Comparing Patient-Centered Medical Home Implementation in Urban and Rural VHA Clinics: Results from the Patient Aligned Care Team (PACT) Initiative

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INTRODUCTION

The Veterans Health Administration (VHA) is the largest integrated healthcare system in the United States, serving over 5 million veterans annually for primary care in more than 900 clinics.[1,2] Implementation of the VHA's Patient-Centered Medical Home (PCMH) model, the Patient-Aligned Care Team (PACT), began nationwide in April 2010 across all VHA primary care clinics, encompassing diverse clinic and community settings.[2] Major goals of the PACT initiative are to improve care continuity and coordination as well as access to care by realigning primary care services around an interdisciplinary, team-based model.[2] Prior studies have shown that the extent to which VHA primary care clinics implemented PACT varied substantially during the first two years of implementation.[3,4] PCMH transformation has been described as a "local process," and variation in PACT implementation may be related to unique implementation contexts.[5] The contextual influence of rurality is of high interest to the VHA, given that 36% of enrolled veterans live in rural areas and approximately one-third of VHA primary care clinics are located in rural areas.[6]

Characteristics of rural VHA primary care clinics, including features of clinics' communities and characteristics of patients served, may facilitate or hinder PACT implementation. Rural VHA primary care clinics are more likely to be community-based, less likely to be in a VHA Medical Center, and generally have fewer patients and providers, which may make restructuring primary care less complex. However, lack of proximity to VHA specialty care, as well as greater dual use of VHA and non-VHA primary care services among rural compared to urban VHA patients, may make

care coordination more difficult.[7,8] Rural clinics also face greater challenges related to provider shortages, and difficulty recruiting providers, which has been associated with lower PACT implementation.[9-11]

Clinics' readiness to integrate PCMH components may also affect level of PACT implementation. In a VHA survey prior to PACT rollout, primary care clinic directors at rural clinics reported more care delivery and population health management challenges related to core components of PCMH compared to urban primary care clinic directors.[12] In studies outside the VHA, evidence is mixed as to whether smaller and rural practices were prepared for PCMH implementation.[13-15] In a study of private practices, minimal differences were found between non-metropolitan and metropolitan practices in overall readiness to implement PCMH.[15] However, Friedberg and colleagues found that relatively larger and network-affiliated practices were more likely than smaller, non-affiliated practices to have implemented several recommended PCMH structural capabilities.[16]

No prior studies have directly evaluated rural-urban differences in PCMH implementation. We sought to compare degree of PACT implementation for rural and urban VHA primary care clinics and to examine clinic characteristics that may contribute to variation in implementation associated with clinic rurality. These findings will help guide context-specific interventions to better support PACT implementation. Understanding how PACT implementation varied by rural-urban context will inform future investigation of rural-urban differences in PACT-related outcomes. This study uniquely contributes to the broader PCMH literature by

describing how rurality influences PCMH implementation in a large integrated healthcare system.

METHODS

Study Design and Sample

This was a cross-sectional, observational study of VHA primary care clinics in Fiscal Year (FY) 2012 (October 1, 2011 – September 30, 2012). All non-mobile VHA primary care clinics in the United States and Puerto Rico were included for analysis. We identified all patients assigned to a primary care provider in FY 2012 to construct clinic-level measures based on patient-level data (e.g. average age and comorbidity).

Outcome Measure

We used a previously developed measure, the PACT Implementation Progress Index (PI^2), to measure PCMH implementation in VHA clinics during FY2012.[3] PI^2 is a composite score reflecting 8 core PCMH domains that were the focus of the PACT initiative: access, continuity, coordination, comprehensiveness, self-management support, patient-centered care and communication, shared decision-making and team-based care. Domain measures are composite scores reflecting subsets of 53 individual items derived from administrative and survey data. We calculated standardized Z-scores for each item to allow for comparability across measures. Clinics were ranked on each of the 8 PI^2 domains. A clinic's PI^2 score represents the

number of domains in which the clinic is in the top quartile minus the number of domains in which the clinic is in the bottom quartile, ranging from -8 to 8.

