

Implementation of Patient-Centered Medical Homes in Adult Primary Care Practices

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Abstract

There has been relatively little empirical evidence about the effects of patient-centered medical home (PCMH) implementation on patient-related outcomes and costs. Using a longitudinal design and a large study group of 2,218 Michigan adult primary care practices, our study examined the following research questions: Is the level of, and change in, implementation of PCMH associated with medical surgical cost, preventive services utilization, and quality of care in the following year? Results indicated that both level and amount of change in practice implementation of PCMH are independently and positively associated with measures of quality of care and use of preventive services, after controlling for a variety of practice, patient cohort, and practice environmental characteristics. Results also indicate that lower overall medical and surgical costs are associated with higher levels of PCMH implementation, although change in PCMH implementation did not achieve statistical significance.

Keywords

PCMH, PCMH evaluation, primary care, implementation

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The “patient-centered medical home” (PCMH) is defined as a holistic and integrated model of primary care designed to improve the processes and outcomes of health care, including increasing value, improving responsiveness to patients, and improving outcomes in the areas of access, timeliness, patient-centeredness, safety, equity, and efficiency (Patient-Centered Primary Care Collaborative [PCPCC], 2007). The recently passed federal health care reform bill, the Patient Protection and Affordable Care Act (HR3590), includes federal PCMH demonstration programs, and PCMH implementation is underway in a wide variety of practice settings across the country (The Commonwealth Fund, 2012; Fields, Leshen, & Patel, 2010).

Recent research has provided some empirical evidence that PCMH has potential for improving patient-related outcomes and reducing costs (i.e., Alexander & Bae, 2012; Burton, Devers, & Berenson, 2012; Flottemesch et al., 2012; Friedberg, Schneider, Rosenthal, Volpp, & Werner, 2014; Hoff, Weller, & DePuccio, 2012; Homer et al., 2008; Kern, Edwards, & Kaushal, 2014; Nielsen et al., 2014; Paustian et al., 2014; Peikes et al., 2012; Roby et al., 2010; Rosenthal, 2008; Rosenthal et al., 2013; Starfield & Shi, 2004; Turchi, Gatto, & Antonelli, 2007; Werner, Duggan, Duey, Zhu, & Stuart, 2013).

Others have noted that the decision to adopt PCMH as model of care is merely the first step in the PCMH journey. The implementation of the PCMH model is not a given and can be challenging for physician practices. In complex, multifaceted interventions such as PCMH, the assessment of implementation is particularly important because the probability that all components of the PCMH model will not be fully implemented increases. Moreover, since PCMH is designed to function as a system of care, it remains unclear how partial implementation of the model will affect quality and costs (Carrier et al., 2009).

New Contribution

This research aims to assess the relationship between PCMH implementation and cost and quality outcomes, using an analytic sample of 2,218 Michigan primary care practices that is both geographically and sociodemographically diverse. It includes practices that operate in rural and urban areas, are both large and small, are centrally managed and independent, and are both well-off and underresourced. To advance understanding of PCMH implementation, we utilize a longitudinal design, an updated and validated PCMH implementation measure, and a sample of adult primary care practices that treat patients subject to both acute and chronic conditions to examine the following research questions:

Research Question 1: Is the level of implementation of the PCMH model associated with outcomes related to patient medical surgical cost, preventive services utilization, and quality of care in the following year?

Research Question 2: Controlling for previous implementation, are changes in implementation of PCMH over the course of a year associated with outcomes related to cost, use of preventive services, and quality of care during that year?

The article advances current research on PCMH by conceptualizing and measuring PCMH implementation as an incremental transformation in primary care practices and assessing the extent to which such incremental change is associated with quality and cost-related outcomes. This approach, the large, diverse sample of practices, and the extensive study period offers insight into how the “journey” toward PCMH can affect outcomes before full implementation is achieved and whether such impact is applicable across a broad range of primary care practice types and operating contexts. The study also accounts for the considerable evolution of primary care practices through merger and reorganization, which can potentially affect both PCMH implementation and generalizability in longitudinal studies.

Conceptual Framework

PCMH is a holistic, multifaceted model of care wherein the patient’s primary physician is responsible for providing all of the patient’s health care needs or appropriately arranging care with other qualified professionals. A team-based approach and use of information systems to enhance care are central tenets of the model. The PCMH model includes care for all stages of a disease, or across the life course (acute care, chronic care, preventive services, and end-of-life care). As a comprehensive approach to care, the PCMH model is designed to affect multiple patient outcomes (PCPCC, 2007).

Recent reviews of the literature on PCMH reveal a mixed, but generally positive, picture of PCMH effects on patient related outcomes. Medical home care has been associated with improvements in specific aspects of quality of care, notably enhanced prevention and chronic disease management (Hoff et al., 2012; Rosenthal et al., 2010; Alexander & Bae, 2012). Findings also suggest that PCMH can improve appropriate service utilization, patient satisfaction, and cost reduction (Alexander & Bae, 2012; Nielson et al., 2014). Results appear to be somewhat less clear, however, concerning the relationship between PCMH and other quality outcomes (Alexander & Bae, 2012; Burton et al., 2012; Hoff et al., 2012; Homer et al., 2008; Nielsen et al., 2014; Rosenthal, 2008; Starfield & Shi, 2004; Turchi et al., 2007).

Why should implementation make a difference in assessing PCMH effects? When an organization implements an innovation, it is intended to result in routine use of the innovation in order to improve performance (Klein & Sorra, 1996; Nutt, 1986; Nutting et al., 2010; Rogers, 2003). In practice, implementation refers to the processes and practices, such as staff training, financial rewards, and leaders’ communications, used by organizations to foster targeted organizational members’ skillful, consistent, and committed use of an innovation (Klein & Sorra, 1996; Nutt, 1986; Stewart et al., 2010). Furthermore, implementation of complex innovations, such as PCMH, often necessitate an approach that allows for changes in implementation processes and practices, and even in the innovation itself (Rogers, 2003; Crabtree et al., 2010), to obtain targeted organizational members’ desired innovation use (Noble, 1999).

Given the above complexities, implementation of new, innovative models of care, such as PCMH, can be demanding on both individuals and organizations, and is by

no means a given. It often requires sustained leadership, extensive training and support, robust measurement and data systems, realigned incentives and human resource practices, and cultural receptivity to change (Nembhard, Alexander, Hoff, & Ramanujam, 2009; Nutting et al., 2009; Friedberg et al., 2009). Furthermore, because implementation is rarely prescribed or standardized, physician practices may implement PCMH narrowly, focusing on a particular clinical condition, or broadly by employing the PCMH model as a standard way of conducting clinical practice and patient care across all conditions and patients. Furthermore, practices may embrace the PCMH model in wholesale fashion or choose to implement it more incrementally. Hence, practices may vary in the level with which they approach PCMH implementation. *Level*, in this case, refers to the extent or range of application of PCMH principles and methods within and across domains comprising the PCMH model of care and, as such, indicates the pervasiveness with which PCMH permeates organizational structures and routines.

Because PCMH implementation often requires changes to the basic structures or processes in physician practices, these changes often play out over different time intervals and not always in linear fashion. For example, many complex interventions, such as those requiring multiple changes in organizational process and structure, may need to be introduced and implemented incrementally and require more extended periods to actually demonstrate intended results. From a different perspective, newly implemented innovations are sometimes subject to entropy as organizational members revert to more familiar, long-standing routines and practices.

Finally, PCMH implementation can be significantly disrupted or enhanced by the frequent merger or reorganization of practices. This phenomenon is occurring at increasing rates as physician practices and health care systems consolidate and reorganize in response to the Affordable Care Act and competitive pressures. PCMH implementation in practices subject to such changes may be accelerated as more facilitative resources become available to them through increased size and personnel, or they may experience implementation setbacks as other priorities emerge or new, less supportive cultural contexts develop (Nutting et al., 2010). From a methodological perspective, previous work has demonstrated that practice changes, such as those described earlier, are common and affect both the definition of a practice, the determination of sample size, and perhaps most important, the ability to track transformational practice change over time (Markovitz et al., 2014).

