Longitudinal Analysis of Quality of Diabetes Care and Relational Climate in Primary Care

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Objective. To assess the influence of relational climate on quality of diabetes care.

Data Sources/Study Setting. The study was conducted at the Department of Veterans Affairs (VA). The VA All Employee Survey (AES) was used to measure relational climate. Patient and facility characteristics were gathered from VA administrative datasets.

Study Design. Multilevel panel data (2008–2012) with patients nested into clinics.

Data Collection/Extraction Methods. Diabetic patients were identified using ICD-9 codes and assigned to the clinic with the highest frequency of primary care visits. Multiple quality indicators were used, including an all-or-none process measure capturing guideline compliance, the actual number of tests and procedures, and three intermediate continuous outcomes (cholesterol, glycated hemoglobin, and blood pressure).

Principal Findings. The study sample included 327,805 patients, 212 primary care clinics, and 101 parent facilities in 2010. Across all study years, there were 1,568,180 observations. Clinics with the highest relational climate were 25 percent more likely to provide guideline-compliant care than those with the lowest relational climate (OR for a 1-unit increase: 1.02, p -value <.001). Among insulin-dependent diabetic veterans, this effect was twice as large. Contrary to that expected, relational climate did not influence intermediate outcomes.

Conclusions. Relational climate is positively associated with tests and procedures provision, but not with intermediate outcomes of diabetes care.

Key Words. Diabetes, primary care, quality of care, relational climate

Successful diabetes quality improvement strategies often involve enhancing team functioning. Expanding roles, building multidisciplinary teams, and collaboratively providing care are a common quality improvement formula (Wagner 2000; Shojania et al. 2006; Kahn and Anderson 2009). Relational climate is an important dimension of the work environment that may facilitate collaborative employee behavior (Benzer et al. 2011; Mossholder, Richardson, and Settoon 2011). Relational climate captures shared perceptions of interpersonal interactions, including teamwork, conflict resolution, and diversity acceptance.

Relational climate may be particularly relevant to diabetes care, which requires interdependent relationships among primary care providers, nurse educators, pharmacists, or social workers over an extended time period (Wagner 2000; Harris and Zwar 2007). This interdependence presents challenges to health care systems for coordination and continuity of care. Barriers include disease-specific characteristics, patient behavior, and health care system issues (Larme and Pugh 1998; Rätsep et al. 2007). A strong relational climate may foster collaboration among providers and optimize the use of their skill sets within primary care teams. This improved teamwork may have multiple beneficial effects on diabetes care. Self-management support services may be expanded, which may facilitate shared decision making and patient engagement with care. A strong relational climate may also help teams work more efficiently and better address health system issues.

The goal of this study was to assess whether relational climate influences diabetes quality of care. The innovation of this enquiry resides in the panel study design and measuring diabetes quality of care using both process and intermediate outcome indicators. Panel models minimize the effect of unmeasured variables that may influence either relational climate or diabetes quality of care. This study will provide a robust estimate of the association between relational climate and diabetes process measures, and also test whether relational climate is associated with intermediate outcomes.

CONCEPTUAL FRAMEWORK

Relational climate involves the shared perceptions of interpersonal relationships such as support and respect, communication, and coordination (Benzer

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et al. 2011; Mossholder, Richardson, and Settoon 2011). Klein and Kozlowski's framework linking organizational climate (including relational climate) to performance guided this research (Klein and Kozlowski 2000). It postulates that human resource (HR) systems shape individuals' perceptions of organizations. HR systems encompass policies, procedures, and practices for managing people (e.g., expanding teamwork, reward systems) and developing a highly qualified workforce (recruiting, hiring, and training of personnel) (Arthur and Boyles 2007). Organizational climate is the shared perception of these HR policies, procedures, and practices (Schneider 1975; Schneider and Reichers 1983). It influences employee attitudes and behaviors (job satisfaction, effort, and collaboration) by signaling which behaviors will be rewarded, punished, or ignored, guiding the evaluation of self and others and influencing motivation levels. Therefore, the HR system represents a set of salient practices that create the foundation for relational climate to develop.

Diabetic patients have high comorbidity, averaging five different medical problems (Beasley et al. 2004). The complexity of this chronic disease often requires the distribution of tasks across a multidisciplinary team to provide continuous, coordinated, and timely care. Existing research suggests that diabetes management can be improved through collaboration among providers. Scatena and colleagues reported a positive influence of a multidisciplinary team intervention on quality of care delivery and ulcer recurrence among diabetic foot patients with limb ischemia. The treatment strategy was decided jointly by a team including diabetologists, radiologists, and vascular surgeons (Scatena et al. 2012). Similarly, Peterson and colleagues concluded that strengthening collaboration among providers reduced mean glycated hemoglobin (HbA1c) across 12 pediatric diabetes centers in Sweden. Each team defined treatment targets, areas needing improvement, and action plans (Peterson et al. 2014). Finally, Graetz and colleagues conducted a longitudinal retrospective study testing whether cohesion among primary care team members strengthened the positive association between electronic medical records and clinical outcomes. Larger improvements in HbA1c and LDL-C were reported among more cohesive teams (Graetz et al. 2015).