Data Sources

Data sources used to construct the PI^2 score included administrative data from the VHA Corporate Data Warehouse (CDW), patient survey data from the 2012 Consumer Assessment of Healthcare Providers and Systems – Patient Centered Medical Home Survey (administered to a nationally weighted random sample of veterans who received outpatient care) and employee survey data from the 2012 PACT Primary Care Personnel Survey (administered to all VHA primary care personnel). Further details regarding data sources and individual measures used to construct PI^2 and a detailed description of the psychometric properties of PI^2 are provided elsewhere.[3]

Clinic address and/or latitude and longitude were obtained from the VA Site Tracking (VAST) database. Patient residential address and/or latitude and longitude as well as driving-time distance to nearest VHA primary care clinic were determined using Planning Systems Support Group (PSSG) enrollment data. Patient demographics and clinical characteristics were obtained from the CDW. Clinic organizational characteristics were obtained from the following sources: CDW, PACT Compass in the VHA Support Service Center, VAST, the PACT Primary Care Personnel Survey and VHA Personnel and Accounting Integrated Data. Community characteristics were obtained from the Area Health Resources Files (2012-2013).[17]

Rural-Urban Measurement

We used 2 measures to designate clinics as urban or rural. The first measure classified clinics as urban, rural or highly rural based on the Rural-Urban Commuting Area (RUCA) code corresponding to a clinic's address and/or latitude and longitude, which is the classification approach used by VHA.[18,19] Clinics with RUCA codes of 1.0 or 1.1 were considered urban, 10.0 were considered highly rural and all other codes were considered rural.[19] Rural and highly rural clinics were combined into a single category in our study due to the low number of highly rural clinics (N=14).

We also categorized clinics as urban or rural based on the proportion of clinics' primary care patients residing in rural areas. Patient rurality was assigned using the RUCA code-based scheme described above. Clinics with $\geq$50% of assigned primary care patients designated as rural or highly rural were considered rural, while clinics with <50% of assigned primary care patients designated as rural or highly rural were considered urban.

Additional Covariates

We hypothesized urban-rural variation in PACT implementation may be related to urban-rural differences in patient, organizational or community factors. We constructed clinic-level measures for each of these categories to examine potential mediating effects.

Covariates capturing clinics' patient population included within-clinic means for age, gender, comorbidity, driving distance to the nearest clinic, exemption from copayments for VHA care and socioeconomic status. The Charlson-Deyo index was used to estimate patient comorbidity.[20] Area-level socioeconomic status (SES) in patients' Census tract was defined using a previously validated index, constructed from 6 measures using a 5-year average of American Community Survey data (2008-2012).[21]

Covariates capturing clinics' organizational structure included number of assigned primary care patients, panel size, number and type of primary care providers (PCPs), number of PACT teamlet assignments for PCPs, and clinic staffing type (VHA or contracted). We additionally assessed PCP turnover rate and average staff tenure category for each clinic. To evaluate for facility effects, we assessed which clinics had changed address between FY 2010 and FY 2012. To assess effects of clinic "age," we calculated the number of years each clinic had been operating prior to 2010 (year of PACT rollout).

To assess community factors, we assigned clinics to U.S. regions according to Census regional classifications by clinic state (clinics in Puerto Rico were grouped separately). County unemployment rate was used as an indicator for neighborhood-level socioeconomic status and county average number of active, non-federal MDs was used as an indicator for area-level health care resources.

Analysis

We compared the PI[2] composite score, PI[2] domain scores and clinic characteristics by clinic rurality using *t* tests for continuous measures and $\chi 2$ tests for proportional measures. We additionally compared trends across PI[2] composite score categories between rural and urban clinics using a non-parametric test of trend for ranks across ordered groups. Clinics were categorized by degree of PACT implementation based on previously utilized categories: PI[2] scores from 5 to 8 (highest performing clinics), 2 to 4, -1 to 1, -4 to -2 and -8 to -5 (lowest performing clinics).[3]

We first assessed the relationship between rurality and PACT implementation by estimating a linear regression with no additional covariates. Based on our conceptual model, we then estimated a series of 3 multivariable linear regression models to further characterize the mechanism between clinic rurality and PACT implementation. In these models, we separately adjusted for patient, organizational and community factors. We estimated the association between clinic rurality and PI[2] using the two previously describes rural measures. To assess mediation of the effect of rurality on PI[2] score via model covariates, we estimated the total indirect effect of variables included in the model for each linear regression model. We used bootstrapping to estimate bias-adjusted 95% confidence intervals for total indirect effect estimates.

