

Patient-Centered Medical Home Demonstration: A Prospective, Quasi-Experimental, Before and After Evaluation

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Improving the delivery of primary care is high on the healthcare reform agenda in the United States and other industrialized nations. Evidence shows that when health systems emphasize primary care, patients achieve better outcomes at lower cost.¹ Compared with other countries, US healthcare costs significantly more² and has large gaps in coverage, wide variation in quality, and poorer patient experiences.³ Primary care physicians leave the workforce sooner than specialists⁴ and complain of a hectic work environment,^{5,6} and fewer medical trainees choose primary care careers.⁷

The patient-centered medical home (PCMH), a new model of primary care, is widely regarded as a potential solution to these problems.^{8,9} This model of practice redesign emphasizes the core attributes of primary care (access, longitudinal relationships, comprehensiveness, and coordination), promotes the chronic care model, maximizes the use of advanced information technology, and aligns reimbursement methods with improved patient access and outcomes.¹⁰ Despite growing enthusiasm and desire that the PCMH be fast-tracked, more information on its performance is needed.¹¹ Based on early experiences from a national demonstration project, Nutting and colleagues caution that whole-practice transformation is required, even in highly motivated practices, along with significant resource investment.¹² We describe a multifaceted PCMH demonstration at Group Health Cooperative, a large, nonprofit integrated delivery system, and the changes observed in its first year.

SETTING AND CONTEXT

Group Health provides healthcare insurance and comprehensive care to approximately half a million residents in the northwestern United States. Twenty primary care clinics are located in western Washington State, where patients choose a primary care physician to guide and coordinate their care. These physicians (81.6% family physicians, 3.5% general internists, and 14.9% pediatricians) care for an average of 2300 patients and work in multidisciplinary teams. For every 3 physicians, the teams include 4 medical assistants (or licensed practical nurses), 1 registered nurse, 0.5 physician assistants (or nurse practitioners), and 0.3 clinical pharmacists. The primary care clinics have on-site pharmacies, laboratories, and radiology suites. A system of 4 specialty clinics, 6 urgent care/emergency

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Take-Away Points / e72
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Background: A patient-centered medical home (PCMH) demonstration was undertaken at 1 healthcare system, with the goals of improving patient experience, lessening staff burnout, improving quality, and reducing downstream costs. Five design principles guided development of the PCMH changes to staffing, scheduling, point-of-care, outreach, and management.

Objective: To report differences in patient experience, staff burnout, quality, utilization, and costs in the first year of the PCMH demonstration.

Study Design: Prospective before and after evaluation.

Methods: Baseline (2006) and 12-month (2007) measures were compared. Patient and staff experiences were measured using surveys from a random sample of patients and all staff at the PCMH and 2 control clinics. Automated data were used to measure and compare change components, quality, utilization, and costs for PCMH enrollees versus enrollees at 19 other clinics. Analyses included multivariate regressions for the different outcomes to account for baseline case mix.

Results: After adjusting for baseline, PCMH patients reported higher ratings than controls on 6 of 7 patient experience scales. For staff burnout, 10% of PCMH staff reported high emotional exhaustion at 12 months compared with 30% of controls, despite similar rates at baseline. PCMH patients also had gains in composite quality between 1.2% and 1.6% greater than those of other patients. PCMH patients used more e-mail, phone, and specialist visits, but fewer emergency services. At 12 months, there were no significant differences in overall costs.

Conclusions: A PCMH redesign can be associated with improvements in patient experience, clinician burnout, and quality without increasing overall cost.

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**For author information and disclosures,
see end of text.**

Take-Away Points

Redesign of a patient-centered medical home (PCMH) was done with the goals of improving patient experience, lessening staff burnout, improving quality, and reducing downstream costs.

- Compared with controls, PCMH patients had a better patient experience, improved quality, and PCMH staff experienced less burnout at 12 months.
- At 12 months, there was no significant differences in overall costs between the PCMH and control clinics.

