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Purpose

The purpose of this article is to examine the relationship between organizational characteristics as measured by the Chronic Care Model (CCM) and patient self-management behaviors among patients with type 2 diabetes.

Methods

The study design was cross-sectional. The study setting included 20 primary care clinics from South Texas. The sample included approximately 30 consecutive patients that were enrolled from each clinic for a sample of 617 patients. For the data collection procedures, the CCM survey was completed by caregivers in the clinic. Self-management behaviors were obtained from patient exit surveys. For measures, the CCM consisted of 6 structural dimensions: (1) organization support, (2) community linkages, (3) self-management support, (4) decision support system, (5) delivery system design, and (6) clinical information systems. Patient self-management behavior included whether the patient reported always doing all 4 of the following behaviors as they were instructed: (1) checking blood sugars, (2) following diabetes diet, (3) exercising, and (4) taking medications. For data analyses, to account for clustering of patients within clinics, hierarchical logistic regression models were used.

Results

Self-management support was positively associated with medication adherence, while decision support system

was positively associated with exercise and all 4 self-management behaviors. Surprisingly, community linkages were negatively associated with medication adherence, while clinical information system was negatively associated with diet and all 4 behaviors. A total score, including all dimensions, was positively associated with only exercise.

Conclusions

Health care providers and diabetes educators in primary care clinics should consider how organizational characteristics of the clinic might influence self-management behaviors of patients. The focus should be on better access to evidence-based information at the point of care and self-management needs and activities.

Self-management behaviors play a significant role in the control of blood glucose levels among patients with type 2 diabetes. These behaviors typically include checking blood glucose level, following a diabetes diet, always exercising, and taking diabetes medications as instructed by the primary care physician or diabetes educator. Patient-level characteristics associated with these behaviors are well documented in the literature. However, very little is known about how organizational-level characteristics at the primary care clinic where the patient receives his/her care are associated with these behaviors. These organizational characteristics can be understood through the lens of the Chronic Care Model (CCM).

Support for patient self-management is not just part of the treatment for diabetes, it is central to its management. The main goals of support are to change behavior and promote self-management. Self-management of diabetes means that a patient can be independent and participate safely in a wide variety of activities while living with diabetes. Based on his/her understanding of medication, nutrition, and monitoring, a patient is aware that behavior changes can lead to increased flexibility and improvement in metabolic control.[1] Several studies have shown that self-management behaviors are directly associated with the control of blood glucose levels among patients with type 2 diabetes. In recent studies, diet and exercise have been shown to be inversely associated with A1C levels,[2] whereas self-monitoring of blood glucose is associated with better metabolic control[3] and reduced diabetes-related morbidity and all-cause mortality in type 2 diabetes patients.[4] Previous studies had also shown that diet explains a significant amount of the variance in the relationship between continuity of care and A1C among this same population of patients.[5]

Several factors are associated with self-management behaviors such as race,[6] family support,[7] patient demographics, doctor-patient behavior, stress, and social context.[8] However, little is known about the influence of clinic characteristics on these behaviors. Many health care settings still lack effective programs that can provide the full complement of support services needed by diabetes patients and often do not have the mechanisms to coordinate the services needed.[9] Since a large majority of patients with type 2 diabetes receive their care in small primary care physician offices,[10,11] new studies that focus on these settings are highly needed.

The CCM (Table 1) suggests that there are 6 important structural dimensions of primary care teams necessary for optimizing outcomes from chronic disease care: (1) organizational support, (2) community linkages, (3) decisions support, (4) self-management support, (5) delivery system design, and (6) clinical information systems.[12,13] Primary care clinics with these elements in place are more likely to have prepared proactive team as well as activated, informed patients. Several studies have demonstrated that implementation of elements of the model is associated with improved processes of care for several chronic illnesses, including diabetes.[14-19] The purpose of this study is to examine the relationships between individual elements of the CCM at the clinic level and patient self-management behavior, after controlling for patient characteristics.

Research Design and Methods

Study Design

The results reported here are from data collected in the Direct Observation of Diabetes Care study.[20,21] This study collected data in 20 clinics from 2002 to 2004 as part of an in-depth examination of predictors of the quality of care delivered to patients with type 2 diabetes across a wide variety of primary care settings. The overall study design is cross-sectional as the organizational (staff an clinician surveys) and patient-level characteristics (patient surveys and chart abstractions) were collected at the same time in each clinic.

