Original Research

Improving Quality of Care for Diabetes Through a Maintenance of Certification Activity: Family Physicians' Use of the Chronic Care Model

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Introduction: *Improving the care of patients with diabetes is a health care priority. Through Part 4 of Maintenance of Certification for Family Physicians (MC-FP), American Board of Family Medicine (ABFM) diplomates participate in quality improvement (QI) modules for diabetes. Our objective was to determine associations between physician characteristics and actions taken during Part 4 diabetes modules with quality of care outcomes.*

Methods: *The study sample was all Part 4 modules completed by family physicians from 2005 to 2012. Descriptive statistics were used to characterize the physicians and their behavior in the module. We used linear regression to test for associations between choice of intervention, mode of intervention, and chronic care model domain with improvement in quality measures.*

Results: *There were 7924 modules completed by family physicians, whose mean age was 48.2 years; 61.9% were male, and 76.9% lived in urban areas. All physician and patient quality measures improved over the course of the Part 4 module. Regression models found that only baseline performance was consistently associated with quality outcomes. No other consistent association was seen between intervention type, mode, or chronic care model domain and greater likelihood of improvements; however, every quality measure improved.*

Discussion: *Through MC-FP, family physicians improved the quality of care they delivered to diabetic patients. Improvement of care across nearly all measures, despite no consistent associations between processes of care or physician characteristics with improvement, suggests that participation in QI itself may lead to higher quality health care and this may be achieved through MC-FP.*

Key Words: *maintenance of certification/licensure, quality improvement/Six Sigma/TQM, evaluation-educational intervention*

Introduction

Diabetes is a leading cause of morbidity in the United States and a major cause of heart disease and stroke.[1,2] Health care expenditures for diabetes are estimated to be 12% of all worldwide health care spending.[3] Despite the significant expenditures on diabetes, the quality of care for diabetic patients in the United States is low[4,5] but has been improving.[6] A new focus on measuring and reporting quality of care has emerged, with payers and policy makers proposing altering payment based on measurement and/or demonstration of quality of care.[7,8]

The Chronic Care Model has served as a framework for interventions to improve the quality of care for chronic conditions, such as diabetes, and has 6 components; self-management support, delivery system redesign, decision support, clinical information systems, the health care system, and community resources and policies.[9] A recent systematic review of use of the Chronic Care Model–based interventions to improve diabetes care found that its use is generally associated with higher-quality care.[10] A prominent finding of this review was that many studies found that training physicians on how to implement evidence-based care was associated with both improved patient engagement and better outcomes. This is important, as many physicians were not trained in

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quality improvement (QI) methodology during residency. QI training in residency is associated with increased QI activity in practice among family physicians,[11] but already practicing physicians, particularly those in small practices, need a pathway to learn QI methods in order to improve the care they deliver.

All American Board of Medical Specialties (ABMS) member boards have adopted the maintenance of certification framework to certify their diplomates, with the goal of improving health and the quality of health care. Part 4 of the American Board of Family Medicine's (ABFM) Maintenance of Certification for Family Physicians (MC-FP) process requires family physicians to perform a QI project. To complete this requirement, physicians measure the quality of care they provide, report it to the ABFM and receive comparative feedback, plan and execute an intervention, and then remeasure and report their outcomes, again receiving comparative feedback. To meet MC-FP requirements, family physicians complete a Part 4 activity at least once every 3 years. Participation in MC-FP remains high, with over 85% of the nearly 82 000 ABFM diplomates engaged.[12,13] Since 2005, when the ABFM introduced its Web-based Part 4 Performance in Practice Modules (PPMs), family physicians have completed over 45 000 ABFM-produced Part 4 activities, with the diabetes module being the most frequently performed. The objective of our study was to characterize the actions and practice outcomes of the ABFM diplomates who have completed the ABFM Diabetes PPM since its inception.

