distributions of sex (56–53 percent men, $p = .74$), age (31–29 percent age 50–60, $p = .85$), median household income ($p = .87$), comorbidity (51–11 percent Charlson Comorbidity Index Score 1, $p = .51$), and disease severity ($p = .99$).

The hypertensive cohort included 560 and 1,120 patients in the corresponding cohorts. The groups had similar percentages of males (37–38 percent, $p = .63$) and similar distributions of age (32–29 percent age 50–60, $p = .40$), median household income ($p = .95$), comorbidity levels (43–45 percent Charlson Comorbidity Index Score 0, $p = .25$), and disease severity ($p = .34$).

Across the three disease categories, the uninsured group had more non-white patients ($p < .01$).

Chronic Disease Outcomes of Uninsured Relative to Insured Patients after the 2006 Reform

Mean follow-up durations for the uninsured and insured groups were 4.4 and 4.5 years, respectively. In time series analysis, uninsured patients with hyperlipidemia had no detectable difference in baseline serum cholesterol trend relative to insured patients (+0.32 mg/dl per quarter [−0.29 to 0.94], $p = .31$, Figure 1a). After the phase-in period, the uninsured group did not experience a statistically significant level change (−0.32 mg/dl [−4.86 to 4.21], $p = .89$) or trend change (−0.39 mg/dl per quarter [−1.11 to 0.33], $p = .29$) relative to controls.

Among patients with diabetes, uninsured and insured patients had no differences in baseline HbA1C trend (0.03 percent per quarter [−0.01 to 0.07, $p = .16$, Figure 1b) as well as no detectable baseline to follow-up change in HbA1C level (−0.20 percent [−0.50 to 0.09], $p = .17$) or trend (−0.02 percent per quarter [−0.06 to 0.03], $p = .48$).

Patients with hypertension demonstrated similar patterns: no relative baseline trend difference (+0.09 mm Hg per quarter [−0.12 to 0.31], $p = .40$, Figure 1c), level change (1.24 mmHg [−2.87 to 0.40], $p = .14$), or trend change (−0.06 mmHg per quarter [−0.29 to 0.18], $p = .64$) in mean systolic blood pressure.

Subgroup analyses of uninsured patients who had no established primary care in the baseline period did not show improvement in the follow-up period (Figure 2). Similarly, patients entered at baseline in the highest quintile of outcome measure severity revealed no statistically significant level or trend changes across the chronic disease cohorts (Fig-

Figure 2: Patients with No Established Primary Care in the Baseline Period: (a) Patients with Hyperlipidemia; (b) Patients with Diabetes; (c) Patients with Hypertension

Note:†Level changes represent the estimated absolute change in outcome units (HbA1C percent, mmHg, or mg/dl) from immediately before to immediately after the phase-in period in the uninsured group relative to the insured group. ‡Trend changes represent the estimated slope of the follow-up trend in the uninsured group relative to the insured group as measured by outcome units (HbA1C percent, mmHg, or mg/dl) per quarter. *Uninsured is defined as uninsured in the baseline and being insured in the first year of the follow-up period. Insured is defined as having health insurance over the entire study period.

ure 3). Similarly, patients who received insurance in the first year of the follow-up period showed no statistically significant improvements (Appendix SA2). Interpretation did not differ in subgroup analyses using alternative definitions of disease severity or 1 : 1 and 1 : 3 propensity score matching (Appendix SA3 and SA4, respectively).

DISCUSSION

We examined the impact of Massachusetts Health Reform on uninsured chronically ill patients and found no changes in hyperlipidemia, diabetes, or hypertension control after 5 years of follow-up. Results were similar among patients with poorly controlled disease, those who had no evidence of an established primary care provider at baseline, and those who gained insurance during the follow-up period, groups that we hypothesized would benefit most.

Reasons for this lack of improvement might be multifactorial. Improving disease control requires appropriate diagnosis, optimized prescribing, affordable access to a tailored treatment regimen, patient adherence, and timely follow-up care. Well-recognized challenges facing the US health care system such as fragmented delivery, an inadequate focus on preventive health, and high rates of suboptimal patient lifestyles might have an outsized impact on chronic disease outcomes compared with lack of insurance. Also, many previously uninsured patients might have chosen health insurance with high out-of-pocket costs after the 2006 reform, leading to relatively higher health-related financial burdens and a state of “underinsurance” (Galbraith et al. 2013). Finally, the Massachusetts uncompensated care approach prior to the 2006 reform might have been relatively successful in facilitating care for uninsured patients, leaving less room for improvement.

