Three-Year Impacts Of The Affordable Care Act: Improved Medical Care And Health Among Low- Income Adults

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Three-Year Impacts of the Affordable Care Act:

**Improved Medical Care and Health
Among Low-Income Adults in Two States**

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ABSTRACT:

Significant policy uncertainty continues to surround the Affordable Care Act (ACA) at both the state and federal level. We assessed changes in health care use and self-reported health after three years of the ACA's coverage expansion, using survey data collected from low-income adults through the end of 2016 in three states: Kentucky, which expanded Medicaid; Arkansas, which expanded private insurance to low-income adults using the federal marketplace; and Texas, which did not expand coverage. We used a difference-in-differences model with a control group, and an instrumental variables model to provide individual-level estimates of the effects of gaining insurance. By the end of 2016, the uninsured rate in the two expansion states had dropped by more than 20 percentage points relative to the non-expansion state. For uninsured individuals gaining coverage, this change was associated with a 41 percentage-point increase in having a usual source of care, a \$337 reduction in annual out-of-pocket spending, significant increases in preventive health visits and glucose testing, and a 23 percentage-point increase in "excellent" self-reported health. Among adults with chronic conditions, we found improvements in affordability of care, regular care for those conditions, medication adherence, and self-reported health.

Introduction

The Affordable Care Act (ACA) has produced the largest gains in insurance coverage in nearly 50 years,¹ but its future is uncertain after the 2016 election. While initial attempts to repeal the law in 2017 failed in Congress, leading policymakers remain committed to substantial changes. Estimates are that as many as 20 million Americans have obtained insurance under the ACA,² with more than half via Medicaid and the remainder largely from health insurance marketplaces.³ Meanwhile, several states that have yet to expand Medicaid are in the midst of a renewed debate over this possibility.⁴ The impact of the ACA's coverage expansion on medical care and health is critical to evaluating future policy efforts related to the law.

National studies of the full non-elderly population have detected improvements in trends for coverage, satisfaction with insurance, and access to care.^{5,6} Research specifically comparing Medicaid expansion versus non-expansion states have shown important clinical changes including increased primary care visits,⁷ improved blood pressure control and Pap testing rates,⁸ and suggestive evidence of improved self-reported health.^{9,10} However, published analyses have been limited to 2014 or 2015 data,¹¹ and since insurance expansions extend their reach gradually,¹² updated analyses with more recent data could provide valuable insights.

Meanwhile, patients with chronic medical conditions may have the most to gain from coverage expansion. These conditions affect nearly half of all Americans, disproportionately those who have gained coverage under the ACA.¹³ Given the high costs of care for this group¹⁴ and the public health implications of these conditions,¹⁵ there is substantial policy interest in whether expanding coverage improves quality of care and health in this population.

Our objective was to assess ongoing changes in health care use and self-reported health among low-income adults, including those with chronic conditions, after three full years of the

ACA's coverage expansion. Using survey data in three states collected through the end of 2016, we provide timely evidence of the law's ongoing impact on patient care.

METHODS

Study Design

We conducted a difference-in-differences analysis, which compares pre- versus post-expansion outcomes in two expansion states, with one non-expansion state as the control group. Our study states were Kentucky, which expanded coverage to low-income adults via Medicaid beginning in 2014; Arkansas, which used federal Medicaid funding to provide private insurance from the health insurance marketplace to low-income adults beginning in 2014; and Texas, which did not expand coverage to low-income adults. Thus, our study captures elements of both private marketplace insurance expansion and Medicaid expansion under the ACA; for brevity, we refer below to "ACA expansions" to describe Kentucky's Medicaid expansion and Arkansas's "private option" approach. In sensitivity analyses, we test for differences between these two approaches.

We selected Texas as a comparison state for Kentucky and Arkansas because it is a non-expansion state in the same Census region that had a similarly restrictive set of Medicaid eligibility criteria prior to the ACA (Texas covered parents only up to 26% of poverty as of 2012, compared to 17% for Arkansas and 59% in Kentucky, versus the national median of 81%).¹⁶ Our study design relies on the assumption that if not for Medicaid expansion, trends in coverage and other outcomes would have been similar across these three states. Data from the U.S. Census Bureau show that coverage trends for our study population were similar in all three states from 2010-2013 (see Appendix Figure 1), offering support for this assumption.²⁷

For our primary difference-in-differences model, we separately identified the expansion effects for each year of expansion – 2014, 2015, and 2016 – all compared to the pre-expansion 2013 data. This approach allows us to trace out differential changes over time. We also tested a model that pooled 2015-2016 together to increase statistical power.

We then conducted an instrumental variables (IV) analysis, in order to estimate individual-level changes in health care outcomes for uninsured individuals who acquired coverage under the ACA. We repeated this analysis among the subset reporting at least one chronic condition. The IV approach uses a quasi-experimental source of variation in a key predictor to identify the treatment effect of that predictor;¹⁷ in our case, the variation was the state ACA expansion policy, and the key predictor of interest was having health insurance. This approach builds on the underlying quasi-experimental design of our difference-in-differences model, but provides more directly interpretable estimates of patient-level outcomes, similar to the local average treatment effect estimated using an IV model in the Oregon Health Insurance Experiment.¹⁸ This approach does not change the causal inference for our study, which still relies on the assumption that in the absence of the ACA expansion, trends in our outcomes would have been similar in Texas versus the expansion states.

One key assumption for an IV analysis is that the instrument has a significant relationship with the predictor of interest; here, the state expansion decisions clearly had large effects on insurance coverage. The other key assumption is that the instrument (state expansion) only affects outcomes via the predictor of interest (insurance coverage). While this seems plausible in our case, other potential aspects of coverage expansions might affect access to care and health, even among those who did not gain insurance. For instance, there could be positive spillovers of expansion via better funding to safety net institutions,¹⁹ which would bias our IV estimates

upwards; or negative spillovers via reduced health system capacity to care for previously-covered populations,²⁰ which would have the opposite effect on our estimates. In addition, some people may not have gone from uninsured to insured, but simply switched types of coverage due to expansion. While these influences are likely swamped by the individual-level effects of gaining insurance, they are nonetheless potential sources of bias.

Data

We contracted with a research firm to conduct a random-digit dialing telephone survey from November to December each year, from 2013-2016. The survey sample contained U.S. citizens ages 19-64, with family incomes below 138% of the federal poverty level (FPL), the ACA's Medicaid expansion eligibility threshold. The survey was available in Spanish and English, and the sample included cellphone and landline users. Each year, we recruited a new sample split equally across our three study states. Annual sample sizes ranged from 2,209 to 3,011, for an overall total of 10,885. The study was exempted from review by the Harvard Chan Institutional Review Board since the investigators only had access to deidentified data.

The overall response rate was 22%, which compares favorably to several other surveys that have been used to evaluate the ACA.²¹⁻²³ Previous research demonstrates that the use of population-weighting in random-digit telephone surveys can mitigate non-response bias and produce estimates similar to those from government surveys.²⁴⁻²⁶ Accordingly, our analyses were weighted to demographic targets for low-income adults in our study states based on age, gender, education, marital status, race/ethnicity, geographic region, population density, and cell-phone use. Our survey has been previously validated against two large government-sponsored sources, the American Community Survey and the Behavioral Risk Factor Surveillance System.