A strong relational climate may serve as a strategic asset to organizations, particularly when implementing quality improvement projects (Shojania et al. 2006; Vanhaecht et al. 2012). Specifically, it may enhance diabetes care provision by fostering attitudes and behaviors such as high effort levels, work group cohesion, and coordination that may help optimize the use of human capital resources (i.e., the knowledge, skills, and abilities of individual employees) (Warren et al. 2007; Jonsson et al. 2011; Carr et al. 2003). In

other words, the effort, cohesion, and coordination promoted by a strong relational climate may optimize the contributions of individual employees. Providers in organizations with stronger relational climates may exert more effort into delivering care than those in organizations with weaker climates. They may be more motivated in a work environment with a stronger spirit of teamwork and coordination, fairer resolution of conflicts, and broader difference acceptance. Teamwork and coordination may facilitate treatment design, execution, and assessment by avoiding unnecessary duplication of work, facilitating fluent communication among providers, and making visit time more efficient in addressing patient needs.

The influence of relational climate on performance is still underexplored, but it has been related to job commitment and satisfaction (Benzer and Horner 2015). More important, Benzer and colleagues (2011) found a cross-sectional relationship between relational climate and processes of diabetes quality of care, including foot inspections and HbA1c tests, with smaller effects for blood pressure as an intermediate outcome (Benzer et al. 2011). However, the cross-sectional study design may misrepresent the influence of relational climate on diabetes care. Unobserved or unmeasured variables associated with relational climate and quality of diabetes care may bias parameter estimates (Gujarati 2008; Hsiao 2015). Some examples of these factors are leadership style, communication among providers, or turnover rates. The main strength of longitudinal studies, besides more sample variability, is the ability to minimize the influence of unobserved variables.

This study also aims to measure processes of diabetes quality of care with alternative indicators than those used by Benzer and colleagues. We hypothesize that relational climate has a positive influence on diabetes quality of care processes and intermediate outcomes. Also, we postulate that a strong relational climate may be particularly relevant in providing care to patients in a more advanced stage of the disease (on insulin medication). This group is more likely to develop complications and to visit several providers. Therefore, a higher group effort in terms of teamwork and coordination of care is required to ensure timely and continuous care.

METHODS

Study Sample

The study was conducted at the Veterans Health Administration (VHA). The VHA is the largest integrated health system in North America. It provides care

to more than 8.3 million veterans through more than 1,400 sites of care, including hospitals and community-based outpatient clinics (CBOCs) among other various facilities. CBOCs facilitate access to care by offering common outpatient services without the hassle of visiting a VHA hospital. Both hospital-based primary care clinics (HBCs) and CBOCs were considered in this analysis.

The study sample included patients with at least two diabetes diagnosis codes between 2008 and 2012. Diagnosis codes were retrieved from inpatient admissions, outpatient encounters, and providers' problem lists. Diabetes diagnoses were identified using ICD-9 codes (250–250.93). To assign patients to clinics, we categorized outpatient encounters as either primary care or specialty care using provider type and the procedures performed during the visit (CPT codes) (Burgess et al. 2011). Patients who visited multiple clinics were assigned to the clinic they frequented most often to obtain primary care services. Patients without primary care visits in a given year were assigned to a clinic based on specialty care visits. In case of a tie between two clinics, patients were linked to the last facility they visited in a given year. The assignment of patients to clinics was conducted for each of the study years separately based on the outpatient encounters of each patient in a given year.

Data Sources

Quality of Diabetes Care. Quality of diabetes care was measured using both process-based indicators and intermediate outcomes. Two process indicators were tested. An all-or-none process indicator was created to capture whether patients underwent all the tests and examinations recommended by the American Diabetes Association (ADA) guidelines, including HbA1c, cholesterol (LDL-C) testing, blood pressure, retinal, nephropathy, and foot examination. All-or-none measures are recommended when their components are indisputable basics of care for a given condition. These indicators reduce ceiling effects and encourage concern with the design of the whole sequence of care rather than its independent parts (Nolan and Berwick 2006). The second process measure was the number of tests and procedures conducted. This measure indicates how close individuals are to compliance and may help identifying factors contributing to more testing.

Intermediate outcomes for diabetes quality of care are low HbA1c, LDL-C, and blood pressure. Typically, these outcomes are assessed as dichotomous variables with specific thresholds (e.g., HbA1c < 9). We assessed each intermediate outcome as a continuous dependent variable. This

approach recognizes system improvements toward optimal targets, which is disregarded by thresholds (Safford et al. 2009). A single value for each patient was randomly selected, once a year, for each measure.

Relational Climate. The VA All Employee Survey (AES) is assessed annually and measures employees' perceptions and levels of satisfaction with their work environments. AES coordinators at each medical center organize employees into workgroups, which share at least one supervisor. Respondents are instructed to complete the AES based on their assigned workgroup. Relational climate is measured with three Likert-type items about teamwork and cooperation, conflict resolution, and diversity acceptance (Table A1 in Appendix SA2). These three questions form a relational climate scale with adequate internal consistency in prior work (Cronbach's $\alpha \geq 0.86$) (Benzer et al. 2011).