Change Prerequisites

To allow the clinic to incorporate the design components into their daily work, Group Health made substantial workforce investments to reduce physician panels from an average of 2327 patients to 1800, expand the visits from 20 to

departments, and 7 hospitals (1 owned and operated and 6 contracted) support these primary care clinics.

Between 2002 and 2006, Group Health implemented a series of reforms to improve efficiency and access,¹³ including same-day appointment scheduling, direct access to some specialists, primary care redesign to enhance care efficiency, variable physician compensation (salaries with relative value unit [RVU] incentives), and an electronic medical record with a patient Web portal to enable patient e-mail, online medication refills, and record review. The reforms succeeded in improving patient access and satisfaction,^{14,15} but also increased physician workload, as evidenced by larger panel sizes, greater resource intensity per face-to-face visit, and increasing adoption of patient e-mail.¹⁶ These workload changes, combined with the implementation of the electronic medical record, resulted in fatigue and decreased work satisfaction.¹⁵ Relative reductions also were seen in nationally reported quality-of-care indicators as well as downstream utilization increases in specialty care, emergency care, and inpatient days.¹⁵

To counter these trends, Group Health sought to pilot a PCMH redesign in a single metropolitan Seattle clinic serving 9200 adult patients with the goal of spreading lessons learned to other clinics. (The pilot excluded pediatrics because the intervention clinic served relatively few children.) The clinic was chosen based on its modest size, leadership stability, and history of prior successful practice changes. The objectives of demonstration were to (1) maintain or enhance patient care experience, (2) reduce physician and care team burnout, (3) improve clinical quality scores, and (4) reduce emergency, specialty, and avoidable hospitalization use and costs.

PCMH DESIGN AND IMPLEMENTATION

Design Principles

Through 2 participatory design workshops involving leaders, providers, managers, and patients, 5 design principles were established to guide the selection and implementation of the design components. These principles were based on a review of the attributes of primary care,¹⁷ the chronic care model,¹⁸ and the medical home.^{8,9,19} **Table 1** provides details.

30 minutes, and allocate daily “desktop medicine” time for staff to perform outreach, coordination, and other activities. Compared with usual staffing, staffing was increased by 15% for physicians, 44% for physician assistants, 17% for registered nurses, 18% for medical assistants (or licensed practical nurses), and 72% for clinical pharmacists. To accommodate the panel size reductions, 25% of patients were reassigned to other physicians.

Change Components

Throughout 2007, clinic leaders and staff implemented a variety of point-of-care, outreach, and management changes to support the design principles (Table 1; see **Appendix A** for more details). Some components were developed de novo and others were available to all clinics, but emphasized at the PCMH clinic. Of particular note, the clinic systematized the use of team huddles, previsit outreach and chart review, and use of patient-centered quality deficiency reports. The PCMH clinic emphasized both e-mail and telephone encounters (as an alternative or complement to in-person visits), depending on patient abilities and preferences. Throughout the year, staff engaged in team-based rapid process improvements to refine and integrate the change components into their day-to-day work. Finally, physicians were paid by a salary-only model and were exempted from RVU-based adjustments.

METHODS

Evaluation Design

Using measures defined in advance, we designed a prospective, 2-group, before and after evaluation of the PCMH pilot during its first year of implementation (January 1 through December 31, 2007). We assessed and compared change components and outcomes at baseline and 12 months for patients and staff at the PCMH clinic compared with patients and staff at other clinics. We took advantage of automated clinical and administrative data for comparisons with all 19 other clinics on the PCMH change components, continuity, quality of care, utilization, and costs. By contrast, because of feasibility and cost constraints, we limited the comparisons for the survey-based measures (patient experience and staff burnout) to 2 control clinics, selected based on similarities in size, Medicare

