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The impact of the Affordable Care Act Medicaid expansion on visit rates for a patient population with diabetes or pre-diabetes in safety net health centers

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Abstract

Objective—To: (1) compare clinic-level uninsured, Medicaid-insured, and privately-insured visit rates within and between expansion and non-expansion states prior to and after the ACA Medicaid expansion among the three cohorts of patient populations; and, (2) assess whether there was a change in clinic-level overall, primary care, preventive care visits, and diabetes screening rates in expansion versus non-expansion states from pre- to post-ACA Medicaid expansion.

Methods—Electronic health record data on non-pregnant patients aged 19–64 with ≥1 ambulatory visit between 01/01/2012–12/31/2015 (n=483,912 in expansion states; n=388,466 in non-expansion states) from 198 primary care community health centers (CHCs) were analyzed. Using difference-in-difference methodology, we assessed changes in visit rates pre- versus post-ACA among cohort of patients with diabetes, pre-diabetes, no- diabetes.

Results—Rates of uninsured visits decreased for all cohorts in expansion and non-expansion states. For all cohorts, Medicaid-insured visit rates increased significantly more in expansion compared to non-expansion states, especially among pre-diabetes patients (+71%). In non-expansion states, privately-insured visit rates more than tripled for pre-diabetes cohort and doubled for the diabetes and no-diabetes cohorts. Rates for glycosolated hemoglobin screenings increased in all groups with the largest changes among no diabetes (RR=2.26, 95% CI=1.97–2.56) and pre-diabetes cohorts (RR=2.00, 95% CI=1.80–2.19) in expansion states.

Conclusion—The ACA reduced uninsurance and increased access to preventive care for vulnerable patients, especially those with pre-diabetes. These findings are important to consider when making decisions regarding altering the ACA.

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INTRODUCTION

Diabetes mellitus is one of the nation's leading causes of morbidity and mortality: over 30 million people in the United States (US) have diabetes, and another 86 million have pre-diabetes.[1] Patients with diabetes and pre-diabetes need to maintain a regular source of care and access healthcare services (*e.g.*, prescription medications, diabetic eye exams, laboratory monitoring) to control, manage, or prevent diabetes-related complications, a challenging task for patients without continuous health insurance coverage. In addition, patients without health insurance are more likely to have undiagnosed diabetes and receive fewer preventive services overall than those with coverage.[2] Uninsured patients are also less likely to receive recommended diabetes screening and care and have poorer diabetes control than those with insurance.[3–11] Thus, both health insurance and continued access to healthcare services are essential for optimal diabetes prevention, care, and management.[2]

The Patient Protection and Affordable Care Act (ACA) reform substantially improved access to health insurance and healthcare services for patients, especially among low-income adults.[12–15] With the goal of covering all low-income US citizens and legal residents,[16] the ACA mandated health insurance coverage, called for the expansion of Medicaid to adults earning ≤138% of the federal poverty level (FPL), and provided subsidies to those making between 100 and 400% FPL to help purchase individual health insurance. Following the Supreme court ruling allowing states to choose whether or not to expand Medicaid, 32 states (and the District of Columbia) implemented expansions and 18 states did not (as of January 2018).[17] This 'natural experiment' presents a unique opportunity to learn whether and to what extent Medicaid expansion can affect healthcare access and services for low-income patients with diabetes.

Many low-income adults in the US receive care from community health centers (CHCs). CHCs provide healthcare to over 25 million people across America, regardless of patients' insurance status and offer sliding scale fees and low-income discounts to assist with cost.[18] Despite discounted care, significant cost barriers still exist for uninsured patients. For example, one study estimated the average mean price for a CHC office visit for an uninsured patient was $89.[19] These financial barriers likely contribute to lower rates of preventive services, specialty care, and diagnostic procedures among uninsured compared to insured CHC patients.[11,20–22] In fact, CHC visit patterns and services received at visits are different among patients with and without health insurance.[23] Following ACA implementation, CHCs saw a sharp rise in Medicaid-paid visits and a decrease in uninsured visits,[24,25] most notably in expansion states. Additionally, CHCs continue to accept new patients with Medicaid coverage, which is not the case for other primary care providers.[26,27]

This longitudinal, four-year study used electronic health record (EHR) data from CHCs in 13 states (9 expansion states; 4 non-expansion states) to compare changes in payer mix and primary care visit rates in expansion and non-expansion states among three cohorts of patient populations, those with: 1) diabetes, 2) pre-diabetes, and 3) no diabetes. Specifically, we (i) compared clinic-level uninsured, Medicaid-insured, and privately-insured visit rates within and between expansion and non-expansion states prior to and after the ACA Medicaid expansion among three cohorts of patient populations; and, (ii) assessed whether

there was a change in clinic-level total, primary care, preventive care visits, and diabetes screening rates in expansion versus non-expansion states from pre- to post-ACA Medicaid expansion. We hypothesized that CHCs in expansion states would see an increase in insured visits and overall visits among all three patient populations, but expected the greatest increase to be among those with diabetes, as they have ongoing disease management needs. We also hypothesized that in non-expansion states, CHC patient populations would experience a growth in insured visits and overall visits, but the increase would be smaller than in expansion states due to private health insurance cost sharing. These results will describe population-level changes in type of payment CHCs received and healthcare services CHCs provided following the ACA Medicaid expansion and whether these changes were different among the three population cohorts.