Table 1

Assessment of Chronic Illness Care (ACIC) Components

Organization of the practice/clinic
1. Organizational commitment for diabetes management
2. Improving strategies for diabetes management
3. Incentives and regulations for diabetes management
4. Senior leaders
Community linkages
5. Linking primary care clinicians to diabetes specialists and educators
6. Patients' diabetes education resources
7. Coordination of diabetes care guidelines
Self-management support
8. Assessment and documentation of self-management needs and activities
9. Self-management support
10. Addressing concerns of diabetes patients and families
11. Effective behavior change interventions and peer support
Decision support
12. Evidence-based guidelines for diabetes
13. Involvement of diabetes specialists in improving primary care
14. Provider education for diabetes care
Delivery system design
15. Practice team functioning
16. Practice team leadership
17. Appointment system
18. Follow-up
19. Planned visits for diabetes management
20. Continuity and coordination of care
Clinical information systems
21. A registry (list of patients with diabetes)
22. Reminders to providers
23. Feedback available to team
24. Information about relevant subgroups of patients needing services
25. Patient treatment plans

Source: Adapted from Bonomi.[16]

Study Setting and Sample

The study was conducted in 20 primary care clinics with 45 primary care physicians from across South Texas for a total of 617 patients. The following different types of primary care settings where people with type 2 diabetes are mostly likely to seek care were selected: 11 solo physician clinics (11 physicians); 3 group practice settings (10 physicians); 1 community health center (CHC) (1 physician); 2 Veteran Affairs primary care clinics (11 physicians); and 3 city/county health clinics for uninsured patients (12 physicians). A research assistant enrolled approximately 30 patients who presented with an established diagnosis of type 2 diabetes from each clinic. Patients were enrolled consecutively as they presented for care over a period of 2 to 3 weeks in each clinic. For every patient, the survey was administered after the physician visit. None of the patients approached declined to participate in the study.

Data Collection Procedures and Measures

The extent to which components of the CCM were present in each clinic was measured by having clinicians and office staff in each clinic complete the Assessment of Chronic Illness Care (ACIC) survey. The ACIC survey includes 25 questions that constitute the following 6 structural dimensions of the chronic illness care model: (1) organization support, (2) community linkages, (3) self-management support, (4) decision support system, (5) delivery system design, and (6) clinical information systems.[16] Its validity has been supported by several previous studies.[16,22] Each question is scored on a 0 to 11 scale and provides subscale scores for each of the 6 dimensions as well as a total score. In the instrument, scores from 0 to 2 represent "limited support," 3 to 5 represent "basic support," 6 to 8 represent "good support," and 9 to 11 represent "fully developed support." Evaluation of the implementation of the CCM in prior studies has been accomplished with the ACIC survey (see Table 1). In a previous study, we suggested that a version of the ACIC tool that is tailored to diabetes management can be used to examine structural dimensions in primary care clinics, but may be more valid if completed by clinicians and staff who are directly involved in patient care, or an independent observer, than by staff whose role is primarily related to front office activities such as scheduling, billing, or telephone management.[23]

The wording of each question in the CCM model was modified slightly to be specific to the care of patients with type 2 diabetes. For example, instead of asking staff and clinicians to rate their improvement strategy for

chronic illness care, they were asked to rate their improvement strategy for diabetes management. Finally, this self-assessment instrument completed by staff and providers was used to measure the presence of the CCM in each clinic because at the time of the study the Patient Assessment of Chronic Illness Care (PACIC) survey was not yet available.

Patient self-management behaviors were measured by patient self-report on an exit survey completed after their clinician encounter. The stage of change continuum found in the transtheoretical model was used as a basis for measuring patient self-management behaviors.[25,26] When attempting to change a wide range of health behaviors, individuals move through several stages of change including: precontemplation, contemplation, preparation, action, and maintenance. Patients that are not considering a change in their behavior in the next 6 months are considered to be in the precontemplation stage. Those that are seriously considering such change in the next 6 months are considered to be in the contemplation stage. Those that have decided to change their behavior and are about to do so usually within the next month are considered to be in the preparation stage. Those that have made a change in their behavior within the past 6 months are considered to be in the action stage. Those that have sustained their behavior change in the last 6 months are considered to be in the maintenance stage.[25] The survey contained 1 item for each of the 4 self-management behaviors: (1) diet, (2) physical activity, (3) self-monitoring of glucose, and (4) medication adherence. Response categories were congruent with each stage of change.