In that validation, we compared estimates for low-income adults in our three study states for coverage and several measures of access to care in our survey and the government datasets. We found moderate-to-strong correlations and a range of absolute differences in estimates consistent with analogous differences between various federal surveys.^{9,21}

Statistical Analysis

For each outcome, we estimated a linear regression model including binary indicators for each year and state, plus interaction terms between “expansion state” and each post-expansion year (2014, 2015, and 2016). These interaction terms capture the changes attributable to coverage expansion for each year of the expansion, compared to the non-expansion state. All models adjusted for age, sex, race/ethnicity, education, family size, income, urban versus rural residence, and state. Regression equations are in the Appendix Methods.²⁷

Our study outcomes spanned seven domains: 1) health insurance (uninsured, Medicaid, and private insurance, in which each individual was assigned a primary type of insurance [see Appendix Methods],²⁷ as well as any coverage changes within 12 months); 2) access to care (having a personal doctor, usual location of care, difficulty obtaining primary care and specialty appointments, and reasons for ED use); 3) affordability (skipping needed care or medications due to cost, trouble with medical bills, and medical out-of-pocket spending); 4) utilization (outpatient, emergency department, and inpatient care in the prior 12 months); 5) preventive care (receipt of a check-up, cholesterol test, or glucose test in the prior 12 months); 6) quality of care (cholesterol and glucose testing for high-risk patients, regular care for chronic conditions, and self-rated quality of care); and 7) health status (self-reported health on a five-point scale²⁸ and a two-item depression score²⁹).

We then examined the same outcomes (other than coverage) in an instrumental variables

(IV) analysis. We used a two-stage least-squares regression,³⁰ in which the first stage predicted the likelihood of a person having any health insurance (i.e. *1 – uninsured*) as a function of state expansion decisions and the year, using the difference-in-differences model described above (see Appendix Table 1).²⁷ The second stage then provided an estimate of the impact of gaining insurance from the ACA expansion on individual-level health care outcomes. This method also has the advantage of using all four years of data simultaneously to produce a single estimated policy effect from expansion.

We used Stata 14.0 for all analyses. All regression models used county-level robust clustered standard errors to account for the non-independence of observations within the same state and county.

Sensitivity and Subgroup Analyses

We repeated our IV analysis for the subset of respondents who reported having been diagnosed with any of nine chronic conditions: hypertension, coronary artery disease, stroke, asthma / chronic obstructive pulmonary disease (COPD), kidney disease, diabetes, depression, cancer (other than skin cancer), or substance abuse. We also tested whether the prevalence of these conditions changed in association with expansion status.

We conducted several sensitivity analyses. We tested the impact of pooling 2015 and 2016 expansion state data together to increase statistical power. To account for multiple hypothesis testing within each domain of outcomes, we estimated “family-wise” p-values using a step-down bootstrapping approach similar to other recent analyses.^{11,31} We also tested a spatial correlation model described below.

Finally, we repeated our primary model with the expansion states divided into

Kentucky's Medicaid expansion versus Arkansas's private option. This produced separate estimates for expansion effects in Arkansas and Kentucky.

Limitations

Our analysis has several limitations. Our study includes only three states. This means our results may not generalize to the nation as a whole. It also affects our estimation of standard errors and the possibility of idiosyncratic changes in any given state exerting an outsized influence on our findings. In studies with a larger number of states, the use of state-clustered standard errors can limit this risk, but standard methods to estimate correlation within states are biased when there are only three states.³² Instead, we used county-level clustering to estimate standard errors as in our previous work with this dataset,⁹ and also present results using spatial correlation across counties similar to other health care analyses using small numbers of states.³³ Our main findings were similar under both alternatives.

As discussed earlier, the response rate for random digit telephone surveys like ours is lower than that for government interview surveys. However, we believe that the tradeoff of timeliness and ability to design our own comprehensive survey outweighed those concerns, particularly given the previous validation of our survey instrument.⁹

Other limitations are inherent to our study's quasi-experimental design, which helps control for secular trends and takes advantage of a comparison group using a non-expansion state, but is still subject to unmeasured confounders that vary over time across states. Our IV analyses produced estimates with fairly wide confidence intervals, which means that the exact magnitudes of change should be interpreted cautiously. Finally, the possibility of recall or social desirability bias may affect our survey-based results. However, our findings in several domains

are consistent with ACA studies using non-survey data such as pharmacy claims,^{34,35} lab results,³⁶ and community health center reports.⁸

RESULTS

Exhibit 1 presents descriptive statistics by state for our full sample and for those with chronic conditions. Respondents in Texas were disproportionately Latino and urban compared to Arkansas and Kentucky. Chronic conditions affected 69% in Arkansas, 72% in Kentucky, and 55% in Texas. Changes in disease prevalence between 2013 and 2016 by state were non-significant for all but kidney disease, which showed a small decline in expansion states (-2.2 percentage points, $p=0.06$) (Appendix Table 2).²⁷ Individuals with chronic conditions were older and less likely to be male or Latino. Among those with a condition, the mean number of conditions ranged from 2.0 to 2.3 by state, with depression (57-64%), hypertension (52-54%), asthma/COPD (32-43%), and diabetes (22-26%) the most common.

Exhibit 2 presents the percentages of respondents in each state that were uninsured from 2013-2016. The three states began with similar pre-ACA uninsured rates of approximately 40% among low-income adults in 2013. This fell steeply in 2014 in Kentucky and Arkansas and declined more gradually in 2015 and 2016. Meanwhile the uninsured rate fell moderately in 2014 in Texas and then plateaued. By the end of the study period, the uninsured rate was 7.4% in Kentucky, 11.7% in Arkansas, and 28.2% in Texas.

Exhibit 3 presents regression-based estimates for differential changes in our study outcomes, comparing expansion to non-expansion states (Appendix Table 3 presents unadjusted mean values for each outcome in each year, by state).²⁷ Compared to Texas, the ACA expansion to low-income adults was associated with an increase in coverage of 14 percentage points in

2014, 22.9 percentage points in 2015, and 20.7 percentage points in 2016 (all $p < .01$). By 2016, in our main model, the expansions had led to significant increases in multiple measures of access to care and affordability, including having a personal doctor and reductions in cost-related delays in care and medication use. Expansion was associated with a decline in difficulty paying medical bills, but an increase in difficulty obtaining appointments with specialists in 2016.

Exhibit 3 also presents changes in utilization and preventive care. Compared to Texas, ACA coverage expansion in 2015 and 2016 was associated with a significantly reduced likelihood of any emergency department visits and an increased likelihood of a checkup within the prior 12 months, but no significant changes in hospitalizations. Our two measures of clinical screening tests – glucose screening and cholesterol monitoring – significantly increased in association with coverage expansion in 2015 or 2016, respectively. Perceived quality of care showed some improvement in 2015 that did not persist. Finally, coverage expansion led to improvements in self-reported health (for “excellent”, $p < 0.05$ in 2015; for both “excellent” and “fair/poor” $p < 0.10$ in 2016).

Appendix Tables 4 and 5 present sensitivity analyses for our difference-in-differences model.²⁷ When we used bootstrapped “family-wise” p-values that accounted for multiple variables within each domain of outcomes, we continued to find significant changes in 2016 for outcomes related to coverage, access, affordability, and prevention ($p < .05$) and quality ($p < .10$), but not for utilization and self-reported health.²⁷ Pooling 2015-2016 data together strengthened the statistical significance of some 2016 findings such as private insurance gains, having a usual source of care, out-of-pocket spending, and excellent self-reported health, and outcomes in 5 of 7 domains were significant at $p < .05$ and the other two at $p < .10$ using family-wise p-values. Difficulty obtaining an appointment to see a specialist was no longer significant in the pooled

model. In models using spatially-correlated standard errors, several estimates were affected by the lack of weighting, but overall this approach yielded similar precision as the main model, offering support for our primary method using county-level clustering.

Exhibit 4 presents individual-level estimates of changes in these outcomes for patients acquiring insurance using our IV model. For the full sample, we estimated that expansion led to significant changes including a 41 percentage-point increase in having a usual source of care among those gaining coverage, a \$337 reduction in medical out-of-pocket spending, a 28 percentage-point reduction in the likelihood of any emergency department visits, and a 25 percentage-point increase in glucose testing. The proportion in excellent health increased by nearly 23 percentage points.

Exhibit 4 also shows IV results for adults with chronic conditions. While out-of-pocket spending and cholesterol and glucose testing among high-risk patients (those with diabetes, stroke, hypertension, or heart disease) did not change significantly, we otherwise found similar results for most outcomes as in the full sample, including a 51 percentage-point decrease in skipping medications due to cost and a 20 percentage-point increase in excellent health. In a question asked only of this subgroup, we estimated a 56 percentage-point increase in obtaining regular care for chronic conditions.