The cross-sectional association between uninsured status and poorer health is well documented; individuals without insurance have higher rates of adverse outcomes such as all-cause mortality (McWilliams et al. 2004), in-hospital mortality (Hadley, Steinberg, and Feder 1991), and adverse cancer treatment events (Ayanian et al. 1993). However, due to difficulty in examining objective clinical measures before uninsured patients receive insurance, few US-based studies have examined how uninsured patients’ health changes after receiving insurance coverage, and results have been mixed. In the 1980s, several studies of natural experiments found no

Figure 3: Patients with Disease Severity in the Highest Quintile at Study Entry: (a) Patients with Hyperlipidemia; (b) Patients with Diabetes; (c) Patients with Hypertension

Note.†Level changes represent the estimated absolute change in outcome units (HbA1C percent, mmHg, or mg/dl) from immediately before to immediately after the phase-in period in the uninsured group relative to the insured group. ‡Trend changes represent the estimated slope of the follow-up trend in the uninsured group relative to the insured group as measured by outcome units (HbA1C percent, mmHg, or mg/dl) per quarter. *Uninsured is defined as uninsured in the baseline and either being insured or uninsured in the follow-up period. Insured is defined as having health insurance over the entire study period.

improvement in maternal and birth outcomes following expansion of Medicaid to previously uninsured individuals (Piper, Ray, and Griffin 1990; Haas et al. 1993), but studies in the 1990s using simulation models suggested Medicaid expansions could have improved infant and child mortality (Currie and Gruber 1994, 1996). In addition, studies of previously uninsured adults have found Medicare acquisition to be associated with improvement in self-reported health (McWilliams et al. 2007), but with no associated change in mortality (Finkelstein and McKnight 2008). A more recent study concluded that Medicaid expansion in three states was associated with reduced all-cause mortality compared to neighboring control states without Medicaid expansion (Sommers, Baicker, and Epstein 2012). The recent Oregon Health Insurance Study (Baicker et al. 2013) found no significant difference in blood pressure, cholesterol, and HbA1c between groups that did and did not receive Medicaid. While this and previous studies have added valuable insights, interpretation of results has been limited by factors such as strong selection bias and failure to control for differing baseline morbidity and mortality trends.

Our study adds several key insights. First, uninsured patients did not experience improvement in control of chronic diseases even years after coverage expansion. In addition, patients with the most poorly controlled disease, who presumably benefit most from better access to outpatient care and medications, might not improve in the absence of additional interventions. Policy makers should consider prioritizing research to understand whether barriers to care such as out-of-pocket costs and access to timely visits persist even after receipt of insurance.

Generalizability of our findings to other states should be considered carefully. Compared with Massachusetts, other states might not have as generous a compensated care pool, might not have baseline rates of uninsured patients as low, and might not have as high a concentration of health providers. It is possible that patients with more severe access limitations in other states would have improved outcomes after receiving insurance. On the other hand, it is also possible that other states will have fewer resources for enrolling, subsidizing, or treating uninsured patients after health reform, so that outcomes could be worse compared to those we detected.

Our study has several other limitations. We could not capture measurements that occurred outside the Partners HealthCare system, but mean follow-up durations were long (about 4.5 years in both groups) and rates of attrition and mean number of measurements per patient per year were very similar between the study groups (Appendix SA5). Results of our subgroup of

patients without an established primary care provider at baseline (Figure 2) should be interpreted with caution because we are unable to verify whether they were being treated or seen in other institutions. Because we sought to assess baseline trends in health outcomes, we included only uninsured individuals who received clinical evaluation prior to the 2006 reform. Including baseline prehealth reform disease trends strengthens the internal validity of our study, but it limits generalizability of our findings to uninsured patients who have contact with the health care system. However, this population is significant; as noted above, prior to the 2006 reform most uninsured Massachusetts adults (61.1 percent) reported having a usual source of care and the 2003 National Health Interview Survey revealed that 80–93 percent of uninsured persons with diabetes, hypertension, or hyperlipidemia reported visiting a health professional in the prior year.