Data Analyses

For the ACIC scores, a mean total score and individual dimension score is calculated for each clinic. For each of the patient self-management behaviors, we constructed a stage of change variable as a dichotomous outcome: the patient is either in the maintenance stage of change or not. We also constructed an overall measure relating to whether the patient is in the maintenance stage of change or not for all 4 self-management behaviors at the same time. Additional patient characteristics such age, sex, number of visits, and race/ethnicity were controlled for. To account for clustering of patients within clinics, 2-level hierarchical logistic regression models were used with patient level predictors entered at level 1 and clinic ACIC scores entered at level 2. A total of 10 unit specific models with robust standard errors were run. In the first 5 models, the predictor variables entered were the 6 individual ACIC scores in addition to the 4 patient variables, while the outcomes depended on whether the following self-management behaviors were in the maintenance stage of change: (1) diet, (2) exercise, (3) glucose control, (4) medication adherence, and (5) all 4 behaviors. In the other 5 models, we entered the total ACIC score as a predictor variable in addition to the 4 patient variables, while the outcomes were similar to the first 5 models.

Hypotheses

We hypothesized that all 6 ACIC dimensions (organizational support, community linkages, self-management support, decision support, delivery system design, and clinical information system) as well as total ACIC score will be positively associated with each self-management behaviors (diet, exercise, glucose monitoring, and medication adherence) being in the maintenance stage of change, and with all 4 self-management behavior being in that same stage, after controlling for patient characteristics.

Results

Patient and clinic characteristics are reported in Table 2. The mean age of the patients was approximately 57 years, more than half are females and almost 57% are Hispanics. The mean number of visits to the clinic in the last 12 months is approximately 6 visits. Nearly 26% of the patients reported maintaining all 4 self-management behaviors in the last 6 months. Less than half reported adhering to diet (46%) and exercise (45%), around two thirds reported adhering to self-monitoring of blood glucose (61%), and the majority (85%) reported adhering to their medications in the last 6 months. At the clinic level, the ACIC score across all clinics was 6.2 on a 0 to 11 scale, which falls in the "good support" category. The individual mean ACIC scores were as follows: organization support (mean = 6.5, good support); community linkages (mean = 7.1, good support); self-management (mean = 6.9, good support); decision support system (mean = 6.0, good support); delivery system design (mean = 6.6, good support); and clinical information system (mean = 5.2, basic support).

In the models that included individual ACIC dimensions in addition to patient characteristics (Table 3), as

Table 2

Descriptive Statistics (618 patients; 20 clinics)

Variable	Mean or %	SD	Minimum	Maximum
Age (years)	58.6	12.9	19.0	94.0
Sex (%)				
Female	51.5			
Male	48.5			
Race/ethnicity (%)				
Hispanic	57.3			
Non-Hispanic	42.7			
Visits (last 12 months)	6.4	3.8	1.0	23.0
Maintenance stage of change (%)				
Diet	46.0			
Exercise	45.0			
Self-monitoring blood glucose	61.0			
Medication adherence	85.0			
All 4 behaviors	26.0			
ACIC Dimensions				
Organization support	6.5	2.3	2.5	10.0
Community linkages	7.1	1.7	4.3	10.7
Self-management	6.9	1.9	2.7	10.2
Decision support system	6.0	1.8	2.7	9.0
Delivery system design	6.6	2.2	3.4	11.0
Clinical information system	5.2	2.4	0.6	10.2
Total ACIC score	6.2	1.7	2.9	9.5

age increased, the likelihood of a patient being in maintenance stage of change for diet, exercise, self-monitoring of blood glucose, medication adherence, as well as all 4 self-management behaviors, increased. Male patients were more likely to adhere to exercise, whereas female patient were more likely to adhere to self-monitoring of blood glucose. Patients who had more visits in the prior 12 months were more likely to adhere to self-monitoring of blood glucose and all 4 self-management behaviors.

The organizational support dimension and the delivery system design dimension were not associated with any of the outcomes at a statistically significant level (Table 3). The self-management support dimension was positively associated only with medication adherence, while the decision support system dimension was positively associated with exercise and the composite outcome for all 4 self-management behaviors. The community linkages dimension was inversely associated with medication adherence, while the clinical information system dimension was inversely associated with diet and all 4 self-management behaviors.

In the models that included the total ACIC score in addition to patient characteristics (Table 4), similar results were observed for patient characteristics, whereas the total ACIC score was positively associated with only exercise.

