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Features of the Chronic Care Model associated with behavioral counseling and diabetes care in community primary care

Pamela A. Ohman Strickland, PhD[1,2,3], **Shawna V. Hudson, PhD**[2,3], **Alicja Piasecki, MPH**[2], **Karissa Hahn, MPH**[2], **Deborah Cohen, PhD**[2], **A. John Orzano, MD, MPH**[4], **Michael L. Parchman, MD**[5], and **Benjamin F. Crabtree, PhD**[2,3,6,7]

[1]Department of Biostatistics, UMDNJ-School of Public Health, Piscataway, NJ

[2]Department of Family Medicine, UMDNJ-Robert Wood Johnson Medical School, New Brunswick, NJ

[3]The Cancer Institute of New Jersey, UMDNJ-Robert Wood Johnson Medical School, New Brunswick, NJ

[4]Department of Family Medicine, Dartmouth, Concord, NH

[5]South Texas Veterans Health Care System, San Antonio, TX

[6]Center for Research in Family Practice and Primary Care Cleveland, OH, New Brunswick, NJ, San Antonio, TX, Allentown, PA

[7]Department of Epidemiology, UMDNJ – School of Public Health, Piscataway, NJ

Abstract

Background—The Chronic Care Model (CCM) was developed to improve chronic disease care, but may also inform other types of preventive care delivery. Using hierarchical analyses of service delivery to patients, we explore associations of CCM implementation with diabetes care and counseling for diet or weight loss and physical activity in community-based primary care offices.

Methods—Secondary analysis focused on baseline data from 25 practices (with an average of four physicians per practice) participating in an intervention trial targeting improved colorectal

Corresponding author: Pamela A. Ohman-Strickland, Ph.D., Department of Biostatistics, UMDNJ-School of Public Health, 683 Hoes Lane West, Room 218, P.O. Box 9, Piscataway, NJ 08854, Office #: 732-235-9721, Fax #: 732-235-5464, ohmanpa@umdnj.edu.

Author Information:
Pamela A. Ohman Strickland, PhD (Corresponding Author), Department of Biostatistics, UMDNJ-School of Public Health, 683 Hoes Lane West, Room 218, P.O. Box 9, Piscataway, NJ 08854, Office #: 732-235-9721, Fax #: 732-235-5464, ohmanpa@umdnj.edu
Shawna V. Hudson, PhD, The Cancer Institute of New Jersey, 195 Little Albany Street, New Brunswick, NJ 08903, Office #: 732-235-9591, Fax #: 732-235-8808, hudsonsh@umdnj.edu
Alicja Piasecki, MPH, Department of Family Medicine, UMDNJ-RWJMS, 1 Worlds Fair Drive, Somerset, NJ 08873, Office #: 732-743-3260, Fax #: 732-743-3395, piasecak@umdnj.edu
Karissa Hahn, MPH, Department of Family Medicine, UMDNJ-RWJMS, 1 Worlds Fair Drive, Somerset, NJ 08873, Office #: 732-743-3382, Fax #: 732-743-3395, clarkeka@umdnj.edu
Deborah Cohen, PhD, Department of Family Medicine, UMDNJ-RWJMS, 1 Worlds Fair Drive, Somerset, NJ 08873, Office #: 732-743-3239, Fax #: 732-743-3395, cohendj@umdnj.edu
A. John Orzano, MD, MPH, Department of Family Medicine, Dartmouth, 250 Pleasant St, Concord, NH 03301, Office #: 603-227-7000, Fax #: 603-228-7173, jorzano@crhc.org
Michael L. Parchman, MD, South Texas Veterans Health Care System #11C6, 7400 Merton Minter Blvd, San Antonio, TX 78229, Office #: 210-3930, Fax #: 210-220-3763, parchman@uthscsa.edu
Benjamin F. Crabtree, PhD, Department of Family Medicine, UMDNJ-RWJMS, 1 Worlds Fair Drive, Somerset, NJ 08873, Office #: 732-743-3220, Fax #: 732-743-3395, crabtrbf@umdnj.edu

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cancer screening rates. This intervention made no reference to the CCM. CCM implementation (measured through staff and clinical management surveys) and was associated with patient care indicators (chart audits and patient questionnaires).