Methods

Quality Measures in the Diabetes Performance in Practice Module

Quality measures used in the PPM were National Quality Forum (NQF) endorsed and included (1) foot examination, (2) assessment of the presence of microalbuminuria, (3) hemoglobin A_{1c} measurement, (4) blood pressure measurement, (5) smoking cessation counseling for smokers, (6) retina examination, and (7) low-density lipoprotein (LDL) measurement. Patients whose measures are reported are also surveyed and asked the following:

1. Do you know your goal blood pressure?
2. Has your doctor checked your urine for signs of diabetic kidney disease this year?
3. If you smoke, has your doctor talked to you about quitting?
4. Have you had your A_{1c} checked in the last 6 months?
5. Did the doctor check your blood pressure during today's visit?
6. Have you had an eye exam in the last 12 months?
7. Have you had your cholesterol checked in the past year?

Completion of Performance in Practice Module

The PPM is completed on-line. Due to concerns of legal discoverability of quality data, limited physician demographic information is moved over to the PPM database. Once the PPM is complete, the link between the physician and PPM is broken in the ABFM database. This necessary step makes it difficult to study the relationship between PPM outcomes and the full range of physician and practice characteristics. The remainder of the PPM process resembles a plan-do-study-act (PDSA) cycle. First, the physician gathers data about the next 10 patients they see who have diabetes. These patients complete a survey to gauge their knowledge of their health care goals and severity of disease and report their responses to the questions noted above. The data are then uploaded via a secure ABFM Web portal, and the physician is provided a "quality dashboard" that compares their performance on all abstracted quality indicators to all physicians who have previously completed the PPM. Next, physicians select at least 1 quality measure for improvement. Once the measure(s) is selected, the physician is guided through creating a QI plan that incorporates at least 2 intervention areas within the Chronic Care Model.[9] At least 1 clinical intervention must be selected within each chosen domain of the Chronic Care Model. Examples of interventions available within the PPM include flow sheets, patient care cards, staff education on blood pressure measurement, disease registry, and reminder systems. After physicians implement their interventions, they repeat the data-gathering and patient survey process on the next 10 patients they see with diabetes, who are not necessarily the same as the preintervention sample, and again receive comparative feedback. To allow for "rapid-cycle" projects, physicians may enter postintervention data in as little as 7 days after the initial data entry.

Physician Demographic Variables and Performance in Practice Module Data

Because the link between the physician and the PPM is broken on completion of the module, we had limited demographic data for the analyses. The available physician variables were age in years (calculated from date of birth to PPM start date), gender, date of residency graduation, years in practice, ZIP code, and number of recertifications. We determined urban, large rural, small rural, and isolated status by linking the ZIP code to the Rural-Urban Commuting Area Codes (RUCA) Version 2.0.[14]

Analytic Strategy

We analyzed data from all Diabetes PPM's completed from 2005 to 2012. We used the PPM as the unit of analysis, as physicians may repeat the PPM multiple times, and we

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were unable to control for this, given the inability to link each physician with their PPM. We excluded PPMs done by physicians in residency, those with incomplete quality data, and those residing outside the 50 states of the United States or Washington, DC. We used descriptive statistics to characterize available physician demographics and to calculate the mean or proportion of quality measures, counts of quality measures, Chronic Care Model domain, and intervention chosen. Statistical tests for differences between pre- and postinterventions were done using either *t*-tests or chi-square tests.

We performed a separate multiple regression analysis for each of the 7 chart-abstracted indicators and 8 patient survey quality indicators. For the chart-abstracted measures, these were operationalized as (1) hemoglobin A_{1c} value < 7.0; (2) LDL cholesterol < 100 mg/dL; (3) systolic blood pressure < 130 mm Hg and diastolic blood pressure < 90 mm Hg; (4) foot examination; (5) retina examination; (6) assessment of microalbuminuria; and (7) if the patient smoked, counseling them on smoking cessation. Patient survey quality measures were operationalized as (1) know goal blood pressure; (2) having your urine checked for signs of diabetic kidney disease this year; (3) if you smoke, being counseled on smoking cessation; (4) A_{1c} checked in the past 6 months; (5) blood pressure measurement during today's visit; (6) having an eye exam in the past 12 months; (7) having cholesterol checked in the past year; and (8) having your feet examined in the past 6 months. For each of these measures, an aggregate percentage was calculated for both pre- and postintervention measures and the change in percentage (between –1 and 1) was used as the outcome in linear regression models. The interpretation of the β-coefficient in these models is the percent change in the outcome associated with a unit increase, or having a characteristic as opposed to not, in an independent variable. For example, a β of 0.02 for "standing order" in the regression for A_{1c} would mean that using a standing order as an intervention was associated with a 2% increase in the proportion of patients with an A_{1c} < 7.0%.