To check for multi-collinearity, we calculated the variance inflation factor (VIF) for each model. Based on this analysis, we excluded measures of clinic years of

operation and total number of PCPs, which were found to be collinear with other model variables with VIF $\geq$4.[22]

In sensitivity analysis, we estimated 3 logistic regression models, adjusting separately for characteristics of clinics' assigned patients, organizational and community factors, to evaluate the odds of a rural compared to urban clinics scoring in the highest implementation category compared to the odds rural compared to urban clinics scoring in any other implementation category. All statistical analyses were performed in STATA version 13.1.

These evaluation efforts are part of an ongoing quality improvement effort at the VHA and are not considered research activity; they are thus not subject to institutional review board review or waiver.

RESULTS

All results presented are based on the location-based measure for clinic rurality utilized by VHA, unless otherwise stated.

Sample Characteristics

Our sample included 905 primary care clinics serving approximately 5.4 million veterans enrolled in VHA primary care in FY 2012, including 350 (39%) rural and 555 (61%) urban clinics (*Table 1*). There were 831 VHA primary care clinics with data available for both patient neighborhood SES and veteran residence, including

426 clinics with fewer than 50% rural patients assigned to primary care and 405 rural clinics with greater than 50% rural patients assigned to primary care.

Bivariate Analysis

Facility type and other organizational clinic characteristics varied significantly between rural and urban clinics (*Table 1*). Rural clinics had, on average, fewer assigned primary care patients, fewer PCPs and smaller adjusted panel sizes compared to urban clinics. A lower proportion of rural compared to urban clinics were staffed by VHA employees and staff-reported tenure category was significantly lower for rural compared to urban clinics. Rural clinics had been in operation for fewer years prior to PACT implementation in 2010 compared to urban clinics.

A greater proportion of patients assigned to primary care at rural clinics were from rural areas (*Table 2*). Patients assigned to rural clinics lived further from the nearest VHA primary care facility, were older and more likely to be White compared to patients assigned to primary care at urban clinics. Patients assigned to rural clinics were from neighborhoods with lower average SES compared to patients assigned to urban clinics.

Overall PACT Implementation

Rural clinics had significantly higher mean overall PI^2 scores compared to urban clinics (0.39 vs. -0.24, $p<0.005$). Clinics with ≥50% rural patients assigned to primary care also had significantly higher mean overall PI^2 score compared to

clinics with <50% rural patients assigned (0.34 vs. -0.37, p<0.002). Tests of trend indicated higher proportions of rural clinics exhibited greater PACT implementation based on both measures of rurality (location-based measure: p<0.003; patient-based measure: p<0.002)(*Figure 1*).

PI² Domain Scores

Rural clinics had higher mean domain scores for team-based care (0.16 vs. -0.08, p<0.001), patient-centered care (0.10 vs. -0.06, p<0.001), care coordination (0.07 vs. -0.05, p<0.019) and shared decision-making (0.06 vs. -0.04, p<0.044) compared to urban clinics. Urban clinics had a significantly higher mean score for care continuity (0.05 vs. -0.06, p<0.036) (*Figure 2)*. Comparison of domain scores for clinics with ≥50% rural patients compared to clinics with <50% rural patients yielded similar results.

Comparison of the 11 individual measures comprising the access domain revealed that urban clinics performed significantly better than rural clinics on 3 of 4 administrative measures, including all measures of non-traditional encounter utilization, while rural clinics performed better than urban clinics on 5 of 7 patient-reported access measures (*Figure 3*).

Adjusted Results

Greater clinic rurality was associated with higher PI² score in base models for both rural measures (location-based measure: β = 0.64, p=0.004; patient-based measure:

β = 0.70, p<0.001) (*Figure 4*). This association increased after adjustment for factors describing the patient population for both rural measures (location-based measure: β = 0.79, p=0.002; patient-based measure: β = 0.80, p=0.003). Separate adjustment for clinic organizational factors attenuated the association between clinic rurality and overall PI^2 score for both rural measures (location-based measure: β = 0.35, p=0.226); patient-based measure: β = 0.41, p=0.134). With separate adjustment for area factors, greater clinic rurality continued to be significantly associated with higher PI^2 score for both rural measures (location-based measure: β = 0.55, p<0.017; patient-based measure: β = 0.52, p<0.028).