Results—Overall, practices had low levels of CCM implementation. However, higher levels of CCM implementation were associated with better diabetes assessment and treatment of patients (p=0.009, 0.015), particularly in practices open to "innovation". Physical activity counseling for obese and particularly overweight patients was strongly associated with CCM implementation (p=0.0017), particularly among practices open to "innovation"; however, this association did not hold for overweight and obese patients with diabetes.

Conclusions—Very modest levels of CCM implementation in unsupported primary care practices are associated with improved care for patients with diabetes and higher rates of behavioral counseling. Incremental incorporation of CCM components is an option, especially for resource stretched community practices with cultures of "innovativeness."

Keywords

care delivery system; chronic care; health promotion; obesity; organizational design; primary care

INTRODUCTION

The Chronic Care Model (CCM) provides a blueprint for changing office systems to improve chronic illness care.(1–4) The CCM focuses on improving and optimizing six key elements of the health care system: health care organization, delivery system design, clinical information systems, decision-support, self-management support and community resource linkages.(5–8) Together, these six elements are hypothesized to produce effective interactions between proactive, prepared primary care practice teams and informed, activated patients.(6,8)

A number of studies show that when care is consistent with the elements of the CCM, quality and outcomes of diabetes are better.(1,4,7,9–13) The CCM may also be a pragmatic model for improving preventive service delivery.(3,14–15) Hung et al.(14) examined the usefulness of the CCM for addressing health risk behaviors related to tobacco, alcohol, diet and physical activity. Their research(14) and the work of others(3,15) suggest that the CCM may provide a useful framework for addressing these risk behaviors, reducing the gap between recommended and actual health promotion in primary care.

Complete implementation of the CCM, however, proves challenging.(14,16) It is unclear whether comprehensive implementation of the CCM results in better outcomes than implementation of various individual elements.(1,17) We do not know if some elements result in better improvements in chronic care delivery than others.(1,18) Further, most of the studies that examine the effectiveness of the CCM do so in primary care offices within larger health care systems (e.g., academic medical centers, large multi-specialty groups or federally funded community health centers).(7,9–10,19–22) Little research addresses the effectiveness of the CCM in small, independent primary care practices that typically lack formal infrastructure(1,4,23) to support quality improvement efforts. Yet, redesign and Medical Home initiatives that incorporate CCM features(24–25) are increasingly envisioned as paths to improving care.

This study examines whether offices that incorporate more features of the CCM deliver better diabetes care and more counseling for diet or weight loss and physical activity in community-based primary care settings. Specifically, we test the following hypotheses. First, family medicine practices that incorporate more features of the CCM will have better

delivery of care for patients with diabetes and better behavioral counseling for overweight and obese patients. Second, practices with leadership that is open to innovation will see greater effectiveness of other CCM features with respect to behavioral counseling for overweight & obese patients.

METHODS

Study Design

This secondary analysis evaluated cross-sectional, baseline data, collected in 2006 and 2007 for a quality improvement intervention study, Supporting Colorectal Cancer Outcomes through Participatory Enhancements (SCOPE). Data included practice and patient characteristics as well as measures of practice organization and the care delivered to patients.

Specifically, 30 consecutive patients age 50 and over were recruited from each of 25 practices. After informed consent was obtained, each patient completed a patient survey, providing the following personal information: race, age, height, health status, perceived continuity of care within the practice as well as receipt of diet, weight loss, or physical activity counseling in the past year by either a clinician or someone else within the practice. Medical record reviews conducted by trained research nurses were then used to obtain information concerning the presence of co-morbidities and most recent weight. In addition, medical record reviews provided information on diabetes assessment, treatment and achievement of intermediate outcomes for those patients with diabetes. Height and weight, obtained from the patient survey and chart audit, respectively, were used to calculate body mass index (BMI).

Practice level information was collected as follows. The lead physician completed a Clinical Management Survey (CMS) with items on practice organization and services provided to patients to assist with behavioral change. Each staff member was asked to complete a Practice Staff Questionnaire (PSQ), providing perceptions of practice organization, which included that practice's openness to change. Within the PSQ, clinicians and clinical staff were asked additional questions concerning use of tools for decision making and organizing patient care.

This project was approved by the University of Medicine and Dentistry of New Jersey's Institutional Review Board. Written, informed consent was obtained from the head physician at each practice as well as each patient. Consent was implied for any of remaining practice staff who completed the CMS and PSQ. Practice staff received a $5 gift card to Walmart or Blockbuster Video as an incentive for completing the PSQ.