To address the issue of PCMH implementation and practice performance, we employ a longitudinal design and a validated PCMH implementation instrument to assess the impact of PCMH implementation on three patient related outcomes—use of preventive services, quality of care, and cost of care. As a process innovation, we hypothesize that PCMH will affect the performance of an adopting physician practice most saliently when the practice modifies both its existing work routines and also the structures and practices that support those routines. It follows that practices that have more extensively implemented PCMH should see more benefit in terms of improved quality and reduced costs.

Method

Study Population

We examined a dynamic cohort of 2,218 nonpediatric Michigan primary care practices, defined as having at least one primary care physician (PCP). These practices were participants in Blue Cross Blue Shield of Michigan's (BCBSM) Physician Group Incentive Program (PGIP) between June 2009 and June 2012. PGIP is a voluntary incentive and payment reform program designed to support physician organizations and their affiliated practices achieve transformation and value-based care delivery (Share & Mason, 2012). Physician organizations, such as independent physician associations and integrated health systems, are legal entities consisting of members who are licensed to practice medicine as well as perform contractual functions, administer programs, and facilitate practice improvement. PGIP incentives are intended to support practice transformation activities such as the PCMH as well as collaborative quality initiatives involving nonprimary care specialists (Birkmeyer et al., 2013). The PCMH practice model within PGIP originated in 2008, was developed collaboratively with physician organization leaders based on the Joint Principles of the patient-centered medical home (PCPCC, 2007) and the Chronic Care Model (Bodenheimer, Wagner, & Grumbach, 2002). The model encompasses 13 care process domains considered important to achieving a PCMH (see Measures section). PCMH incentives support incremental implementation by providing financial incentives to physician organizations when their member practices implement PCMH capabilities.

In total, these practices contributed 5,451 observed practice years for the study time period. As discussed above, to account for changes in practice organization and physician practice affiliation, a practice was considered a new practice when (a) 25% or more of the physicians left a practice and the practice name changed or (b) the practice merged with another practice. Because of our interest in studying the effects of change in medical home capabilities over time, practices were only included in the study if they were present for two consecutive years. Practices were excluded from the analytic sample if more than one half of the physicians in the practice were nonprimary care specialists ($n = 41$), 80% of patients were below 18 years ($n = 329$), or missing data precluded full model specification ($n = 128$).

Data Sources. Data were obtained from: (a) The BCBSM Self-Reported Database (SRD), (b) BCBSM member enrolment and claims data, and (c) the 2010 U.S. Census and 2011 American Community Survey (ACS). Physician organizations report practice and physician information to BCBSM through the SRD semiannually. This database includes physician demographic information, physician organization and practice affiliation (i.e., the physician makeup within each practice), a PCP indicator, and practice PCMH capabilities. To address potential overreporting that may be encouraged through the PGIP incentive program, practices must demonstrate functional use of capabilities during site visits, such as a populated patient registry usable at the point of care. In 2012, 95% of self-reported capabilities were able to be demonstrated at 323 primary care practices randomly selected for site visits.

We used BCBSM enrolment information to obtain demographic data on members who received care at these practices and administrative claims data for the services received. A primary care attribution algorithm using administrative claims data was applied to determine the BCBSM commercial member cohort for each practice (see Appendix A). The BCBSM member cohort was restricted to those younger than 65 years because BCBSM's cohort of commercial members 65 years and older is small and likely not generalizable to the 65 years and older population.

Finally, items from the 2010 U.S. Census and 2011 ACS were incorporated to assess potential confounding from practice environment, socioeconomic, or demographic factors not available through the SRD or BCBSM administrative data.

Measures

PCMH Implementation Score. For each June reporting cycle from 2009 to 2012, a practice-level PCMH implementation score was created using information reported in the SRD on 115 capabilities consistently reported across 13 domains of PCMH functioning (see Appendix B for a full list of domains and capabilities). We used capability information to create a PCMH implementation measure in a multistage process. In the first stage, capabilities reported as "fully in place" were assigned a value of 1, while capabilities reported as "not in place" were assigned a value of 0. When capabilities had multiple gradients, the capability score was calculated as a proportion of the maximum gradient. For example, the Extended Access domain asked respondents to identify the percentage of appointments reserved for same day scheduling from the following options: 30% or 50%. A response of 30% implementation on same-day scheduling was assigned a value of 0.6 ($0.3/0.5$). Domain-specific scores were calculated by summing all capability scores within the domain and dividing by the maximum number of distinct capabilities within that domain (see Appendix C for an example of a domain-specific score calculation). Finally, we calculated the overall PCMH implementation score as the mean of all 13 domain-specific scores. Thus, a one-unit change in the overall PCMH implementation score corresponds to the difference between no implementation (0) and full implementation (1), although almost all practice-year values fall along the continuum between these two endpoints. This method intentionally gives equal scoring weight to each PCMH domain to avoid giving greater weight to domains with a greater number of capabilities.

Level of PCMH Implementation and Change in PCMH Implementation. We focused on 3 study years: July 2009 to June 2010, July 2010 to June 2011, and July 2011 to June 2012. Level of PCMH implementation was recorded as the PCMH implementation score in June preceding the study year. Change in PCMH implementation was recorded as the difference between the PCMH implementation score between consecutive June reporting periods. Thus, the estimated value for change in implementation is dependent on the level of PCMH implementation previously attained. The maximum combined value of the level of implementation and the change in implementation is one.

Cost and Quality Outcomes. Based on recommended outcomes to evaluate practice transformation, we constructed a single practice-level measure of cost and two composite measures of quality of care and preventive service use, respectively, for each practice year (The Commonwealth Fund, 2012; Higgins, Stewart, Dawson, & Bocchino, 2011; Jaén et al., 2010). Total combined medical and surgical allowed cost per member per month (PMPM) was calculated to assess cost of care. We opted for composite measures of quality and preventive service use over individual measures due to concerns about sufficient numbers of patients and heterogeneity in performance across individual measures (Scholle et al., 2009). Two composite quality and preventive measures were generated from Healthcare Effectiveness Data and Information Set and BCBSM-defined individual quality and preventive measures (Reeves et al., 2007; see Appendix D for a detailed description of these measures).

Practice Characteristics. Six practice characteristics were analyzed as covariates: practice size, primary care focus, BCBSM patient volume, physician turnover, number of years in the PGIP, and practice movement between physician organizations. Practice size was measured categorically based on total number of physicians, including specialists, in the practice as reported in the SRD. Practices were classified as “primary care-only” if only PCPs were present and “multispecialty” if both primary care and nonprimary care specialty physicians were present. Total BCBSM paid services delivered per PCP were calculated annually for each practice as a proxy for BCBSM volume within the practice. Average number of years that the practice’s PCPs participated in PGIP was used as the measure of the practice’s longevity in PGIP. Several measures were included in the model to account for stability of physician or organizational membership over the study period, both of which may affect the ability of a practice to implement PCMH in a consistent fashion or to sustain momentum in PCMH transformation. We measured physician turnover as the proportion of practice physicians who left the practice in each time period. A binary (0/1) indicator identified practices that changed physician organizations between practice years.

Patient Cohort Characteristics. We used the member enrolment information of each practice’s attributed member cohort to estimate the two practice-level patient characteristics: proportion of members who were female and mean prospective risk score (Igenix, 2009; OptumInsight®, 2013) for adult patients in the practice. The prospective risk score employs a large national database of aggregated claims and membership information to derive a numerical, diagnosis-based episode assessment used to predict future medical costs.

Practice Environment Characteristics. We examined six zip code-level practice environment characteristics and one physician organization characteristic to address additional sources of variation that might influence cost and quality outcomes. Zip code data from the 2010 U.S. Census were used to identify the percent of residents who were non-White or Hispanic and the percent of residents who lived in a rural area. Data from the 2011 ACS were used to capture median household income and percent

unemployment. BCBSM Provider Enrollment and Credentialing System, which captures 94% of actively licensed physicians in Michigan, and 2010 U.S. Census population estimates were used to measure total PCPs per 1,000 population estimated at the zip code level. We also calculated zip code-level BCBSM market share based on member subscriber addresses from BCBSM enrolment data and total estimated zip code population from 2010 U.S. Census. All zip code measures were weighted for each practice to account for the proportion of their care provided to members residing in each zip code. Physician organization size was measured as the total number of affiliated practices with at least one PCP.

