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# Estimating The Potential Impact Of Insurance Expansion On Undiagnosed And Uncontrolled Chronic Conditions

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**ABSTRACT** **Policy makers have paid considerable attention to the financial implications of insurance expansion under the Affordable Care Act (ACA), but there is little evidence of the law's potential health effects. To gain insight into these effects, we analyzed data for 1999–2012 from the National Health and Nutrition Examination Survey to evaluate relationships between health insurance and the diagnosis and management of diabetes, hypercholesterolemia, and hypertension. People with insurance had significantly higher probabilities of diagnosis than matched uninsured people, by 14 percentage points for diabetes and hypercholesterolemia and 9 percentage points for hypertension. Among those with existing diagnoses, insurance was associated with significantly lower hemoglobin A1c (−0.58 percent), total cholesterol (−8.0 mg/dL), and systolic blood pressure (−2.9 mmHg). If the number of nonelderly Americans without health insurance were reduced by half, we estimate that there would be 1.5 million more people with a diagnosis of one or more of these chronic conditions and 659,000 fewer people with uncontrolled cases. Our findings suggest that the ACA could have significant effects on chronic disease identification and management, but policy makers need to consider the possible implications of those effects for the demand for health care services and spending for chronic disease.**

The Affordable Care Act (ACA) has as its primary goal improving access to affordable, high-quality health insurance. Before implementation of the ACA, an estimated fifty million Americans were uninsured.[1] A number of recent studies have found evidence of sizable insurance coverage gains for nonelderly adults, likely as a result of the act.[2–6] The financial impacts of major illnesses on people without insurance are well known. For example, unpaid medical bills remain the leading cause of bankruptcy among Americans.[7] Beyond financial protection, a major goal of insurance expansion is to improve the health of the US population.[8] However, the potential impact of the ACA on the health of Americans remains unclear.

Understanding the association between health insurance and health effects is critical for at least two reasons. First and foremost, improving the health of the population is a fundamental goal unto itself. Second, the pathways through which insurance improves health—namely, through better diagnosis and management of health conditions—could also have substantial implications for the demand for health care services and, ultimately, for health care spending. Evidence on expected health impacts and health services use is urgently needed by policy makers as they plan for the likely effects of the ACA's full implementation.

Multiple studies have examined the direct

health effects of insurance.[9–25] The best known recent example is the Oregon Health Insurance Experiment, which reported small and inconsistent effects of Medicaid coverage on diagnosis and medication use for chronic conditions, with little overall effect on clinical measures relating to hypertension, diabetes, and cholesterol.[26] However, despite its substantial strengths, the Oregon study had limited power to detect clinical changes because of its relatively small sample sizes. In addition, results among Medicaid beneficiaries in Oregon might not be generalizable to the US population.

Several earlier analyses of nationally representative data have suggested positive associations between health insurance and the diagnosis and control of chronic diseases.[14,15,17] Contemporary national estimates of the potential effects of insurance expansion on diagnosis and treatment of chronic conditions would provide valuable information about how the ACA could affect the health of the US population during a time of continuing public debate about the act.

In this study we applied matching-based algorithms to nationally representative health examination survey data to estimate the relationships between health insurance and the diagnosis and management of diabetes, hypercholesterolemia, and hypertension. Using these results, we then estimated the likely population-level impact of insurance expansion under the ACA on the numbers of Americans who are living with these conditions either undiagnosed or uncontrolled.

## Study Data And Methods

**DATA** We analyzed data from the National Health and Nutrition Examination Survey (NHANES), a nationally representative survey of the US civilian noninstitutionalized population.[27] The survey, which is continuously conducted, combines an interview about sociodemographic characteristics, health conditions, and risk factors with a health examination that includes laboratory tests. The National Center for Health Statistics (NCHS) administers the survey and has obtained Institutional Review Board approval for it.