METHODS

Data source

EHR data were obtained from the Accelerating Data Value Across a National Community Health Center Network (ADVANCE) clinical data research network (CDRN) of PCORNnet.[28] The ADVANCE CDRN is a unique 'community laboratory' for research with underrepresented populations receiving care in CHCs. The four-year study period included two years pre- (1/1/2012–12/31/2013) and two years post- (1/1/2014–12/31/2015) ACA Medicaid expansion. Data for >5 million ambulatory visits were collected for 872,378 non-pregnant patients aged 19–64 with ≥1 ambulatory visit between 1/1/2012 and 12/31/2015 (n=483,912 in expansion states; n=388,466 in non-expansion states) from 198 primary care CHCs 'live' on their EHR system as of 1/1/2012 (n=131 CHCs in expansion states; n=67 CHCs in non-expansion states).

Data quality

EHR data contain information on payer types as well as billable codes for services performed at each visit; as these data are used for billing purposes, they represent reliable information on insurance status and services received at each visit, overcoming the limitations of recall bias and potential misinformation from survey respondents who may be confused regarding their insurance coverage status, especially given the complexity of the US health insurance system. Additionally, CHCs are required to collect and report many individual-level demographic data variables to the US Health Resources and Services Administration to receive funding or designation under the Health Center Program. Therefore, EHR data from CHCs contain self-reported data on race/ethnicity, language, and FPL, on nearly all patients.

Definitions of population cohorts

We used a validated computable phenotype to identify the *patient population with diabetes*.[29–33] Those in the diabetes cohort had any combination of two diabetes-relevant 'events,' which included: outpatient International Classification of Disease-9 or 10 diabetes-relevant diagnoses code(s), diagnostic level laboratory results [one glycosylated hemoglobin (HbA1c) or glucose test meeting criteria for diabetes], and/or an order for anti-hyperglycemic agents no more than 730 days apart.[29–33] Patient populations who had only

one diabetes-relevant event were considered unconfirmed diabetes and included in the pre-diabetes cohort. *Patients were also included in the pre-diabetes cohort* if they had at least one HbA1c result between 5.7–6.4% and/or a fasting glucose between 100–125 mg/deciliter, and no diabetes-relevant events. All others were included in the population cohort of *patients without diabetes* (referred to as no diabetes). Because the objective of this study was to assess changes in CHC population coverage and patterns in total, primary care, and preventive care visits, and diabetes screening rates, we included patients diagnosed with diabetes and pre-diabetes at any time during the entire study period (pre- or post-ACA). Most pre-diabetes (95%) and diabetes (68%) received a diagnosis prior to 2014.

Medicaid expansion status

We defined pre- and post-Medicaid expansion periods based on if a state expanded Medicaid. We defined expansion states as those that expanded Medicaid on 1/1/2014 and non-expansion states as those that had not expanded by 12/31/2015. Expansion states included: California, Hawaii, Maryland, New Mexico, Ohio, Oregon, Rhode Island, Washington, and Wisconsin; non-expansion states included: Florida, Kansas, Missouri, and North Carolina. Wisconsin was considered an expansion state because although they did not expand Medicaid to 138% federal poverty level, they opened enrollment to adults with 100% federal poverty level on 1/1/2014, thus behaving more like an expansion state.[12,15,24]

Insurance coverage

For this visit-based study, we determined patient insurance status at the time of care receipt and knew how insurance status differed from visit to visit. These visit-level data were aggregated to the CHC level to estimate insurance mix pre- and post-ACA and provide information on how the insurance visit mix changed overall between expansion and non-expansion CHCs. Visit coverage was based on the primary payer listed for each visit and grouped as Medicaid, private, uninsured, or other public. Other public included: (1) Medicare (for disability-eligible patients, as our patient population was under age 65); and, (2) grant programs that cover specific services such as breast and cervical cancer screening, family planning, and HIV/AIDS care. In CHCs, most private insurance is directly purchased as opposed to employer-sponsored coverage. CHCs serve patient populations who are predominantly low-income (71% with FPL below 100%) and national CHC data show that less than 30% of adults <100% FPL have employer-sponsored coverage.[18] Additionally, Census data show that while direct-purchase insurance increased by 29% nationwide post-ACA, employer-sponsored insurance changed by <1%.[34] Therefore, any changes in private insurance visit rates in CHC likely reflect an increase in direct-purchase insurance.

Healthcare services

Healthcare utilization included total visits (rates of all billable encounters), primary care visits (all primary care, new patient, and established patient visits), and receipt of preventive care services. New patient visits included those who had not received services in the past three years, following the Current Procedural Terminology (CPT). Established patients with new types of insurance coverage are not considered new patients. Preventive care visits indicated non-problem focused encounters for general wellness and prevention (e.g., annual exams and physicals). Visit-types were determined using the primary CPT code for each

visit and primary care provider type. Diabetes screening included both HbA1c and fasting glucose testing.