Implications and Conclusions

The results of this study suggest that the organizational context, as viewed through the lens of the CCM, in

Table 3

Odds Ratio (95% CI) of Maintenance Stage of Change for Self-management Behaviors and Individual Elements of the Chronic Care Model

Variable	Model 1: Diet	Model 2: Exercise	Model 3: Glucose	Model 4: Medication	Model 5: All 4
Age	1.03 (1.01, 1.04)[a]	1.12 (1.02, 1.06)[a]	1.02 (1.01, 1.04)[a]	1.06 (1.04, 1.08)[a]	1.04 (1.02, 1.06)[a]
Male	0.93 (0.67, 1.29)	1.29 (1.00, 1.66)	0.69 (0.50, 0.96)	0.79 (0.45, 1.39)	1.04 (0.76, 1.43)
Hispanic ethnicity	1.34 (0.96, 1.89)	0.71 (0.46, 1.08)	1.06 (0.60, 1.87)	0.79 (0.45, 1.39)	0.96 (0.65, 1.44)
Visits prior 12 months	0.93 (0.67, 1.29)	1.03 (0.98, 1.10)	1.11 (1.04, 1.19)[a]	1.05 (0.98, 1.15)	1.06 (1.01, 1.12)[a]
Organization support	1.01 (0.77, 1.33)	1.18 (0.98, 1.45)	1.02 (0.77, 1.34)	1.19 (0.96, 1.49)	1.15 (0.89, 1.51)
Community linkages	1.04 (0.75, 1.45)	0.81 (0.61, 1.07)	0.99 (0.72, 1.38)	0.64 (0.42, 0.97)[a]	0.87 (0.65, 1.16)
Self-management support	0.96 (0.78, 1.20)	1.11 (0.92, 1.37)	1.06 (0.89, 1.27)	1.36 (1.05, 1.76)[a]	1.24 (0.99, 1.55)
Decision support system	1.08 (0.95, 1.23)	1.12 (1.01, 1.26)[a]	1.01 (0.90, 1.13)	1.02 (0.92, 1.14)	1.28 (1.06, 1.55)[a]
Delivery system design	1.03 (0.81, 1.30)	0.98 (0.78, 1.24)	1.01 (0.81, 1.26)	1.03 (0.82, 1.29)	0.93 (0.74, 1.16)
Clinical information system	0.87 (0.77, 0.99)[a]	0.96 (0.83, 1.11)	0.95 (0.86, 1.05)	0.87 (0.72, 1.03)	0.82 (0.70, 0.97)[a]

[a]Statistical significance at < .05.

Table 4

Odds Ratios (95% CI) for Maintenance Stage of Change for Self-management Behaviors and Total ACIC Score

Variable	Model 1: Diet	Model 2: Exercise	Model 3: Glucose	Model 4: Medication	Model 5: All 4
Age	1.02 (1.01, 1.04)[a]	1.04 (1.02, 1.06)[a]	1.02 (1.01, 1.04)[a]	1.06 (1.04, 1.08)[a]	1.04 (1.03, 1.06)[a]
Male	0.92 (0.67, 1.27)	1.24 (0.96, 1.61)	0.67 (0.48, 0.92)[a]	0.75 (0.43, 1.29)	1.03 (0.75, 1.42)
Hispanic ethnicity	1.39 (0.97, 1.99)	0.66 (0.43, 1.03)	1.07 (0.63, 1.82)	0.74 (0.43, 1.30)	0.92 (0.63, 1.36)
Visits prior 12 months	1.04 (1.01, 1.08)[a]	1.04 (0.98, 1.10)	1.11 (1.04, 1.19)[a]	1.05 (0.98, 1.13)	1.05 (1.01, 1.11)[a]
Total ACIC score	0.93 (0.80, 1.09)	1.15 (1.05, 1.28)[a]	1.03 (0.92, 1.16)	0.96 (0.82, 1.15)	1.07 (0.90, 1.29)

[a]Statistical significance at < .05.

which patients with type 2 diabetes receive their care, is associated with their self-management behaviors at home. Although the overall odds ratios may appear small, it might help to think about them in terms of how the ACIC scores are interpreted. As discussed above, ACIC scores are anchored to 4 categories regarding the degree to which care delivered in each clinic is consistent with the CCM: (1) limited, (2) basic, (3) good, and (4) fully implemented. Given the range of scores across these categories, compared with a clinic with full support, a clinic with limited support would have an ACIC score that would be at least 4 points higher. This 4 point increase would translate into a 60% increase in the likelihood that a patient is in the maintenance stage of change for exercise with a 95% CI of 20% to 74%.