The total indirect effect for the model adjusting for clinic organizational characteristics (PCP turnover was omitted for this estimation due to singular covariance when this was included) was β = 0.43 (95% CI: 0.21, 0.67). For the models adjusting for patient and area characteristics, the indirect effects were β = -0.16 (95% CI: -0.43, 0.13) and β = 0.11 (95% CI: -0.05, 0.27), respectively. This suggests that clinic organizational characteristics significantly mediated the effect of clinic rurality on PI^2 score, while patient and area characteristics did not serve as significant mediators of this effect.

Logistic regression models yielded similar results (*Supplemental Table*).

DISCUSSION

Implementation of the VHA's PCMH model was significantly greater in rural compared to urban primary care clinics. Our findings suggest that observed urban-rural differences in PACT implementation may largely be related to clinic organizational characteristics. These findings provide a more nuanced understanding of how rurality influences PCMH implementation in a large integrated health system, and have important implications for VHA to better support PACT implementation across the widely varying rural-urban contextual spectrum of VHA primary care clinics.

Notably, several potential barriers to PCMH adoption identified for non-VHA rural primary care practices are greatly reduced or eliminated in VHA.[13] All VHA primary care clinics have fully operational electronic medical records as well as infrastructure to facilitate continuous quality improvement. Reimbursement-related PCMH implementation issues are also not relevant in VHA. However, with this infrastructure in place, PCMH implementation may be easier for smaller primary care clinics with fewer staff and patients to re-organize.

There are a number of potential explanations for why organizational characteristics of rural primary care clinics may facilitate PACT implementation. In our study, a greater proportion of rural compared to urban located primary care clinics had moved between 2010 and 2012, and changing location may provide an opportunity for clinics to re-design facilities to better support PACT. Additionally, given that

rural clinic directors reported more management challenges amenable to PACT intervention, the perceived benefit of PACT may have been greater for rural clinics, potentially increasing motivation of leadership at rural clinics to implement PACT.[12] Rural clinics were also less likely to have resident physicians compared to urban clinics, and large academic medical centers face unique challenges in implementing PCMH due to their large size as well as the presence of part-time providers and residents.[23]

Despite known challenges in access to care related to distance for rural veterans, the mean access domain score was not significantly different when comparing rural and urban clinics for either rurality measure.[24] To expand access to care, PACT sought to increase utilization of non-traditional encounters, including group and phone visits as well as secure messaging. In our study, non-traditional encounters were utilized less by patients at rural compared to urban clinics. This finding may reflect rural-urban cultural differences, issues with telephone call completion and more limited access to the broadband Internet in rural areas, or that patients at rural clinics are more easily able to obtain and present for face-to-face appointments.[25-27] In addition, group visits may be less desirable in rural areas where anonymity is less likely. Of note, rural providers may not perceive significant benefit for group visits.[28]

This study has a number of limitations. Causal inference is limited due to the cross-sectional nature of this study. In the team-based care domain score, provider survey data was available approximately 30% of clinics in the sample. Finally, both the

PACT model and the PI[2] index measure are specific to the VHA and may not be directly generalizable other non-VHA health systems.

In summary, our findings demonstrating significantly greater implementation of PACT elements in FY 2012 for rural compared to urban VHA clinics that were robust to 2 different measures of clinic rurality across a large, national sample of primary care clinics. These findings have implications for rural-urban clinic variation in PACT-related outcomes, given prior findings that a lower degree of PACT implementation was associated with worse clinical outcomes, lower patient satisfaction and higher staff burnout.[3]

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Table 1. Organizational Characteristics of Rural and Urban Clinics in Fiscal-Year 2012