Analysis

We summarized demographic characteristics of CHC patient populations in expansion and non-expansion states stratified by population cohort. We estimated clinic-level insurance types (uninsured, Medicaid, private, and other public), total, primary care, and preventive care visit rates, and diabetes screening in both the pre- and post-ACA periods, stratified by diabetes status (diabetes, pre-diabetes, and no diabetes). We computed visit rates by dividing the number of visits in a given interval (*i.e.*, pre- or post-ACA period) by the total number of adult patients seen in a clinic over the study period, scaled to 1,000 patients per month. We estimated post- vs pre-expansion rate ratios (RR) within each expansion group and difference-in-difference (DD) ratios (comparing pre-post changes in rates between expansion groups) with 95% confidence intervals (CI) by fitting generalized estimating equation Poisson models with robust sandwich variance estimators for each outcome. We clustered all models by CHC and used an exchangeable covariance structure to account for within-clinic temporal correlation for each diabetes status level. We produced unadjusted and adjusted estimates of RR and DD ratios. In all adjusted models, we included the following covariates associated with differences in health insurance status:[24,25] sociodemographic variables (clinic-level distributions of sex, age, race/ethnicity, and FPL), urban vs. rural clinic location, and state-level factors (type of health insurance marketplace [state-run or federally facilitated], 2013 minimum wage, 2013 uninsured rate, and 2013 unemployment rate, and prevalence of diabetes among CHC patients in 2013). Of note, there was no evidence of multicollinearity between 2013 uninsured rate and 2013 unemployment rate (correlation <0.5). We conducted a sensitivity analysis excluding the state-level variables from models; results were not altered (see Appendix 1). Analyses were conducted using R version 3.4.0; and statistical significance was set at type I error of 5%. This study was approved by the Institutional Review Board.

RESULTS

Table 1 describes the patient population and facility characteristics by expansion and diabetes status. The distribution of patient characteristics across the three population cohorts was similar in expansion and non-expansion states. A greater proportion of the population with diabetes were male and older (40–64 years of age), relative to those with pre-diabetes or no diabetes. Notably, a large proportion of the patient population in non-expansion states and expansion states had incomes ≤138% FPL (the expanded Medicaid eligibility criteria). In both expansion and non-expansion states, CHCs saw an increase in new patient visits in the post-period, especially in the no diabetes cohort. With this increase in new patient visits, CHCs saw an equivalent decrease in established patient visits. Yet, >70% of visits in the post-period were established patient visits in the diabetes and pre-diabetes cohorts.

Change in rates of payment types by diabetes status and expansion status

Before ACA implementation, CHCs in expansion and non-expansion states saw greater rates of uninsured visits among patient populations with diabetes and pre-diabetes than among

those with no diabetes (Table 2). The decline in uninsured visits after ACA implementation was significantly greater in expansion states, with a decrease of >50% compared to non-expansion states with <20% change. CHCs saw similar drops in uninsured visit rates among all three cohorts (diabetes, pre-diabetes, and no diabetes).

The rate of Medicaid visits (Table 3) at CHCs in expansion states increased the most among the pre-diabetes cohort (RR = 1.71, 95% CI = 1.53–1.88), a 71% increase compared to an increase of 57% for the diabetes cohort (RR = 1.57, 95% CI = 1.43–1.71) and 60% for the no diabetes cohort (RR = 1.60, 95% CI = 1.46–1.73). In non-expansion states, the rate of privately-insured visits more than tripled for the pre-diabetes cohort (RR = 3.17, 95% CI = 2.02–3.38) and more than doubled for the diabetes (RR = 2.77, 95% CI = 1.79–375) and no diabetes (RR = 2.70, 95% CI = 2.02–3.38) cohorts; despite the large increases in privately-insured visit rates from pre- to post-ACA, the post-ACA rate of insured visits (private + Medicaid insured) was lower in non-expansion state than the insured visit rate in expansion states.

Change in rates of visit types by diabetes status and expansion status

In both expansion and non-expansion states, CHCs' rates of total visits post-ACA were highest among the cohort with diabetes. Overall, the rates of total and primary care visits did not increase from pre- to post-ACA in expansion and non-expansion states for the diabetes or no diabetes cohorts. Among the pre-diabetes cohort, total and primary care visit rates at CHCs in expansion significantly increased, by 15% (RR = 1.15, 95% CI = 1.09–1.20) and 14% (RR = 1.14, 95% CI = 1.08–1.19), respectively. Total visit rate also increased in non-expansion states for the pre-diabetes cohort (RR = 1.10, 95% CI = 1.10–1.19).

After ACA implementation, preventive care visits for the pre-diabetes cohort increased 31% in expansion state CHCs (RR = 1.31, 95% CI = 1.19–1.42) and 35% in non-expansion state CHCs (RR = 1.35, 95% CI = 1.13–1.58). Among the pre-diabetes cohort in expansion states, rates for HbA1c screenings doubled (RR = 2.00, 95% CI = 1.80–2.19) and rates for glucose testing increased by 23% (RR = 1.23, 95% CI = 1.17–1.30). Among the pre-diabetes cohort in non-expansion states, HbA1c screenings increased 76% and glucose testing increased 24%. Among the cohort with diabetes, HbA1c tests increased less in expansion states than in non-expansion state CHCs (26% versus 46%, respectively). Among the cohort with no diabetes, rates of screening for HbA1c and glucose testing increased in both expansion and non-expansion state CHCs.