We identified our employee sample using the assigned workgroup code and an item indicating the service for which a respondent is primarily responsible. Because the AES is not collected for research purposes, several inclusion criteria were applied to ensure appropriate respondents. First, we only included workgroups that were designated by the local AES coordinator in each medical center as primary care or ambulatory care. We evaluated the accuracy of the chosen workgroup names by calculating the percentage of respondents who indicated that they were responsible for primary care services. We excluded HBCs with less than 50 percent of its respondents on average across time (2008–2012) indicating that they provided primary care services. This was necessary for the HBC workgroups because they cover more diverse health care tasks than CBOCs, so we were concerned with referents to inappropriate workgroups. We excluded workgroups that combined multiple CBOCs.

AES responses were selected based upon occupational categories and included physicians (both primary care and all subspecialists), nurses, pharmacists, and social workers (Table A2 in Appendix SA2). These selection criteria aimed to capture the diverse composition of the diabetes health care providers (Pham et al. 2009; Weeks et al. 2013).

Finally, we required a minimum of five respondents per facility. This criterion provided adequate intraclass correlations (ICC(1) and ICC(2)) with minimum patient loss. Figure A1 in Appendix SA2 summarizes the AES sample evolution as the discussed inclusion criteria were applied. Existence of relational climate was assessed through inter-rater reliability (ICC(1)) before

aggregating individual relational climate scores to the workgroup and then to the clinic level (STA5A) (Schneider, Ehrhart, and Macey 2011). We also calculated the reliability of the resulting measure using the ICC(2) (Koch 2004).

Statistical Analyses

The dataset was structured as an unbalanced hierarchical panel. Some patients appeared in the medical records inconsistently over time. They were clustered into clinics, which in turn were part of parent facilities. By combining time series of cross-sectional observations, panel data lead to more accurate parameter estimates than cross-sectional study designs due to larger sample variability. It also accounts for the impact of omitted (mismeasured or unobserved) variables in the model specification (Gujarati 2008; Hsiao 2015). Correlation among observations arises from the cross-sectional level (patients clustered within clinics and clinics within parent facilities) and the longitudinal level (quality measurements of the same individual across time).

The Hausman specification test (Hausman 1978) was conducted for all outcome variables, including the all-or-none indicator, the number of tests, and the three intermediate outcome measures. In all cases, estimating the model using fixed effects (FE) rather than random effects (RE) was supported. The null hypothesis of independence between the error term and the regressors was clearly rejected (p -value $<.001$). An important difference between FE and RE is that the latter assumes no correlation between unmeasured or unobservable variables and the explanatory variables, while FE accounts for it. FE models heterogeneity among entities (clinics in our case) using dummy variables, while RE conceptualizes it as a random variable that becomes an additional component of the error term (Gujarati 2008). A two-way fixed effects model with two sets of dummy variables for clinics and year was used across all models (p -value F -test of two-way fixed $<.001$).

Logistic regression was used to estimate the influence of relational climate on the diabetes process indicators, including the all-or-none measure and the number of tests. The number of tests was modeled as five separate binary-dependent variables capturing the compliance continuum (1 vs. 0 tests and procedures, 2 vs. 1 or fewer, 3 vs. 2 or fewer, 4 vs. 3 or fewer, and 5 vs. 4 or fewer). Notice that modeling the number of tests and procedures as a continuous count variable following a Poisson distribution was not an adequate choice in our setting. Poisson regression is used to model events that are independent one from the other (random). However, undergoing a test or procedure involves a decision (by the provider or the patient), not an occurrence.

The distribution of continuous outcome indicators, including HbA1c, LDL-C, and blood pressure, was assessed to inform model choice. Potential transformations based upon Box–Cox results were evaluated when variables were not normally distributed (Box and Cox 1964). An appropriate transformation to make the distribution of a variable approximately normal is useful because many statistical tests and intervals are based on the assumption of normality. Also, generalized linear models (GLMs), particularly a Gamma model, were used when the outcome measure was skewed. GLMs are a flexible generalization of ordinary linear regression that accommodate non-normal distribution of the residuals (McCullagh and Nelder 1989). The link function relates the mean of the dependent variable to the predictors. We used both the identity and the log link functions across all models. The correct specification of the link function was assessed with the Pregibon link test (Pregibon 1980) and the choice of the distribution function with the modified Park test (Manning, Jackson, and Fusilier 1996). Finally, the Hosmer–Lemeshow test (Lemeshow and Hosmer 1982) was conducted for the continuous models to evaluate model specification, while it was not used for the large sample logistic models, as Lemeshow recommends more recently (Paul, Pennell, and Lemeshow 2013).

Models were built in blocks. Relational climate, clinic, and year effects were included first, and the rest of the variables were added sequentially in groups. The goodness of fit of nested models was compared using the likelihood ratio test and deviance over the degrees of freedom. The likelihood ratio compares the likelihood of the dataset under two alternative models. A ratio of the deviance to degrees of freedom close to 1 suggests good model fit. Models were also contrasted using the AIC criterion.

Model goodness of fit (calibration and discrimination) of the logistic regressions was evaluated through c-statistics and the inspection of observed versus predicted values.