Measures for Hierarchical Analyses

Practice Implementation of CCM—Relevant items from all survey instruments were identified and sorted according to the definitions of the components of the Chronic Care Model (CCM), with the Assessment of Chronic Illness Care (ACIC; (5)) providing guidelines for classification. The ACIC was originally designed to measure adoption of six components of CCM for practices engaging in interventions specifically aimed at integrating the CCM into practice. Specifically, the two primary authors created a draft sorting of items, which was then vetted and modified by the paper team in a series of three meetings. Table 1 provides definitions of each CCM component, and the items selected from our instruments (along with the sources for those items) that operationalize practice characteristics regarding CCM implementation. A couple of modifications have been made from the CCM/ACIC. In particular, the original component relating to Organization of Healthcare Delivery System

was modified to reflect Practice Organization, focusing on the practices' openness to "innovation"—a culture embracing change and learning. The Community Linkages component was not assessed in this study: previous experience demonstrated community linkages within these practices were rare, so that it made little sense to collect detailed information about this component. Behavior Change Support focused on items indicating direct communication with patients surrounding risky behavior and managing their own health. Some items could have been classified as either Delivery System Design or Clinical Information Systems (e.g. registries for chronic diseases). Those items that pertained to mechanistic systems for organizing patient or visit information, such as registries, were classified under Clinical Information Systems. Items that directly affected communication between staff or reflected continuity of care were classified as Delivery System Design. Finally, Decision Support focused on items that provided general, non-patient-specific information to aid clinicians in understanding how to provide better care to their patients.

For all items, practice-level values were merged into a single dataset (taking averages of responses from patient or practice staff members when appropriate). Because items were measured on different scales ranging from binary to a five-point Likert scale, z-scores were created for each item in order to ensure comparability across items within a practice. Practice level scores for each of the 5 CCM components were created by taking the average of the relevant items' z-scores. This approach provides roughly equal weighting for items within each CCM component. Comprehensive CCM implementation was represented by an average of the component scores for each practice.

Patient Services—These measures represent services at the patient level which will be used as the outcomes of interest for this study. Receipt (yes/no) of either diet or weight loss counseling and physical activity counseling within the last year were obtained from patient surveys, while assessment (whether HbA1c assessed within the last 6 months, LDL assessed within last 12 months, and blood pressure checked at each of the last three visits), treatment (HbA1c<7.0 or HbA1c≥7.0 and on hypoglycemic; LDL≤100 or LDL>100 and on lipid lowering medication, and BP<=130/85 or, if not, on hypertensive) and attainment of at least 2 out of 3 intermediate outcomes (HbA1c<7.0, LDL<=100, and BP<=130/85) for diabetes patients were obtained from medical review.

BMI

Each patient's Body Mass Index (BMI) was calculated (weight [kg]/height [m] ^{2}) using self-reported height and last recorded weight (medical record) and classified as normal (<25), overweight (25 to <30) or obese (≥30). This variable was used to identify the population of subjects who were overweight or obese.

Statistical Methods

Summary statistics of patient-level characteristics, calculated as means and standard deviations for continuous variables or frequencies for categorical variables, were calculated for all patients, as well as for subsets of patients who were overweight, obese or had diabetes. Similar statistics were calculated for the practice descriptors.

Hierarchical logistic regression examined the association between delivery of services or achievement of intermediate outcomes at the patient level and level of CCM implementation at the practice level. Specifically, generalized estimating equations(26–27) using a working correlation matrix with exchangeable structure modeled log-odds of service delivery as a function of practice- and patient-level covariates. These analyses, while using the patient as the unit of analysis, control for nesting of patients within practice and appropriately test for the significance of both patient- and practice-level variables.

For Hypothesis 1, only patients with diabetes (n=196) or patients who were overweight or obese (n=491) were included in the analyses. The average of the practice-level scores for each of the 5 CCM components was used as a comprehensive measure of CCM implementation to predict service delivery. Secondary analyses for this hypothesis evaluated the individual components simultaneously within a single model. For each of these predictors, odds ratios (95% confidence intervals) were estimated comparing the effectiveness for practices in the 25th and 75th percentiles of CCM implementation in delivering services. Post-hoc analyses stratified these analyses to examine counseling for patients who did and did not have diabetes separately.