CONCLUSIONS

After ACA Medicaid expansion, rates of total and primary care visits did not change significantly for CHC patient populations with diabetes or those with no diabetes in expansion and non-expansion states. Instead, CHCs experienced a shift in visit payer types (from uninsured to insured visits) rather than an increase in healthcare utilization. Patient populations with pre-diabetes saw a slight increase in total visit rates in both expansion (15%) and non-expansion (14%) state CHCs.

Although total visit rates remained fairly stable, rates of insured CHC visits increased and rates of uninsured visits decreased among all three population cohorts included in this study in both expansion and non-expansion state CHCs, which was reported previously for CHC patients.[12–15] When comparing visit rates among the three population cohorts, those with diabetes had higher total visit rates (2.2/year) than those with pre-diabetes (1.9/year) or no diabetes (1.1/year). This total visit rate for those with diabetes is similar to national averages.[35]

As expected in expansion states, CHCs saw an increase in Medicaid-insured visits for all three population cohorts included in the study. Non-expansion state CHCs had a surge in privately-insured visits, especially among the populations of patients with diabetes and pre-diabetes. This change is likely due to: 1) a shift in type of visits from uninsured to privately-insured due to the individual mandate, 2) motivated patients who obtained insurance to help manage existing health conditions, and 3) an influx of new patients with private insurance. Paradise et al[36] showed that CHCs are caring for a larger number of patients with private insurance post-ACA compared to pre-ACA because these patients experienced difficulties affording high deductibles and are in private plans with significant cost-sharing. Han et al[37] highlighted increased funding for CHCs following the implementation of the ACA, which allowed CHCs to hire additional staff members and boost capacity for care. Indeed, the Uniform Data System (https://bphc.hrsa.gov) reports showed that the number of key staff members (e.g., physicians, nurses, physician assistant) have progressively increased to care for this influx of patients. Despite improvement, uninsured visit rates in non-expansion states were higher post-ACA than in expansion states, suggesting that financial barriers may still exist for uninsured patients to acquire insurance coverage in non-expansion states.

Contrary to our hypothesis, total visit rates for the *population of patients with diabetes* pre- versus post-ACA were stable, which is likely due to the accessibility of care provided by CHCs. In addition to accessible care, CHCs provide high quality care; they exceed Healthy People 2020 goals in various health outcomes, including diabetes control.[18] These findings reinforce the importance of CHCs for delivering care to vulnerable populations with chronic disease. Notably, even though the total number of visits for the population of patients with diabetes did not change, diabetes-specific screening rates increased, suggesting that insurance coverage had a positive impact on receipt of timely preventive care.

The *population of patients with pre-diabetes* had an increase in total visit rates after ACA implementation, and this pre-diabetes cohort also experienced the most sizable rise in rates of diabetes-specific screenings, especially in expansion state CHCs. The greatest change was observed for rates of HbA1c screenings, a critical preventive service for monitoring this population at risk of developing diabetes.[2]

The significant increase in screening tests for the diabetes and pre-diabetes cohorts suggest that although uninsured patient populations were able to access visits pre-ACA, gaining insurance helped many of them access needed laboratory services post-ACA, which is consistent with previous findings in a much smaller subset of CHC patients.[23] Furthermore, the ACA included provisions that required all payers to fully cover many preventive services, including diabetes screening, and imposed strict limitations on cost-sharing (*e.g.*,

co-payments, deductibles) for others. It is likely that these provisions benefited even CHC patient populations who had insurance pre-ACA by removing cost-barriers to preventive services receipt, especially among those with high-deductible private insurance plans.[11] Since this provision was enacted prior to the study period, it likely did not impact our findings.

Proposals to 'repeal and replace' the ACA suggest loosening or eliminating cost-sharing limitations.[38] Yet, insurance plans with significant cost sharing and high out-of-pocket costs create critical access barriers to medical care, including specialty care and prescription medications essential for patients with chronic conditions. Under the ACA, low-income patients making <150% FPL can enroll in plans with significantly lower cost sharing. Thus, removing requirements for payers to cover preventive services and enabling payers to increase cost sharing for patients with diabetes or pre-diabetes could be harmful for access to needed preventive care.

This study has some limitations; it includes CHCs who are part of the ADVANCE network and therefore results may not be representative of all clinics, states, or expansion status groups. This analysis is visit-based and does not assess the CHC population without visits. Although we adjusted for clinic panel and economic differences, unmeasured confounders such as clinic-specific insurance outreach efforts, private insurance details (e.g., deductibles, co-payments), provider-patient communication, context and content of the visits, and citizenship status could impact our results. Patients who gained health insurance post-ACA may seek care outside CHCs; however, evidence suggests that most established CHC patients who gain coverage continue to receive care from CHCs.[39,40] Additionally, the present analysis does not assess whether the diabetes screenings were conducted as recommended. Future patient-level work is needed to assess whether the observed increase in HbA1c testing follows recommended screening interval and eligibility. Some states (California, Washington, Minnesota) expanded Medicaid eligibility early which may attenuate the observed changes from pre- to post- in expansion states. Lastly, this analysis does not address changes in HbA1c or other patient outcomes. Future work should assess whether these changes improved patients' health outcomes.