We used data for the period 1999–2012 to estimate relationships between insurance and health outcomes. We focused on the most recent data (for 2011–12) to estimate current numbers of people nationwide who might benefit from insurance expansion. While data for 1999–2012 were pooled to maximize sample sizes, we conducted a sensitivity analysis in which we allowed effects to vary in the earlier (1999–2006) and later (2007–12) segments of the study period.

**ANALYTIC SAMPLE AND MEASURES** We restricted our analysis to adults ages 20–64. We excluded older adults because most of them have health insurance through Medicare and are therefore ineligible for coverage expansion under the ACA. Individuals were considered to have health insurance if they answered yes to the survey question, "Are you covered by health insurance or some other kind of health care plan?"

▶ **DIABETES:** To maintain a consistent definition of *undiagnosed diabetes* across survey rounds, we included only respondents who participated in the morning examination session and completed a fasting plasma glucose test in the diabetes analysis. In NHANES, participants are randomly assigned to one of two examination sessions, with those who are selected for the morning session asked to fast for nine hours beforehand. Individuals were considered to have diagnosed diabetes if they answered yes to the question, "Other than during pregnancy, have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?" Following the predominant diagnostic criteria for most of the study period, we considered participants to have undiagnosed diabetes if they had a survey-measured fasting plasma glucose level of ≥126 mg/dL and did not report a previous diagnosis of diabetes.[28] In a sensitivity analysis, we defined *undiagnosed diabetes* based on a measured hemoglobin A1c level of ≥6.5 percent.

▶ **HYPERCHOLESTEROLEMIA:** Survey respondents in the morning and afternoon examination sessions were eligible for a total serum cholesterol test. Participants were considered to have diagnosed hypercholesterolemia if they answered yes to the question, "Have you ever been told by a doctor or other health professional that your blood cholesterol level was high?" We considered participants to have undiagnosed hypercholesterolemia if their total cholesterol was ≥240 mg/dL and they did not report a previous diagnosis of the condition. As a sensitivity analysis, we restricted the analysis to participants in the morning session who had fasted before the test.

▶ **HYPERTENSION:** Participants in the morning and afternoon examination sessions were also eligible to have their blood pressure measured. We used the NCHS-recommended algorithm for computing mean systolic and diastolic blood pressure from repeated blood pressure measurements.[29]

We considered participants to have diagnosed hypertension if they answered yes to the question, "Have you ever been told by a doctor or other health professional that you had hypertension, also called high blood pressure?" We considered participants to have undiagnosed hypertension if their systolic blood pressure was ≥140 mmHg or their diastolic blood pressure

was ≥90 mmHg and if they did not report a previous diagnosis of the condition.

▶ **PHYSIOLOGICAL HEALTH INDICATORS AND MEASURES OF CONTROL:** We assessed clinical indicators for diabetes, hypercholesterolemia, and hypertension as continuous variables. We also analyzed dichotomous outcomes of control based on standard clinical definitions: HbA1c <8 percent for diabetes, total cholesterol <240 mg/dL for hypercholesterolemia, and systolic blood pressure <140 mmHg for hypertension.

**STATISTICAL ANALYSES** We used matching as a data preprocessing step,[30] followed by regression modeling to adjust for remaining confounding from observed covariates.[31] Our primary measures of association were risk differences for probabilities of diagnosis and control and mean differences for continuous measures. Analyses were conducted using Stata, version 12, and R, version 3.0.3.

**MATCHING PROCEDURE** We used a matching approach to address a limitation in several previous analyses of insurance and health outcomes that relied only on regression to adjust for observed confounders.[14,15,17] Because distributions of some potential confounders can differ greatly between the insured and the uninsured (for example, there are few wealthy uninsured people), regression estimates of associations between insurance and health outcomes can be sensitive to model specification, which can compromise the validity of a causal interpretation of the results.[30] To address this issue, for each uninsured individual in the sample, we selected as a match from the insured population an individual who was similar in terms of the following observed characteristics: sex, age, race/ethnicity, household income, marital status, current smoking status, body mass index, and survey round.