	ALL	RURAL	URBAN	*p* value[3]
Total clinics, N	905	350	555	-----
Total primary care patients assigned, N	5,392,480	836,059	4,556,421	-----
# Primary care patients, mean (SD)	5,959 (6,721)	2,389 (2,389)	8,210 (7,548)	**<0.001**
Adjusted panel size, mean (SD)[1]	1,055 (251)	1,014 (288)	1,079 (224)	**0.001**
Total PCPs, mean (SD)	11.9 (23.4)	3.5 (4.2)	17.2 (28.4)	**<0.001**
PCP Type (% all clinic PCPs)				
Physician	65.3	61.9	67.5	0.091
Nurse Practitioner	23.2	28.7	19.7	**0.002**
Physician Assistant	7.3	9.1	6.2	0.117
Has resident PCPs (%)	9.0	0.6	14.2	**<0.001**
Facility type (%)[2]				
VHA Medical Center	18.3	7.0	25.4	**<0.001**
Health Care Center	1.5	0.0	2.4	**0.004**
Multi-specialty Community-Based Outpatient Clinic	20.1	10.7	26.0	**<0.001**
Primary Care Community-Based Outpatient Clinic	54.7	69.9	45.2	**<0.001**
# Teamlet assignments per PCP, mean (SD)	1.1 (0.3)	1.1 (0.3)	1.0 (0.2)	0.075
PCP turnover rate (%)	2.4	2.7	2.2	0.658
VHA Staffed (%)[3]	85.7	76.9	91.1	**<0.001**
Staff tenure category (%)				
Less than 1 year	29.3	28.0	29.9	0.631
Between 1 and 5 years	14.2	14.9	13.9	0.730
Between 5 and 15 years	40.2	41.1	39.7	0.739
Greater than 15 years	16.3	15.9	16.5	0.859
Operational years prior to 2010, mean (SD)	20.9 (23.5)	13.0 (16.9)	25.8 (25.7)	**<0.001**
Address change between 2010 and 2012 (%)	14.9	21.3	11.2	**<0.001**

1. Adjusted for provider type. In VHA nurse practitioner and physician assistant PCPs have 20% reduction in panel size compared to physician PCPs.
2. 2015 VA Site Tracking (VAST) Classifications: VA Medical Center: provides at least 2 categories of care (inpatient, outpatient, residential, institutional extended care). Health Care Center: provides primary care, mental health care, on-site specialty and ambulatory surgery services. Multi-Specialty Community-Based Outpatient Clinic: primary care and mental health services as well as at least 2 types of specialty care services. Primary Care Community-Based Clinic: medical and mental health care.
3. *p* values from test of differences between urban and rural clinics.

PCP=primary care provider; VHA=Veterans Health Administration

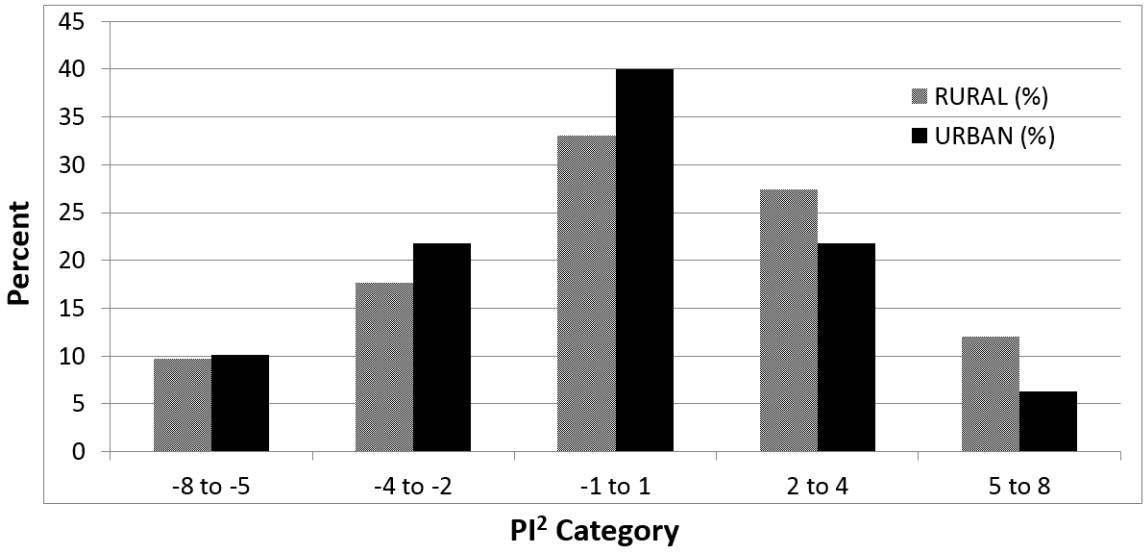
Table 2. Patient and Regional Characteristics of Rural and Urban Clinics in Fiscal-Year 2012