In conclusion, CHCs do an excellent job of providing access to care to vulnerable populations. After implementation of the ACA, CHCs experienced a reduction in uninsured visit rates and an increase in Medicaid-insured visit rates, which has likely enabled them to provide more comprehensive services to their vulnerable patients. For example, the CHC population with pre-diabetes had increased rates of diabetes screenings after ACA implementation. The various different options to repeal, replace, under budget, or alter the ACA could lead to millions of low-income patients who gained coverage under the ACA to lose coverage, benefits, financial assistance, and/or consumer protection. Though the findings show that CHC populations, especially those with diabetes or pre-diabetes, receive healthcare services from CHCs regardless of health insurance status, they also show that gaining health insurance coverage after implementation of the ACA was associated with improved receipt of preventive services, which reduces healthcare expenditures and saves lives.[41]

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Appendix 1:: CHC visit rates pre- versus post-Affordable Care Act in expansion and Non-expansion states, ADVANCE CDRN 2012–2015

	Model excluding state level factors[1]				**Model adjusting for state level factors excluding DM prevalence[2]**				**Model adjusting for state level factors and state DM prevalence[3]**			
	Non-expansion Visit Rate		Expansion Visit Rate		Non-expansion Visit Rate		Expansion Visit Rate		Non-expansion Visit Rate		Expansion Visit Rate	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Uninsured												
DM	50.1	42.6	62.9	27.8	43.2	36.7	63.1	27.8	46.6	39.6	61.9	27.3
Pre-DM	44.8	38.4	45.4	21.8	39.8	34.1	50.1	24.1	42.8	36.7	48.6	23.3
No DM	36.5	29.8	40.1	18.8	27.6	22.5	37.2	17.4	29.4	23.9	35.7	16.7
Medicaid												
DM	32.9	32.7	67.8	106.3	35.8	35.5	62.7	98.4	37.0	36.7	62.8	98.5
Pre-DM	25.2	27.0	53.6	91.4	27.9	29.9	48.9	83.5	28.6	30.7	48.5	82.7
No DM	19.1	19.1	40.0	63.9	20.6	20.5	36.5	58.3	20.8	20.7	35.9	57.3
Privately-insured												
DM	9.4	26.0	27.8	30.7	16.0	44.2	19.2	21.2	16.6	46.0	19.2	21.2
Pre-DM	10.4	33.1	30.8	34.0	18.0	57.0	20.2	22.3	18.6	58.9	19.9	22.0
No DM	6.0	16.1	19.5	20.6	12.0	32.3	14.5	15.4	12.1	32.8	14.1	15.0
Other Public												
DM	27.5	21.7	32.1	34.8	47.7	37.7	21.6	23.4	49.2	38.8	21.4	23.2
Pre-DM	26.3	22.1	23.5	24.4	48.3	40.5	15.8	16.4	49.7	41.6	15.6	16.2
No DM	15.0	11.0	8.0	7.2	29.6	21.7	6.1	5.5	30.4	22.2	6.0	5.4
Total Visit												
DM	139.1	139.1	210.0	219.5	169.9	169.9	177.8	185.8	180.6	180.7	176.7	184.7
Pre-DM	116.8	128.0	160.5	184.1	148.8	163.0	140.2	160.9	157.0	171.9	137.3	157.6
No DM	74.9	73.4	99.4	102.3	99.1	97.2	90.9	93.6	102.6	100.6	87.7	90.3
Primary Care												
DM	109.1	107.3	162.9	167.7	132.9	130.7	140.7	144.9	140.3	138.0	140.3	144.5
Pre-DM	96.4	103.8	134.5	152.7	120.9	130.2	118.0	134.1	126.6	136.4	116.0	131.7

	Model excluding state level factors[1]				Model adjusting for state level factors excluding DM prevalence[2]				Model adjusting for state level factors and state DM prevalence[3]			
No DM	70.4	67.8	94.8	96.3	90.8	87.4	86.2	87.7	93.5	90.0	83.5	84.9
Preventive Care												
DM	4.7	5.9	4.1	4.7	6.6	8.3	2.9	3.2	7.1	8.9	2.9	3.2
Pre-DM	6.6	8.9	6.0	7.8	10.2	13.8	4.5	5.9	10.8	14.7	4.4	5.7
No DM	5.6	6.7	4.8	5.3	9.9	11.9	4.3	4.7	10.4	12.5	4.1	4.5
Glucose Testing												
DM	71.6	87.0	71.5	81.8	65.4	79.5	78.2	89.5	64.0	77.8	78.6	89.8
Pre-DM	38.3	47.5	33.2	40.9	33.9	42.0	35.3	43.6	33.2	41.2	35.6	43.9
No DM	20.9	25.2	18.2	23.5	18.5	22.3	19.3	24.8	18.2	21.9	19.5	25.1
HbA1c Screening												
DM	58.8	85.7	68.5	86.4	53.8	78.4	70.9	89.5	57.3	83.5	70.3	88.7
Pre-DM	15.7	27.6	9.9	19.8	14.4	25.3	10.4	20.7	15.2	26.7	10.1	20.2
No DM	3.4	5.9	2.2	5.0	3.2	5.5	2.3	5.2	3.3	5.7	2.2	5.1