Regression models included all of the available physician demographic data and days to PPM completion. All six Chronic Care Model domains were included in the models, with self-management support as the reference. For the physician-abstracted measures, we included a variable for each quality indicator, indicating if that measure was chosen for improvement. Our models also included specific interventions if they were chosen in at least 5% of the PPM's for that specific quality measure. To account for differences in baseline performance, we included in each regression the mean value of the regressed, preintervention quality measure. We also included dummy variables indicating the number of outcomes selected for improvement and the number of interventions chosen. Institutional Review Board approval was not sought since we were unable to link any PPM data to an individual physician and all data were deidentified and proprietary to the ABFM. We performed the analysis using SAS 9.3 (SAS Institute, Cary, NC) and R 2.15.2.

TABLE 1. Demographics of Physicians Who Completed the Diabetes Quality Improvement Module

Variable (n = 7,924 completed modules)	% or Mean
Age in years (SD)	48.2 (9.2)
Male gender	61.9
Years in practice (SD)	13.8 (9.1)
Number of recertifications (SD)	1.9 (1.4)
Days to complete quality improvement module (SD)	184.5 (168.2)
Setting	
Urban	76.9
Large rural	11.5
Small rural	7.8
Isolated	3.9

Results

We identified 7924 PPMs that met our inclusion criteria. The mean age of physicians completing the modules was 48.2 years; 61.9% were male; mean years in practice was 13.8; and they had recertified with the ABFM an average of 1.9 times (TABLE 1). The mean time to complete a PPM was 184.5 days.

Both patient-reported and physician-abstracted quality measures improved during the PPM (TABLES 2 and 3). Larger improvements were seen in measures with poorer quality prior to the intervention, foot exams and eye exams, in particular. The agreement between physician-abstracted and patient-reported outcomes was quite high; for foot exam preintervention, 68% physician reported and 77% patient reported and for smoking cessation, 87% versus 91%.

The results of the regression analyses of physician-abstracted quality measures are shown in TABLE 4 and patient-reported quality measures in TABLE 5. Quality performance preintervention was significantly (p values < 0.05) and negatively associated with postintervention in all of the regression models. The β coefficients of these variables were also clinically significant (β magnitude ranging from –0.31 to –0.93) indicating that 30% to 90% of the change in measures was associated with baseline line quality. The days it took to complete the PPM was statistically significant (p value < 0.05) in 8 of the 15 models and was always negative, indicating shorter project time was associated with more improvement. In only 5 outcome measures were any of the

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TABLE 2. Chart-Abstracted Pre- and Postintervention Quality Measures

	Percentage in control preintervention	Percentage in control postintervention
Hemoglobin A_{1c} in control (< 7.0)	57.4	61.3*
Foot exam	68.0	85.8*
Microalbuminuria	74.5	88.3*
Smoking cessation	87.1	93.1*
Retina exam	55.5	71.1*
Low-density lipoprotein (LDL) < 100 mg/dL	63.1	64.6*
Systolic blood pressure < 130 and diastolic blood pressure < 90	53.3	56.3*

*p value < 0.05.

TABLE 3. Patient Survey Pre- and Postintervention Quality Measures

	Pre	Post
Have you had your hemoglobin A_{1c} checked in the past 6 months?	92.4	95.9*
Has your doctor checked your feet in the past 6 months?	76.5	89.7*
When you see your doctor, is your blood pressure checked?	99.6	99.8*
Do you know your goal blood pressure (the blood pressure you should have for good health)?	77.0	85.9*
Has your doctor tested your urine for signs of diabetic kidney disease this year?	77.2	87.4*
Have you had an eye exam by an eye care professional in the past 12 months?	69.5	79.4*
If you smoke, has your doctor talked to you about quitting?	91.1	95.2*
Have you had your cholesterol checked in the past year?	94.0	96.6*

*p value < 0.05.