Patient Covariates. Multivariable analyses adjusted for patient sociodemographic characteristics (age, gender, marital status, and priority status), comorbidities, and diabetes severity. Priority status includes eight categories indicating priority for enrollment in the health care program based on eligibility and income. We adapted the *Comorbidity* Software, version 3.7, to both inpatient and outpatient VHA data. This method adds up at the patient level diagnosed Elixhauser comorbidities based upon ICD-9 codes (Agency for Healthcare Research and Quality 2011; Table A3 in Appendix SA2). The

number of registry categories also were included, which capture chronic conditions characterizing veterans' disease prevalence and complexity, such as chronically mentally ill, spinal cord injury, or HIV, used in making resource allocation determinations for VHA (Allocation Resource Center 2013; Table A4 in Appendix SA2). Diabetic patients with multiple comorbidities may face difficulties complying with their visit schedule or treatment, which may compromise quality of diabetes care (Fortin et al. 2007; Parekh and Barton 2010). A dummy variable indicating whether the patient filled a prescription for insulin was also included in the model as a measure of disease severity (Jackson et al. 2005). It signals failure of oral therapies and reflects more advanced stages of the disease (Safford et al. 2009).

Clinic and Parent Facility Covariates. The diabetes quality of care models controlled for some measures of the organizational context, including the resources available to facilities, specifically, funding stability, full-time equivalent employees, and number of beds. Funding stability was defined as the percentage change in the funding available to facilities between 2011 and 2012 (Byrne et al. 2004). Also, teaching status was measured as the residents to bed ratio, and those facilities with a ratio above 0.25 were classified as teaching (Ayanian et al. 1998). Resignation rates, which indicate the percent of resignations per average onboard employee, were also added to the model as a proxy of employee satisfaction (Zhang et al. 2007). They capture the voluntary resignations (potentially preventable) and transfers out of the selected facility (Support Service Center VSSC 2012). Finally, at the clinic level, relational climate was included.

The prevalence of diabetes at the state level was also adjusted for as a measure of the organizational environment. It served as a proxy to account for patient selection to facilities more specialized in diabetes care.

RESULTS

Across all study years, there were 1,568,180 observations. In 2010, 327,805 patients, 212 primary care clinics, and 101 parent facilities satisfied the inclusion criteria and were part of the study sample (Tables 1 and 2). The average age was 65 years, most patients were men, 35 percent married, and 35 percent had the highest priority status to access medical services. Eighty percent of diabetic patients had between 2 and 4 diagnosed comorbidities, including

Table 1: Patient and Parent Facility Sample Characteristics in 2010

<i>Patient</i>	<i>n = 327,805</i>
Age	65.51 (11.17)
Gender (male)	96.44 (96.37–96.50)
Marital status (Single; Married; Separated, Divorced, or Widowed)	
Married	35.55 (35.38–35.71)
Priority status (Group 1–Group 8)	
Group 1	35.36 (35.20–35.53)
Elixhauser Index (0, 1, 2–4, +4)	
2–4 (both included)	80.69 (80.55–80.82)
Mental health diagnosis (Yes)	37.94 (37.78–38.11)
Insulin (Yes)	59.14 (58.97–59.31)
<i>Parent Facility</i>	<i>N = 101</i>
Funding available (% change 2012–2011)	2.14 (4.01)
Beds available	350.18 (224.07)
Teaching status (Nonteaching)	96.24 (96.17–96.30)
Resignation rate	6.36 (0.02)
Full-time equivalent employees	2,537 (1363.95)
Diabetes prevalence (state level)	9.35 (1.21)

Note. Mean for continuous variables (SD); percentage for categorical variables (95% CI).

diabetes, 38 percent had a mental health diagnosis, and close to 60 percent were on insulin medication. At the parent facility level, on average, the funding available increased between 2011 and 2012 by 2.14 percent, the number of beds available was 350, there were 2,537 full-time equivalent employees, most facilities were nonteaching, and the resignation rate was 6.36 percent (Table 1). Table A5 in Appendix SA2 presents the descriptive statistics for all study years.

The percentage of diabetic patients that underwent all tests and procedures, and thus were guideline compliant, increased between 2008 and 2010 from 51.62 to 56.78 percent and slightly decreased to 55.51 percent in 2012. Foot examinations are underreported at the VHA and, thus, were excluded from our quality measure. CPT codes commonly used to identify this procedure (G9226, G0245, G0246, and G0247) led to only 4.02 percent of diabetic patients having had a foot examination in 2008, which was considered implausible. Average LDL-C, blood pressure, and HbA1c remained quite stable across the study period. A constant improvement in relational climate was observed from 10.93 in 2008 to 11.75 in 2011, indicating a better rating of the perceptions of teamwork and cooperation, conflict resolution, and diversity acceptance, yet it declined to 10.83 in 2012 (Table 2).