In addition to this set of matching variables, we also matched on a propensity score for having insurance, which we estimated via logistic regression predicted by the other matching variables.[32,33] Matching was done with replacement.

There are a variety of different matching algorithms available to analysts.[34] For this study we used a genetic matching algorithm. Genetic matching is a generalization of propensity score and Mahalanobis distance matching that maximizes covariate balance with an evolutionary search.[32] Preliminary testing for covariate balance showed that this approach outperformed both nearest-neighbor matching and matching on the propensity score alone for our analysis. Separate matched samples were generated for analyses of diabetes, hypercholesterolemia, and hypertension, to maximize sample sizes and balance in each case.

**ESTIMATES OF ASSOCIATION** We used linear regression to estimate relationships between health insurance and study outcomes within the matched samples. We controlled for the covariates listed in Exhibit 1 and an indicator for the survey round. Separately for each matched sample of respondents with diabetes, hypercholesterolemia, or hypertension, we estimated the association between insurance and the probability of diagnosis. For each of the three conditions, among those with a previous diagnosis of that condition, we estimated associations between health insurance and HbA1c, total cholesterol, and average systolic blood pressure, as well as the associations between insurance and dichotomous indicators of control in each case.

Sampling weights were omitted in regression models because the models controlled for age, sex, and race/ethnicity. Standard errors and confidence intervals for analyses on the matched samples accounted for stratification and clustering in the survey design[27] and for the sampling of insured individuals with replacement during matching.[35]

**SENSITIVITY ANALYSES** For the main analysis, we included respondents with private and public forms of health insurance in the insured sample.

**EXHIBIT 1**

**Characteristics Of Uninsured Adults Ages 20–64 With Diabetes, Hypercholesterolemia, Or Hypertension, 1999–2012**

| Characteristic | Diabetes (n = 314) | Hypercholesterolemia (n = 1,771) | Hypertension (n = 1,799) |
|---|---|---|---|
| Mean age (years) | 49.9 | 45.8 | 47.1 |
| Male | 51% | 54% | 52% |
| **RACE/ETHNICITY** | | | |
| Non-Hispanic white or other | 30% | 39% | 36% |
| Hispanic | 54 | 45 | 37 |
| Non-Hispanic black | 16 | 16 | 27 |
| **INCOME ($)** | | | |
| Less than 20,000 | 42% | 40% | 455 |
| 20,000–34,999 | 25 | 27 | 25 |
| 35,000–54,999 | 17 | 17 | 14 |
| 55,000–74,999 | 5 | 5 | 5 |
| 75,000 or more | 5 | 5 | 5 |
| Other[a] | 6 | 7 | 6 |
| **MARITAL STATUS** | | | |
| Never married | 13% | 16% | 19% |
| Married or living with partner | 58 | 59 | 54 |
| Widowed, divorced, or separated | 29 | 25 | 27 |
| **OTHER CHARACTERISTICS** | | | |
| Current smoker | 26% | 33% | 34% |
| Mean body mass index | 31.7 | 29.6 | 30.8 |

**SOURCE** Authors' analyses of data for 1999–2012 from the National Health and Nutrition Examination Survey. **NOTES** The analysis sample included both the uninsured adults whose characteristics are shown here and a matched sample of insured adults. For additional details, see Appendix Exhibit A2 (see Note 37 in text). [a]Refused to answer or answered "Don't know" or "Over $20,000."

**This study extends existing literature that aims to understand the relationship between health insurance and health.**

However, because Medicaid expansion and narrow-network plans provide important vehicles for expanded coverage under the ACA, an analysis that focused on public insurance could be enlightening. Thus, we conducted a sensitivity analysis in which we restricted the sample to the uninsured and those with public insurance only, and we then repeated the matching and estimation procedures.