Chronic Care Model domains statistically significant, and these were negative in every instance. The outcome being chosen for improvement was statistically significant in only 4 regressions (physician-abstracted foot exam, retina exam, and microalbuminuria and patient-reported foot exam) and was positive when it was significant but the βs were moderate in size—0.02 to 0.08. This suggests that only 2% to 8% of improvement was due to selecting the measure. There were few "bleed-over" effects, where a quality measure chosen for improvement was also associated with improvement in a reported measure that was not chosen for improvement. This was most common with the foot exam, which was significant in physician-reported hemoglobin A_{1c}, LDL, and retina exam, as well as patient-reported retina exam. Number of quality indicators and number of interventions selected per PPM were rarely significant and all had small βs in both patient-reported and physician-abstracted quality measures. Specific interventions for a quality measures were rarely statistically significant, with the exception of physician-documented foot exam with standing order ($\beta = 0.04$), foot exam chart ($\beta = 0.02$), and posters ($\beta = 0.03$).

Discussion

With the exception of baseline performance, we found no consistent patterns of association between specific components of QI efforts done to meet MC-FP requirements and the resulting patient outcomes over multiple quality measures. Baseline performance was negatively associated with postintervention quality, meaning that better preperformance was associated with less improvement in the post-period possibly indicating a "ceiling effect," which can occur when there is little room for improvement. This lack of association between QI components and outcomes was surprising, given that we found significant improvement in all quality measures. This suggests that rather than specific elements predicting increased improvement in quality measures, the process of completing a QI project and the practice and workflow changes that accompany it may be more important than the specific QI project. This interpretation is supported by a meta-analysis of interventions to improve chronic care, over multiple conditions including diabetes, which demonstrated no single domain of the chronic care model resulted in improved outcomes.[15]

Our findings of overall improvement for QI interventions based on the Chronic Care Model are consistent with the overall results of a recent systematic review.[10] As to why care improved, the authors of the prior review concluded that incorporating multiple domains of the Chronic Care Model in the same intervention may improve change implementation. Our findings did not support this, as variables representing the number of Chronic Care Model domains chosen per quality measure were significant in only 1 of 15 models. However, this does not mean that specific domains of the Chronic Care Model are not important, just that no one domain is more important than another.

Rapid-cycle quality interventions with quick assessment and action have been shown to raise the quality of diabetes

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TABLE 4. Linear Regression of Associations Between Improvement in Physician Abstracted Quality Measures With Physician Characteristics and Characteristics of the Quality Improvement Intervention