Analytic Approach

The unit of analysis for our study was the primary care practice. We analyzed relationships between level of PCMH implementation, change in PCMH implementation, and three practice-level outcome measures using a dynamic cohort design, which allowed practices to enter and leave the study population over time and minimized the loss of observations due to practice mergers and splitting (Caplan, Lane, & Grimson, 1995; Kleinbaum, Kupper, & Morgenstern, 1982). These practice dynamics are important to the generalizability of the findings and practices affected by these changes account for approximately 20% of the practice years in the study population. Specifically, we applied multivariable cross-classified linear mixed models, incorporating a random effect for practice and a cumulative random effect for the physician organization. This model accounts for the longitudinal data, clustering of practices within physician organizations, and movement of practices between physician organizations to estimate the effects of PCMH implementation (Raudenbush & Bryk, 2001).

To assess the effects of level of PCMH implementation in combination with change in PCMH implementation, the models for each of the three outcomes included both the level of PCMH implementation, measured at the start of each study year, and the change in PCMH implementation that occurred during the study year. Effect estimates for level of PCMH implementation were interpreted as the expected difference in cost, quality, or preventive outcomes in the following year for practices with full PCMH implementation at the beginning of the study year compared with practices with no implementation at the beginning of the study year. Effect estimates for change in PCMH implementation were interpreted as the expected difference in cost, quality, or preventive outcomes for practices who achieved full PCMH implementation during the year without any preexisting PCMH infrastructure compared with practices with no PCMH implementation during the study year. All analyses were performed in SAS® Version 9.2 (SAS Institute, 2012).

Outcome-specific exclusion criteria were applied prior to constructing multivariable models. Practice years that failed to meet the minimum sample threshold of 50 members for cost measures or 30 denominator events for composite quality and preventive outcomes were excluded from their respective analyses. Practice years, where the cost outcome measure exceeded three interquartile range (IQR) units from the median or where the composite outcome measures exceeded two IQR units from the

median, were excluded from their respective analyses to minimize the impact of the tail of the distributions on parameter estimates (Carling, 2000; Schwertman, Owens, & Adnan, 2004).

We examined potential collinearity of predictor variables using Pearson correlation coefficients and then evaluated variable collinearity in the multivariable models. Median income of the population in the practice environment was dropped from the models due to collinearity with the unemployment rate.

Results

Three study years were examined: July 2009 to June 2010 (Year 1), July 2010 to June 2011 (Year 2), and July 2011 to June 2012 (Year 3). The mean (level) PCMH implementation score among participating nonpediatric primary care practices doubled between June 2009 and June 2011, from 0.20 ($SD = 0.15$) to 0.41 ($SD = 0.25$). The largest mean increases were seen in the following PCMH functional domains: preventive services (0.09-0.55), linkage to community services (0.07-0.50), and specialist referral process (0.07-0.50). However, the acceleration of capability implementation decreased over the study period. The mean change in implementation scores from June 2009 to June 2010 was 0.18 ($SD = 0.18$), while the mean change from June 2011 to June 2012 was 0.06 ($SD = 0.14$).

Among the three outcomes studied, PMPM cost showed the largest change during the study period. Mean PMPM cost for adults receiving care in study practices increased from \$413.00 ($SD = \262.85) from July 2009 through June 2010 to \$447.50 ($SD = \289.31) from July 2011 through June 2012. The average composite quality of care score remained consistent during the study period ($M = 75\%$, $SD = 10\%$), while the mean preventive services score decreased from 74.9% ($SD = 10.9\%$) to 71.9% ($SD = 12.2\%$), largely reflecting a decrease in the cervical cancer screening rate due to changes in clinical guidelines.

Most of the member, practice, and practice environment characteristics studied remained relatively stable during the study period (see Table 1). The number of practices eligible for the study increased over time, from 1,635 in June 2009 to 1,974 in June 2011, reflecting an increase in participation in the PGIP among Michigan PCPs. In all years of the study, solo physician practices made up the majority of practices (ranging from 57.2% to 58.6%), but were more likely to be excluded from analyses due to small sample sizes.

Table 2 shows estimates of the effect of PCMH across the entire study period using cross-classified models and for each study year using linear mixed models, adjusting for member, practice, and practice environment characteristics. Full multivariable model results are available in Appendices E to G.

Costs

The multivariable model of PMPM cost included 4,961 practice years of observation among 2,020 practices (see Table 3), excluding 375 practice years with insufficient

Table 1. Practice, Patient Cohort, and Practice Environment Characteristics of Primary Care Physician Practices Participating in the BCBSM Physician Group Incentive Program, July 2009 to June 2012.

	July 2009 to June 2010 (N = 1,635 practices)		July 2010 to June 2011 (N = 1,842 practices)		July 2011 to June 2012 (N = 1,974 practices)	
	Median	IQR	Median	IQR	Median	IQR
Outcomes						
Adult PMIPM cost	\$366.68	\$309.46-\$448.96	\$382.68	\$323.17-\$467.45	\$395.84	\$330.95-\$480.99
Adult quality composite	76.3%	69.9%-81.1%	76.4%	70.2%-81.5%	75.6%	69.6%-80.9%
Adult preventive composite	76.8%	69.2%-82.1%	75.4%	68.2%-81.1%	74.0%	66.7%-80.0%
Continuous variables						
PCMH score at beginning of time period	0.17	0.06-0.30	0.34	0.16-0.56	0.43	0.21-0.64
Change in PCMH score during time period	0.15	0.03-0.28	0.06	-0.01-0.18	0.03	0.00-0.11
Professional services per PCP in practice	1,549	868-2,492	1,487	857-2,445	1,440	813-2,397
Average number of years in PGIP for PCPs in practice	2.50	2.00-2.50	3.39	2.50-3.50	4.00	2.88-4.50
Turnover of physicians in practice during time period	0.00	0.00-0.00	0.00	0.00-0.00	0.00	0.00-0.00
Total practices in PO with a PCP	104	63-570	111	58-710	103	55-168
Percent BCBSM market share	32.9%	28.3%-37.0%	31.8%	26.2%-36.0%	31.1%	26.1%-35.0%
Percent of residents who are non-White or Hispanic	18.9%	10.9%-27.0%	18.0%	9.7%-25.9%	18.0%	9.8%-26.3%

(continued)

Table 1. (continued)

	July 2009 to June 2010 (N = 1,635 practices)		July 2010 to June 2011 (N = 1,842 practices)		July 2011 to June 2012 (N = 1,974 practices)	
	Median	IQR	Median	IQR	Median	IQR
Percent rural	17.4%	2.8%-41.5%	18.5%	3.0%-44.9%	18.0%	2.9%-42.9%
Percent of residents who are unemployed	11.8%	10.1%-14.0%	11.9%	10.1%-13.9%	12.0%	10.1%-13.9%
Number of PCPs per 1,000 residents	0.78	0.61-0.99	0.78	0.60-0.98	0.76	0.59-0.98
Percent of attributed members who are female	51.0%	46.0%-57.6%	51.0%	46.2%-57.9%	51.0%	45.8%-58.0%
Mean prospective risk score (adult)	1.59	1.43-1.81	1.75	1.56-2.00	1.74	1.54-2.03
Categorical variables	N	%	N	%	N	%
Practice size						
Solo physician practice	949	58.0	1,053	57.2	1,156	58.6
2-3 physicians	385	23.5	448	24.3	484	24.5
4-5 physicians	141	8.6	177	9.6	160	8.1
6 or more physicians	160	9.8	164	8.9	174	8.8
Practice specialty						
Primary care only	1,575	96.3	1,773	96.3	1,891	95.8
Multispecialty	60	3.7	69	3.7	83	4.2
Whether practice changed POs during time period						
No	1,582	96.8	1,692	91.9	1,718	87.0
Yes	53	3.2	150	8.1	256	13.0

Note. BCBSM = Blue Cross Blue Shield of Michigan; IQR = interquartile range; PMPM = per member per month; PCMH = patient-centered medical home; PO = physician organization; PCP = primary care physician.

Table 2. Multivariable Mixed Model Results: Medical Home Implementation and Adult Composite Quality of Care Measure, Composite Preventive Measure, and Per Member Per Month Medical and Surgical Costs.