[1] Adjusted for clinic-level distributions of sex, age, race/ethnicity, and federal poverty level), urban vs. rural clinic location,

[2] Adjusted for clinic-level distributions of sex, age, race/ethnicity, and federal poverty level), urban vs. rural clinic location, and state-level factors (type of health insurance marketplace [state-run or federally facilitated], 2013 minimum wage, 2013 uninsured rate, and 2013 unemployment rate)

[3] Adjusted for clinic-level distributions of sex, age, race/ethnicity, and federal poverty level), urban vs. rural clinic location, and state-level factors (type of health insurance marketplace [state-run or federally facilitated], 2013 minimum wage, 2013 uninsured rate, and 2013 unemployment rate), state-level 2013 CHCs DM prevalence (source=HRSA, Health Center Data & Reporting, https://bphc.hrsa.gov/datareporting/index.html)

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Table 1:

Characteristics of community health centers and patients in the ADVANCE CDRN 2012–2015, by non-expansion and expansion status

	Non-expansion states			Expansion states		
Community health center/state-level covariates						
States	FL, KS, MO, NC			CA, HI, MD, NM, OH, OR, RI, WA, WI		
# Eligible CHCs	67			131		
Rural CHCs, # (%)	3 (4.5)			23 (17.6)		
Urban CHCs, # (%)	64 (95.5)			108 (82.4)		
Marketplace type, # (%)						
Federally-supported state-based	0			75 (57.3)		
Federal	67 (100)			13 (9.9)		
State	0			43 (32.8)		
Minimum wage, 2013, mean $/hour	$7.73			$8.26		
Unemployment rate, 2013, mean %	7.26%			7.91%		
Adult uninsured rate, 2013, mean %	25.07%			17.62%		
Patient-level covariates						
	Diabetes	**Pre-diabetes**	**No Diabetes**	**Diabetes**	**Pre-diabetes**	**No Diabetes**
Total patients	48,382	69,476	270,608	58,205	87,020	338,687
Established patient visit count pre-ACA	217,063	238,129	476,218	379,394	414,318	806,398
Established patient visit count post-ACA	168,026	198,079	310,978	332,773	384,859	583,975
New patient visit count pre-ACA	8,928	9,389	11,578	29,895	11,998	13,134
New patient visit count post-ACA	58,028	73,017	167,133	298,178	76,325	105,671
Female # (%)	27,485 (56.8)	42,546 (61.2)	173,390 (64.1)	31,250 (53.7)	46,312 (53.2)	191,485 (56.5)
Age group # (%)						
19 to 25	1,375 (2.8)	3,745 (5.4)	59,453 (22.0)	1,923 (3.3)	5,867 (6.7)	81,296 (24.0)
26 to 39	7,834 (16.2)	16,511 (23.8)	101,157 (37.4)	11,043 (19.0)	24,507 (28.2)	132,408 (39.1)
40 to 64	39,173 (81.0)	49,220 (70.8)	109,998 (40.6)	45,239 (77.7)	56,646 (65.1)	124,983 (36.9)
Household Income, # (%)						
≤100% FPL	33,779 (69.8)	46,543 (67.0)	181,044 (66.9)	33,721 (57.9)	50,324 (57.8)	182,657 (53.9)
100–138% FPL	4,912 (10.2)	6,856 (9.9)	27,891 (10.3)	7,199 (12.4)	11,004 (12.6)	37,128 (11.0)
≤138% FPL	5,834 (12.1)	9,329 (13.4)	32,457 (12.0)	8,099 (13.9)	13,304 (15.3)	52,517 (15.5)
Unknown	3,857 (8.0)	6,748 (9.7)	29,216 (10.8)	9,186 (15.8)	12,388 (14.2)	66,385 (19.6)
Race/Ethnicity, # (%)						
Hispanic	16,935 (35.0)	27,100 (39.0)	101,690 (37.6)	22,230 (38.2)	28,572 (32.8)	98,218 (29.0)
NH Non-White	17,165 (35.5)	21,070 (30.3)	71,111 (26.3)	9,431 (16.2)	12,800 (14.7)	48,178 (14.2)
NH White	12,461 (25.8)	18,481 (26.6)	85,897 (31.7)	24,294 (41.7)	42,040 (48.3)	173,868 (51.3)
Unknown	1,821 (3.8)	2,825 (4.1)	11,910 (4.4)	2,250 (3.9)	3,608 (4.1)	18,423 (5.4)

Note: CHC: community health center, FPL: Federal poverty level; NH: Non-Hispanic; ADVANCE CDRN: Accelerating Data Value Across a National Community Health Center Network clinical data research network

Table 2.