	ALL (N=905)	**RURAL (N=350)**	**URBAN (N=555)**	***p* value[2]**
Rural patients assigned (%)	52.1	88.0	28.8	**<0.001**
Age, mean (SD)	64.4 (3.9)	65.6 (2.8)	63.7 (4.3)	**<0.001**
Female patients (%)	5.4	4.3	6.1	0.251
Ethnicity (%)				
White	78.9	86.1	74.3	**<0.001**
Black	9.9	4.8	13.1	**<0.001**
Hispanic	5.0	3.1	6.1	**0.040**
Deyo comorbidity index, mean (SD)	0.9 (0.2)	0.9 (0.2)	0.9 (0.2)	0.627
Patient with service-connected disability rating > 50% (%)	20.9	19.3	22	0.342
Miles to nearest primary care clinic, mean (SD)	17.0 (10.5)	21.8 (13.8)	14.0 (6.2)	**<0.001**
Patient neighborhood SES index, mean (SD)[1]	69.8 (4.3)	69.2 (3.8)	70.2 (4.5)	**0.001**
U.S. region (%)[2]				
Northeast	18.0	14.9	20.0	0.050
Midwest	25.2	34.0	19.6	**<0.001**
South	35.0	31.4	37.3	0.071
West	21.2	19.7	22.2	0.380
Puerto Rico	0.6	0.0	0.9	**<0.001**
County active, non-federal MDs in 2011, mean (SD)	1,689 (3,875)	156 (577)	2,642 (4,668)	**<0.001**
County 2011 unemployment rate (% of civil labor force)	8.8	8.6	9.0	0.832

1. SES neighborhood index measures reflect a 5-year average of American Community Survey data (2008-2012). Index measures: % adults older than 25 with less than a high school education; % of males who were unemployed; % households with income below the poverty line; % households receiving public assistance; % households with children that were headed by women; median household income. Score standardized to U.S. mean, range 0-100.
2. *p* values from tests of differences between urban and rural clinics.

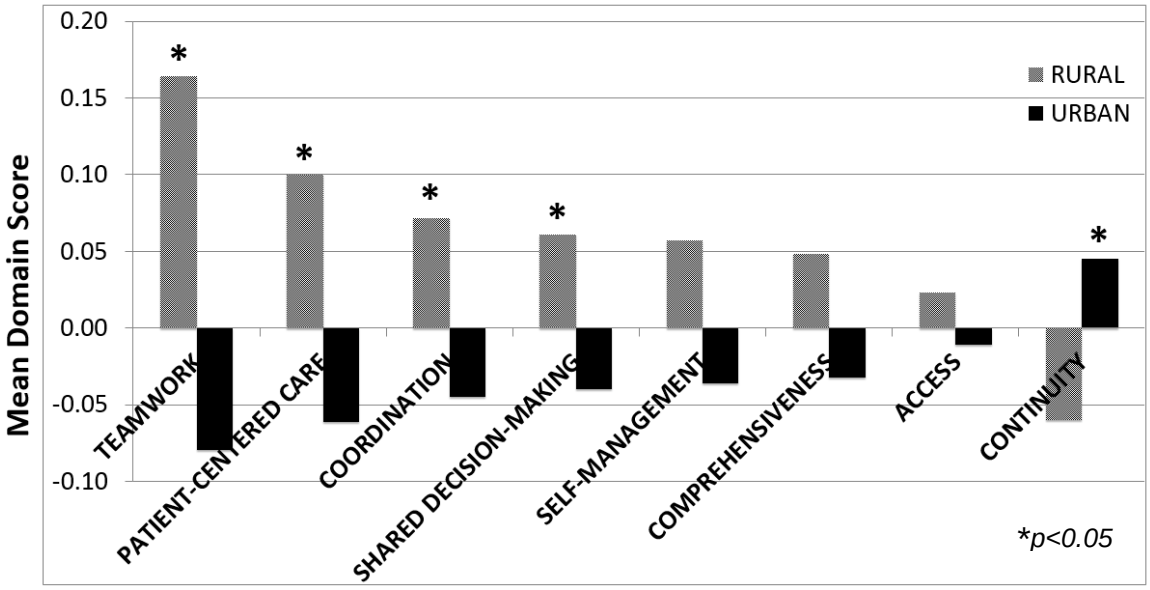
SES=Socioeconomic status; U.S.=United States; MD=Doctor of Medicine