For Hypothesis 2, practices were stratified using a median split on the Practice Organization component as being ‘high’ or ‘low’ on practice openness to innovation. Analyses similar to those described above examined the association of the average of the 4 remaining CCM components with service delivery within each group of practices. Odds ratios estimated the effect of CCM implementation (comparing the 25th and 75th percentiles of implementation of the 4 remaining CCM components) and service delivery among practices more and less open to innovation.

All analyses included age, gender, obesity status, general health status and whether the patient had diabetes (when appropriate), hypertension or a heart condition as patient-level covariates and whether the practice used an EMR or not as a practice-level covariate.

All analyses were conducted using the SAS/STAT software (SAS system for Windows, Version 9.1.3; SAS Institute Inc, Cary North Carolina).(28)

RESULTS

Table 2 presents patient characteristics. Out of 25 practices, 23 (92%) had 2 or more physicians; the average number of physicians was 4.28 (SE=3.10). Practices had been in existence for an average of 11 years (SE=8.5).

Means and standard deviations for the CCM component scores are given in Table 1. Also, of interest, the CCM components had varying levels of correlation with one another, with only one significant correlation of 0.61 between Decision Support and Behavioral Change Support (p=0.0013). Decision support was also marginally associated with openness to change (r=0.35, p=0.089) and Clinical Information Systems (r=0.37, p=0.066); and Behavioral Change Support was marginally associated with Clinical Information Systems (r=0.36, p=0.074). (All other correlations, r<0.18, had p-values>0.40.)

Hypothesis 1 (Table 3)

For patients with diabetes, increased CCM implementation was significantly associated with increased assessment of HbA1c, lipids and blood pressure (OR=1.90, p=0.009) and with treatment for HbA1c, lipids and blood pressure (OR=1.79, p=0.015). For example, the odds of appropriate assessment for patients with diabetes are 90% greater for practices in the 75th percentile relative to the 25th percentile of CCM implementation. The relationships of achievement of targets as well as counseling for diet/weight loss or physical activity among diabetic patients with CCM implementation were not significant.

However, for all obese and overweight patients, including those with and without diabetes, CCM implementation was associated with physical activity counseling (p=0.0017) but not diet or weight loss counseling (p=0.31). The odds of counseling for physical activity were 35% higher for patients in practices at the 75th percentile of CCM implementation relative to

the 25th percentile. This odds ratio is comparable to the magnitude of those for assessment, treatment and achievement of targets for patients with diabetes (also shown in Table 3).

In additional analyses to understand the discrepancy between results for counseling among patients with diabetes and among overweight/obese patients, the latter category was broken down into patients with and without diabetes. Overall CCM implementation was significantly associated with physical activity counseling among obese/overweight patients without diabetes (OR=1.51, p=0.0017), but not among obese/overweight patients with diabetes (p=0.76).

Hypothesis 2 (Table 4)

Among practices with low scores on Practice Organization, defined as open to innovation, there was no effect of the remaining CCM components on the outcomes of interest, either for patients with diabetes or for obese or overweight patients. However, the level of implementation of remaining CCM component did was associated with appropriate assessment, treatment and attainment of targets among patients with diabetes (p= 0.042, 0.0033 and 0.012, respectively). In addition, in practices that were more open to innovation, physical activity counseling was more likely to occur among patients who were obese or overweight with increased CCM implementation (p=0.0006).

DISCUSSION

In this study, patients with diabetes seen in practices that have implemented more CCM features were significantly more likely to receive appropriate diabetes care. In addition, physical activity counseling for overweight/obese patients was more likely to occur in primary care practices where more CCM features were implemented, particularly within practices reporting leadership that was more open to “innovation” or among obese or overweight patients without diabetes. However, no association was seen between implementation of CCM features and weight loss or diet counseling.

While associations were strongest and most significant when the CCM was considered as a whole rather than subdivided into components, correlations between components of the CCM were small to moderate. This suggests with others(1) that none of the individual components are universally important; but rather, small efforts in several of the components or a major effort within one component may be acceptable ways to incorporate CCM features into community primary care practices and to enhance patient care.(22) This finding is consistent with the idea that primary care practices are complex adaptive systems where a “one-size-fits-all” approach is unlikely to be successful.(29,30) Each practice may incorporate features of the CCM in their practice that are most consistent with their resources, values and culture, resulting in improved patient care for that unique practice.