Outcome variable	PCMH score at beginning of time period			Change in PCMH score during time period				
	Beta estimate	95% CI (lower)	95% CI (upper)	p Value	Beta estimate	95% CI (lower)	95% CI (upper)	p Value
Adult medical and surgical per member per month cost	-\$16.73	-\$30.66	-\$2.80	.02	-\$5.93	-\$20.41	\$8.56	.42
Adult quality composite measure	4.6%	3.3%	5.9%	<.001	4.0%	2.9%	5.1%	<.001
Adult preventive composite measure	4.0%	2.8%	5.2%	<.001	2.3%	1.3%	3.2%	<.001

Note. BCBSM = Blue Cross Blue Shield of Michigan; CI = confidence interval; PCMH = patient-centered medical home; PO = physician organization; PCP = primary care physician. Covariates included the following practice characteristics: mean prospective risk score for attributed adults, percent female attributed members, paid services per PCP, the average number of years that the physicians in the practice has participated in the Physician Group Incentive Program, the percentage of PCPs in the practice that left during the time period, practice size based on total physicians in the practice, practice as primary care only or mixed primary and specialty care, and whether the practice changed POs during the time period; and practice environment characteristics: total primary care practices in the physician organization, PCPs per 1,000 population, BCBSM market share, percentage non-White residents, and percentage of residents who lived in a rural area, and percentage of residents who were unemployed. Models also control for study year.

Table 3. Number of Blue Cross Blue Shield of Michigan's Physician Group Incentive Program Practices Eligible for Models by Outcome Variable of Interest, July 2009 to June 2012.

Study year	Number of practices eligible for adult per member per month cost model ^a	Number of practices eligible for adult quality composite model ^b	Number of practices eligible for adult preventive composite model ^c
July 2009 to June 2010	1,514	1,502	1,433
July 2010 to June 2011	1,678	1,692	1,615
July 2011 to June 2012	1,769	1,781	1,697
July 2009 to June 2012	2,020	2,050	1,944

a. Practice eligibility criteria: (1) participation in the BCBSM PGIP program for two consecutive years, (2) at least half of the physicians were primary care providers, (3) not a pediatric practice, (4) at least 50 adult members, (5) adult per member per month cost did not exceed outlier criteria of three interquartile range units from the median (\$797).

b. Practice eligibility criteria: (1) participation in the BCBSM PGIP program for two consecutive years, (2) at least half of the physicians were primary care providers, (3) not a pediatric practice, (4) at least 30 quality events, (5) adult quality composite score was not less than outlier criteria of two interquartile range units from the median (54.6%).

c. Practice eligibility criteria: (1) participation in the BCBSM PGIP program for two consecutive years, (2) at least half of the physicians were primary care providers, (3) not a pediatric practice, (4) at least 30 preventive events, (5) adult preventive composite score was not less than outlier criteria of two interquartile range units from the median (51.9%).

sample size and 115 that exceeded IQR thresholds. Practices included in the model had a median BCBSM patient panel size of 607 adults, ages 18 to 64 years. After multivariable adjustment, full PCMH implementation at the beginning of the study year was associated with a \$16.73 lower PMPM cost for adult patients in the following year compared with no level of PCMH implementation at the beginning of the study year ($p = .02$). This difference corresponds to a 4.4% (95% CI: [0.7%, 8.1%]) lower adult PMPM cost for practices with median population characteristics. Change in PCMH implementation was also associated with lower costs but the effect was not statistically significant ($p = .42$).

Quality of Care

In total, 2,050 practices were included in the multivariable model of quality of care, contributing 4,975 practice years (see Table 3). We excluded 335 practice years with insufficient sample size and 141 practice years that exceeded IQR thresholds. The median number of quality opportunities for practices included in the model was 340 per year. After multivariable adjustment, full PCMH implementation at the beginning of the study year was associated with a 4.6% higher quality composite score during the study year compared with no PCMH capabilities at the beginning of the study year ($p < .001$). With respect to change in PCMH implementation, achieving full

implementation during a study year without any preexisting PCMH infrastructure was associated with a 4.0% higher quality composite score compared with no PCMH capability implementation during the study year ($p < .001$).

Preventive Care

The multivariable model for the adult preventive composite measure included 4,745 practice years among 1,944 eligible practices (see Table 3), after excluding practice years with insufficient sample size ($n = 600$) or that exceeded IQR thresholds ($n = 106$). Practices included in the model had a median of 273 prevention opportunities per year. After multivariable adjustment, full PCMH implementation at the beginning of the study year was associated with a 4.0% higher preventive composite score in the study year compared with no PCMH implementation at the beginning of the study year ($p < .001$). Achieving full implementation during a study year from a starting level of zero PCMH implementation was associated with a 2.3% higher quality composite score compared with no capability implementation during the study year ($p < .001$).

Sensitivity Tests

To account for the possibility that findings may be influenced by systematic entry and exit of practices into the study group, we ran the models using only practices that were continuously eligible for the study for all 4 years. These models yielded similar results (results available on request).

Discussion

Our study examined whether, given the decision to pursue PCMH as a model of care, the level of implementation of PCMH in primary care practices is associated with quality and cost outcomes. Our results indicate that higher levels of PCMH implementation and the amount of PCMH change were positively associated with composite measures of quality of care and use of preventive services, after controlling for a range of practice, patient cohort, and practice environment characteristics. Although results also indicated lower overall medical and surgical costs for adults attributed to practices experiencing more change in PCMH capabilities, this finding did not achieve statistical significance. Results also indicate that partial implementation of the PCMH model may have benefits well before full PCMH implementation has been achieved, and these benefits are sustained as practices progress toward full implementation. Although the PCMH is intended to operate as a system of care, our findings suggest that even partial implementation of components of that system can result in improved patient care. Notably, these associations between PCMH and cost, quality, and preventive services measures were observed 3 years into the program, thus adding strength to the positive empirical evidence on PCMH effects, and partially alleviating concerns

about the sustainability and entropy of this type of practice change. These findings carry important implications since many practices may be reluctant to embrace PCMH given their concerns about disruption of care routines and the costs of major transformation in patient care systems. Furthermore, public and private funders of PCMH initiatives need supportive evidence on implementation and its impact to appropriately align payment models for PCMH.

Although our findings point to positive quality outcomes associated with change in PCMH implementation, cost measures did not conform as clearly to this pattern. This may reflect the proximal impact of change in implementation whereby initial improvements in quality are followed later by reductions in cost. Such explanations are consistent with PCMH emphasis on improved chronic care management and care coordination due to the higher chronic disease burden in adults. Our analysis was based on the assumption that a capability would achieve full effects one year after implementation, but this may vary by outcome and specific capability. Although our study of PCMH effects was of relatively longer duration, even longer study periods may be required before significant cost savings are achieved by practices undertaking PCMH. Further studies are needed to determine the appropriate time lag between PCMH implementation and anticipated effects.

Descriptively, our findings indicate that the pace of PCMH implementation declines somewhat over time. This may suggest that practices attack the “low-hanging fruit” initially, focusing on those PCMH capabilities that most easily fit into existing routines, while avoiding the more challenging changes. This has been supported by other studies that suggest that capabilities such as e-prescribing and automated test ordering are undertaken before more challenging capabilities such as e-visits and group visits (Bitton et al., 2012). In addition, practices may be less motivated to implement capabilities such as e-visits due to inadequate reimbursement models to financially support these activities. This decrease in momentum of implementation may also reflect change fatigue and indicate need for support systems such as practice coaching and shared learning, and that such support should be introduced at critical junctures during the transformation process.

Our analyses of the association between PCMH implementation and quality and cost-related outcomes estimate the potential effects of PCMH when full implementation is achieved. However, extrapolation of results observed at partial implementation to estimate full implementation effects should be interpreted cautiously as the relationship between these outcomes and PCMH implementation may change over more extended time periods, at higher levels of implementation, or as a function of PCMH assessment methods. Despite the extended time period of our study, no practices had yet achieved full implementation of PCMH, leaving open the possibility that extrapolation may not represent the effects of full implementation. As important, it suggests that practice transformation efforts such as PCMH are difficult and require long term commitment of time and resources. Finally, although the measurement instrument developed for the BCBSM program may not capture all elements crucial to creating a fully functional PCMH, it was developed with significant physician

input, incorporated the PCPCC guiding principles and was specifically designed to capture partial PCMH implementation and incremental PCMH changes under multiple implementation pathways.