Table 2: Patients and Clinic Sample Characteristics for the Key Study Variables from 2008 to 2012

	2008	2009	2010	2011	2012
Patients	<i>n</i> = 296,183	<i>n</i> = 321,272	<i>n</i> = 327,805	<i>n</i> = 325,664	<i>n</i> = 297,256
All tests and procedures	51.62 (51–44–51.80)	56.55 (56.38–56.72)	56.78 (56.61–56.95)	55.89 (55.70–55.99)	55.54 (55.36–55.72)
(% Yes)					
LDL-C (mg/Dl)	92.49 (34.88)	91.89 (34.78)	91.88 (34.85)	89.97 (34.83)	90.29 (35.28)
Blood pressure (mm Hg)					
Systolic	133.29 (19.74)	133.38 (19.55)	133.28 (19.38)	133.33 (19.47)	133.66 (19.68)
Diastolic	74.37 (12.53)	74.70 (12.54)	74.85 (12.46)	75.06 (12.45)	75.24 (12.50)
HbA1c (mmol/mol)	7.37 (1.75)	7.36 (1.68)	7.39 (1.65)	7.47 (1.73)	7.50 (1.75)
Clinics	<i>N</i> = 189	<i>N</i> = 204	<i>N</i> = 212	<i>N</i> = 231	<i>N</i> = 242
Relational climate [‡]	10.93 (1.28)	11.16 (1.13)	11.51 (1.25)	11.75 (1.08)	10.83 (1.34)

Notes. Mean for continuous variables (SD); percentage for categorical variables (95% CI).

[‡]ICC(1) captures how much the score will shift by virtue of who responds. At least 0.08 is required to aggregate scores from respondent to workgroup and then clinic level. ICC(1) for relational climate ranged from 0.09 to 0.14.

Bivariate analyses using t-tests and Wilcoxon rank-sum tests between relational climate and the different diabetes quality measures for all study years indicated a statistically significant relationship ($p < .001$). As described in the following sections, multivariate-adjusted analyses suggested that relational climate is significantly related to quality processes of diabetes care. However, it does not influence intermediate outcomes.

All-or-None Model

A one-unit increase in relational climate improved the odds of undergoing all tests and procedures by 2 percent ($OR = 1.02$, $p < .001$). This result implies that clinics with the highest relational climate score (equal to 15) were 25 percent more likely to be diabetes guideline compliant than those clinics with the lowest relational climate score (equal to 4; Table 3). If in 2012 all clinics had a relational climate score of at least 14, which corresponds to the top 5 percent of facilities, 12,032 more diabetic veterans would have been guideline compliant. This estimate results from summing the additional conditional probability of testing if relational climate had been 14 across noncompliant patients of facilities with a relational climate score of 14 or lower (695,319 patients).

We also found that diabetic veterans who were married, with the highest priority status (one), a higher number of diagnosed comorbidities, or a mental health diagnosis had higher odds of being guideline compliant (Table 3). Selected interactions between relational climate and disease complexity and severity were evaluated. A statistically significant interaction was found between relational climate and insulin medication, indicating that relational climate had twice the positive influence on quality of diabetes care (all-or-none indicator) among insulin-dependent veterans. Model calibration was in the acceptable range (c-statistic almost .7), suggesting that our compliance model was able to discriminate well between those who underwent all tests and procedures and those who did not. We also computed the observed versus predicted likelihood of guideline compliance by decile, and most of the observed over-predicted ratios were close to 1 (Table A6 in Appendix SA2).

Number of Tests and Procedures Models

Results suggest that relational climate contributes achieving 5 or 4 tests and procedures compared to fewer ($OR = 1.02$, p -value $< .001$; Table 4). Relational climate did not influence lower levels of testing. Age, priority status, comorbidities, a mental health diagnosis, or insulin medication also increased

Table 3: Logistic Model Predicting the Odds of Having All Tests and Procedures Done ($N = 923,653$)

<i>Variable[†]</i>	<i>OR (95% CI) p-value</i>
Age (ref = Over 81 years old)	
<52	1.44 (1.42–1.47)***
52–57	1.56 (1.53–1.59)***
57–71	1.68 (1.65–1.70)***
71–76	1.57 (1.53–1.59)***
76–81	1.32 (1.29–1.34)***
Marital status (ref = Married)	
Divorced, Separated, or Widowed	1.02 (1.01–1.02)**
Single	0.95 (0.93–0.97)***
Priority status (ref = Group 1)	
Group 2	0.88 (0.86–0.89)***
Group 3	0.86 (0.84–0.87)***
Group 4	0.8 (0.78–0.82)***
Group 5	0.94 (0.92–0.95)***
Group 6	0.69 (0.66–0.72)***
Group 7	0.78 (0.77–0.79)***
Elixhauser Index (ref = +4)	
0 or 1	0.29 (0.28–0.29)***
2–4 (both included)	0.71 (0.69–0.72)***
Registry categories (ref = 0)	
1	0.91 (0.89–0.92)***
2	0.71 (0.69–0.73)***
3	0.66 (0.62–0.71)***
4	0.59 (0.47–0.75)***
5	0.51 (0.17–1.49)
Mental health diagnosis (ref = No)	1.04 (1.03–1.05)***
Insulin (ref = No)	1.68 (1.66–1.69)***
Relational climate	1.02 (1.01–1.03)***
Teaching status(ref = non-teaching)	1.44 (1.27–1.46)***
Resignation rate	0.11 (0.08–0.15)***
Diabetes prevalence	1.02 (1.01–1.04)**
Test Global Null Hypothesis (Wald, Score, Likelihood Ratio)	<0.001
C-statistic	0.69
Deviance/degrees of freedom	1.2

[†]This model also adjusts for gender, number of beds, full-time equivalent employees, which were nonsignificant.