Table 1. Patient-Centered Medical Home Design Principles and Change Components

PCMH Design Principles	
1. The relationship between the primary care physician and patient is at the core. The organization will align to promote and sustain this relationship.	
2. The primary care physician will be the leader of the clinical team, be responsible for coordination of services, and will collaborate with patients in care planning.	
3. Continuous healing relationships will be proactive and encompass all aspects of health and illness. Patients will be actively informed and encouraged to participate.	
4. Access will be centered on patients' needs, be available by various modes 24/7, and maximize the use of technology.	
5. Clinical and business systems will align to achieve the most efficient, satisfying, and effective patient experiences.	
Change Components^a	
Structural and Team Changes	
Smaller physician rosters	Longer standard visits time
Physician/medical assistant pairing	Automated phone call routing system
Team member colocation	Dedicated "desktop medicine" time
Point-of-Care Changes	
Communication of team roles to patients	Motivational interviewing techniques
Promotion of e-mail and phone visits	EMR "best practice alerts"
Previsit chart review and visit planning	EMR "health maintenance reminders"
Real-time specialist consulting via EMR	Promotion of patient Web portal functions
Collaborative care planning	Redirect consulting nurse calls to team
Patient Outreach Changes	
New patient outreach	Mailed "birthday reminder" care letters
Emergency visit and inpatient follow-up	Abnormal test outreach
Chronic disease medication outreach	Promotion of e-HRA
Outreach using care deficiency reports	Promotion of self-management workshops
Group visit outreach	
Management Changes	
Daily care team huddles	Rapid process improvement cycles
Visual reporting system to track changes	Salary-only physician compensation
PCMH indicates patient-centered medical home; e-HRA, electronic health risk assessment; EMR, electronic medical record. ^a See Appendix A for further details.	

enrollment, and leadership stability. All study procedures were approved by the Group Health Institutional Review Board.

Data Collection

Change Components. We assessed 8 change components that could be measured using automated data across all clinics during the baseline (2006) and implementation (2007) years (Appendix B). These components included the use of secure e-mail threads, telephone calls, group visits, and calls to the 24-hour consulting nurse service. (Although the PCMH sought to increase use of e-mail and calls to the care team, it sought to decrease nonemergent calls to the consulting nurse service by redirecting them to the care team when possible.) We also measured whether patients completed electronic health risk assessments (e-HRAs) and enrolled in peer-led

self-management support workshops.²⁰ Previsit outreach was assessed by identifying those patients who received a well-care visit during the study year and who received an e-mail in the 14 days before the visit. In order to exclude e-mail activity that was part of another care episode, we excluded patients with an in-person visit in the 30 days before their well-care visit. Emergency department follow-up was measured by the presence of a provider-initiated e-mail or a telephone call to a patient within 3 days of an emergency visit.

Because a main principle of the PCMH was to strengthen physician-patient relationships, we also compared continuity of primary care in the baseline and intervention years, using the Bice-Boxerman Continuity of Care (COC) Index.²¹ The COC Index measures the degree that care is concentrated with a single provider and accounts for the number of visits and different

providers seen. Because continuity measures may be spuriously elevated when patients make few visits,^{22,23} we limited this measure to adult patients with 3 or more visits in both study years.

Patient Experience. The sampling frame for the patient experience survey included insured adults age 21 to 85 years who were paneled at the PCMH or at 2 control clinics. Between September and December 2006, we randomly sampled 6187 adult enrollees by mailing them a questionnaire. Respondents were followed up at 12 months. Patient experience was assessed by using 5 domains of the Ambulatory Care Experiences Survey (ACES) Short Form: access, quality of doctor-patient interactions, shared decision making, coordination of care, and helpfulness of physician office staff.^{24,25} We supplemented the ACES with 2 subscales from the Patient Assessment of Chronic Illness Care (PACIC) survey²⁶: the degree to which patients reported being involved in their own care (patient activation/involvement) and the degree to which care teams helped set and refine healthcare goals (goal setting/tailoring).