Unadjusted and adjusted visit rates pre- versus post-Affordable Care Act in expansion versus non-expansion states stratified by diabetes status, ADVANCE CDRN 2012–2015

	Unadjusted				Covariate Adjusted					
	Non-expansion Visit Rate		Expansion Visit Rate		Non-expansion Visit Rate			Expansion Visit Rate		
	Pre	Post	Pre	Post	Pre	Post	Absolute rate difference	Pre	Post	Absolute rate difference
Uninsured										
Diabetes	61.2	52.0	75.3	33.2	43.2	36.7	−6.5	63.1	27.8	−35.3
Pre-diabetes	52.6	45.1	52.4	25.2	39.8	34.1	−5.7	50.1	24.1	−26.0
No Diabetes	30.2	24.6	31.4	14.7	27.6	22.5	−5.1	37.2	17.4	−19.8
Medicaid										
Diabetes	37.4	37.1	80.0	125.6	35.8	35.5	−0.3	62.7	98.4	35.7
Pre-diabetes	29.4	31.4	70.4	120.0	27.9	29.9	2.0	48.9	83.5	34.6
No Diabetes	15.0	15.0	31.7	50.6	20.6	20.5	−0.1	36.5	58.3	21.8
Privately-insured										
Diabetes	9.7	26.9	34.0	37.5	16.0	44.2	28.2	19.2	21.2	2.0
Pre-diabetes	9.9	31.5	31.3	34.5	18.0	57.0	39.0	20.2	22.3	2.1
No Diabetes	4.7	12.6	18.4	19.5	12.0	32.3	20.3	14.5	15.4	0.9
Other Public										
Diabetes	36.4	28.8	39.9	43.2	47.7	37.7	−10.0	21.6	23.4	1.8
Pre-diabetes	28.7	24.1	26.9	28.0	48.3	40.5	−7.8	15.8	16.4	0.6
No Diabetes	13.2	9.7	7.8	7.0	29.6	21.7	−7.9	6.1	5.5	−0.6
Total Visits										
Diabetes	144.8	144.8	229.2	239.5	169.9	169.9	0.0	177.8	185.8	8.0
Pre-diabetes	120.6	132.1	181.0	207.7	148.8	163.0	14.2	140.2	160.9	20.7
No Diabetes	63.1	61.9	89.3	91.9	99.1	97.2	−1.9	90.9	93.6	2.7
Primary Care Visits										
Diabetes	122.6	120.6	190.1	195.8	132.9	130.7	−2.2	140.7	144.9	4.2
Pre-diabetes	103.6	111.6	152.8	173.6	120.9	130.2	9.3	118.0	134.1	16.1
No Diabetes	54.8	52.7	75.4	76.6	90.8	87.4	−3.4	86.2	87.7	1.5
Preventive Care Visits										
Diabetes	4.7	5.9	4.1	4.6	6.6	8.3	1.7	2.9	3.2	0.3
Pre-diabetes	7.0	9.4	5.2	6.8	10.2	13.8	3.6	4.5	5.9	1.4
No Diabetes	5.8	7.0	4.6	5.1	9.9	11.9	2.0	4.3	4.7	0.4
Glucose Testing										
Diabetes	67.4	81.9	76.6	87.6	65.4	79.5	14.1	78.2	89.5	11.3
Pre-diabetes	36.3	45.0	35.8	44.2	33.9	42.0	8.1	35.3	43.6	8.3
No Diabetes	12.2	14.7	11.1	14.3	18.5	22.3	3.8	19.3	24.8	5.5
HbA1c Screening										
Diabetes	52.3	76.3	65.5	82.7	53.8	78.4	24.6	70.9	89.5	18.6
Pre-diabetes	16.0	28.0	10.2	20.3	14.4	25.3	10.9	10.4	20.7	10.3

	Unadjusted						Covariate Adjusted			
	Non-expansion Visit Rate		Expansion Visit Rate		Non-expansion Visit Rate			Expansion Visit Rate		
	Pre	Post	Pre	Post	Pre	Post	Absolute rate difference	Pre	Post	Absolute rate difference
No Diabetes	2.6	4.3	1.3	3.0	3.2	5.5	2.3	2.3	5.2	2.9

ADVANCE CDRN: Accelerating Data Value Across a National Community Health Center Network clinical data research network. Non-expansion states: FL, KS, MO, NC. Expansion states: CA, HI, MD, NM, OH, OR, RI, WA, WI. Visit rates were by dividing the number of visits in a given interval (*i.e.*, pre- or post-ACA period) by the total number of adult patients seen in a clinic over the study period, scaled to 1,000 patients per month. Total visits: CPT 99201–99205, 99212–99215, 99241–99245, 99381–99384, 99385–99387, or 99391–99397 with MD, DO, NP, PA, midwife, or resident with no specialty listed. Generalized estimating equation Poisson models adjusted for clinic-level demographic distributions (sex, age, federal poverty level, primary language, race, and ethnicity), state-level factors (marketplace type, 2013 minimum wage and unemployment rates, and 2013 uninsured rate), and 2013 state-level CHCs diabetes prevalence (https://bphc.hrsa.gov/datareporting/index.html) clustered by facility to account for within-facility correlation.

Table 3.