* $p < .05$, ** $p < .01$, *** $p < .001$.

the odds of having 4 or 5 tests compared to fewer. Yet registry categories reduced the odds of having 4 versus fewer than 4 tests, but increased the odds of 5 versus fewer than 5. Teaching status and diabetes prevalence showed a similar pattern. Resignation rates consistently reduced the odds of more testing, particularly in achieving the 5 tests and procedures.

Table 4: Logistic Models Predicting the Odds of Having 4 versus Fewer Tests and Procedures and 5 versus Fewer ($N = 923,653$)

Variable [†]	4 Tests and Procedures versus Fewer	5 Tests and Procedures versus Fewer
	OR (95% CI), <i>p</i> -value	
Age (ref = Over 81 years old)		
<52	1.51 (1.46–1.56)***	1.56 (1.53–1.59)***
52–57	1.5 (1.47–1.54)***	1.68 (1.65–1.70)***
57–71	1.39 (1.35–1.43)***	1.57 (1.53–1.59)***
71–76	1.22 (1.18–1.25)***	1.32 (1.29–1.34)***
76–81	1.39 (1.36–1.44)***	1.44 (1.42–1.47)***
Gender (ref = male)	1.04 (1.01–1.09)*	1.02 (0.99–1.04)
Marital status (ref = Married)		
Single	1.02 (0.99–1.05)	0.95 (0.94–0.97)**
Priority status (ref = Group 1)		
Group 2	0.88 (0.85–0.91)***	0.88 (0.86–0.89)***
Group 3	0.88 (0.86–0.90)***	0.86 (0.84–0.87)***
Group 4	1 (0.98–1.02)	0.8 (0.78–0.818)***
Group 5	0.81 (0.76–0.85)	0.94 (0.92–0.95)***
Group 6	0.80 (0.76–0.85)	0.69 (0.66–0.72)***
Group 7	0.86 (0.84–0.88)	0.78 (0.77–0.79)***
Elixhauser Index (ref = +4)		
0 or 1	0.28 (0.27–0.29)***	0.29 (0.28–0.29)***
2–4 (both included)	0.73 (0.71–0.75)***	0.71 (0.69–0.72)***
Registry categories (ref = 0)		
1	1.17 (1.14–1.2)***	0.91 (0.89–0.92)***
2	1.21 (1.15–1.27)***	0.71 (0.69–0.73)***
3	1.34 (1.01–1.27)*	0.66 (0.62–0.71)***
4	1.20 (0.83–1.73)	0.59 (0.47–0.75)***
Mental health diagnosis (ref = No)	1.15 (1.13–1.7)***	1.04 (1.03–1.05)***
Insulin (ref = No)	1.98 (1.95–2.01)***	1.67 (1.65–1.68)***
Relational climate	1.02 (1.01–1.03)***	1.02 (1.01–1.03)***
Teaching status(ref = nonteaching)	0.73 (0.65–0.81)***	1.36 (1.27–1.46)***
Resignation rate	0.67 (0.37–1.19)	0.11 (0.1–0.15)***
Diabetes prevalence	0.96 (0.94–0.98)	1.02 (1.01–1.04)***
Test Global Null Hypothesis (Wald, Score, Likelihood Ratio)	<0.0001	<0.0001
C-statistic	0.68	0.69
Deviance/degrees of freedom	1.29	1.28

[†]This model also adjusts for number of beds and full-time equivalent employees, which were non-significant.
 * $p < .05$, ** $p < .01$, *** $p < .001$.

Intermediate Outcomes Models (LDL-C, Blood Pressure, and Glycated Hemoglobin)

Relational climate was nonsignificant across the four models (Table 5). Women compared to men had on average lower blood pressure and glycated

Table 5: Ordinary Least Squares Models Predicting Intermediate Continuous Outcomes