The effectiveness of the CCM may be diminished when psycho-social barriers or competing demands are strong. For example, in this study, with rates of counseling for diet or weight loss counseling already relatively high for overweight and obese patients (67%) as compared to previously published studies(29–30), persistent barriers already recognized in the literature may limit any additional improvement due to the CCM. For example, despite comprehensive published guidelines(31–32) aimed at increasing the frequency of weight counseling, physicians report feeling poorly prepared to effectively recommend weight management strategies or to develop and implement weight reduction and treatment plans.(33–36) Further, while weight and obesity are delicate topics,(36–37) talking about physical activity may be a way to broach the subject indirectly. This less direct approach may encounter fewer barriers and be more easily influenced by the implementation of mechanistic procedures intended to motivate physicians. Similar explanations may be found

to explain why CCM implementation is effective in improving rates of physical activity counseling among patients without diabetes, but not patient with diabetes. In this case, the competing demands during the encounter of providing care to manage diabetes, its complications, or other chronic diseases may provide barriers for counseling that are difficult to overcome.(38)

A study finding that has potential broad-reaching implication, not just for CCM implementation but also for implementing other care quality improvement models, practice redesign efforts, or Medical Home initiatives, is that a practice's openness to innovation can impact how effective a model is for improving care. Existing literature identifies practice organizational characteristics (39–40) that may inform these processes, such as the nature of relationships among practice members(41–42), a practice's ability to work as a team(43), and how a practice manages knowledge (44). Thus, regardless of the model to be used for change, consideration needs to be given to development of a practice's organizational systems to innovate and deliver high quality care (45), whether chronic disease management or health promotion advice and services.

A number of limitations exist for this study. Because this study was an observational, cross-sectional study rather than a clinical trial, inference of causation is not appropriate. Several clinical trials have been conducted or are underway that examine full CCM implementation within primary care practices.(23,46–47) Additional studies have found improved patient care following CCM implementation using before-/after-implementation study designs.(48–49)

Another limitation is the small sample (n=25) of mostly privately-owned practices located in New Jersey, such that results may not be broadly generalizable. However, of all community-based primary care practices in the US, approximately two-thirds have 5 or fewer physicians(50). Further, the results found here reflect those from other studies.(51) As an additional limitation, the instruments were not specifically designed to measure CCM implementation. Thus, our measurement of characteristics of CCM within practices in this secondary analysis may include both theoretical and measurement error with respect to the true intent of the CCM. However, practices in this study did not seek to implement the CCM or even have direct knowledge of the model. Further, review of qualitative data validated that practices enrolled in this study had very minimal levels of CCM implementation, most of which were captured in our surveys.

This study focused on small, mostly privately owned primary care practices, typical of the majority of primary care settings in the U.S., many of which were struggling with the basic issues related to financial solvency and staff turnover. There are a number of studies that look at weight counseling in idealized settings (52–55) yet few studies adequately examine the delivery of weight counseling in the primary care setting(56–59) where most people receive their care most of the time. The level of CCM implementation witnessed in this study was quite low relative to the ideal as described in the ACIC. While this may be seen as a weakness of this study, the fact that we saw effects of such low levels of CCM implementation is extremely promising in that an ordinary primary care practice which is open to innovation may not need to invest large amounts of capital and other resources in implementing the complete CCM in order to see positive results.

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Table 1

Chronic Care Model operational definitions and items used to describe them (Average component scores were created as an average of z-scores from items used to assess each component.)

Practice Organization: An organization that provides safe, high quality care with leadership that encourages efforts to improve care (Average Practice Score=0.04, Standard deviation=1.00)

- People in our practice actively seek new ways to improve how we do things. *
- The practice leadership makes sure that we have the time and space necessary to discuss changes to improve care. *
- Most people in this practice are willing to change how they do things in response to feedback from others. *

Behavioral Change Support: Effective behavior change support is used to help patients and families improve their health behavior (Average Practice Score=0.00, Standard deviation=0.43)

- Use of patient questionnaire at either the first visit or routine visits to identify patients who may benefit from counseling for eating habits, physical activity, smoking, alcohol use and cancer screening (maximum across first and routine-use responses and then averaged across behavior categories). ‡
- Refer out for counseling or screening (averaged across behavior categories). ‡
- Use nurses or health educators within the practice for individual counseling or use group counseling activities (averaged across behavior categories). ‡
- Frequency with which practices use a process or system for reminding patients about visits. §