Several additional strengths of this study are worth noting. First, practices in our sample encompass nearly two thirds of PCPs practicing in Michigan, span 82 of the 83 counties in Michigan, represent both small and large practices, urban and rural practices, practices within integrated systems, and practices loosely affiliated in independent physician associations. Although our study group is self-selected by virtue of participating in the PGI program, the size, diversity, and comprehensiveness of practice participants in Michigan allows detailed examination of PCMH implementation under a wide range of conditions. Indeed, recent literature suggests a need to evaluate PCMH in a broad array of practice settings with greater emphasis on the diversity of practices rather than the number of patients (Peikes et al., 2012).

Furthermore, our study group is more likely to reflect “real world” experience under a PCMH-related incentive program where some practices choose not to adopt PCMH, while others implement PCMH to varying degrees. Because common challenge for PCMH interventions is scaling the model to the larger population of physician practices, our analyses provides evidence that a practice model can still be effective even when a large, diverse population of practices take up a similar model using different implementation approaches. However, our analysis also illustrates the challenges of conducting large-scale, longitudinal evaluations of PCMH and other practice transformation efforts in the midst of significant consolidation and reorganizations in the population of primary care practices. Such changes make it difficult to track practices over time and limit the ability to apply traditional longitudinal designs requiring a fixed study population.

Further evaluation is needed to determine *how* PCMH affects both quality and costs. For example, what are the sources of utilization (e.g., emergency department, inpatient) affected by PCMH that contribute to lower costs? Does the association between PCMH and medical costs extend to pharmacy costs, and do these effects span multiple payers and different patient populations, including pediatric, 65 years and older, publically insured, and uninsured patients? Additional efforts should aim to understand which specific PCMH elements contribute to higher quality care and lower cost of care. Further research is also needed to determine whether these relationships span other quality measures, are limited to specific subsets of quality measures, or extend into additional health areas such as preconception care (Johnson et al., 2006). Diverse populations of practices, such as the one examined in this study, will allow for subsequent examination of these areas and address whether PCMH effects are universal across practices or dependent on the practice setting. It is important to note that all practices in the analysis have “adopted” the PCMH by virtue of participating in PGI. Because the identification strategy underlying the current study rests on between-practice differences in implementation, there may confounding stemming from factors that compel some practices to do more implementation and others to do less (such as differences in practice leadership and culture, which are not measured). Results should be considered in that context.

Finally, although statistically significant relationships between PCMH and quality measures were observed in this study, our results do not directly address the clinical significance of these relationships, an important distinction given the potentially high costs associated with implementing and maintaining a transformational change such as PCMH. Three points are relevant to this issue. First, many of our quality measures are based on established clinical guidelines strongly linked to improved health outcomes in other studies (Larsen, Horder, & Mogensen, 1990). Second, it may be premature to assess the cost effectiveness of PCMH as many study practices are still in the early stages of PCMH implementation and have not yet fully realized its clinical benefits. Third, even relatively small changes at the physician practice level may translate into important differences at the population level, assuming widespread implementation of PCMH.

If the cost savings and quality improvement relationships observed in this study are reinforced by additional evaluations of the PCMH model, further support for PCMH may be warranted. Implementing PCMH capabilities presents a considerable challenge for many primary care practices, with significant investment of time and expense (Nutting et al., 2011). Requiring primary care practices to shoulder this investment alone may severely limit PCMH implementation. Payers, purchasers, and providers should consider methods for sharing cost savings derived from PCMH implementation to provide further incentives to support ongoing efforts to implement the PCMH model. If cost savings and improved quality can indeed be obtained at intermediate stages of PCMH implementation, and sustained during more advanced stages of implementation, the potential for a permanent program of shared savings that support continuous improvements may well be viable.

Appendix A

Primary Care Relationship Attribution

The PCP Care Relationships algorithm is a retrospective assignment process jointly developed by the Clinical Epidemiology and Biostatistics Department at BCBSM and the Michigan PGIP Analytic Consortium. The primary care relationships used in this study represent the PCP considered most responsible for that member's primary care during the outcome time period based on relevant claims data.

Physician Eligibility. To be eligible for primary care relationships, a physician must either be credentialed in a primary care specialty (pediatrics, internal medicine, family medicine, general practice, geriatric medicine, adolescent medicine) or declare that they are functioning as a primary care provider if they are not credentialed in a primary care specialty. Physicians credentialed in a primary care specialty may declare that they are not functioning as a primary care provider and be ineligible to receive primary care assignments.

Member Eligibility. To be eligible for primary care relationships, a member must have had coverage with BCBSM at any time within the past 24 months.

Attribution Process. The process of assigning care relationships is an iterative process expanding either the time period or the contributing claims until the member is assigned to a PCP. The initial step is assignment based on the previous 12 months of evaluation and management claims for office and preventive visits in the outpatient setting. Ties between physicians are resolved based on the number of claims followed by the most recent visit. Overall, 75% of attributed members are assigned in this first step of the process. For members not assigned by the initial 12 months of claims, this process is repeated using 18 and 24 months of claims. These two additional steps account for 24% of attributed members assigned a primary care relationship. For members still not assigned, this process is repeated using preventive counseling and immunizations in addition to the evaluation and management services. If ties persist between physicians after all of these steps, the primary care relationship is assigned randomly among the tied physicians.

Appendix B

Capabilities Used to Calculate PCMH Implementation Scores, by PCMH Functional Domain.

Domain 1: Patient–Provider Partnership

- 1.1: Practice unit has developed PCMH-related patient communication tools, has trained staff, and is prepared to implement patient–provider partnership with each established patient, which may consist of a signed agreement or other documented patient communication process to establish patient–provider partnership.
- 1.2: Process of reaching out to established patients is underway, and practice unit is using a systematic approach to inform patients about PCMH, including patients who do not visit the practice regularly.
- 1.3: Patient–provider agreement or other documented patient communication process is implemented and documented for at least 10% of current patients.
- 1.4: Patient–provider agreement or other documented patient communication process is implemented and documented for at least 30% of current patients.
- 1.5: Patient–provider agreement or other documented patient communication process is implemented and documented for at least 50% of current patients.
- 1.6: Patient–provider agreement or other documented patient communication process is implemented and documented for at least 60% of current patients.
- 1.7: Patient–provider agreement or other documented patient communication process is implemented and documented for at least 80% of current patients.
- 1.8: Patient–provider agreement or other documented patient communication process is implemented and documented for at least 90% of current patients.

Domain 2: Patient Registry

- 2.1: A paper or electronic all-payer registry is being used to manage all established patients in the practice unit with diabetes.
- 2.2: Registry incorporates patient clinical information, for all established patients in the registry, for a substantial majority of health care services received at other sites that are necessary to manage chronic care and preventive services for the population.
- 2.3: Registry incorporates evidence-based care guidelines.
- 2.4: Registry information is available and in use by the practice unit team at the point of care.
- 2.5: Registry contains information on the individual-attributed practitioner for every patient currently in the registry who has a medical home in the practice unit.
- 2.6: Registry is being used to generate routine, systematic communication to patients regarding gaps in care.
- 2.7: Registry is being used to flag gaps in care for every patient currently in the registry.
- 2.9: Registry is fully electronic, comprehensive, and integrated, with analytic capabilities.

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Appendix B (continued)

- 2.10: Registry is being used to manage all patients with persistent asthma.
- 2.11: Registry is being used to manage all patients with coronary artery disease.
- 2.12: Registry is being used to manage all patients with congestive heart failure.
- 2.13: Registry is being used to manage patients with at least two other chronic conditions for which there are evidence-based guidelines and the need for ongoing population and patient management, and which are sufficiently prevalent in the practice to warrant inclusion in the registry based on the judgment of the practice leaders.
- 2.14: Registry incorporates preventive services guidelines and is being used to generate routine, systematic communication to all patients in the practice regarding needed preventive services.