Variable	Systolic Blood Pressure	Diastolic Blood Pressure	Cholesterol	Glycated Hemoglobin
Age (ref = Over 81 years old)				
<52	−1.28 (0.09)***	12.61 (0.06)***	0.239 (0.002)***	0.123 (0.001)***
52–57	−0.08 (0.09)	11.13 (0.06)***	0.171 (0.002)***	0.096 (0.001)***
57–71	0.39 (0.07)***	7.16 (0.04)***	0.092 (0.001)***	0.052 (0.0008)***
71–76	0.06 (0.09)	2.87 (0.06)***	0.023 (0.002)***	0.019 (0.001)***
76–81	0.06 (0.09)	1.51 (0.05)***	0.239 (0.002)***	0.007 (0.001)***
Gender (ref = male)	−0.53 (0.12)***	−2.64 (0.07)***	0.094 (0.002)***	−0.03 (0.0012)***
Marital status (ref = Married)				
Single	0.16 (0.08)*	0.94 (0.05)***	0.021 (0.002)***	0.008 (0.0008)***
Priority status (ref = Group 1)				
Group 2	0.25 (0.09)**	0.78 (0.05)***	0.028 (0.002)***	−0.007 (0.0009)***
Group 3	0.38 (0.08)***	0.84 (0.04)***	0.031 (0.002)***	−0.0001 (0.0002)
Group 4	0.63 (0.11)***	−0.18 (0.06)**	−0.003 (0.002)	0.012 (0.0011)***
Group 5	0.63 (0.05)***	0.39 (0.03)***	0.017 (0.001)***	0.014 (0.0006)***
Group 6	0.73 (0.19)***	1.23 (0.11)***	0.061 (0.004)***	−0.011 (0.002)***
Group 7	0.42 (0.07)***	0.49 (0.04)***	0.03 (0.001)***	0.005 (0.0007)***
Elixhauser Index (ref = +4)				
0 or 1	−3.44 (0.1)***	1.83 (0.06)***	0.146 (0.002)***	−0.006 (0.001)***
2–4 (both included)	−0.23 (0.08)**	1.79 (0.05)***	0.069 (0.002)***	0.005 (0.0008)***
Registry categories (ref = 0)				
1	−1.96 (0.06)***	−1.75 (0.04)***	−0.08 (0.0013)***	−0.009 (0.0007)***
2	−2.56 (0.13)***	−2.30 (0.08)***	−0.107 (0.0028)***	−0.024 (0.0014)***
3	−1.94 (0.34)***	−2.67 (0.20)***	−0.145 (0.007)***	−0.038 (0.004)***
4	−2.08 (1.08)	−2.68 (0.65)***	−0.144 (0.022)***	−0.05 (0.011)***
5	3.98 (5.23)	−4.56 (3.14)	−0.191 (0.10)	−0.04 (0.054)
Mental health diagnosis (ref = No)	−1.47 (0.04)***	0.29 (0.03)***	0.013 (0.0009)***	−0.017 (0.0005)***
Insulin (ref = No)	−0.43 (0.04)***	0.32 (0.03)***	−0.018 (0.0009)***	0.042 (0.0005)***
Relational climate	−0.004 (0.023)	0.03 (0.01)	0.0001 (0.0004)	0.00013 (0.0002)
Diabetes prevalence	0.23 (0.07)***	−0.004 (0.92)	0.003 (0.0014)*	−0.002 (0.0007)*
Test Global Null Hypothesis (<i>F</i> -test)	<0.001	<0.001	<0.001	<0.001
<i>R</i> -square	0.02	0.12	0.06	0.05
Hosmer–Lemeshow Test (<i>F</i> -value, <i>p</i> -value) [†]	8.03 (0.53)	197.46 (<0.001)	25,328.1 (<0.001)	632.19 (<0.001)

Notes. Parameter estimates (standard error). *N* = 923,653 in the blood pressure models, *N* = 792,658 in the cholesterol model, and *N* = 840,000 in the glycated hemoglobin model. These models also adjust for teaching status, quit rates, number of beds, and full-time equivalent employees, which were nonsignificant. Also, they include year and clinic fixed effects (dummies).

[†]It assesses whether the mean of the residuals across the deciles of the predicted values is simultaneously zero.

p* < .05, *p* < .01, ****p* < .001.

hemoglobin, but higher cholesterol levels. Patients who were single showed higher recordings for all intermediate outcomes than those who were married, which signals the importance of social support. A higher priority group was related to better outcomes for blood pressure and cholesterol, while diagnosed comorbidities besides diabetes worsen glycated hemoglobin results. The prevalence of diabetes at the state level was a significant variable in all models.

DISCUSSION

Relational climate facilitates diabetes processes of care, but it does not contribute to better intermediate outcomes (LDL-C, blood pressure, and HbA1c). We found that patients receiving care from clinics with the highest relational climate score were associated with a 25 percent greater likelihood to undergo all diabetes tests and procedures than those in clinics with the lowest relational climate scores. If these results generalize to the population, and we assume that all clinics had in 2012 a relational climate of at least 14, 12,000 more veterans would have been diabetes guideline compliant. The finding that relational climate is associated with performing 4 of 5 or 5 of 5 tests but not with fewer tests may provide insight into how relational climate affects processes of care. The patient safety literature conceptualizes teamwork as an important component of high-reliability organizations (Baker, Day, and Salas 2006). Just as teamwork can decrease the likelihood of safety incidents, relational climate may increase the likelihood of achieving all or almost all processes of care.

Our findings indicate that relational climate has twice its positive influence on insulin-dependent diabetic patients. This complex-needs group is at a higher risk of diabetes complications such as kidney disease, nephropathy, or stroke. They may receive care from a more diverse group of providers than non-insulin-dependent patients, which increases the risk of care fragmentation. A strong relational climate may facilitate collaboration and teamwork among providers, which may be particularly relevant among insulin-dependent diabetic patients to ensure the provision of continuous, timely, and high-quality care.