	Hemoglobin A_{1c} value	Foot exam performed	Micro-albuminuria checked	Smoking cessation counseling performed	Retina exam performed	Low-density lipoprotein (LDL) < 100 mg/dL	Blood pressure in control
Variable	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
Intercept	**0.3636**	**0.4982**	**0.5326**	**0.8620**	**0.3791**	**0.3351**	**0.3135**
Gender							
Female	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Male	−0.0010	0.0046	**−0.0088**	−0.0096	−0.0026	**0.0108**	**−0.0161**
Location							
Urban	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Small rural	−0.0084	−0.0078	−0.0060	−0.0131	−0.0121	−0.0062	−0.0021
Large rural	−0.0004	−0.0023	−0.0090	−0.0045	−0.0039	**−0.0172**	−0.0050
Isolated	0.0075	−0.0060	**−0.0359**	**0.0050**	−0.0143	−0.0067	**−0.0224**
Age in years	−0.0006	**0.0021**	**0.0010**	−0.0002	**0.0015**	**−0.0012**	0.0002
Days to complete QI project	<0.0001	**−0.0001**	**<0.0001**	**<0.0001**	**−0.0001**	<0.0001	<0.0001
Number of recertifications	0.0052	−0.0044	**−0.0039**	−0.0025	−0.0057	**0.0104**	−0.0047
Years practicing	−0.0005	−0.0004	−0.0005	0.0004	**−0.0009**	**0.0006**	0.0006
CCM Category							
Self-management support	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Clinical information systems	0.0009	0.0001	0.0034	−0.0054	0.0040	0.0087	−0.0016
Community resources and policies	0.0045	−0.0015	0.0102	−0.0068	0.0158	0.0014	−0.0007
Decision support	−0.0082	−0.0119	−0.0031	−0.0053	**−0.0055**	0.0017	0.0025
Delivery system design	0.0004	−0.0046	−0.0053	−0.0079	−0.0175	0.0071	−0.0028
Health system	−0.0034	0.0007	−0.0005	−0.0087	−0.0026	0.0087	−0.0002
Indicator Chosen							
Smoking cessation	Reference	Reference	Reference	Reference	Reference	Reference	Reference
A_{1c}	−0.0013	−0.0062	0.0053	−0.0066	0.0064	0.0032	**0.0251**
Blood pressure	−0.0008	**−0.0196**	0.0022	−0.0004	**−0.0022**	0.0159	0.0369
Eye exam	−0.0027	**−0.0164**	−0.0041	−0.0009	**0.0473**	0.0004	0.0036
Foot exam	**−0.0136**	**0.0839**	−0.0049	-0.0006	**−0.0177**	**−0.0154**	-0.0108
LDL	−0.0137	**−0.0017**	0.0021	0.0080	0.0032	0.0290	0.0078
Microalbuminuria	**−0.0149**	−0.0105	**0.0438**	0.0015	**−0.0140**	**−0.0146**	**−0.0124**
Total number of combinations	0.0018	0.0026	−0.0008	0.0008	0.0019	−0.0003	<0.0001
Number of indicator interventions	0.0063	**−0.0207**	0.0063	−0.0337	−0.0100	0.0046	−0.0004
Preindicator control	**−0.4934**	**−0.6270**	**−0.5719**	**−0.8753**	**−0.4859**	**−0.4666**	**−0.5321**
Intervention Chosen							
Standing order	−0.0162	**0.0416**	0.0106		**0.0275**	−0.0117	−0.0035
Flow sheets	0.0136	0.0083	0.0156	0.0482	0.0139	−0.0266	−0.0107
Reminder system	−0.0300	0.0115	0.0049	0.0595	0.0094	−0.0318	0.0040

(*Continued*)

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TABLE 4. Continued

	Hemoglobin A_{1c} value	Foot exam performed	Micro-albuminuria checked	Smoking cessation counseling performed	Retina exam performed	Low-density lipoprotein (LDL) < 100 mg/dL	Blood pressure in control
Patient education	−0.0207	0.0091	−0.0771	0.0446	0.0143	−0.0036	0.0101
Patient and physician communication aids	−0.0054	**0.0094**	−0.0221	0.0396		−0.0045	−0.0101
Plan of care cards	−0.0089						
Chart stickers		0.0197					
Foot exam chart		**0.0239**	0.0059				
Patient care cards		0.0148		0.0633	0.0122	−0.0301	
Posters		**0.0344**					
Counseling tools				0.0450			
Group visits				−0.0187			
Referral to counseling/services				0.0083			
Tool for communication with ophthalmologist/eye education for physicians					0.0129		
Registry						0.0129	
Staff in-service training on blood pressure checks							0.0273

QI = quality improvement, CCM = Chronic Care Model, LDL = low-density lipoprotein.
*Bolded numbers are statistically significant with a p value < 0.05.

care in multiple settings.[16–18] Our finding that longer completion time was negatively associated with improvement may suggest improvement fatigue, lack of sustainability, or that shorter, rapid-cycle projects or multiple PDSA cycles are better for QI.