Domain 3: Performance Reporting

- 3.1: Performance reports that allow tracking and comparison of results at a specific point in time across the population of patients are generated for diabetes.
- 3.2: Performance reports are generated at the population level, practice unit, and individual provider level.
- 3.3: Performance reports include patients with at least two other chronic conditions for which there are evidence-based guidelines and the need for ongoing population and patient management, and which are sufficiently prevalent in the practice to warrant inclusion in the registry based on the judgment of the practice leaders.
- 3.4: Data contained in performance reports have been fully validated and reconciled to ensure accuracy.
- 3.5: Trend reports are generated, enabling physicians and their POs/sub-POs to track, compare, and manage performance results for their population of patients over time.
- 3.7: Performance reports include all current patients in the practice, including well patients, and include data on preventive services.
- 3.8: Performance reports include patient clinical information for a substantial majority of health care services received at other sites that are necessary to manage chronic care and preventive services for the population.
- 3.9: Performance reports include information on services provided by specialists.
- 3.10: Performance reports are generated for the population of patients with persistent asthma.
- 3.11: Performance reports are generated for the population of patients with coronary artery disease.
- 3.12: Performance reports are generated for the population of patients with congestive heart failure.

Domain 4: Individual Care Management

- 4.1: Practice unit leaders and staff have been trained/educated and have comprehensive knowledge of the patient-centered medical home model, the Chronic Care model, and practice transformation concepts.
- 4.2: Practice unit has developed an integrated team of multidisciplinary providers and a systematic approach is in place to deliver coordinated care management services that address patients' full range of health care needs for at least one chronic condition.
- 4.3: Systematic approach is in place to ensure that evidence-based care guidelines are established and in use at the point of care by all team members of the practice unit.
- 4.5: Development of written action plan and goal setting is systematically offered to all patients with the chronic condition selected for initial focus, with substantive patient-specific and patient-friendly documentation provided to the patient.
- 4.6: A systematic approach is in place for appointment tracking and generation of reminders for all patients with the chronic condition selected for initial focus.
- 4.7: A systematic approach is in place to ensure that follow-up for needed services is provided for all patients with the chronic condition selected for initial focus.
- 4.8: Planned visits are offered to all patients with the chronic condition selected for initial focus.
- 4.9: Group visit option is available for all patients in the practice unit with the chronic condition selected for initial focus (as appropriate for the patient).
- 4.10: Medication review and management is provided at every visit for all patients with chronic conditions.
- 4.11: Action plan development and goal setting is systematically offered to all patients with chronic conditions or other complex health care needs prevalent in practice's patient population.
- 4.12: A systematic approach is in place for appointment tracking and generation of reminders for all patients.
- 4.13: A systematic approach is in place to ensure follow-up for needed services for all patients.
- 4.14: Planned visits are offered to all patients with chronic conditions prevalent in practice population.
- 4.15: Group visit option is available to all patients with chronic conditions prevalent in practice population.

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Appendix B (continued)

Domain 5: Extended Access

- 5.1: Patients have 24-hour access to a clinical decision maker by phone, and clinical decision maker has a feedback loop within 24 hours or next business day to the patient's PCMH.
- 5.2: Clinical decision maker accesses and updates patient's EMR or registry info during the phone call.
- 5.3: Provider has made arrangements for patients to have access to non-ED after-hours provider for urgent care needs during at least 8 after-hours per week and, if different from the PCMH office, after-hours provider has a feedback loop within 24 hours or next business day to the patient's PCMH.
- 5.4: A systematic approach is in place to ensure that all patients are fully informed about after-hours care availability and location, at the PCMH site as well as other after-hours care sites, including urgent care facilities, if applicable.
- 5.5: Practice unit has made arrangements for patients to have access to non-ED after-hours provider for urgent care needs (as defined under 5.3) during at least 12 after-hours per week.
- 5.6: Non-ED after-hours provider for urgent care accesses and updates the patient's EMR or patient's registry record during the visit.
- 5.7: Advanced access scheduling is in place, reserving at least 30% of appointments for same-day appointments for acute and routine care (i.e., any elective nonacute/urgent need, including physical exams and planned chronic care services, for established patients).
- 5.8: Advanced access scheduling is in place reserving at least 50% of appointments for same-day appointment for acute and routine care (i.e., any elective nonacute/urgent need, including physical exams and planned chronic care services, for established patients).
- 5.9: Practice unit has telephonic or other access to interpreter(s) for all languages common to practice's established patients.

Domain 6: Test Tracking and Follow-Up

- 6.1: Practice has test-tracking process/procedure documented, which requires tracking and follow-up for all tests and test results, with identified timeframes for notifying patients of results.
- 6.2: Systematic approach and identified timeframes are in place for ensuring patients receive needed tests and practice obtains results.
- 6.3: Process is in place for ensuring patient contact details are kept up to date.
- 6.4: Mechanism is in place for patients to obtain information about normal tests.
- 6.5: Systematic approach is used to inform patients about abnormal test results.
- 6.6: Systematic approach is used to ensure that patients with abnormal results receive the recommended follow-up care within defined timeframes.
- 6.7: Systematic approach is used to document all test tracking steps in the patient's medical record.
- 6.8: All clinicians and appropriate office staff are trained to ensure adherence to the test-tracking procedure; all training is documented either in personnel file or in training logs or records.
- 6.9: Practice has Computerized Order Entry integrated with automated test-tracking system.

Domain 8: E-Prescribing

- 8.1: E-prescribing system is in place and is used by physician champions in the practice unit.
- 8.2: E-prescribing system is in place and is used by all physicians in the practice unit.

Domain 9: Preventive Services

- 9.1: Primary prevention program is in place that focuses on identifying and educating patients about personal health behaviors to reduce their risk of disease and injury.
- 9.2: A systematic approach is in place to providing preventive services.
- 9.3: Strategies are in place to promote and conduct outreach regarding ongoing well care visits and screenings for all populations, consistent with guidelines for such age and gender-appropriate services promulgated by credible national organizations.
- 9.4: Practice has process in place to inquire about a patient's outside health encounters and has capability to incorporate information in patient tracking system or medical record.
- 9.5: Practice has a systematic approach in place to ensure the provision/documentation of tobacco use assessment tools and advice regarding smoking cessation.
- 9.6: Written standing order protocols are in place allowing practice unit care team members to authorize and deliver preventive services according to physician-approved protocol without examination by a clinician.

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Appendix B (continued)

- 9.7: Secondary prevention program is in place to identify and treat asymptomatic persons who have already developed risk factors or preclinical disease, but in whom the disease itself has not become clinically apparent.
- 9.8: Staff receives regular training and/or communications in health promotion and disease prevention and incorporates preventive-focused practices into ongoing administrative operations.

Domain 10: Linkage to Community Services

- 10.1: PO has conducted a comprehensive review of community resources for the geographic population that they serve, in conjunction with practice units.
- 10.2: PO maintains a community resource database based on input from practice units that serves as a central repository of information for all practice units.
- 10.3: PO in conjunction with practice units has established collaborative relationships with appropriate community-based agencies and organizations.
- 10.4: All members of practice unit care team involved in establishing care treatment plans have received training on community resources so that they can identify and refer patients appropriately.
- 10.5: Systematic approach is in place for educating all patients about community resources and assessing/discussing need for referral.
- 10.6: Systematic approach is in place for referring patients to community resources.
- 10.7: Systematic approach is in place for tracking referrals of high-risk patients to community resources made by the care team, and making every effort to ensure that patients complete the referral activity.
- 10.8: Systematic approach is in place for conducting follow-up with high-risk patients regarding any indicated next steps as an outcome of their referral to a community-based program or agency.

Domain 11: Self-Management Support

- 11.1: Member of clinical care team or PO is educated about and familiar with self-management support concepts and techniques and works with appropriate staff members at the practice unit at regular intervals to ensure they are educated in and able to actively use self-management support concepts and techniques.
- 11.2: Self-management support is offered to all patients with the chronic condition selected for initial focus (based on need, suitability, and patient interest).
- 11.3: Systematic follow-up occurs for all patients with the chronic condition selected for initial focus who are engaged in self-management support to discuss action plans and goals and provide supportive reminders.
- 11.4: Regular patient experience/satisfaction surveys are conducted for patients engaged in self-management support, to identify areas for improvement in the self-management support efforts.
- 11.5: Self-management support is offered to patients with all chronic conditions prevalent in the practice's patient population (based on need, suitability, and patient interest).
- 11.6: Systematic follow-up occurs for patients with all chronic conditions prevalent in the practice's patient population who are engaged in self-management support to discuss action plans and goals, and provide supportive reminders.
- 11.7: Support and guidance in establishing and working toward a self-management goal is offered to every patient, including well patients.