**POPULATION IMPACT** The Congressional Budget Office (CBO) estimates that the ACA will reduce the number of nonelderly Americans without health insurance by approximately 50 percent.[36] We therefore used estimated mean differences in probabilities of diagnosis and control to predict the expected population health impacts of providing health insurance to half of all uninsured nonelderly Americans.

Population sizes were derived by combining survey-weighted prevalence estimates computed from 2011–12 NHANES data with total population estimates from the 2011–12 American Community Survey, as recommended by the NCHS for analysis of the 2011–12 NHANES. The potential impact of insurance on reducing the numbers of people who have uncontrolled disease was estimated by applying the risk differences estimated among diagnosed patients both to the diagnosed and uninsured population and to those who would be newly diagnosed after gaining insurance. Uncertainty intervals around population effect estimates accounted for sampling errors in the estimated prevalence of conditions and probabilities of diagnosis or control, as well as uncertainty in estimated insurance effects.

**LIMITATIONS** Our study had a number of limitations. Our matching approach improved the balance between the insured and the uninsured sample on observed characteristics, compared to that observed in the full survey data set. However, estimated effects could be biased by confounding from unobservable characteristics. Accordingly, caution is still needed in drawing causal inferences about the effects of insurance expansion.

Other limitations in the study were related to definitions and classifications for both insurance status and health outcomes. We included a sensitivity analysis that focused on public insurance. Nonetheless, it is possible that health benefits might differ between the insurance types considered in this analysis and the various forms of insurance used to expand coverage under the ACA, such as narrow network plans. Also, we defined control of each chronic condition in terms of measurement at a single point in time, whereas measures likely fluctuate over time.

Finally, the standardized definitions of disease used in this study may be more or less sensitive than those used in clinical practice. Therefore, the definitions in the study did not precisely identify which individuals would potentially be newly diagnosed under expanded insurance coverage.

## Study Results

**SAMPLE** The starting point for our analysis was the full sample of 28,157 respondents ages 20–64 from the 1999–2012 NHANES (for a diagram of the analytic sample, see online Appendix Exhibit A1).[37] Of the 11,548 individuals for whom complete information on diabetes was available, 875 had a previous diabetes diagnosis, and 348 had undiagnosed diabetes. Sample sizes for analyses of hypercholesterolemia and hypertension were larger because participants in both morning and afternoon sessions were eligible. Of the 25,327 individuals with complete information on cholesterol, 6,026 had a previous diagnosis of high cholesterol, and 2,230 had undiagnosed hypercholesterolemia. Of the 25,576 individuals with complete information on blood pressure, 6,366 had a previous hypertension diagnosis, and 1,531 had undiagnosed hypertension.

Characteristics of the uninsured sample are shown in Exhibit 1. Matching resulted in highly comparable distributions of observed potential confounders between uninsured and insured individuals in the analytic sample, which addressed significant prematching differences in race/ethnicity and household income distributions (for a summary of covariate balance after matching, see Appendix Exhibit A2).[37]

**PREVALENCE OF DISEASE** In 2011–12, 9.2 percent (95% confidence interval: 6.7, 11.7) of nonelderly American adults had diabetes, and over 60 percent of them had either undiagnosed

(prevalence: 3.1 percent; 95% CI: 1.8, 4.3) or diagnosed but uncontrolled (prevalence: 2.7 percent; 95% CI: 1.5, 3.8) disease. Hypercholesterolemia and hypertension were more prevalent than diabetes—35.4 percent (95% CI: 31.9, 39.0) and 31.2 percent (95% CI: 29.0, 33.3), respectively—and were more likely to be diagnosed and controlled. The prevalence of undiagnosed hypercholesterolemia was 6.9 percent (95% CI: 5.6, 8.2), and that of diagnosed but uncontrolled hypercholesterolemia was 6.4 percent (95% CI: 5.0, 7.8). The prevalence of undiagnosed hypertension was 5.5 percent (95% CI: 4.5, 6.4), and that of diagnosed but uncontrolled hypertension was 5.2 percent (95% CI: 4.2, 6.1) (data not shown).