We used a nonequivalent control group (continuously insured patients), a methodologically rigorous approach (Campbell, MD, and Gage 1966), but future studies might have the option to also include a contemporaneous control group that remains uninsured. Finally, we assessed intermediate health outcomes rather than endpoints such as myocardial infarction or death. Patients might experience improvement in such outcomes if being insured facilitates earlier detection of disease or prevents deferral of high severity care. We also did not study impacts on important measures such as out-of-pocket costs or quality of life that might markedly improve after receiving insurance coverage.

In summary, we found that expansion of insurance coverage was not associated with improvement in hyperlipidemia, diabetes, or hypertension control. Further research is needed to understand reasons for lack of clinical improvement and it is possible that additional care models, health finance restructuring, or innovative insurance benefit designs might be needed.

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REFERENCES

- Amery, A., W. Birkenhäger, P. Brixko, C. Bulpitt, D. Clement, M. Deruyttere, A. De Schaepe-dryver, C. Dollery, R. Fagard, and F. Forette. 1985. "Mortality and Morbidity Results from the European Working Party on High Blood Pressure in the Elderly Trial." *The Lancet* 1 (8442): 1349–54.
- Ayanian, J. Z., B. A. Kohler, T. Abe, and A. M. Epstein. 1993. "The Relation between Health Insurance Coverage and Clinical Outcomes among Women with Breast Cancer." *New England Journal of Medicine* 329 (5): 326–31. doi:10.1056/NEJM199307293290507.
- Baicker, K., S. L. Taubman, H. L. Allen, M. Bernstein, J. H. Gruber, J. P. Newhouse, E. C. Schneider, B. J. Wright, A. M. Zaslavsky, and A. N. Finkelstein, Oregon Health Study Group, Carlson, M., Edlund, T., C. Gallia, and J. Smith. 2013. "The Oregon Experiment—Effects of Medicaid on Clinical Outcomes." *New England Journal of Medicine* 368(18): 1713–22. doi:10.1056/NEJMsa1212321.
- Campbell, D., J. C. Stanley, and N. Gage. 1966. "Experimental and Quasi-Experimental Designs for Research." Chicago: R. McNally.
- Capoccia, V. A., K. L. Grazier, C. Toal, J. H. Ford, and D. H. Gustafson. 2012. "Massachusetts's Experience Suggests Coverage Alone Is Insufficient to Increase Addiction Disorders Treatment." *Health Affairs (Project Hope)* 31 (5): 1000–8. doi:10.1377/hlthaff.2011.0326.
- Charlson, M., T. P. Szatrowski, J. Peterson, and J. Gold. 1994. "Validation of a Combined Comorbidity Index." *Journal of Clinical Epidemiology* 47 (11): 1245–51.
- Chen, C., G. Scheffler, and A. Chandra. 2011. "Massachusetts' Health Care Reform and Emergency Department Utilization." *New England Journal of Medicine* 110907140018030: doi:10.1056/NEJMp1109273.
- Chobanian, A. V., G. L. Bakris, H. R. Black, W. C. Cushman, L. A. Green, J. L. Izzo, D. W. Jones, B. J. Materson, S. Oparil, J. T. Wright, and E. J. Roccella, National Heart, Lung, and Blood Institute Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, National High Blood Pressure Education Program Coordinating Committee. 2003. "The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: The JNC 7 Report." *Journal of the American Medical Association*. May 21. doi:10.1001/jama.289.19.2560.
- Coca-Perraillon, M. 2007. "Local and Global Optimal Propensity Score Matching" [accessed December 19, 2009]. Available at <http://Www2.Sas.com/Proceedings/Forum2007/185-2007.pdf>
- Cook, E. F., and L. Goldman. 2013. "Performance of Tests of Significance Based on Stratification by a Multivariate Confounder Score or by a Propensity Score." *Journal of Clinical Epidemiology* 42 (4): 317–24.
- Currie, J., and J. H. Gruber. 1994. *Saving Babies: The Efficacy and Cost of Recent Expansions of Medicaid Eligibility for Pregnant Women*. No. W4644. National Bureau of Economic Research.