Domain 12: Patient Web Portal

- 12.1: Available vendor options for purchasing and implementing a patient web portal system have been evaluated.
- 12.2: PO or practice unit has assessed liability and safety issues involved in maintaining a patient web portal at any level and developed policies that allow for a safe and efficient exchange of information.
- 12.3: Ability for patients to request and schedule appointments electronically is activated and available to all patients.
- 12.4: Ability for patients to log and/or graphs results of self-administered tests (e.g., daily blood glucose levels) is activated and available to all patients.
- 12.5: Providers are automatically alerted by system regarding self-reported patient data that indicate a potential health issue.
- 12.6: Ability for patients to participate in e-visits is activated and available to all patients.
- 12.7: Providers are using patient portal to send automated care reminders, health education materials, links to community resources, educational websites, and self-management materials to patients electronically.
- 12.8: Patient portal system includes capability for patient to create personal health record, and is activated and available to all patients.
- 12.9: Ability for patients to review test results electronically is activated and available to all patients.
- 12.10: Ability for patients to request prescription renewals electronically is activated and available to all patients.

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Appendix B (continued)

Domain 13: Coordination of Care

- 13.1: For every patient with chronic condition selected for initial focus, mechanism is established for being notified of each patient admit and discharge or other type of encounter, at facilities with which the PCMH physician has admitting privileges or other ongoing relationships.
- 13.2: Process is in place for exchanging necessary medical records and discussing continued care arrangements with other providers, including facilities, for all patients with chronic condition selected for initial focus.
- 13.3: Approach is in place to systematically track care-coordination activities for each patient with chronic condition selected for initial focus.
- 13.4: Process is in place to systematically flag for immediate attention any patient issue that indicates a potentially time-sensitive health issue for all patients with chronic condition selected for initial focus.
- 13.5: Process is in place to ensure that written transition plans are developed, in collaboration with patient and caregivers, where appropriate, for patients with chronic condition selected for initial focus who are leaving the practice (i.e., because they are moving, going into a long-term care facility, or choosing to leave the practice).
- 13.6: Process is in place to coordinate care with payer case manager for patients with complex or catastrophic conditions.
- 13.7: Practice has written procedures and/or guidelines on care-coordination processes, and appropriate members of care team are trained on care coordination processes and have clearly defined roles within that process.
- 13.8: Care coordination capabilities as defined in 13.1 to 13.7 are extended to all patients with chronic conditions that need care coordination assistance.
- 13.9: Coordination capabilities as defined in 13.1 to 13.7 are extended to all patients who need care coordination assistance.

Domain 14: Specialist Referral Process

- 14.1: Documented procedures are in place to guide each phase of the specialist referral process—including desired timeframes for appointment and information exchange—for preferred or high volume providers.
- 14.2: Documented procedures are in place to guide each phase of the specialist referral process—including desired timeframes for appointment and information exchange—for other key providers.
- 14.3: PO or practice unit has developed specialist referral materials supportive of process and individual patient needs.
- 14.4: Practice unit or designee routinely makes specialist appointments on behalf of patients.
- 14.5: Each facet of the interaction between preferred/high-volume specialists and the PCPs at the practice unit level is automated by using electronically based tools and processes to avoid duplication of testing and prescribing across multiple care settings.
- 14.6: For all specialist and subspecialist visits deemed important to the patient's well-being, process is in place to determine whether or not patients completed the specialist referral in a timely manner, reasons they did not seek care if applicable, additional subspecialist visits that occurred, specialist recommendations, and whether patients received recommended services.
- 14.7: Appropriate practice unit staff is trained on all aspects of the specialist referral process.

Note. PCMH = patient-centered medical home; PO = physician organization; EMR = electronic medical record; ED = emergency department; PCP = primary care physician.

Sources for capability descriptions.

Mason, M. Patient-Centered Medical Home Initiative Plans, 2009 Program Year: BCBSM Department of Health Care Value; March 2009.

Mason, M. Patient-Centered Medical Home Interpretive Guidelines, September 2010: BCBSM Department of Health Care Value; September 2010.

Mason, M. Patient-Centered Medical Home Interpretive Guidelines, 2011-2012: BCBSM Department of Health Care Value; July 2011.

Mason, M. Patient-Centered Medical Home and Patient-Centered Medical Home-Neighbor Interpretive Guidelines, 2012-2013: BCBSM Department of Health Care Value; September 2012.

Appendix C

Example Showing Capability and Domain Scoring for the Extended Access PCMH Functional Domain (Domain Number 5), July 2009 to July 2012.

Capability	Capability status	Capability score	Maximum score	Extended access domain score
5.1: Patients have 24-hour access to a clinical decision maker by phone, and clinical decision maker has a feedback loop within 24 hours or next business day to the patient's PCMH.	In place	1	1	5.6/7 = 0.8
5.2: Clinical decision maker accesses and updates patient's EMR or registry info during the phone call.	Not in place	0	1	
5.3: Provider has made arrangements for patients to have access to non-ED after-hours provider for urgent care needs during at least 8 after-hours per week and, if different from the PCMH office, after-hours provider has a feedback loop within 24 hours or next business day to the patient's PCMH.	In place	12/12 = 1	12	
5.5: Practice unit has made arrangements for patients to have access to non-ED after-hours provider for urgent care needs (as defined under 5.3) during at least 12 after-hours per week.	In place			
5.4: A systematic approach is in place to ensure that all patients are fully informed about after-hours care availability and location, at the PCMH site as well as other after-hours care sites, including urgent care facilities, if applicable.	In place	1	1	
5.6: Non-ED after-hours provider for urgent care accesses and updates the patient's EMR or patient's registry record during the visit.	In place	1	1	
5.7: Advanced access scheduling is in place, reserving at least 30% of appointments for same-day appointments for acute and routine care (i.e., any elective nonacute/urgent need, including physical exams and planned chronic care services, for established patients).	In place	0.3/0.5 = 0.6	0.5	
5.8: Advanced access scheduling is in place reserving at least 50% of appointments for same-day appointment for acute and routine care (i.e., any elective nonacute/urgent need, including physical exams and planned chronic care services, for established patients).	Not in place			
5.9: Practice unit has telephonic or other access to interpreter(s) for all languages common to practice's established patients.	In place	1	1	

Note. PCMH = patient-centered medical home; EMR = electronic medical record; ED = emergency department.

Appendix D

Individual Component Measures of Adult Quality and Preventive Composite Measures and Source Definition for Each Individual Component Measure.

Adult quality composite	Source definition
Diabetes	
HbA1c testing	HEDIS
LDL cholesterol screening	HEDIS
Nephropathy monitoring	HEDIS
Lipid lowering drug rate	BCBSM
ACE/ARB use with comorbid congestive heart failure	BCBSM
ACE/ARB use with comorbid nephropathy	BCBSM
ACE/ARB use with comorbid hypertension	BCBSM
Congestive heart failure	
Rate of ACE/ARB	BCBSM
ACE/ARB continuation and persistence	BCBSM
Coronary artery disease	
LDL cholesterol screening	BCBSM
Lipid lowering drug rate	BCBSM
Persistence of beta-blocker treatment after an acute myocardial infarction	HEDIS
Medication management	
Antidepressant medication management	HEDIS
Annual monitoring of patients on persistent medications	HEDIS
Additional measures	
Use of spirometry testing in assessment and diagnosis of chronic obstructive pulmonary disease	HEDIS
Use of imaging studies for low back pain	HEDIS
Avoidance of antibiotic treatment in adults with acute bronchitis	HEDIS
Adult preventive composite	Source definition
Breast cancer screening	HEDIS
Cervical cancer screening	HEDIS

Note. BCBSM = Blue Cross Blue Shield of Michigan; HEDIS = health effectiveness data and information set; ACE = angiotensin converting enzyme inhibitor; ARB = angiotensin receptor blocker; LDL = low density lipoprotein.