**INSURANCE, DIAGNOSIS, AND CONTROL** Health insurance was significantly associated with improved diagnosis and control of diabetes, hypercholesterolemia, and hypertension. Comparing those without insurance to similar people with insurance, the probability of diagnosis for those with insurance was 13.5 (95% CI: 4.9, 22.2) percentage points higher for diabetes, 13.5 (95% CI: 10.1, 17.0) percentage points higher for hypercholesterolemia, and 8.8 (95% CI: 5.7, 11.9) percentage points higher for hypertension (Exhibit 2). Among diagnosed cases, having insurance was associated with lower HbA1c in those with diabetes (adjusted difference: −0.58 percent; 95% CI: −1.08, −0.07), lower total cholesterol in those with hypercholesterolemia (adjusted difference: −8.0 mg/dL; 95% CI: −13.2, −2.8), and lower systolic blood pressure in those with hypertension (adjusted difference: −2.9 mmHg; 95% CI: −4.8, −1.0). Compared to uninsured patients with hypercholesterolemia, those with insurance also had significantly lower systolic blood pressure (adjusted difference: −2.3 mmHg; 95% CI: −3.9, −0.7).

Dichotomous measures of disease control indicated similar improvements with insurance, although the benefit was not significant for diabetes control at a threshold of HbA1c <8.0 percent (adjusted difference: 9.5; 95% CI: −1.5, 20.5) (Exhibit 2).[37] A sensitivity analysis that used HbA1c instead of fasting plasma glucose as an indicator of undiagnosed diabetes found similar results, with the insured having an 11.0-percentage-point (95% CI: 5.4, −16.6) greater probability of being diagnosed, compared to the uninsured (data not shown). Restricting the hypercholesterolemia analysis to the morning fasting sample led to a slightly larger difference in probability of diagnosis given insurance: 16.4 percentage points (95% CI: 10.6, 22.2).

In sensitivity analyses allowing for different effects during the periods 1999–2006 and 2007–12, none of the time differences were found to be significant. Lastly, a reanalysis that restricted the sample to a comparison between the uninsured and people with public insurance identified relationships between insurance, diagnosis, and control that were similar to those in the main analysis that included all forms of insurance (for a version of Exhibit 2 that summarizes comparisons of the uninsured and those with public insurance, see Appendix Exhibit A4).[37]

**PROJECTED POPULATION IMPACT** If the number of nonelderly Americans without health insurance were reduced by half, which is the expected effect of the ACA as projected by the CBO, we estimate that there would be 313,000 (95% CI: 108,000, 545,000) fewer cases of undiagnosed diabetes, 811,000 (95% CI: 565,000, 1,078,000) fewer cases of undiagnosed hypercholesterolemia, and 485,000 (95% CI: 302,000, 681,000) fewer cases of undiagnosed hypertension (Exhibit 3). These benefits would occur among 1.5 million unique individuals, some of whom might have more than one condition. This corresponds to approximately one-fifth of the currently uninsured and undiagnosed individuals for the three conditions.

**EXHIBIT 2**

**Probabilities Of Being Diagnosed With Diabetes, Hypercholesterolemia, And Hypertension And Key Clinical Outcomes For Adults Ages 20–64, By Insurance Status, 1999–2012**