Comparisons of the 2016 effects of private versus public insurance approaches in Arkansas and Kentucky (Appendix Table 6) showed no significant differences for most outcomes.²⁷ As expected, health insurance type differed, with more private coverage gains in Arkansas and more Medicaid in Kentucky. The only other significant difference was a greater decline in “fair/poor quality of care” in Arkansas compared to Kentucky. Both expansions were associated with significant improvements in numerous outcomes compared to Texas, including

access to a personal doctor and medications, trouble with medical bills, checkups and cholesterol testing, and self-reported health.

DISCUSSION

In our analysis of survey data of low-income adults in three states, we note three key contributions to the growing body of research on the ACA. First, we provide the earliest published estimates using data through the law's third year of expansion (2016), allowing us to document the expansions' changing impact on health care outcomes over time. Second, we use an instrumental variables model to provide individual-level estimates of the ACA's coverage impacts, showing large improvements in self-reported health status and other outcomes directly relevant to patients. Third, we document benefits in numerous previously-unstudied outcomes for adults with chronic conditions, a vulnerable and high-cost population.

Our 4 years of data indicate that the ACA's coverage expansion to low-income adults was associated with significant improvements in access to primary care and medications, affordability of care, preventive visits, screening tests, and self-reported health. Though coverage gains in the two expansion states were largest in the first two years with little additional change in 2016, the time course was more variable for access and utilization measures. While some changes were present in 2014 or 2015, others changes such as increased cholesterol testing and reduced fair/poor health did not become evident until 2016.

Individual-level estimates indicate large and policy-relevant changes for those gaining coverage. The average newly-covered adult experienced savings of \$337 per year in out-of-pocket medical spending, a 41 percentage-point increase in the likelihood of having a usual source of care, and a 23 percentage-point increase in the likelihood of being in excellent health.

The validity of these estimates is supported by their similarity to those from the IV analyses in the randomized Oregon Health Insurance Experiment, which showed an average reduction of \$390 in medical debt, a 34 percentage-point increase in office-based usual source of care, and a 13 percentage-point change in the share in excellent, very good, or good health.³¹

These latter results are particularly noteworthy given policy interest in the impact of the ACA on health status. For context, prior research indicates that a self-reported health rating of fair or poor confers a mortality risk 2-4 times higher than those in the healthiest category.²⁸ Our finding of improved self-reported health is consistent with results in the Oregon study and other pre-ACA Medicaid expansions,³⁷ though the evidence on similar changes under the ACA has been more mixed.^{6,10,11,38} In part, this likely reflects differences in sample frame and timing. Studies that have not found significant changes in self-reported health after the Medicaid expansion have typically used only 1-2 years of post-expansion data and have studied expansion-related coverage gains on the order of 3 to 8 percentage points.^{6,11,38} Here, we assessed 3 full years of post-expansion data and studied a population experiencing a much larger coverage change of over 20 percentage points.

Adults with chronic conditions experienced numerous improvements in both access and quality of care, including more checkups, improved adherence to medications, higher rates of regular care for chronic disease, and – perhaps as a consequence of these changes – improved self-reported health. These findings build on a previous study using national data through 2014 showing gains in two access measures for adults with chronic conditions (having a check-up and no cost-related delays in care);³⁹ however, our study included a much richer set of outcomes and two additional years of data.

We detected an increased rate of difficulty obtaining specialist appointments in 2016 in

the expansion states, particularly in Kentucky. This is consistent with a recent national study that showed an increase in appointment wait times after expansion,⁷ as well as some studies showing greater barriers to specialty care in Medicaid than primary care.⁴⁰ However, in part this may also reflect that patients without coverage are less likely to attempt to make appointments with specialists; thus, coverage expansion may increase the share who try but experience difficulties in doing so, even as their overall access to care has improved.

Our results also offer insights into alternative state approaches to coverage expansion. With increased interest under the new administration in state flexibility and innovation, we find that either a private insurance expansion via marketplace coverage (as in Arkansas) or a Medicaid expansion (as in Kentucky) produce similar benefits across most study outcomes. Consistent with prior comparisons,⁴¹ the results imply that coverage expansion is quite important for patients, but the type of coverage obtained is less critical.

Conclusion

Over three years of coverage expansion in two states, the ACA was associated with statistically significant and clinically relevant improvements for low-income adults' access to care, preventive services utilization, and self-reported health. Among those with chronic conditions, coverage expansion was linked to improved medication adherence, more regular communication with physicians, and improved perceived health status. As policymakers debate the ACA's future and additional states consider whether to expand Medicaid, our findings demonstrate the benefits associated with coverage expansion for two particularly vulnerable populations – low-income adults and those with chronic conditions.

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EXHIBIT LIST

Exhibit 1 (Table)

Caption: Descriptive Statistics for Full Sample (N=10,885) and Adults with Chronic Conditions (N=7,734), by State

Source/Notes:

SOURCE: Survey of U.S. citizens aged 19-64 with income < 138% of the federal poverty level in Arkansas, Kentucky, and Texas.

NOTES: The table reflects pooled estimates for the years 2013-2016.

Exhibit 2 (Figure)

Caption: Percentage of Low-Income Adults without Health Insurance Coverage By State and Year

Source/Notes:

SOURCE: From a telephone survey of 10,885 U.S. citizens ages 19-64, with family income below 138% of the federal poverty level. The survey was conducted in November-December of each year with a new sample, divided evenly between the three states – Arkansas (AR), Kentucky (KY), and Texas (TX).

Exhibit 3 (Table)

Caption: Year-by-Year Changes in Health Care Outcomes After Coverage Expansion, Compared to Non-Expansion

Source/Notes:

SOURCE: From a telephone survey of U.S. citizens ages 19-64, with family income below 138% of the federal poverty level, in Arkansas, Kentucky, and Texas. The sample contained 10,885 adults (minus item non-response for each specific outcome), except where otherwise noted below.

NOTES:

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

ED = Emergency Department. Results show differences-in-differences estimates for expansion states (Arkansas and Kentucky) versus Texas, by year. All analyses adjusted for sex, age, race/ethnicity, marital status, family size, education, income, urban vs. rural residence, county annual unemployment rate, state, and year.

a – All estimates are reported as percentage-point changes for binary outcomes, other than number of office and ED visits and out-of-pocket spending.

b - Usual source of care was grouped into 3 categories – those reporting an office-based usual source of care, those without any usual source of care, and those using the ED as the usual source of care.

c – Sample limited to patients reporting heart disease, stroke, diabetes, or hypertension (n=5,611).

d – Sample limited to patients reporting a history of diabetes (n=2,213).

e– Sample limited to patients reporting at least one of the following conditions: hypertension, heart attack/coronary artery disease, stroke, asthma/COPD, kidney disease, diabetes, depression, cancer, and substance abuse (n=7,734).

Exhibit 4 (Table)

Caption: Instrumental Variables (IV) Analysis – Individual-Level Change Per Person Gaining Insurance

Source/Notes:

SOURCE: From a telephone survey of U.S. citizens ages 19-64, with family income below 138% of the federal poverty level, in Arkansas, Kentucky, and Texas. The sample contained 10,885 adults (minus item non-response for each specific outcome), except where otherwise noted below.

NOTES:

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

ED = Emergency Department. IV = Instrumental Variables.

Results show local average treatment effect from gaining coverage via expansion in Arkansas and Kentucky, compared to Texas (which did not expand) using two-stage least squares IV regression. All analyses adjusted for sex, age, race/ethnicity, marital status, family size, education, income, urban vs. rural residence, state, and year.

a – All estimates are reported as percentage-point changes for binary outcomes, other than number of office and ED visits and out-of-pocket spending.

b – Sample limited to patients ($n=7,734$ adults) reporting at least one of the following conditions: hypertension, heart attack/coronary artery disease, stroke, asthma/COPD, kidney disease, diabetes, depression, cancer, and substance abuse.

c - Usual source of care was grouped into 3 categories – those reporting an office-based usual source of care, those without any usual source of care, and those using the ED as the usual source of care.

d – Sample limited to patients reporting heart disease, stroke, diabetes, or hypertension ($n=5,611$).

e – Sample limited to patients reporting a history of diabetes ($n=2,213$).