- Currie, J., and J. Gruber. 1996. "Health Insurance Eligibility, Utilization of Medical Care, and Child Health." *Quarterly Journal of Economics* 111 (2): 431–66.
- D'Agostino, R. B. 1998. "Propensity Score Methods for Bias Reduction in the Comparison of a Treatment to a Non-Randomized Control Group." *Statistics in Medicine* 17 (19): 2265–81.
- Davidoff, A., and G. Kenney. 2005. *Uninsured Americans with Chronic Conditions: Key Findings from the National Health Interview Survey*. Princeton, NJ: Robert Wood Johnson Foundation.
- DeNavas-Walt, C., B. D. Proctor, and J. Smith. 2007. U.S. Census Bureau, Current Population Reports, P60-233, "Income, Poverty, and Health Insurance Coverage in the United States: 2006." Washington, DC: U.S. Government Printing Office.
- . 2013. U.S. Census Bureau, Current Population Reports, P60-245, "Income, Poverty, and Health Insurance Coverage in the United States: 2012." Washington, DC: U.S. Government Printing Office.
- Finkelstein, A., and R. McKnight. 2008. "What Did Medicare Do? The Initial Impact of Medicare on Mortality and Out of Pocket Medical Spending." *Journal of Public Economics* 92 (7): 1644–68. doi:10.1016/j.jpubeco.2007.10.005.
- Galbraith, A. A., A. D. Sinaiko, S. B. Soumerai, D. Ross-Degnan, M. M. Dutta-Linn, and T. A. Lieu. 2013. "Some Families Who Purchased Health Coverage through the Massachusetts Connector Wound Up with High Financial Burdens." *Health Affairs (Project Hope)* 32 (5): 974–83. doi:10.1377/hlthaff.2012.0864.
- Haas, J. S., I. S. Udvarhelyi, C. N. Morris, and A. M. Epstein. 1993. "The Effect of Providing Health Coverage to Poor Uninsured Pregnant Women in Massachusetts." *Journal of the American Medical Association* 269 (1): 87–91.
- Hadley, J., E. P. Steinberg, and J. Feder. 1991. "Comparison of Uninsured and Privately Insured Hospital Patients. Condition on Admission, Resource Use, and Outcome." *Journal of the American Medical Association* 265 (3): 374–9.
- Hanchate, A. D., K. E. Lasser, A. Kapoor, J. Rosen, D. McCormick, M. M. D'Amore, and N. R. Kressin. 2012. "Massachusetts Reform and Disparities in Inpatient Care Utilization." *Medical Care* 50 (7): 569–77. doi:10.1097/MLR.0b013e31824e319f.
- International Expert Committee. 2009. "International Expert Committee Report on the Role of the A1C Assay in the Diagnosis of Diabetes." *Diabetes Care* 32 (7): 1327–34. doi:10.2337/dc09-9033.
- Iseline, S. 2007. "Uncompensated Care Pool PFY06 Annual Report. Massachusetts Division of Health Care Finance and Policy" [accessed on May 28, 2013]. Available at <http://www.mass.gov/chia/docs/p/ucp/pfy06-annual.pdf>
- Keating, N. L., E. M. Kouri, Y. He, D. W. West, and E. P. Winer. 2012. "Effect of Massachusetts Health Insurance Reform on Mammography Use and Breast Cancer Stage at Diagnosis." *Cancer* 119 (2): 250–8. doi:10.1002/cncr.27757.
- Khaw, K.-T., N. Wareham, S. Bingham, R. Luben, A. Welch, and N. Day. 2004. "Association of Hemoglobin A1c with Cardiovascular Disease and Mortality in Adults: The European Prospective Investigation Into Cancer in Norfolk." *Annals of Internal Medicine* 141 (6): 413–20.