| | Insured | Uninsured | Adjusted difference | *p* value |
|---|---|---|---|---|
| **DIABETES** | | | | |
| Diagnosed | 77% | 62% | 13.5 | 0.003 |
| Among diagnosed: | | | | |
| Control | 65% | 55% | 9.5 | 0.098 |
| HbA1c (%) | 7.6 | 8.2 | −0.58 | 0.033 |
| Total cholesterol (mg/dL) | 196.5 | 204.4 | −6.2 | 0.356 |
| Systolic blood pressure (mmHg) | 128.6 | 128.1 | 1.1 | 0.658 |
| **HYPERCHOLESTEROLEMIA** | | | | |
| Diagnosed | 75% | 60% | 13.5 | <0.001 |
| Among diagnosed: | | | | |
| Control | 74% | 69% | 5.0 | 0.036 |
| HbA1c (%) | 6.1 | 6.1 | 0.09 | 0.216 |
| Total cholesterol (mg/dL) | 214.0 | 221.8 | −8.0 | 0.003 |
| Systolic blood pressure (mmHg) | 123.1 | 125.3 | −2.3 | 0.005 |
| **HYPERTENSION** | | | | |
| Diagnosed | 83% | 73% | 8.8 | <0.001 |
| Among diagnosed: | | | | |
| Control | 73% | 69% | 5.5 | 0.006 |
| HbA1c (%) | 6.0 | 6.1 | −0.07 | 0.300 |
| Total cholesterol (mg/dL) | 202.9 | 206.0 | −3.0 | 0.217 |
| Systolic blood pressure (mmHg) | 130.2 | 132.5 | −2.9 | 0.003 |

**SOURCE** Authors' analyses of data for 1999–2012 from the National Health and Nutrition Examination Survey. **NOTES** The column labeled "insured" refers to the sample of matched insured individuals. Adjusted differences are estimated from linear regressions fit to the matched samples, controlling for the covariates used to construct the matched samples. "Control" is HbA1c <8 percent for diabetes, total cholesterol <240 mg/dL for hypercholesterolemia, and systolic blood pressure <140 mmHg for hypertension. Full regression results appear in Appendix Exhibit A3 (see Note 37 in text).

**EXHIBIT 3**

**Estimated Gains In Diagnosis And Control Of Diabetes, Hypercholesterolemia, And Hypertension Among Adults Ages 20–64, Assuming A 50 Percent Reduction In The Number Of Uninsured People**

| | Diabetes | Hypercholesterolemia | Hypertension |
|---|---|---|---|
| Currently uninsured | 4,628,000 | 11,979,000 | 10,969,000 |
| Currently uninsured and undiagnosed | 1,856,000 | 3,917,000 | 2,161,000 |
| Increase in number of diagnoses with 50% reduction in the number uninsured | 313,000 | 811,000 | 485,000 |
| Currently uninsured and diagnosed | 2,771,000 | 8,063,000 | 8,807,000 |
| Currently uninsured, diagnosed, and uncontrolled | 1,176,000 | 2,153,000 | 2,159,000 |
| Increase in number of controlled cases with 50% reduction in the number uninsured | 162,000 | 241,000 | 271,000 |

**SOURCE** Authors' analyses of data for 1999–2012 from the National Health and Nutrition Examination Survey. **NOTES** The estimated impact of insurance expansion on new diagnoses of a given disease was computed as the product of the proportion of individuals in the US population with the disease but without insurance in 2011–12 multiplied by 50 percent, the estimated risk difference for the probability of diagnosis, and the size of the nonelderly American population for 2011–12 from the American Community Survey. The estimated impact of insurance on the number of individuals with newly controlled conditions was computed as the sum of the following: (1) the number of individuals in the US population with uncontrolled conditions and without insurance in 2011–12 multiplied by 50 percent and (2) the projected number of newly diagnosed individuals, assuming 50 percent insurance coverage expansion, multiplied by the estimated risk difference for the probability of control. We simulated uncertainty intervals around projected impacts by drawing values for population prevalence and risk differences from uncorrelated normal distributions, based on the estimated means and standard errors for these estimates. The total number of unique individuals predicted to benefit for at least one condition from a 50 percent expansion in insurance coverage was obtained by applying a scaling factor to the sum of the projected gains in diabetes, hypercholesterolemia, and hypertension in Exhibit 3. This scaling factor was computed from the morning examination sample by comparing the projected number of beneficiaries obtained from independently estimated samples of the three disease states to the projected number of beneficiaries obtained from applying independently acting risk differences to the joint distribution of the three disease states.