**Exhibit 1: Descriptive Statistics for Full Sample (N=10,885)
and Adults with Chronic Conditions (N=7,734), by State**

VARIABLE		Full Sample			Adults with Chronic Conditions		
		Arkansas	Kentucky	Texas	Arkansas	Kentucky	Texas
Sample size (N)		3,623	3,639	3,623	2,666	2,825	2,243
Female		57%	56%	58%	60%	61%	62%
Age	19-34	41%	39%	46%	34%	31%	33%
	35-44	19%	20%	18%	19%	21%	18%
	45-54	16%	17%	16%	19%	19%	20%
	55-64	23%	24%	20%	28%	29%	29%
Race/ ethnicity	White non-Latino	66%	84%	36%	66%	85%	41%
	Latino	4%	2%	40%	3%	1%	32%
	Black non-Latino	25%	11%	19%	26%	11%	22%
	Other	5%	3%	5%	5%	3%	4%
Education	Less than High School Degree	20%	25%	23%	22%	28%	25%
	High school graduate	47%	43%	40%	49%	44%	40%
	Some college/college graduate	33%	32%	38%	29%	28%	35%
Family Income	Under 50% of Poverty	32%	33%	30%	33%	35%	32%
	50% -100% of Poverty	36%	36%	37%	37%	36%	36%
	100%-138% Poverty	25%	23%	25%	24%	22%	24%
	Don't know/Refused	7%	7%	8%	6%	7%	8%
Married or Living with a Partner		41%	42%	40%	40%	40%	37%
Family Size (number)		2.9	2.9	3.2	2.8	2.7	3.0
Rural		56%	55%	14%	58%	57%	15%
Chronic Conditions	Hypertension	37%	39%	28%	54%	54%	52%
	Coronary Artery Disease	8%	11%	6%	12%	16%	12%
	Stroke	5%	6%	4%	7%	8%	8%
	Asthma/COPD	26%	31%	18%	37%	43%	32%
	Kidney Disease	2%	4%	2%	4%	5%	4%
	Diabetes	15%	17%	14%	22%	23%	26%
	Depression	41%	46%	32%	60%	64%	57%
	Cancer	5%	6%	3%	7%	8%	6%
	Substance Abuse	4%	5%	4%	6%	7%	7%
	≥1 condition	69%	72%	55%	100%	100%	100%
	Mean # Conditions	1.4	1.6	1.1	2.1	2.3	2.0

SOURCE: Survey of U.S. citizens aged 19-64 with income < 138% of the federal poverty level in Arkansas, Kentucky, and Texas.

NOTES: The table reflects pooled estimates for the years 2013-2016.

Exhibit 2:
Percentage of Low-Income Adults without Health Insurance Coverage By State and Year

SOURCE: From a telephone survey of 10,885 U.S. citizens ages 19-64, with family income below 138% of the federal poverty level. The survey was conducted in November-December of each year with a new sample, divided evenly between the three states – Arkansas (AR), Kentucky (KY), and Texas (TX).

**Exhibit 3: Year-by-Year Changes in Health Care Outcomes After Coverage Expansion,
Compared to Non-Expansion**

OUTCOME	2014*Expansion^a	2015*Expansion^a	2016*Expansion^a
<u>Coverage</u>			
Uninsured	-14.0***	-22.9***	-20.7***
Medicaid	9.5***	12.2***	17.6***
Private insurance	7.7**	8.5**	5.9*
Coverage change within past year	5.8*	1.2	1.9
<u>Access to Care</u>			
Has a personal doctor	7.6*	12.1***	16.7***
Usual source of care	3.8	10.4***	6.8
Trouble obtaining primary care appointment	3.6	0.1	2.1
Trouble obtaining specialist appointment	2.5	1.1	6.4**
ED is usual location of care ^b	-5.1*	-5.9***	-3.7
ED visit because office visit unavailable	4.9**	5.0*	3.5
<u>Affordability</u>			
Cost-related delay in care	-4.3	-18.4***	-12.8***
Skipped medication due to cost	-9.9***	-12.0***	-10.5***
Trouble paying medical bills	-8.9***	-14.1***	-10.9***
Annual out-of-pocket medical spending	-\$33	-\$88**	-\$62*
<u>Utilization</u>			
Any office visits in past year	2.3	2.7	4.3
Any ED visits in past year	-1.8	-5.8**	-6.6**
# office visits in past year	0.51	0.66**	0.60
# ED visits in past year	-0.12	-0.09	0.13
Any hospitalization in past year	-1.6	1.9	2.9
<u>Prevention</u>			
Checkup in past year	6.9*	16.0***	11.1**
Cholesterol check in past year	-1.1	1.4	9.9***
Glucose check in past year	2.2	6.3**	4.3
<u>Quality of Care</u>			
Cholesterol check in high-risk patients ^c	2.3	1.1	2.7
Glucose check in those with diabetes ^d	4.5	11.1**	6.3
Regular care for chronic condition ^e	11.3**	11.5**	11.2**
Excellent quality of care	4.1	1.3	2.0
Fair/poor quality of care	-2.5	-7.3**	-2.3
<u>Health Status</u>			
Excellent self-reported health	2.4	5.0**	5.1*
Fair/poor self-reported health	0.6	-3.7	-6.0*
Positive depression screen (PHQ2 ≥2)	2.0	-6.9*	-1.8

SOURCE: From a telephone survey of U.S. citizens ages 19-64, with family income below 138% of the federal poverty level, in Arkansas, Kentucky, and Texas. The sample contained 10,885 adults (minus item non-response for each specific outcome), except where otherwise noted below.

NOTES:

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

ED = Emergency Department. Results show differences-in-differences estimates for expansion states (Arkansas and Kentucky) versus Texas, by year. All analyses adjusted for sex, age, race/ethnicity, marital status, family size, education, income, urban vs. rural residence, county annual unemployment rate, state, and year.

a – All estimates are reported as percentage-point changes for binary outcomes, other than number of office and ED visits and out-of-pocket spending.

b - Usual source of care was grouped into 3 categories – those reporting an office-based usual source of care, those without any usual source of care, and those using the ED as the usual source of care.

c – Sample limited to patients reporting heart disease, stroke, diabetes, or hypertension (n=5,611).

d – Sample limited to patients reporting a history of diabetes (n=2,213).

e– Sample limited to patients reporting at least one of the following conditions: hypertension, heart attack/coronary artery disease, stroke, asthma/COPD, kidney disease, diabetes, depression, cancer, and substance abuse (n=7,734).

**Exhibit 4: Instrumental Variables (IV) Analysis – Individual-Level Change
Per Person Gaining Insurance**

OUTCOME^a	Effect of Any Insurance, Full Sample	Effect of Any Insurance, Adults with Chronic Conditions^b
<u>Access to Care</u>		
Has a personal doctor	62.1***	40.9*
Usual source of care	41.1**	20.0
Trouble obtaining primary care appointment	3.3	-6.5
Trouble obtaining specialist appointment	13.7	25.1*
ED is usual location of care ^c	-23.1**	-0.9
ED visit because office visit unavailable	20.2	29.8
<u>Affordability</u>		
Cost-related delay in care	-74.7***	-74.6***
Skipped medication due to cost	-52.3***	-50.8**
Trouble paying medical bills	-58.6***	-66.6***
Annual out-of-pocket medical spending	-\$337**	-\$361
<u>Utilization</u>		
Any office visits in past year	14.7	-8.2
Any ED visits in past year	-27.6**	-29.5*
# office visits in past year	2.86*	2.68
# ED visits in past year	-0.05	-0.06
Any hospitalization in past year	10.5	18.0
<u>Prevention</u>		
Checkup in past year	64.7***	56.8**
Cholesterol check in past year	20.2	15.7 ^d
Glucose check in past year	25.4**	92.0 ^e
<u>Quality of Care</u>		
Regular care for chronic condition	N/A	55.9***
Excellent quality of care	9.7	31.5
Fair/poor quality of care	-29.8	-27.2
<u>Health Status</u>		
Excellent self-reported health	22.7**	20.4**
Fair/poor self-reported health	-20.6	-38.3*
Positive depression screen (PHQ2 ≥2)	-21.9	-31.5

SOURCE: From a telephone survey of U.S. citizens ages 19-64, with family income below 138% of the federal poverty level, in Arkansas, Kentucky, and Texas. The sample contained 10,885 adults (minus item non-response for each specific outcome), except where otherwise noted below.