While we found that quality measures reported as part of MC-FP improved overall, most improvements were small and not clinically significant. Clinical significance of improvements associated with QI project remains elusive. A meta-analysis of interventions to improve glycemic control among patients with diabetes found that most QI strategies produced small to modest improvements in glycemic control. Further, across 66 trials included in the analysis, interventions reduced A_{1c} values by a mean of 0.42%.[19] The A_{1c} improvement in our study was 0.1% (not shown) which is smaller than the results reported in the meta-analysis.

This study is not without limitations. First, due to concerns over discoverability, we were unable to link to other data elements in the ABFM database, such as specific past PPMs or Self-Assessment Modules taken, or practice information. We also know that 3% of physicians have completed the Diabetes PPM twice, but we were unable to account for this due to the delinking of PPM and physician data, as described previously. We are actively working on ways to obtain protection from discoverability and the ability extract whole-panel patient data directly from electronic health records to enable richer analyses. Second, we were unable to include all physicians who completed the module because some physicians enter their data as aggregate quality measures pulled from an electronic health record or reports generated in other ways. Due to limits on physician-level data in the PPM database, we cannot accurately determine if these physicians are significantly different than physicians in our sample. Third, all data are self-reported by the physician. Previous work has shown that physicians can reliably abstract and report data for QI activities,[20,21] but the PPM captures only a small number of diabetic patients and may not accurately represent the quality of care they provide. However, agreement between patient-reported and physician-abstracted measures argue for the validity of the data. Some

TABLE 5. Linear Regression of Associations Between Improvement in Patient Reported Quality Measures With Physician Characteristics and Characteristics of the Quality Improvement Intervention

	Hemoglobin A_{1c} checked	Foot exam performed	Microalbuminuria checked	Smoking cessation performed	Retina exam performed	Low-density lipoprotein (LDL) checked	Blood pressure checked	Patient knows blood pressure goal
Variable	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate	Estimate
Intercept	**0.7059**	**0.6580**	**0.5476**	**0.8563**	**0.5215**	**0.7048**	**0.9328**	**0.5253**
Gender								
Female	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Male	**−0.0052**	−0.0038	−0.0076	−0.0062	−0.0038	**−0.0038**	−0.0006	0.0033
Location								
Urban	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Small rural	**−0.0080**	**−0.0209**	−0.0133	0.0015	**−0.0283**	**−0.0095**	−0.0005	−0.0122
Large rural	0.0024	−0.0008	**−0.1272**	0.0054	−0.0075	−0.0027	0.0005	0.0013
Isolated	−0.0056	**−0.0204**	**−0.0364**	0.0103	**−0.0296**	**−0.0015**	−0.0016	−0.0148
Age in years	**0.0004**	**0.0012**	**0.0016**	0.0004	**0.0012**	0.0003	0.0000	**0.0016**
Days to complete QI project	**<0.0001**	**<0.0001**	<0.0001	<0.0001	**<0.0001**	<0.0001	<0.0001	**−0.0001**
Number of recertifications	−0.0020	−0.0037	**−0.0084**	−0.0003	**−0.0063**	−0.0018	−0.0002	**−0.0092**
Years practicing	<0.0001	−0.0002	−0.0005	<0.0001	−0.0004	<0.0001	<0.0001	<0.0001
CCM Category								
Self-management support	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Clinical information systems	0.0015	−0.0074	−0.0024	0.0002	−0.0033	0.0008	0.0003	0.0033
Community resources and policies	0.0004	0.0008	−0.0005	−0.0076	0.0103	−0.0009	0.0011	−0.0047
Decision support	−0.0005	**−0.0120**	**−0.0106**	−0.0051	−0.0117	−0.0020	0.0007	**−0.0137**
Delivery system design	−0.0002	−0.0074	**−0.0129**	−0.0062	**−0.0199**	−0.0003	**0.0003**	**−0.0098**
Health system	0.0010	0.0007	-0.0028	-0.0042	-0.0057	0.0017	0.0001	**-0.0115**
Indicator Chosen								
Smoking cessation	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
A_{1c}	−0.0044	−0.0045	0.0039	−0.0039	−0.0017	0.0001	−0.0006	**0.0059**
Blood pressure	0.0060	0.0017	0.0070	0.0038	0.0013	0.0020	<0.0001	0.0217
Eye exam	−0.0013	−0.0081	−0.0017	−0.0102	−0.0099	−0.0022	<0.0001	0.0039
Foot exam	−0.0021	0.0157	−0.0063	−0.0081	**−0.0134**	−0.0017	−0.0002	−0.0071
LDL	−0.0044	−0.0057	0.0019	−0.0084	0.0127	0.0005	**−0.0015**	0.0021
Microalbuminuria	−0.0016	−0.0091	−0.0064	−0.0069	**−0.0113**	−0.0042	0.0001	−0.0015
Total number of combinations	0.0002	**0.0026**	0.0008	0.0016	0.0019	0.0003	<0.0001	0.0022
Number of indicator interventions	0.0054	−0.0077	0.0003	0.0010	−0.0074	0.0016	0.0007	−0.0104
Preindicator control	**−0.7320**	**−0.7354**	**−0.6240**	**−0.8893**	**−0.6305**	**−0.7249**	**−0.9351**	**−0.6319**
Intervention Chosen								
Standing order	−0.0074	0.0117	0.0091		**0.0228**	−0.0086	−0.0010	−0.0146
Flow sheets	−0.0124	−0.0039	0.0150	−0.0209	0.0145	−0.0060	−0.0004	−0.0085
Reminder system	−0.0014	0.0002	0.0134	−0.0598	0.0111	−0.0070	−0.0007	−0.0010