We also estimate that there would be 162,000 (95% CI: −21,000, 374,000) fewer cases of uncontrolled diabetes, 241,000 (95% CI: 25,000, 475,000) fewer cases of uncontrolled hypercholesterolemia, and 271,000 (95% CI: 82,000, 476,000) fewer cases of uncontrolled hypertension among 659,000 individuals (Exhibit 3). In a hypothetical scenario in which all nonelderly Americans had health insurance, we estimate that there would be 3.1 million more people with a diagnosis of one of these chronic conditions and 1.3 million fewer with uncontrolled cases.

## Discussion

Using data from a large, nationally representative survey of the US population, we found that health insurance was associated with higher rates of diagnosis of diabetes, hypercholesterolemia, and hypertension among nonelderly adults. Moreover, we found evidence that once people were diagnosed with one or more of these conditions, having health insurance was associated with improved management and control of the conditions, and the effects were moderate in size.

Our results suggest that for the nation, if insurance expansion under the ACA reduced the number of uninsured people by 50 percent as projected, more than 1.5 million currently uninsured individuals with previously undiagnosed chronic conditions could be newly diagnosed, and an additional 659,000 individuals could achieve control for at least one condition. From a health system perspective, these are positive outcomes that would have important implications for the health of the US population.

We found significant associations between insurance status and the primary measure of effective management for each of the three conditions (for example, blood pressure control among people with hypertension). In addition, we observed an insurance effect on the better management of hypertension among those with elevated serum cholesterol. This could be related in part to the implementation of risk-based prevention strategies, in which clinicians use predicted risk of cardiovascular disease (such as the Framingham Risk Score) to assign cholesterol-lowering or antihypertensive drugs;[38] to the application of the concept of combination pharmacotherapy, in which clinicians may prescribe both an antihypertensive and a cholesterol-lowering drug to prevent cardiovascular disease;[39] or to antihypertensive effects of statins.[40] However, we did not find the same cross-risk effect for diabetes, despite the fact that hypertension control is included in guidelines for diabetes management.

This study extends existing literature that aims to understand the relationship between health insurance and health. Among observational studies that considered health outcomes, associ-

**1.5 million**

**Newly diagnosed**

If insurance expansion under the ACA reduced the number of uninsured people by 50 percent, more than 1.5 million currently uninsured individuals with previously undiagnosed chronic conditions could be newly diagnosed, and an additional 659,000 individuals could achieve control for at least one condition.

ations have been reported between insurance and increased rates of disease diagnosis,[13–15] increased rates of accessing care,[18,19] improved physiological measures of disease control,[15,17,19] and reduced mortality.[16,20,21]

Our study is qualitatively consistent with findings in earlier studies that health insurance may increase levels of diagnosis and control of disease.[13–15,17] It is most closely related to a study by Andrew Wilper and colleagues that, using a regression analysis of NHANES data for 1999–2006, found that insurance was associated with diagnoses of diabetes and elevated cholesterol but not hypertension, and with control of hypertension but not diabetes or elevated cholesterol among already diagnosed cases.[15]

Our study used contemporary data and augmented previous methodologies with an estimation strategy that incorporated matching to improve the ability to derive credible estimates of insurance effects by constructing an appropriate counterfactual population for the uninsured. We also conducted a sensitivity analysis to determine whether public forms of health insurance were associated with improved health outcomes, and we tested for temporal changes in the relationship between health insurance and health outcomes between 1999 and 2012. Finally, our study is distinct in that it translates epidemiological findings into potential population-level health impacts of insurance expansion under the ACA in nonelderly adults.