NOTES:

*** p<0.01, ** p<0.05, *p<0.10

ED = Emergency Department. IV = Instrumental Variables.

Results show local average treatment effect from gaining coverage via expansion in Arkansas and Kentucky, compared to Texas (which did not expand) using two-stage least squares IV regression. All analyses

adjusted for sex, age, race/ethnicity, marital status, family size, education, income, urban vs. rural residence, state, and year.

a – All estimates are reported as percentage-point changes for binary outcomes, other than number of office and ED visits and out-of-pocket spending.

b – Sample limited to patients (n=7,734 adults) reporting at least one of the following conditions: hypertension, heart attack/coronary artery disease, stroke, asthma/COPD, kidney disease, diabetes, depression, cancer, and substance abuse.

c - Usual source of care was grouped into 3 categories – those reporting an office-based usual source of care, those without any usual source of care, and those using the ED as the usual source of care.

d – Sample limited to patients reporting heart disease, stroke, diabetes, or hypertension (n=5,611).

e – Sample limited to patients reporting a history of diabetes (n=2,213).

Appendix Methods

Regression Equation – Year-by-Year Difference-in-Differences Model (Exhibit 3)

$$\begin{aligned} Uninsured_{icst} = & \beta_0 + \beta_1 X_i + \beta_2 Arkansas_s + \beta_3 Kentucky_s + \beta_4 Year2014_t + \beta_5 Year2015_t \\ & + \beta_6 Year2016_t + \beta_7 Expansion State_s * Year2014_t + \beta_8 Expansion State_s * Year2015_t \\ & + \beta_9 Expansion State_s * Year2016_t + \varepsilon_{icst} \end{aligned} \quad (1)$$

where i indexed individuals, c county, s state, and t year. X_i was a vector of demographics (age, sex, race/ethnicity, marital status, family size, education, income, and urban vs. rural status). β_2 and β_3 capture the direct effects of each state at baseline compared to Texas, and β_4 - β_6 adjust for the year. β_7 measures the difference-in-differences estimate for the change in outcome in the expansion states (Arkansas and Kentucky) in 2014, compared to the control group (Texas), while β_8 and β_9 provide the comparable estimates for 2015 and 2016, respectively. The error terms, ε_{icst} , were assumed to be correlated between individuals within counties, which we addressed using robust clustered standard errors. For the 1.9% of our sample that did not report a county of residence, we created a residual county for each state (e.g. “missing county in Arkansas”) that served as its own unit for clustering. We used linear regression models to allow for easy interpretation of the magnitude of the interaction terms β_7 - β_9 .

Regression Equations – Instrumental Variables (Exhibit 4)

1st Stage:

$$\begin{aligned} AnyInsurance_{icst} = & \beta_0 + \beta_1 X_i + \beta_2 Arkansas_s + \beta_3 Kentucky_s + \beta_4 Year2014_t + \beta_5 Year2015_t \\ & + \beta_6 Year2016_t + \beta_7 Expansion State_s * Year2014_t + \beta_8 Expansion State_s * Year2015_t \end{aligned}$$

$$+ \beta_9 \text{Expansion State}_s * \text{Year2016}_t + \varepsilon_{icst} \quad (2)$$

2nd Stage:

$$\begin{aligned} \text{PersonalDoctor}_{icst} = & \beta_0 + \beta_1 X_i + \beta_2 \text{Arkansas}_s + \beta_3 \text{Kentucky}_s + \beta_4 \text{Year2014}_t + \beta_5 \text{Year2015}_t \\ & + \beta_6 \text{Year2016}_t + \beta_7 \text{PREDICTED_AnyInsurance}_{ist} + \varepsilon_{icst} \end{aligned} \quad (3)$$

This IV model uses a standard two-stage least squares approach (2SLS). The first-stage regression (Equation 2) was analogous to the model specified above for Equation 1, except that the outcome was inverted (*I-Uninsured*), so that the results would be expressed as the impact of acquiring insurance. The interaction terms between each post-expansion year and *Expansion State* were the three instrumental variables in this regression for having any insurance. The second-stage regression (Equation 3) then used the predicted value for “*AnyInsurance*” from the first-stage to then estimate a local average treatment effect of gaining insurance from the ACA on each outcome (e.g. *PersonalDoctor*). The full regression results for the first-stage model are presented in Appendix Table 1. The IV model was implemented using the “ivregress 2sls” command in Stata.

Regression Equation – Difference-in-Differences Model Pooling 2015-2016 (Appendix Table 5)

$$\begin{aligned} \text{Uninsured}_{icst} = & \beta_0 + \beta_1 X_i + \beta_2 \text{Arkansas}_s + \beta_3 \text{Kentucky}_s + \beta_4 \text{Year2014}_t + \beta_5 \text{Year2015}_t \\ & + \beta_6 \text{Year2016}_t + \beta_7 \text{Expansion State}_s * \text{Year2014}_t \\ & + \beta_8 \text{Expansion State}_s * (\text{Year2015}_t + \text{Year2016}_t) + \varepsilon_{icst} \end{aligned} \quad (4)$$

This model is the same as Equation 1 except that the expansion effects for 2015 and 2016 are pooled together. In essence, this treats 2014 as a transitional year and 2015-2016 as the long-

run effects of expansion, pooling those years for added statistical power at the expense of year-to-year differences in effect sizes.

Regression Equations – Medicaid Expansion in Kentucky vs. Private Option in Arkansas (Appendix Table 6)

Our comparison between Arkansas and Kentucky used the following regression equation:

$$\begin{aligned}
 Uninsured_{icst} = & \beta_0 + \beta_1 X_i + \beta_2 Arkansas_s + \beta_3 Kentucky_s + \beta_4 Year2014_t + \beta_5 Year2015_t \\
 & + \beta_6 Year2016_t + \beta_7 Arkansas_s * Year2014_t + \beta_8 Arkansas_s * Year2015_t \\
 & + \beta_9 Arkansas_s * Year2016_t + \beta_{10} Kentucky_s * Year2014_t + \beta_{11} Kentucky_s * Year2015_t \\
 & + \beta_{12} Kentucky_s * Year2016_t + \varepsilon_{icst}
 \end{aligned} \tag{5}$$

where the terms were all defined as in Equation 1, but with the replacement of the *Expansion State * Year* variables (which pooled the two expansion states together) with two sets of interaction terms in β_7 - β_9 (which captures the year-by-year changes in Arkansas, compared to Texas) and β_{10} - β_{12} , (which captures the year-by-year changes in Kentucky, compared to Texas). We then used a post-estimation Wald test to determine whether β_9 and β_{12} (the 2016 estimates) differed significantly from one another; these results are reported in the last column of Appendix Table 6. Comparisons between Arkansas and Kentucky in 2014 and 2015 have been published previously – see references 9 and 41.