(*Continued*)

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TABLE 5. Continued

	Hemoglobin A_{1c} checked	Foot exam performed	Microalbuminuria checked	Smoking cessation performed	Retina exam performed	Low-density lipoprotein (LDL) checked	Blood pressure checked	Patient knows blood pressure goal
Patient education	0.0078	0.0095	0.0175	−0.0037	0.0158	−0.0009	−0.0001	0.0223
Patient and physician communication aids	−0.0099	−0.0011	0.0027	−0.0184		0.0114	−0.0008	0.0241
Plan of care cards	−0.0032							
Guidelines	−0.0129							
Chart stickers		0.0163						
Foot exam chart		0.0158						
Patient care cards		−0.0005	−0.0011	0.0100	**0.0226**	0.0050		
Posters		0.0116						
Counseling tools				−0.0072				
Group visits				−0.0163				
Referral to counseling/services				−0.0126				
Tool for communication with ophthalmologist/eye education for physicians					0.0125			
Registry						−0.0178		
Staff in-service training on blood pressure checks							0.0016	0.0156

QI = quality improvement, CCM = Chronic Care Model, LDL = low-density lipoprotein.
*Bolded numbers are statistically significant with a p value < 0.05.

may argue that physicians may select to report on only their "best" patients to make their quality of care look better. Previous work by the American Board of Internal Medicine found that physicians did not exhibit this behavior.[20,21] Additionally, there is no penalty for lack of improvement, so there is no external gain to the physician to alter the numbers.

Our study of nearly 8000 diabetes QI projects, completed by family physicians as part of their requirements for MC-FP, found clinical improvements of similar magnitude to prior studies.[19] Our main finding, that QI occurred without a consistent pattern of association with physician or QI project characteristics, argues that the QI process itself may be responsible for improvement and that physicians should continuously monitor quality and execute multiple, consecutive PDSA cycles to further improve the care they provide. As the largest providers of ambulatory care in the United States,[22] family physicians should embrace the use of QI as a method that not only meets MC-FP requirements but, more important, can improve the quality of care they deliver.

Lessons for Practice

- While we found no consistent patterns of associations between quality measures and specific components of QI projects, all quality measures improved.
- Maintenance of Certification for Family Physicians offers physicians tools and support for quality improvement, and the ABFM has commissioned new tools to promote group QI efforts to enable physicians working together, hopefully reinforcing the effect and extending QI.
- Despite the positive steps seen in our study, the need remains to capture a full range of measures corresponding QI interventions to add to our understanding of what improves care.

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