Appendix E

Multivariable Mixed Model Results for the Association Between Medical Home Implementation and Adult Medical and Surgical Per Member Per Month Costs in BCBSM PGIP Practices, July 2009 to June 2012.

Independent variable	Adult medical and surgical PMPM cost			
	Beta estimate	95% CI (lower)	95% CI (upper)	p Value
Practice PCMH implementation				
PCMH score at beginning of time period	-\$16.73	-\$30.66	-\$2.80	.0186
Change in PCMH score during time period	-\$5.93	-\$20.41	\$8.56	.4226

(continued)

Appendix E (continued)

Independent variable	Adult medical and surgical PMPM cost			
	Beta estimate	95% CI (lower)	95% CI (upper)	p Value
Effects over time				
Time period				
July 2009 to June 2010	Reference			
July 2010 to June 2011	-\$15.40	-\$22.55	-\$8.26	<.0001
July 2011 to June 2012	\$1.20	-\$8.75	\$11.15	.8127
Practice and patient characteristics				
Mean prospective risk score for adults (per unit)	\$203.26	\$195.01	\$211.51	<.0001
Percent female (per 10%)	-\$3.57	-\$6.16	-\$0.98	.0069
Professional services per PCP in practice (per 1,000)	-\$2.31	-\$3.99	-\$0.62	.0073
PCPs' average number of years in PGIP (per 1 year)	-\$0.57	-\$3.78	\$2.63	.7259
Turnover of physicians in practice (per 10%)	-\$0.04	-\$1.74	\$1.67	.9667
Practice size				
Solo physician practice	Reference			
2-3 physicians	\$14.34	\$7.84	\$20.84	<.0001
4-5 physicians	\$10.18	\$0.54	\$19.82	.0385
6 or more physicians	\$13.73	\$2.96	\$24.49	.0125
Practice specialty (reference = primary care only)	\$12.85	-\$0.25	\$25.95	.0545
Whether practice changed POs (reference = no)	-\$1.12	-\$10.46	\$8.22	.8141
PO and market characteristics				
Total practices in PO with a PCP (per 100)	-\$0.45	-\$2.55	\$1.66	.6763
Percent BCBSM market share (per 10%)	\$0.38	-\$6.28	\$7.04	.911
Percent non-White residents (per 10%)	\$4.08	\$0.65	\$7.51	.0196
Percent rural (per 10%)	\$4.10	\$2.48	\$5.71	<.0001
Percent unemployed residents (per 10%)	-\$1.69	-\$17.58	\$14.21	.8351
Number of PCPs per 1,000 residents	\$4.26	-\$6.70	\$15.22	.4461

Note. CI = confidence interval; BCBSM = Blue Cross Blue Shield of Michigan; PGIP = Physician Group Incentive Program; PCMH = patient-centered medical home; PMPM = per member per month; PCP = primary care physician; PO = physician organization.

Appendix F

Multivariable Mixed Model Results for the Association Between Medical Home Implementation and Adult Quality Composite in BCBSM PGIP Practices, July 2009 to June 2012.

Independent variable	Adult quality composite			
	Beta estimate	95% CI (lower)	95% CI (upper)	p Value
Practice PCMH implementation				
PCMH score at beginning of time period	4.6%	3.3%	6.0%	<.0001
Change in PCMH score during time period	4.0%	2.9%	5.0%	<.0001
Effects over time				
Time period				
July 2009 to June 2010	Reference			
July 2010 to June 2011	-0.5%	-1.0%	0.0%	.1007
July 2011 to June 2012	-1.3%	-2.1%	0.0%	.0053

(continued)

Appendix F (continued)

Independent variable	Adult quality composite			
	Beta estimate	95% CI (lower)	95% CI (upper)	p Value
Practice and patient characteristics				
Mean prospective risk score for adults (per unit)	2.5%	1.9%	3.0%	<.0001
Percent female (per 10%)	0.1%	-0.2%	0.0%	.5927
Professional services per PCP in practice (per 1,000)	-0.3%	-0.5%	0.0%	.0013
PCPs' average number of years in PGIP (per 1 year)	-0.2%	-0.5%	0.0%	.2452
Turnover of physicians in practice (per 10%)	0.0%	-0.1%	0.0%	.8616
Practice size				
Solo physician practice	Reference			
2-3 physicians	0.5%	-0.2%	1.0%	.1449
4-5 physicians	0.0%	-0.8%	1.0%	.925
6 or more physicians	0.4%	-0.6%	1.0%	.3921
Practice Specialty (reference = primary care only)	-0.6%	-1.6%	0.0%	.2701
Whether practice changed POs (reference = no)	0.9%	0.2%	2.0%	.0132
PO and market characteristics				
Total practices in PO with a PCP (per 100)	-0.4%	-0.5%	0.0%	<.0001
Percent BCBSM market share (per 10%)	0.3%	-0.3%	1.0%	.3437
Percent non-White residents (per 10%)	-0.2%	-0.5%	0.0%	.4
Percent rural (per 10%)	-0.1%	-0.3%	0.0%	.2642
Percent unemployed residents (per 10%)	-0.5%	-2.0%	1.0%	.4992
Number of PCPs per 1,000 residents	0.4%	-0.7%	1.0%	.5188

Note. BCBSM = Blue Cross Blue Shield of Michigan; PGIP = Physician Group Incentive Program; PCMH = patient-centered medical home; PMPM = per member per month; PCP = primary care physician; PO = physician organization.

Appendix G

Multivariable Mixed Model Results for the Association Between Medical Home Implementation and Adult Preventive Composite in BCBSM PGIP Practices, July 2009 to June 2012.

Independent variable	Adult preventive composite			
	Beta Estimate	95% CI (Lower)	95% CI (Upper)	p Value
Practice PCMH implementation				
PCMH score at beginning of time period	4.0%	2.8%	5.0%	<.0001
Change in PCMH score during time period	2.3%	1.3%	3.0%	<.0001
Effects over time				
Time period				
July 2009 to June 2010		Reference		
July 2010 to June 2011	-1.5%	-2.0%	-1.0%	<.0001
July 2011 to June 2012	-2.8%	-3.6%	-2.0%	<.0001
Practice and patient characteristics				
Mean prospective risk score for adults (per unit)	-0.4%	-1.1%	0.0%	.2582
Percent female (per 10%)	2.0%	1.8%	2.0%	<.0001
Professional services per PCP in practice (per 1,000)	0.2%	0.1%	0.0%	.0105
PCPs' average number of years in PGIP (per 1 year)	0.0%	-0.3%	0.0%	.9281
Turnover of physicians in practice (per 10%)	0.0%	-0.1%	0.0%	.5223

(continued)

Appendix G (continued)

Independent variable	Adult preventive composite			
	Beta Estimate	95% CI (Lower)	95% CI (Upper)	p Value
Practice size				
Solo physician practice		Reference		
2-3 physicians	0.6%	0.1%	1.0%	.0334
4-5 physicians	0.8%	0.0%	2.0%	.0625
6 or more physicians	1.3%	0.3%	2.0%	.0087
Practice Specialty (reference = primary care only)	-0.7%	-1.5%	0.0%	.1078
Whether practice changed POs (reference = no)	0.4%	-0.2%	1.0%	.1841
PO and market characteristics				
Total practices in PO with a PCP (per 100)	-0.2%	-0.3%	0.0%	.0039
Percent BCBSM market share (per 10%)	0.8%	0.2%	1.0%	.0079
Percent non-White residents (per 10%)	-0.4%	-0.8%	0.0%	.0355
Percent rural (per 10%)	0.0%	-0.2%	0.0%	.9561
Percent unemployed residents (per 10%)	-4.8%	-6.4%	-3.0%	<.0001
Number of PCPs per 1,000 residents	3.1%	2.0%	4.0%	<.0001

Note. CI = confidence interval; BCBSM = Blue Cross Blue Shield of Michigan; PGIP = Physician Group Incentive Program; PCMH = patient-centered medical home; PMPM = per member per month; PCP = primary care physician; PO = physician organization.

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