- Long, S. K., and K. Stockley. 2010. "Health Reform in Massachusetts: An Update as of Fall 2009." *The Blue Cross Blue Shield of Massachusetts Foundation*: 1–37.
- Martin, M. J., S. B. Hulley, W. S. Browner, L. H. Kuller, and D. Wentworth. 1986. "Serum Cholesterol, Blood Pressure, and Mortality: Implications from a Cohort of 361,662 Men." *The Lancet* 2 (8513): 933–6.
- Massachusetts. 2006. "An Act Providing Access to Affordable, Quality, Accountable Health Care, Ch. 58, 188th General Court of the Commonwealth of Massachusetts," 1–81.
- Maxwell, J., D. E. Cortés, K. L. Schneider, A. Graves, and B. Rosman. 2011. "Massachusetts' Health Care Reform Increased Access to Care for Hispanics, But Disparities Remain." *Health Affairs (Project Hope)* 30 (8): 1451–60. doi:10.1377/hlthaff.2011.0347.
- McWilliams, J. M., A. M. Zaslavsky, E. Meara, and J. Z. Ayanian. 2004. "Health Insurance Coverage and Mortality among the Near-Elderly." *Health Affairs (Project Hope)* 23 (4): 223–33. doi:10.1377/hlthaff.23.4.223.
- McWilliams, J. M., E. Meara, A. M. Zaslavsky, and J. Z. Ayanian. 2007. "Health of Previously Uninsured Adults after Acquiring Medicare Coverage." *Journal of the American Medical Association* 298 (24): 2886–94. doi:10.1001/jama.298.24.2886.
- National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). 2002. "Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) Final Report." *Circulation* 106: 3143–3421.
- Neaton, J. D., and D. Wentworth. 1992. "Serum Cholesterol, Blood Pressure, Cigarette Smoking, and Death from Coronary Heart Disease. Overall Findings and Differences by Age for 316,099 White Men. Multiple Risk Factor Intervention Trial Research Group." *Archives of Internal Medicine* 152 (1): 56–64.
- Pande, A. H., D. Ross-Degnan, A. M. Zaslavsky, and J. A. Salomon. 2011. "Effects of Healthcare Reforms on Coverage, Access, and Disparities: Quasi-Experimental Analysis of Evidence from Massachusetts." *American Journal of Preventive Medicine* 41 (1): 1–8. doi:10.1016/j.amepre.2011.03.010.
- Piper, J. M., W. A. Ray, and M. R. Griffin. 1990. "Effects of Medicaid Eligibility Expansion on Prenatal Care and Pregnancy Outcome in Tennessee." *Journal of the American Medical Association* 264 (17): 2219–23.
- Rubin, D. B. 2007. "The Design versus the Analysis of Observational Studies for Causal Effects: Parallels with the Design of Randomized Trials." *Statistics in Medicine* 26 (1): 20–36. doi:10.1002/sim.2739.
- Smulowitz, P. B., R. Lipton, J. F. Wharam, L. Adelman, S. G. Weiner, L. Burke, C. W. Baugh, J. D. Schuur, S. W. Liu, M. E. McGrath, B. Liu, A. Sayah, M. C. Burke, J. H. Pope, and B. E. Landon. 2011. "Emergency Department Utilization after the Implementation of Massachusetts Health Reform." *Annals of Emergency Medicine* 58 (3): 225–34.e1. doi:10.1016/j.annemergmed.2011.02.020.

Sommers, B. D., K. Baicker, and A. M. Epstein. 2012. "Mortality and Access to Care among Adults after State Medicaid Expansions." *New England Journal of Medicine* 367 (11): 1025–34. doi:10.1056/NEJMsa1202099.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.

Appendix SA2: Uninsured Patients Who Received Insurance in the First Year after MHR.

Appendix SA3: (I) Patients with Severe Disease at Baseline: (Disease Severity in the Highest Two Quintiles at Study Entry); (II) Patients with Severe Disease at Baseline (At Least One Measurement of Total Cholesterol >240, A1C >9, Systolic Blood Pressure >160 during the Baseline Period).

Appendix SA4: (I) Outcomes of All Patients with Hyperlipidemia, Diabetes, or Hypertension: 1 : 1 Propensity Match; (II) Outcomes of All Patients with Hyperlipidemia, Diabetes, or Hypertension: 1 : 3 Propensity Match.

Appendix SA5: (I) Proportion of Patients Contributing Outcome Data by Quarter and Chronic Disease; (II) Mean Number of Outcome Measurements Contributed per Patient by Year and Chronic Disease.