Spatial Correlation Model

As an alternative to our primary model using county-based robust clustered standard errors, we also test the effects of using a spatial correlation model described by Conley (1999),¹

¹ Conley, T. (1999). Gmm estimation with cross sectional dependence. *Journal of Economet-*

and following Mazumder and Miller (2016).² This approach measures the distance between each county's centroid and uses that distance to account for geographical correlation in outcomes; for observations with missing county identifiers (1.9%), we used the state's overall centroid for this calculation. We adapted Stata code from Hsiang (2010) to implement this model.³ One limitation of this approach is that it does not allow for the use of survey weights, so while it provided a sensitivity test of our standard errors, it also affected our point estimates due to the lack of weighting. We used a spatial correlation cutoff of 100 kilometers and a time lag of 4 years to allow for correlation across all years of our study.

Family-Wise P-Values

To account for multiple hypothesis testing within each domain of our survey, we conducted the step-down bootstrapping approach developed by Westfall and Young (1993),⁴ adapting Stata code written and made available by Finkelstein and colleagues (2012).⁵ We used 1000 iterations within each family to generate the p-values listed in Appendix Tables 4 and 5.

Survey Outcome Measurement: Health Insurance and Out-of-Pocket Spending

Respondents were asked to answer “yes/no” to whether they currently had any of seven distinct types of health insurance: Medicaid (with state specific name), Medicare, military health

rics 92, 1-45.

² Mazumder B, Miller S. The Effects of the Massachusetts Health Reform on Household Financial Distress. *Am Econ J: Economic Policy* 2016;8:284-313.

³ Hsiang, S. (2010). Temperatures and cyclones strongly associated with economic production in the Caribbean and Central America. *Proceedings of the National Academy of Sciences of the United States* 107 (35), 15367-15372. Stata code accessed 14 April 2017 from: <<http://www.fight-entropy.com/2010/06/standard-error-adjustment-ols-for.html>>

⁴ Westfall PH, Young SS. *Resampling based multiple testing: examples and methods for p-value adjustment*. New York: John Wiley & Sons, 1993.

⁵ Finkelstein A, Taubman S, Wright BJ, et al. The Oregon Health Insurance Experiment: Evidence from the First Year. *Quarterly Journal of Economics* 2012;127:1057-106. Stata code accessed 16 April 2017 from: <<http://www.nber.org/oregon/4.data.html>>, in the “tables_analysis.do” file.

care, employer or union coverage, insurance from a health insurance marketplace (with state specific name), health plan purchased directly from an insurance company, and other insurance. Respondents answering no to all seven were asked a confirmation question, “Does this mean you have no health insurance of any kind?” before being classified as “uninsured.” Respondents who indicated having more than one type of coverage were assigned a primary insurance type based on the following hierarchy: Medicaid, Medicare, employer-sponsored insurance, Marketplace coverage, non-Marketplace direct purchase, and other. The exception to this hierarchy was for individuals in Arkansas and Texas who reported both marketplace and Medicaid coverage. In these states, which did not expand Medicaid but did offer marketplace coverage to some (Texas) or all (Arkansas) adults with incomes below 138% of the federal poverty level, such individuals were classified as having marketplace insurance.

Out-of-pocket spending was asked in 6 categories: <\$50, \$50-\$99, \$100-\$199, \$200-\$499, \$500-\$999, and \$1000 or more. We took the midpoint of each bin and top-coded the higher bin as \$1250. In previous work, we have tested the sensitivity of our results to alternative approaches, including using the minimum amount in each bin, and results are largely similar. For all regression analyses, we excluded observations with missing values for the dependent variables.

Appendix Figure 1: State Uninsured Rates Among Low-Income Citizens, Ages 19-64, in the 2010-2013 American Community Survey

Notes: From the authors' analysis of the 2010-2013 American Community Survey (ACS). Outcome shows the percent uninsured by year and state. The sample was limited to U.S. citizens ages 19-64, with family incomes less than or equal to 138% of the federal poverty level. Analyses used ACS survey weights. The time trend for the uninsured rate did not differ significantly for the two expansion states, Arkansas and Kentucky, versus the non-expansion state, Texas ($\beta=.0018$, $p=0.65$)

Appendix Table 1: First-Stage Regression for IV Model of Any Insurance (N=10,885)

Variable	Coefficient	95% Confidence Interval		p-value
<i>Instruments</i>				
<i>Year2014*Expansion</i>	0.140	0.069	0.211	<.001
<i>Year2015*Expansion</i>	0.229	0.158	0.300	<.001
<i>Year2016*Expansion</i>	0.207	0.133	0.280	<.001
Year 2014	0.113	0.052	0.173	<.001
Year 2015	0.063	0.003	0.124	.04
Year 2016	0.106	0.044	0.169	<.001
Female	0.066	0.044	0.089	<.001
Married/Partnered	0.032	0.008	0.057	.009
HouseholdSize	-0.012	-0.019	-0.004	.001
Age19_34	-0.112	-0.137	-0.087	<.001
Age35_44	-0.055	-0.084	-0.026	<.001
Latino	-0.037	-0.077	0.003	.07
BlackNonLatino	0.044	0.013	0.074	.005
OtherNonLatino	-0.030	-0.081	0.021	.26
LessthanHS	-0.048	-0.078	-0.017	.002
HSGrad	-0.030	-0.056	-0.004	.03
Income <50% FPL	-0.051	-0.081	-0.021	.001
Income 50-100% FPL	-0.024	-0.051	0.004	.09
Income Missing	-0.011	-0.056	0.034	.64
Rural	0.006	-0.017	0.030	.61
Arkansas	-0.073	-0.133	-0.014	.02
Kentucky	-0.023	-0.083	0.037	.45
Intercept (constant)	0.718	0.663	0.773	<.001
F-Statistic	28.98	N/A		<.001

Notes:

Results from Equation 2 in the Appendix Methods.

Appendix Table 2: Change in Prevalence of Chronic Conditions After Coverage Expansion from 2013-2016, Compared to Non-Expansion (N=10,885)

Variable	Expansion * 2016 Effect	95% Confidence Interval		p-value
Hypertension	-0.7	-7.0	5.7	.84
Coronary Artery Disease	1.0	-2.4	4.3	.57
Stroke	-2.5	-5.7	0.7	.13
Asthma/COPD	2.0	-5.2	9.3	.58
Kidney Disease	-2.2	-4.4	0.1	.06
Diabetes	-2.1	-7.9	3.7	.47
Depression	1.3	-6.1	8.8	.73
Cancer	-0.1	-3.3	3.1	.97
Substance Abuse	1.5	-2.4	5.5	.45
≥1 condition	-0.1	-6.5	6.2	.97
Total # Conditions	-0.02	-0.21	0.17	.87

Notes:

Results from Equation 1 in the Appendix Methods. All analyses adjusted for sex, age, race/ethnicity, marital status, family size, education, income, urban vs. rural residence, state, and year. The sample contained 10,885 adults (minus item non-response for each specific outcome). All estimates are reported as percentage-point changes, other than total number of conditions.