Overall, only one quarter of the patients included were at the maintenance stage of change for all 4 self-management behaviors. Because the majority of the clinics included are small by nature, physicians in these clinics may be preoccupied with diagnosis and management of diabetes and its associated disorders, and therefore may not have sufficient time to spend with the

patient to educate them.[20] Moreover, the availability of a nurse, dietician, social educator, or qualified diabetes educator is also limited in these settings.

Patients receiving their care in clinics with strong decision support systems were more likely to adhere to exercise, as well as to all 4 self-management behaviors together. The questions for the decision support component ask about access to evidence-based information by the providers at the point of service, involvement of diabetes specialists, and provider education for diabetes care. It is possible that better decision support tools may improve the provider's ability to support change in patients' behavior and to promote self-management.

Of interest is the finding that patients receiving their care in clinics that reported better self-management support were more likely to adhere to their medications but were not more likely to be in the maintenance stage of change for diet, exercise, or glucose monitoring. It is possible that the limited self-management support available in these small clinics cannot overcome external environment influences on diet and exercise such as family support or the easy availability of fast foods. The self-management scale in the ACIC measured the degree to which self-management needs and activities are assessed and documented, concerns of patients and families are addressed, and effective behavior change interventions and peer support are available. It did not measure the degree to which available behavior change resources are actually used by the patient population.

Surprisingly, patients seen in clinics that have better community linkages (ie, linkages between primary care clinicians to diabetes specialists and educators, availability of education resources, and coordination of care guidelines) were less likely to adhere to their medications. It is possible that this reflects a directionality problem in that patients who are poorly controlled because they are not adherent to their medicine are more likely to be referred to specialists or other community resources.

One unexpected finding of this study was that patients seen in clinics with stronger clinical information systems were less likely to report adherence to diet and all 4 self-management behaviors. Here clinical information systems refer to the use of diabetes registries, reminders to providers and feedback for the care team, information about relevant subgroups of patient needing services, and patient treatment plans. It is possible that these systems are not well implemented or they have been in place for a short period of time. Alternatively, the presence of these systems and the additional information made available during the encounter may compete with self-management discussions and patient-centered care. Other studies have shown that primary care encounters by patients with diabetes are complex and filled with competing demands.[20,21]

Overall, patients receiving care in clinics that scored higher on the overall ACIC score were more likely to adhere to exercise but not the other 3 behaviors. These clinics have prepared proactive care teams interacting with informed activated patients, thus resulting in better management of behaviors. It is unclear why exercise and not other self-management behaviors is predicted by the strength of the presence of the CCM. This finding is especially confusing given the lack of strong evidence that outpatient counseling by clinicians to improve physical activity is effective.[27] It is possible that higher CCM scores reflect a more proactive team approach to improving physical activity, rather than just individual counseling by a clinician.[27]

Early studies of the CCM suggested that implementation or presence of the elements of the CCM were associated with traditional process quality of care indicators such as performance of a foot or eye exam for patients with type 2 diabetes.[29-31] More recent studies have found an association between the presence of elements of the CCM in primary care settings and intermediate clinical outcomes such as A1C.[2] In a recent observational study risk of cardiovascular events among patients with diabetes is lower in clinics where the ACIC score is higher.[19] It is possible that the pathway through which the CCM is related to better control of intermediate clinical outcomes, such as A1C control, is through improved patient self-care behavior among patients seen in clinics where the CCM is more fully present.

Several limitations should be noted. The cross-sectional nature of the study implies that no conclusions can be made about causality or the direction of the relationships between the variables. Moreover, measures of self-management behaviors are based on patient self-reporting and thus may vary considerably across physicians and clinics. Finally, the sample was limited to 30 patients in each of 20 primary care clinics in 1 region of the country, perhaps limiting its applicability to other settings.

In conclusion, organizational characteristics as viewed through the lens of the CCM do appear to be important predictors of patient self-management behaviors. Since primary care clinics are the principal source of the tools and support patients need to learn to manage a complex

chronic disease like diabetes, a greater focus on strengthening the presence of the elements of the CCM that might influence self-management behaviors may be needed. Improving our understanding of how such an organizational level characteristic such as the presence of a CCM component is related to patient-level outcomes may be important as we search for ways to continually improve care effectiveness, patient safety, and patient centeredness, which relate to 3 of the 6 goals set by the Institute of Medicine as the most important goals that will allow the healthcare system to cross the quality chasm.[9]

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