Delivery System Design: Organizational features of the practice assure well-planned visits and impact the provision of care (Average Practice Score=0.00, Standard deviation=0.46)

- Frequency of clinical meetings. †
- Inclusion of staff members with different roles in the clinical meetings. $
- Continuity of care: When patient gets sick, they contact the practice first (before going to specialist or emergency room) #

Decision Support: Clinicians have convenient access to the latest evidence-based guidelines and specialist expertise is integrated into the practice. (Average Practice Score=−0.04, Standard deviation=0.57)

- Computers are used for retrieving information, either through PDAs, online literature searching, a CD-based medical knowledge base or the Internet ±
- Use of chart audit for chronic diseases or cancer screening ‡
- Use of nurses and health educators ‡

Clinical Information Systems: Data about patients is organized to facilitate efficient and effective care (Average Practice Score=0.01, Standard deviation=0.77)

- A registry for chronic diseases. ‡
- A process for identifying patients due for screening or tests. ‡
- A process to prompt clinicians at the time of visits about needed tests or additional visits. ‡
- Risk factor chart stickers or electronic flags ‡
- Checklists or flowcharts ‡

* PSQ (Practice Staff Questionnaire), each item scored on 1–5 scale, “strongly disagree” to “strongly agree”

‡ PSQ, each item scored on 1–5 scale, “never used” to “always used”

[§] CMS (Clinical Management Survey), scored on 1–5 scale, “never used” to “always used”

[†] CMS, scored on 1–5 scale, “Weekly, Monthly, Quarterly, Annually, Never”

[$] CMS, a count of the types of staff in attendance: physicians, other clinicians, nursing staff, office staff

[#] Patient survey, scored 1–5, “never” to “always”

[±] PSQ, 0 or 1 for not used or used

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Table 2

Patient Characteristics

Patient Characteristic	Overall (N=674)	Normal (N=183)	Overweight (N=218)	Obese (N=273)	Diabetic (N=196)
Age	64.1 (SD=10.1)	64.21 (SD=11.5)	66.0 (SD=10.3)	62.5 (SD=8.6)	64.9 (SD=10.0)
Gender (Male)	267 (39.6%)	58 (31.7%)	108 (49.5%)	101 (37.0%)	89 (45.4%)
Race					
White	471 (69.9%)	142 (77.6%)	148 (67.9%)	181 (66.3%)	105 (53.6%)
Black	121 (18.0%)	18 (9.8%)	40 (18.4%)	63 (23.1%)	59 (30.1%)
Hispanic	46 (6.8%)	6 (3.3%)	22 (10.1%)	18 (6.6%)	16 (8.2%)
Other	32 (4.8%)	16 (8.7%)	6 (2.8%)	10 (3.7%)	12 (6.1%)
Unknown	4 (0.6%)	1 (0.6%)	2 (0.9%)	1 (0.4%)	4 (2.0%)
Education					
Less than HS	72 (10.7%)	14 (7.7%)	22 (10.1%)	36 (13.2%)	33 (16.8%)
HS or some college	326 (48.4%)	71 (38.8%)	106 (48.6%)	149 (54.6%)	101 (51.5%)
College or grad school	273 (40.5%)	97 (53.0%)	90 (41.3%)	86 (31.5%)	60 (30.6%)
Unknown	3 (0.5%)	1 (0.6%)	0 (0%)	2 (0.7%)	2 (1.0%)
Marital Status					
Married	424 (62.9%)	114 (62.3%)	150 (68.8%)	160 (58.6%)	111 (56.6%)
Not married	250 (37.1%)	69 (37.7%)	68 (31.2%)	113 (41.4%)	85 (43.4%)
Insurance Status					
Medicare	257 (38.1%)	68 (37.2%)	88 (40.4%)	101 (37.0%)	84 (42.9%)
Medicaid	33 (4.9%)	5 (2.7%)	11 (5.1%)	17 (6.2%)	13 (6.6%)
Private	317 (47.0%)	97 (53.0%)	99 (45.4%)	121 (44.3%)	74 (37.8%)
Other	30 (4.5%)	7 (3.83.0%)	9 (4.1%)	14 (5.1%)	7 (3.6%)
None	29 (4.3%)	4 (2.2%)	10 (4.6%)	15 (5.5%)	18 (9.2%)
Unknown	8 (1.2%)	2 (1.1%)	1 (0.5%)	5 (1.8%)	0 (0%)
Global Health	2.29 (SD=0.61)	2.16 (SD=0.62)	2.26(SD=0.64)	2.41 (SD=0.55)	2.54 (SD=0.54)
Physical Health	2.34 (SD=0.63)	2.16 (SD=0.66)	2.30 (SD=0.64)	2.50 (SD=0.57)	2.65 (SD=0.54)
Emotional Health	2.14(SD=0.66)	2.11 (SD=0.61)	2.06 (SD=0.69)	2.22 (SD=0.66)	2.30 (SD=0.67)