Appendix Table 3: Unadjusted State-By-State Changes for Each Study Outcome

OUTCOME ^a	Arkansas				Kentucky				Texas			
	2013	2014	2015	2016	2013	2014	2015	2016	2013	2014	2015	2016
<u>Coverage</u>												
Uninsured	41.8	19.4	14.2	11.7	40.2	12.4	8.6	7.4	38.5	27.1	31.8	28.2
Medicaid	25.1	30.7	30.1	37.5	24.8	44.5	51.1	50.6	22.0	25.4	26.7	24.2
Private Insurance	19.3	36.0	39.5	33.8	22.1	28.2	20.9	24.0	28.7	32.4	28.9	30.3
Coverage change within past year	22.9	26.0	21.0	26.5	21.6	27.4	21.4	26.4	25.2	23.6	22.8	27.4
<u>Access to Care</u>												
Has a personal doctor	57.2	60.8	63.8	67.7	56.6	63.6	71.7	66.1	52.4	50.9	51.3	44.9
Usual source of care ^b	78.4	82.8	86.8	84.4	83.1	86.1	85.5	85.5	79.5	79.8	74.4	76.5
Trouble obtaining primary care appointment	16.0	13.9	13.1	9.9	15.4	15.1	12.7	14.2	19.8	14.8	17.2	14.2
Trouble obtaining specialist appointment	12.1	11.8	12.3	10.3	15.8	15.7	14.8	19.4	18.6	15.8	17.3	13.1
ED is usual location of care ^b	9.9	8.0	5.7	4.7	9.3	5.3	7.9	6.4	8.1	10.0	11.3	7.9
ED visit because office visit unavailable	12.7	12.2	11.8	10.2	13.1	14.9	13.7	13.5	15.6	11.3	10.9	11.4
<u>Affordability</u>												
Cost-related delay in care	39.5	32.1	29.8	29.3	39.6	30.8	25.1	29.5	31.7	27.9	38.4	34.4
Skipped medication due to cost	40.9	30.0	29.5	28.0	37.5	25.8	26.1	29.0	28.3	26.9	29.2	27.9
Trouble paying medical bills	43.1	35.5	31.4	29.6	42.7	28.4	27.4	34.2	31.9	30.0	32.9	31.6
Annual out-of-pocket medical spending	\$446	\$367	\$373	\$376	\$423	\$330	\$318	\$345	\$380	\$334	\$372	\$356
<u>Utilization</u>												
Any office visits in past year	55.3	56.7	53.4	60.4	55.7	59.3	59.4	62.1	44.1	44.7	42.5	45.3
Any ED visits in past year	21.7	19.0	18.5	17.1	20.4	21.5	21.9	19.0	17.1	18.2	22.3	20.8
# office visits in past year	2.61	2.80	2.89	3.15	2.98	3.02	3.31	3.72	2.06	1.69	1.74	2.07
# ED visits in past year	1.04	1.08	1.11	1.17	1.27	1.29	1.23	1.19	0.87	0.99	1.00	77.4
Any hospitalization in past year	14.7	16.6	16.4	19.1	19.0	18.4	20.2	21.7	15.8	18.2	15.5	16.3
<u>Prevention</u>												
Checkup in past year	45.3	53.6	54.7	56.7	46.3	54.5	59.8	58.4	50.7	52.6	46.0	50.8
Cholesterol check in past year	38.1	39.3	39.9	47.0	45.8	47.4	55.2	58.1	44.2	47.6	47.9	43.9
Glucose check in past year	41.5	43.3	44.5	49.7	44.5	49.1	54.7	52.9	46.7	48.4	46.5	49.5
<u>Quality</u>												
Cholesterol check among high-risk patients ^c	60.7	59.0	58.6	63.9	66.2	64.4	73.0	73.5	67.0	60.9	66.1	69.3
Glucose check among those with diabetes ^d	88.5	83.3	87.9	86.3	84.1	84.9	95.7	89.5	90.0	82.5	84.5	86.3
Regular care for chronic condition ^e	61.8	70.1	73.6	74.1	69.4	76.1	78.6	78.3	65.3	61.7	63.8	64.3
Excellent quality of care	27.9	30.7	28.0	29.1	28.3	30.5	29.8	31.8	27.8	26.5	27.4	28.4
Fair/poor quality of care	22.5	18.9	17.3	18.1	17.2	18.0	15.1	20.4	20.1	20.9	24.1	21.8
<u>Health Status</u>												
Excellent self-reported health	13.5	11.7	11.5	11.0	11.0	11.4	8.6	8.2	20.0	16.7	12.6	12.5

Fair/poor self-reported health	39.7	36.2	40.1	35.1	39.6	40.4	38.1	40.9	32.4	30.5	36.0	36.6
Positive depression screen (PHQ2 score $\geq$ 2)	48.1	43.2	47.2	44.9	46.8	46.1	46.4	49.8	38.4	33.6	45.4	40.5

NOTES:

a – All estimates are reported as percentages for binary outcomes, other than number of office and ED visits and out-of-pocket spending.

b - Usual source of care was grouped into 3 categories – those reporting an office-based usual source of care, those without any usual source of care, and those using the ED as the usual source of care.

c – Sample limited to patients reporting heart disease, stroke, diabetes, or hypertension (n=4,446).

d – Sample limited to patients reporting a history of diabetes (n=1,768).

e – Sample limited to patients reporting at least one of the following conditions: hypertension, heart attack/coronary artery disease, stroke, asthma/COPD, kidney disease, diabetes, depression, cancer, and substance abuse (n=6,103).

**Appendix Table 4: Sensitivity Analyses of Difference-in-Differences Estimates,
for 2016 vs. 2013 Estimates**

OUTCOME	2016* Expansion Effect^a	Standard p-value	Family- Wise p-value^b	2016 * Expansion Effect (unweighted)	Spatial- correlation p-value^c
<u>Coverage</u>					
Uninsured	-20.7	<.001	<.001	-17.7	<.001
Medicaid	17.6	<.001	<.001	13.3	<.001
Private insurance	5.9	.091	.20	6.7	.015
Coverage change within past year	1.9	.67	.68	0.2	.94
<u>Access to Care</u>					
Has a personal doctor	16.7	<.001	.003	9.8	.002
Usual source of care ^d	6.8	.12	.42	5.6	.005
Trouble obtaining primary care appointment	2.1	.41	.41	1.8	.38
Trouble obtaining specialist appointment	6.4	.045	.22	3.4	.14
ED is usual location of care ^d	-3.7	.18	.46	-3.2	.049
ED visit because office visit unavailable	3.5	.22	.42	0.0	.99
<u>Affordability</u>					
Cost-related delay in care	-12.8	<.001	.001	-12.5	<.001
Skipped medication due to cost	-10.5	.002	.004	-14.1	<.001
Trouble paying medical bills	-10.9	.003	.004	-12.5	<.001
Annual out-of-pocket medical spending	-\$62	.071	.087	-\$70	.004
<u>Utilization</u>					
Any office visits in past year	4.3	.26	.62	0.8	.79
Any ED visits in past year	-6.6	.021	.12	-1.8	.48
# office visits in past year	0.60	.19	.57	-0.08	.82
# ED visits in past year	0.13	.41	.43	-0.11	.33
Any hospitalization in past year	2.9	.37	.62	-0.2	.95
<u>Prevention</u>					
Checkup in past year	11.1	.023	.065	8.2	.002
Cholesterol check in past year	9.9	.003	.019	8.4	.001
Glucose check in past year	4.3	.27	.30	4.6	.062
<u>Quality of Care</u>					
Cholesterol check in high-risk patients ^e	2.7	.64	.64	2.4	.45
Glucose check in those with diabetes ^f	6.3	.37	.86	1.2	.75
Regular care for chronic condition ^g	11.2	.02	.099	3.3	.20
Excellent quality of care	2.0	.57	.82	1.0	.73
Fair/poor quality of care	-2.3	.53	.90	-1.5	.50
<u>Health Status</u>					
Excellent self-reported health	5.1	.067	.21	3.5	.087
Fair/poor self-reported health	-6.0	.082	.19	-5.2	.041
Positive depression screen (PHQ2 score $\geq$ 2)	-1.8	.69	.67	-4.6	.14

Notes:

ED = Emergency Department. Results show estimated change per year of expansion in Arkansas and Kentucky, compared to the baseline time trend in Texas, which did not expand. All analyses adjusted for sex, age, race/ethnicity, marital status, family size, education, income, urban vs. rural residence, state, and year. The sample contained 10,885 adults (minus item non-response for each specific outcome).

a – All estimates are reported as percentage-point changes for binary outcomes, other than number of office and ED visits and out-of-pocket spending.

b - *Family-Wise* *p*-values use step-down bootstrapping within each family of outcomes, following Finkelstein et al. (2012). See Appendix Methods for additional detail.

c – *p*-values derived from county-level spatial correlation models, following Conley (1999) and using Stata code from Hsiang (2010), which does not allow for survey weights. See Appendix footnotes for additional detail.

d - Usual source of care was grouped into 3 categories – those reporting an office-based usual source of care, those without any usual source of care, and those using the ED as the usual source of care.

e – Sample limited to patients reporting heart disease, stroke, diabetes, or hypertension (n=5,611).

f – Sample limited to patients reporting a history of diabetes (n=2,213).

g– Sample limited to patients reporting at least one of the following conditions: hypertension, heart attack/coronary artery disease, stroke, asthma/COPD, kidney disease, diabetes, depression, cancer, and substance abuse (n=7,734).