Figure 1. Distribution of Urban and Rural Located Clinics By Degree of PACT Implementation



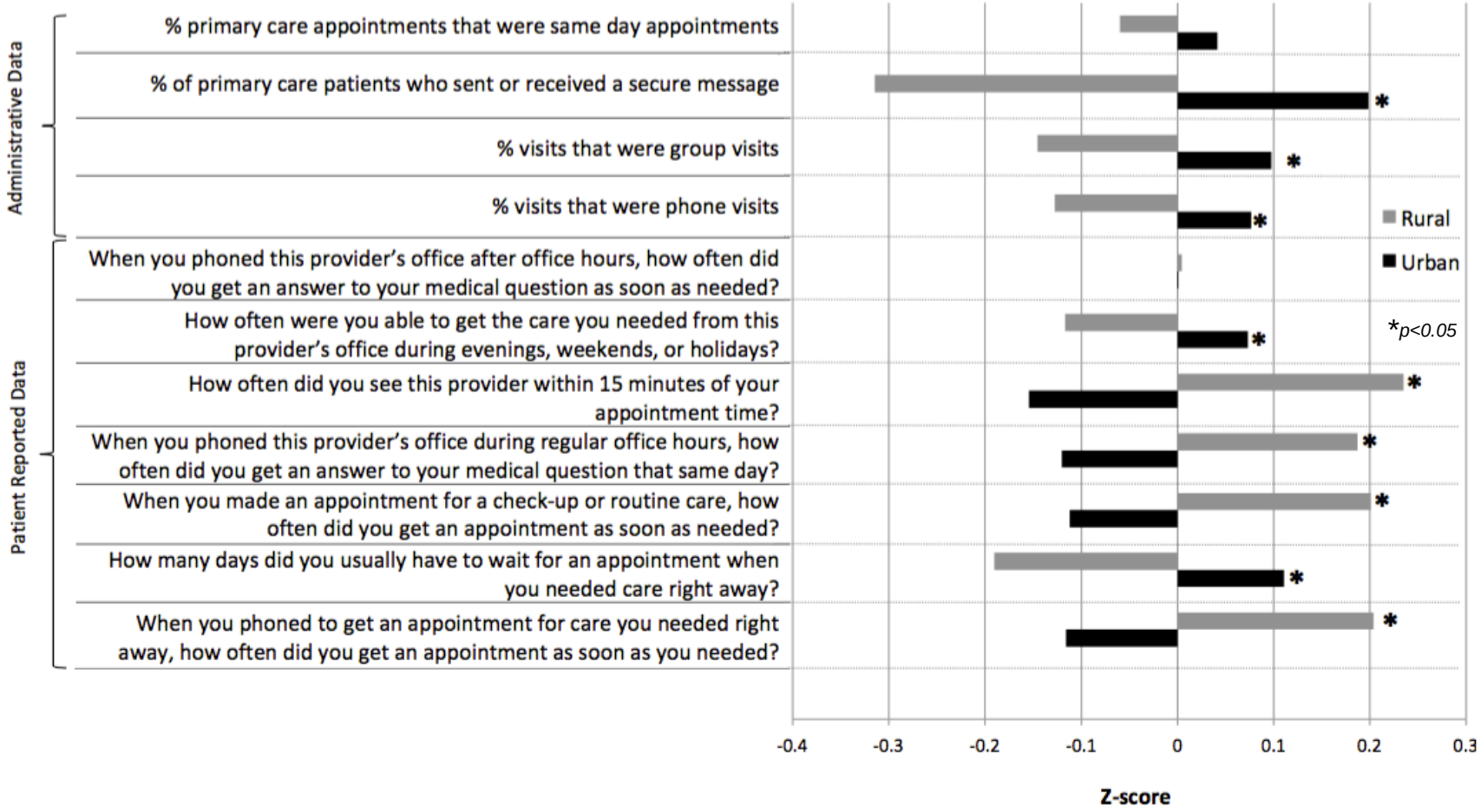
Implementation categories: PI² scores from 5 to 8 (highest performing clinics), 2 to 4, -1 to 1, -4 to -2 and -8 to -5 (lowest performing clinics); PI²=Patient-Aligned Care Team (PACT) Implementation Progress Index