Relational climate does not contribute to explaining diabetes intermediate clinical outcomes (LDL-C, blood pressure, and HbA1c); they seem to be driven by patient factors such as disease severity and complexity. Improved intermediate clinical outcomes are important measures of quality of care, currently recommended by the National Quality Forum (NQF;

National Quality Forum 2015) and the Centers for Medicare and Medicaid Services (CMS; Centers for Medicaid and Medicare Services 2015). This finding may be important for conceptualizing the limitations of how health systems can organize for better care. It may be the case that organizational strategies have limited effect on patient outcomes unless we can target a set of measurable processes that lead to those outcomes. Future research should explore other organizational factors that may contribute to better intermediate outcomes such as waiting times for visits.

Patient and parent facility characteristics also explained quality of diabetes care. We found that married veterans were more likely to be guideline compliant than single ones, which is consistent with prior research underscoring the importance of social support to diabetes management (Schjøtz et al. 2012; Miller and DiMatteo 2013). Second, diabetic patients receiving care at teaching facilities were more likely to undergo all recommended processes of diabetes care. Existing literature mostly concurs that higher quality of care is provided at teaching facilities (Ayanian and Weissman 2002). Third, an increase in resignation rates undermines guideline-based care. Employee resignation is a proxy for employee satisfaction, and it may signal dysfunctional organizational processes such as excessive workloads or poor communication (Davidson et al. 1997; Mohr, Burgess, and Young 2008). Also, it requires searching for and training of new personnel, which may temporarily weaken human capital resources. As a result, continuity of care may be interrupted and quality of diabetes care compromised. Finally, we found a positive association between state-level diabetes prevalence and the odds of undergoing all tests and procedures, which may suggest that higher volume of diabetic patients enables better treatment.

There are several limitations to our analysis. First, the all-or-none indicator built to measure processes of diabetes quality of care assigns the same weights to all its components. Even though assessing LDL-C, blood pressure, HbA1c levels, and conducting eye examination and nephropathy screening are broadly considered as indisputable bases of diabetes care, their relative importance may vary by patient. Future research may study the effects of partial test compliance to build quality measures assigning partial credit across the compliance continuum. Another shortcoming of the all-or-none indicator is that it classifies as noncompliant both patients without any tests and those that had some. To overcome this limitation, we also explored the number of tests as an alternative quality measure. Second, we could not include foot examination as part of the all-or-none measure due to generalized underreporting of this procedure at the VHA. Fifty-two to fifty-seven percent of

diabetic veterans part of our study sample underwent all tests and procedures recommended by the ADA excluding foot examination between 2008 and 2012. Therefore, the percentage of fully compliant patients (including foot examination) is probably lower. Third, another source of bias stems from dually eligible veterans for VHA and Medicare health care services or veterans with private insurance. Some tests and procedures may have been conducted outside the VHA. Our sample resulted from rather conservative inclusion criteria (two diabetes diagnoses rather than one) and, thus, it aims to include veterans using the VHA as their main source of diabetes care. Four, the timeframe of our analysis, 5 years, may not be long enough to fully capture the influence of relational climate on the organization. However, this is one of the first retrospective data analyses that is conducted with a multiyear panel sample to assess the influence of organizational variables on quality of diabetes care. It provides strong evidence of the importance of relational climate to diabetes care that can be used for planning quality improvements, or through future research to better understand how human capital resources can be optimized relative to diabetes intermediate outcomes. Also, the benefits of a strong relational climate should be explored in other conditions requiring integrated and coordinated care such as cancer, heart diseases, or dementia. Patients with multiple comorbidities present care integration challenges particularly when both primary and specialty care are required. Future research should explore quality of care implications when comorbidities are treated within the same integrated workgroup compared to different workgroups, and how relational climate may moderate this association. Mixed methods may be required given the limitations of administrative datasets.

In conclusion, relational climate is a robust predictor of guideline-based care. As the model of patient-centered medical home (PCMH) disseminates through the health care system, strong relational climate could serve as a strategic asset for health care organizations to provide high-quality primary care particularly among patients with chronic conditions. PCMH emphasizes the importance of coordinated and integrated care, which involves substantial changes in interpersonal interactions among providers. Some challenges include clear definition of roles and boundaries, building trust among team members, and fluent communication channels. Clinics with a strong collaborative work environment, fair resolution of conflict, and diversity acceptance (high relational climate score) may experience a smoother transition into this promising care delivery system than clinics with problematic interpersonal environments.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the supporting information tab for this article:

Appendix SA1: Author Matrix.

Appendix SA2:

Figure A1: Sample Size Evolution to Build Relational Climate Based on the All-Employees Survey.

Figure A2: Distribution of the Intermediate Outcome Indicators LDL-C, Diastolic and Systolic Blood Pressure, and Glycated Hemoglobin.

Table A1: Items from the All-Employees Survey Used to Measure Relational Climate.

Table A2: Occupational Categories of Interest Based upon the All Employees Survey (AES).

Table A3: Conditions Included in the Elixhauser Index.

Table A4: Conditions Included in the Registry Categories.

Table A5: Patient, Clinic and Facility Sample Characteristics 2008–2012.

Table A6: Observed versus Predicted Likelihood of Guideline Compliance by Decile.