**Appendix Table 5: Sensitivity Analyses of Difference-in-Differences Estimates,
Pooling 2015-2016 Estimates**

OUTCOME	(2015-2016)* Expansion Effect^a	Standard p-value	Family- Wise p-value^b	(2015-2016)* Expansion Effect (unweighted)	Spatial- correlation p-value^c
<u>Coverage</u>					
Uninsured	-21.9	<.001	<.001	-18.4	<.001
Medicaid	14.5	<.001	.001	13.0	<.001
Private insurance	7.4	.031	.085	5.3	.055
Coverage change within past year	1.5	.67	.67	-1.2	.55
<u>Access to Care</u>					
Has a personal doctor	14.0	<.001	<.001	7.7	.003
Usual source of care ^d	8.9	.017	.074	6.4	<.001
Trouble obtaining primary care appointment	0.9	.70	.70	0.0	.99
Trouble obtaining specialist appointment	3.3	.17	.33	1.4	.48
ED is usual location of care ^d	-5.0	.014	.069	-3.4	.007
ED visit because office visit unavailable	4.3	.11	.30	0.5	.75
<u>Affordability</u>					
Cost-related delay in care	-16.1	<.001	<.001	-13.4	<.001
Skipped medication due to cost	-11.4	<.001	<.001	-13.0	<.001
Trouble paying medical bills	-12.7	<.001	<.001	-12.0	<.001
Annual out-of-pocket medical spending	-\$77	.013	.016	-\$63	.003
<u>Utilization</u>					
Any office visits in past year	3.4	.26	.60	2.6	.28
Any ED visits in past year	-6.1	.014	.092	-3.0	.15
# office visits in past year	0.63	.064	.25	0.23	.49
# ED visits in past year	0.00	.98	.98	-0.08	.41
Any hospitalization in past year	2.4	.34	.57	2.2	.25
<u>Prevention</u>					
Checkup in past year	13.9	<.001	<.001	10.1	<.001
Cholesterol check in past year	5.0	.088	.097	6.7	.002
Glucose check in past year	5.5	.074	.14	5.3	.013
<u>Quality of Care</u>					
Cholesterol check in high-risk patients ^e	1.8	.68	.70	2.6	.34
Glucose check in those with diabetes ^f	9.0	.055	.20	3.8	.22
Regular care for chronic condition ^g	11.4	.006	.036	4.0	.052
Excellent quality of care	1.6	.61	.85	2.8	.21
Fair/poor quality of care	-5.2	.069	.20	-4.1	.024
<u>Health Status</u>					
Excellent self-reported health	5.0	.021	.066	3.1	.098
Fair/poor self-reported health	-4.7	.14	.24	-4.4	.030
Positive depression screen (PHQ2 score $\geq$ 2)	-4.7	.21	.29	-4.8	.073

Notes:

ED = Emergency Department. Results show estimated change per year of expansion in Arkansas and Kentucky, compared to the baseline time trend in Texas, which did not expand. All analyses adjusted for sex, age, race/ethnicity, marital status, family size, education, income, urban vs. rural residence, state, and year. The sample contained 10,885 adults (minus item non-response for each specific outcome).

a – All estimates are reported as percentage-point changes for binary outcomes, other than number of office and ED visits and out-of-pocket spending.

b - *Family-Wise* *p*-values use step-down bootstrapping within each family of outcomes, following Finkelstein et al. (2012). See Appendix Methods for additional detail.

c – *p*-values derived from county-level spatial correlation models, following Conley (1999) and using Stata code from Hsiang (2010), which does not allow for survey weights. See Appendix footnotes for additional detail.

d - Usual source of care was grouped into 3 categories – those reporting an office-based usual source of care, those without any usual source of care, and those using the ED as the usual source of care.

e – Sample limited to patients reporting heart disease, stroke, diabetes, or hypertension (n=5,611).

f – Sample limited to patients reporting a history of diabetes (n=2,213).

g– Sample limited to patients reporting at least one of the following conditions: hypertension, heart attack/coronary artery disease, stroke, asthma/COPD, kidney disease, diabetes, depression, cancer, and substance abuse (n=7,734).

**Appendix Table 6: Change in Outcomes in 2016,
Arkansas vs. Kentucky (Compared to Texas)**

OUTCOME	2016 Expansion * Arkansas		2016 Expansion * Kentucky		P-value for Arkansas vs. Kentucky difference
	Estimate	p	Estimate	p	
<u>Coverage</u>					
Uninsured	-21.7	<0.001	-24.4	<0.001	.45
Medicaid	11.0	.008	23.5	<0.001	.001
Private insurance	12.8	.004	0.9	.80	.006
Coverage change within past year	2.0	.68	3.5	.45	.71
<u>Access to Care</u>					
Has a personal doctor	16.9	.001	14.6	.001	.63
Usual source of care	10.6	.022	6.6	.16	.30
Trouble obtaining primary care appointment	-1.4	.65	3.1	.30	.18
Trouble obtaining specialist appointment	2.8	.38	7.6	.028	.14
ED is usual location of care ^b	-5.9	.019	-3.3	.24	.34
ED visit because office visit unavailable	2.3	.50	4.7	.15	.43
<u>Affordability</u>					
Cost-related delay in care	-15.7	.001	-16.5	<0.001	.87
Skipped medication due to cost	-13.0	.001	-9.5	.011	.43
Trouble paying medical bills	-13.9	<0.001	-9.8	.022	.38
Annual out-of-pocket medical spending	-\$73	.064	-\$82	.019	.82
<u>Utilization</u>					
Any office visits in past year	5.2	.29	5.9	.12	.89
Any ED visits in past year	-9.4	.012	-6.2	.068	.46
# office visits in past year	0.61	.18	0.70	.20	.87
# ED visits in past year	0.22	.24	-0.02	.92	.27
Any hospitalization in past year	5.0	.14	2.9	.41	.54
<u>Prevention</u>					
Checkup in past year	13.6	.016	14.0	.002	.94
Cholesterol check in past year	8.2	.047	11.0	.006	.54
Glucose check in past year	5.9	.20	5.4	.17	.92
<u>Quality</u>					
Cholesterol check among high-risk patients ^c	0.7	.91	3.3	.57	.68
Glucose check among those with diabetes ^d	2.2	.78	10.0	.18	.33
Regular care for chronic condition ^e	12.9	.022	9.0	.093	.41
Excellent quality of care	1.0	.81	3.0	.48	.67
Fair/poor quality of care	-7.4	.05	0.4	.90	.028
<u>Health Status</u>					
Excellent self-reported health	5.4	.12	5.9	.037	.89
Fair/poor self-reported health	-9.2	.019	-4.5	.25	.24
Positive depression screen (PHQ2 ≥2)	-7.9	.10	-2.7	.59	.24

Notes:

ED = Emergency Department. Results show estimated change from 2013 to 2016 in Arkansas and Kentucky, compared to Texas, which did not expand. All analyses adjusted for sex, age, race/ethnicity, marital status, family size, education, income, urban vs. rural residence, state, and year. The sample contained 10,885 adults (minus item non-response for each specific outcome), except where otherwise noted below.

a – All estimates are reported as percentage-point changes for binary outcomes, other than number of office and ED visits and out-of-pocket spending.

b - Usual source of care was grouped into 3 categories – those reporting an office-based usual source of care, those without any usual source of care, and those using the ED as the usual source of care.

c – Sample limited to patients reporting heart disease, stroke, diabetes, or hypertension (n=5,611).

d – Sample limited to patients reporting a history of diabetes (n=2,213).

e– Sample limited to patients reporting at least one of the following conditions: hypertension, heart attack/coronary artery disease, stroke, asthma/COPD, kidney disease, diabetes, depression, cancer, and substance abuse (n=7,734).