Patient Characteristic	Overall (N=674)	Normal (N=183)	Overweight (N=218)	Obese (N=273)	Diabetic (N=196)
# visits in past 2 years	7.57 (SD=5.29)	6.64 (SD=4.62)	7.42 (SD=4.77)	8.32 (SD=5.97)	8.73 (SD=5.94)
Diabetes assessment	--	--	--	--	91 (46.4%)
Diabetes treatment	--	--	--	--	99 (50.5%)
At least 2 out of 3 diabetes outcomes at target	--	--	--	--	84 (42.9%)
Received diet or weight loss counseling	--	--	118 (53.4%)	212 (77.7%)	137 (69.90%)
Received physical activity counseling	--	--	127 (57.5%)	191 (70.0%)	137 (69.90%)

Table 3

Hypothesis 1: Odds ratios (CIs and p-values) describing the relationship between CCM implementation, as a whole and as subcomponents, and diabetes care and behavioral counseling for overweight/obese patients (in each category, y= number received service or achieved targets, p=percent). Odds ratios represent the odds of appropriate service for patients within practices at the 75th percentile versus the 25th percentile of implementation of either the comprehensive CCM or its components.

Patient Services	Comprehensive	By Component				
	CCM Implementation	**Decision Support**	**Clinical Information Systems**	**Practice Organization (Openness to innovation)**	**Behavioral Change Support**	**Delivery Systems**
Patients with Diabetes (n=196) OR (CI) p-value						
Assessment* (y=91, p=46%)	1.90 (1.17, 3.08) 0.009	1.06 (0.28, 4.01) 0.9306	1.42 (0.85, 2.36) 0.1825	1.73 (0.91, 3.28) 0.0965	1.15 (0.47, 2.78) 0.76	0.89 (0.59, 1.34) 0.5818
Treatment** (y=99, p=51%)	1.79 (1.12, 2.86) 0.015	0.90 (0.18, 4.45) 0.894	1.33 (0.77, 2.30) 0.3043	1.41 (0.74, 2.68) 0.3025	1.47 (0.53, 4.04) 0.4602	1.0045 (0.55, 1.83) 0.9882
Targets (at least 2 out of 3) *** (y=84, p=43%)	1.20 (0.86, 1.67) 0.27	0.78 (0.19, 3.36) 0.7573	1.55 (1.04, 2.29) 0.0311	1.044 (0.66, 1.65) 0.8531	1.06 (0.57, 1.97) 0.859	0.99 (0.74, 1.34) 0.9598
Diet or weight loss counseling (y=137, p=70%)	1.03 (0.63, 1.70) 0.90	1.44 (0.63, 3.30) 0.39	0.92 (0.71, 1.19) 0.52	0.79 (0.47, 1.31) 0.36	0.91 (0.51, 1.63) 0.74	1.58 (1.12, 2.23) 0.0086
Physical Activity counseling (y=137, 70%)	0.95 (0.82, 1.09) 0.45	0.60 (0.26, 1.39) 0.23	1.16 (0.78, 1.72) 0.48	0.82 (0.62, 1.09) 0.17	1.06 (0.76, 1.48) 0.74	1.22 (0.92, 1.64) 0.17
All Obese or overweight patients (with or without Diabetes, n=491) OR (CI) p-value						
Diet or weight loss counseling (y=330, p=67%)	1.09 (0.92, 1.28) 0.31	1.20 (0.69, 2.08) 0.51	1.03 (0.77, 1.38) 0.84	0.96 (0.77, 1.20) 0.71	0.9975 (0.74, 1.34) 0.99	1.06 (0.81, 1.39) 0.68
Physical Activity counseling (y=318, p=65%)	1.35 (1.12, 1.63) 0.0017	0.89 (0.51, 1.54) 0.67	1.18 (0.87, 1.59) 0.29	1.14 (0.94, 1.39) 0.19	1.34 (1.06, 1.69) 0.013	1.13 (0.89, 1.45) 0.31
Obese or overweight patients with Diabetes (n=166) OR (CI) p-value						
Diet or weight loss counseling (y=126, p=76%)	1.02 (0.65, 1.60) 0.94	1.60 (0.77, 3.35) 0.21	1.02 (0.73, 1.41) 0.91	0.76 (0.53, 1.09) 0.14	0.74 (0.50, 1.12) 0.15	1.38 (0.87, 2.20) 0.17
Physical Activity counseling (y=123, p=74%)	0.96 (0.76, 1.22) 0.76	0.82 (0.29, 2.31) 0.71	1.37 (0.85, 2.20) 0.19	0.79 (0.52, 1.19) 0.25	0.93 (0.58, 1.48) 0.75	1.12 (0.78, 1.61) 0.53