It is also useful to consider our results in light of those reported in two randomized studies in the United States. In the 1970s the RAND Health Insurance Experiment found few examples of health outcomes that were improved by having more comprehensive insurance. However, it did find that blood pressure was lower among low-income patients with clinically defined hypertension who received free care, compared to those with cost sharing.[41] More recently, the Oregon experiment found no significant effect of Medicaid coverage on diagnosis of or medication use for high cholesterol or hypertension, or on overall levels of cholesterol or blood pressure in the Medicaid population. The study did find a significant increase in the probability of diabetes diagnosis and medication use.[26]

Our results for diabetes diagnosis are consistent with those in the Oregon experiment, but we found additional significant effects relating to blood pressure and cholesterol. There are several possible reasons for these differences. Most important, our study made use of a detailed examination survey that enabled us to identify both undiagnosed and diagnosed patients with each condition and therefore to estimate effects within these groups, instead of in the population as a whole, as in Oregon. Analyzing effects in the entire population is expected to dilute the benefits among those with chronic conditions by averaging these benefits with smaller or null effects among the healthy population. Power in the Oregon experiment was further limited by including relatively small numbers of people with these three chronic conditions and by having a relatively short follow-up period (on average, seventeen months of coverage). Finally, the Oregon study was limited to observing effects relating only to Medicaid and in only one state. Effects for the uninsured adult population in the United States are unlikely to be identical to those in this particular subpopulation.

**Insurance expansion should have a large and meaningful effect on both diagnoses of chronic illnesses and their subsequent treatment, which should lead to better disease control.**

Of course, the Oregon study had an experimental design, which removed the potential for selection bias and unmeasured confounding that can influence results from observational studies. Given the lack of experimental evidence at the national level and among specific populations with chronic conditions, our study used a robust matching approach to optimize our ability to control for potential biases arising in unadjusted or regression-only analyses of observational data. However, none of these methods can adjust for potential bias due to unmeasured confounders, and additional public policy experiments such as the Oregon Health Insurance Experiment may be useful.

## Policy Implications

A major goal of the ACA is to improve the health of the US population through insurance expansion. Our findings suggest that when it comes to chronic disease, insurance expansion should have a large and meaningful effect on both diag-

noses of chronic illnesses and their subsequent treatment, which should lead to better disease control. Moreover, our findings suggest that these health benefits can occur through expanded coverage of public forms of health insurance. While these are undoubtedly positive outcomes, our findings have specific, and nuanced, implications for policy makers.

First, there is a need to prepare the health system to handle the influx of 1.5 million people who will be newly identified as having a chronic disease. These people will need regular access to health care providers, and policy makers need to rethink their strategy for ensuring that newly insured patients can get the care they need. For example, this may require relaxing scope-of-practice rules in some places, to allow nurse practitioners and others to care more independently for these patients.

Second, patients with newly diagnosed chronic disease will surely incur greater medical expenditures than they did when they were uninsured, at least in the short term. While much of this spending is likely to be clinically beneficial, many of the existing models for forecasting future health care spending do not take these effects into account. This is an important omission, since in the long term, better management of chronic conditions might lead to reductions in health care spending because averted complications of hypertension, hypercholesterolemia, and diabetes could translate into fewer interventions needed and lower costs.

Furthermore, our findings are an important reminder of the need to focus on the quality of care for chronic disease, which remains suboptimal.[42] For increased rates of diagnosis to result in better chronic disease control, patients must receive care in systems that are effective and that ensure the provision of evidence-based care.

## Conclusion

The ACA remains a watershed in US health policy. Despite the policy debates that it has spawned, there are still surprisingly few data on the act's likely impact on the health of the US population. Our study provides contemporary estimates of the relationship between health insurance and the diagnosis and control of diabetes, hypercholesterolemia, and hypertension among nonelderly adults, who are the primary target of the ACA. Our findings suggest that the ACA could have significant effects on the identification and management of chronic disease. However, more attention is needed to the potential short-term and long-term implications of these health changes for the demand for health care services and health care spending on chronic disease. ■

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### NOTES

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37 To access the Appendix, click on the Appendix link in the box to the right of the article online.

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