Adjusted rate ratios and difference-in-difference in visit rates by diabetes status and Medicaid expansion status, ADVANCE CDRN 2012–2015

	Non-expansion Post vs Pre RR (95% CI)	Expansion Post vs Pre RR (95% CI)	Expansion vs Non-expansion DD Ratio (95% CI)
Uninsured			
Diabetes	**0.85 (0.76,0.94)**	**0.44 (0.39,0.49)**	**0.52 (0.44,0.60)**
Pre-diabetes	**0.86 (0.76,0.95)**	**0.48 (0.42,0.54)**	**0.56 (0.47,0.65)**
No Diabetes	**0.82 (0.74,0.89)**	**0.47 (0.42,0.52)**	**0.57 (0.50,0.65)**
Medicaid			
Diabetes	0.99 (0.92,1.07)	**1.57 (1.43,1.71)**	**1.58 (1.40,1.77)**
Pre-diabetes	1.07 (0.98,1.16)	**1.71 (1.53,1.88)**	**1.59 (1.38,1.80)**
No Diabetes	1.00 (0.91,1.09)	**1.60 (1.46,1.73)**	**1.60 (1.40,1.80)**
Privately-insured			
Diabetes	**2.77 (1.79,3.75)**	1.10 (0.96,1.25)	**0.40 (0.25,0.55)**
Pre-diabetes	**3.17 (2.03,4.31)**	1.10 (0.90,1.31)	**0.35 (0.21,0.49)**
No Diabetes	**2.70 (2.02,3.38)**	1.06 (0.94,1.18)	**0.39 (0.28,0.50)**
Other Public			
Diabetes	**0.79 (0.66,0.92)**	1.08 (0.97,1.20)	**1.37 (1.10,1.64)**
Pre-diabetes	0.84 (0.65,1.03)	1.04 (0.86,1.22)	1.24 (0.89,1.59)
No Diabetes	**0.73 (0.59,0.87)**	0.90 (0.77,1.04)	1.24 (0.94,1.53)
Total Visit			
Diabetes	1.00 (0.93,1.07)	1.05 (0.99,1.09)	1.04 (0.95,1.14)
Pre-diabetes	**1.10 (1.00,1.19)**	**1.15 (1.09,1.20)**	1.05 (0.94,1.16)
No Diabetes	0.98 (0.91,1.06)	1.03 (0.98,1.08)	1.05 (0.95,1.15)
Primary Care			
Diabetes	0.98 (0.91,1.06)	1.03 (0.98,1.07)	1.05 (0.96,1.14)
Pre-diabetes	1.08 (0.98,1.17)	**1.14 (1.08,1.19)**	1.05 (0.95,1.16)
No Diabetes	0.96 (0.88,1.04)	1.02 (0.96,1.07)	1.06 (0.95,1.16)
Preventive Care			
Diabetes	**1.26 (1.03,1.50)**	**1.12 (1.02,1.23)**	0.89 (0.71,1.08)
Pre-diabetes	**1.35 (1.13,1.58)**	**1.31 (1.19,1.42)**	0.96 (0.79,1.14)
No Diabetes	**1.20 (1.04,1.37)**	**1.11 (1.01,1.2)**	0.92 (0.77,1.07)
Glucose Testing			
Diabetes	**1.22 (1.11,1.32)**	**1.14 (1.09,1.20)**	0.94 (0.84,1.04)
Pre-diabetes	**1.24 (1.13,1.35)**	**1.23 (1.17,1.30)**	0.99 (0.89,1.09)
No Diabetes	**1.20 (1.09,1.31)**	**1.29 (1.21,1.37)**	1.07 (0.95,1.19)
HbA1c Screening			
Diabetes	**1.46 (1.35,1.56)**	**1.26 (1.21,1.31)**	**0.87 (0.80,0.94)**
Pre-diabetes	**1.76 (1.56,1.95)**	**2.00 (1.80,2.19)**	1.14 (0.87,1.4)
No Diabetes	**1.70 (1.45,1.96)**	**2.26 (1.97,2.56)**	**1.33 (1.09,1.57)**

Abbreviations: ADVANCE CDRN: Accelerating Data Value Across a National Community Health Center Network clinical data research network; RR: rate ratio; CI: confidence interval; DD, difference-in-difference testing post- versus pre-period in expansion versus non-expansion states. Non-expansion states: FL, KS, MO, NC. Expansion states: CA, HI, MD, NM, OH, OR, RI, WA, WI. Visit rates were by dividing the number of visits in a given interval (*i.e.*, pre- or post-ACA period) by the total number of adult patients seen in a clinic over the study period, scaled to 1,000 patients per month. Boldfaced values indicate statistically significant difference, P< .05. Total visits: CPT 99201–99205, 99212–99215, 99241–99245, 99381–99384, 99385–99387, or 99391–99397 with MD, DO, NP, PA, midwife, or resident with no specialty listed. Generalized estimating equation Poisson models adjusted for clinic-level demographic distributions (sex, age, federal poverty level, primary language, race, and ethnicity), state-level factors (marketplace type, 2013 minimum wage and unemployment rates, 2013 uninsured rate), and 2013 state-level CHCs diabetes prevalence (https://bphc.hrsa.gov/datareporting/index.html) clustered by facility to account for within-facility correlation. DD estimates obtained from linear combinations of time × expansion status interaction.