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Patient Services	Comprehensive	By Component				
	CCM Implementation	Decision Support	Clinical Information Systems	Practice Organization (Openness to innovation)	Behavioral Change Support	Delivery Systems
Obese or overweight patients without Diabetes (n=325) OR (CI) p-value						
Diet or weight loss counseling (y=204, p=63%)	1.15 (0.99, 1.34) 0.075	1.03 (0.49, 2.20) 0.93	1.01 (0.69, 1.48) 0.96	1.09 (0.85, 1.38) 0.51	1.13 (0.79, 1.61) 0.51	1.01 (0.66, 1.55) 0.97
Physical Activity counseling (y=195, p=60%)	1.51 (1.17, 1.95) 0.0017	0.81 (0.45, 1.45) 0.48	1.13 (0.82, 1.56) 0.47	1.39 (1.04, 1.86) 0.024	1.55 (1.12, 2.15) 0.0079	1.23 (0.91, 1.66) 0.18

* HbA1c assessed within the last 6 months, LDL assessed within the last 12 months and blood pressure checked at each of the last three visits

** HbA1c<7.0 or HbA1c≥7.0 and on hypoglycemic; LDL≤100 or LDL>100 and on lipid lowering medication; and BP≤130/85 or, if not, then on hypertensive

*** HbA1c<7.0; LDL≤100; and BP≤130/85

Table 4

Hypothesis 2: Odds ratios (CIs and p-values) describing the relationship between CCM implementation and diabetes care and behavioral counseling for overweight/obese patients for practice with low and high levels of openness to innovation. Odds ratios represent the odds of appropriate service for patients within practices at the 75th percentile versus the 25th percentile of implementation of either the comprehensive CCM or its components.

Patient Services	Odds Ratios for Practices with	
	Low openness to innovation	High openness to innovation
Patients with Diabetes (n=196)		
Assessment *	1.52 (0.79, 2.92) 0.21	1.84 (1.02, 3.32) 0.042
Treatment **	2.09 (0.77, 5.66) 0.15	2.06 (1.27, 3.34) 0.0033
Target (at least 2 out of 3) **	1.19 (0.51, 2.76) 0.69	1.71 (0.13, 2.58) 0.012
Diet or weight loss counseling	1.27 (0.71, 2.26) 0.41	1.19 (0.73, 1.95) 0.48
Physical Activity counseling	1.17 (0.73, 1.87) 0.51	1.30 (0.91, 1.87) 0.15
All Obese or overweight patients (with or without diabetes, n=491)		
Diet or weight loss counseling	1.15 (0.97, 1.37) 0.10	1.03 (0.86, 1.25) 0.73
Physical Activity counseling	1.30 (0.94, 1.79) 0.11	1.60 (1.23, 2.09) 0.0006

* HbA1c assessed within the last 6 months, LDL assessed within the last 12 months and blood pressure checked at each of the last three visits

** HbA1c<7.0 or HbA1c≥7.0 and on hypoglycemic; LDL≤100 or LDL>100 and on lipid lowering medication; and BP≤130/85 or, if not, then on hypertensive

*** HbA1c<7.0; LDL≤100; and BP≤130/85