Figure 2. PI² Domain Scores for Urban and Rural Located Clinics



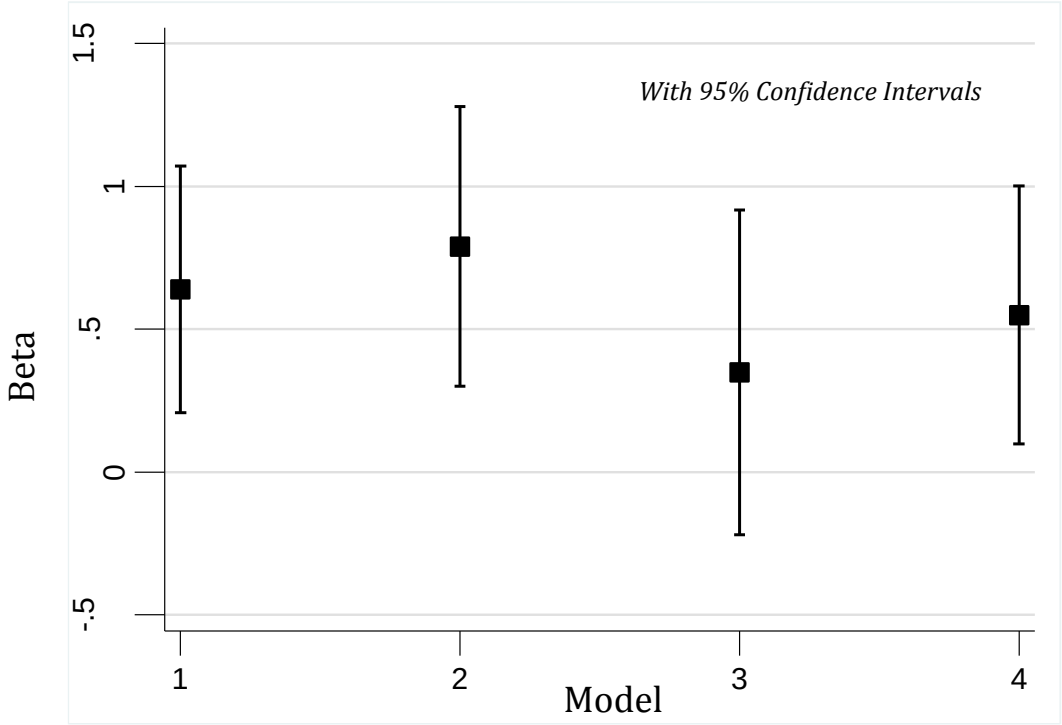
PI²=Patient-Aligned Care Team (PACT) Implementation Progress Index

Figure 3. Comparison of Individual Measures in PI² Access Domain for Rural and Urban Clinics



PI²=Patient-Aligned Care Team (PACT) Implementation Progress Index

Figure 4. Multivariable Linear Regression Models Estimating Change in PI² with Increase in Clinic Rurality



Model 1: Base model assessing relationship between clinic rurality and PI² score
Model 2: Adjusted for patient age, comorbidity, gender, service connection, ethnicity, distance to primary care, neighborhood SES
Model 3: Adjusted for total primary care patients, panel size, staffing, academic function, facility type, address change, staff tenure category, PCP turnover rate
Model 4: Adjusted for region, area unemployment rate, number of non-federal MDs

PI²=Patient-Aligned Care Team (PACT) Implementation Progress Index; SES=socioeconomic status; PCP=primary care provider; MD=Doctor of Medicine