Staff Burnout. Between October and December 2006, all staff with patient care responsibilities at the PCMH and 2 control clinics were asked to complete an online baseline survey; follow-up surveys were administered in November and December 2007. We used the 22-item Maslach Burnout Inventory to measure 3 dimensions of burnout: emotional exhaustion, depersonalization, and personal accomplishment.²⁷ In addition to using continuous variables, we grouped the scales into high, moderate, and low categories using normative cut points for medical workers.²⁷ Because of the small numbers of staff by type at the PCMH clinic, they were aggregated to 2 groups: physicians/physician assistants versus all other clinical staff.

Quality of Care. We used routinely collected clinical data to assess markers of quality of care for all adults enrolled at the PCMH clinic and the other 19 clinics in the baseline (2006) and implementation (2007) years. The markers included 22 indicators specified by the Healthcare Effectiveness Data and Information Set²⁸ (Appendix C). These indicators were selected because they are common measures of clinical quality and could be operationalized using automated data. The measures assess screening (4 measures), chronic illness care (14 measures), and medication monitoring (4 measures). We included the cohort of patients who were continuously enrolled (for at least 9 months in 2006 and 3 months in 2007) and qualified for at least 1 indicator in both years at the PCMH (n = 5442) and the 19 other clinics (n = 148,727). Because multiple indicators are unwieldy and different composites can lead to different conclusions,²⁹ we aggregated the indicators into 4 different composite measures with the patient as the unit of analysis (Appendix D). This measurement approach is consistent with the patient-centered orientation of the PCMH. The

“patient average” computes the percentage of indicators that were achieved for each patient. The 100% performance measure reflects the percentage of patients who achieved success on all qualifying indicators. The 75% and 50% composites are less stringent versions and assess the percentage of patients who achieved success on fewer indicators.

Utilization and Costs. Data on enrollees’ health services use and cost in the baseline (2006) and implementation (2007) years were obtained from a Group Health information system, which captures and allocates utilization and costs for all services at Group Health facilities and from external claims. The cost allocation system allows both the determination of costs of specific encounters and the aggregation of costs for individuals over time. Costs excluded from the allocation include those not directly related to delivering health services (eg, insurance costs) and patient out-of-pocket costs. Group Health collects nominal cost data that were annualized for individuals not enrolled in Group Health for the entire year using the formula: cost × (12/months enrolled). All reported costs are in 2005 inflation-adjusted US dollars using the local Medical Care Price Index from the US Bureau of Labor Statistics. All of PCMH implementation costs (ie, staffing costs) were allocated to patients enrolled at the PCMH clinic.

We compared utilization and cost in the implementation year between adult enrollees at the PCMH clinic and at the other 19 clinics on total cost, primary care, specialty care, emergency department, and inpatient care contacts and costs. The adult population included had at least 6 months of enrollment at Group Health at baseline and at least 3 months of enrollment in the implementation year. To account for the fact that enrollees may transfer between clinics, we defined the clinic location as the one where they were enrolled for the longest period during the implementation year. Primary care included all in-person visits to family physicians, general internists, physician assistants, and nurse practitioners. Specialty care included ambulatory visits to all other physicians except emergency medicine, which are allocated to the emergency department. Inpatient care included all professional and facility costs associated with at least 1 overnight hospital stay. We also examined inpatient utilization for “ambulatory care sensitive conditions,” where primary care can potentially prevent the need for hospitalization.³⁰

Analysis

For the surveys, we compared categorical patient and staff characteristics between the PCMH and 2 control clinics using 2 tests and continuous characteristics with *t* tests assuming unequal variances between clinic groups. To evaluate differences for the 7 patient experience scales at baseline, we performed linear regression adjusting for baseline age, educa-

tion, and self-reported health status. For differences at 12 months, we also adjusted for baseline scores. For the composite quality measures, we performed paired *t* tests to compare changes between baseline and implementation years for qualifying patients at the PCMH and 19 other clinics. We used 2-sample *t* tests, assuming unequal variances to compare average differences across the 2 years. To assess the frequency of use of e-mail, telephone visits, and consulting nurse calls, we used multivariate Poisson regressions, adjusting for overdispersion and for patient age, sex, and a diagnosis-based DxCG case-mix score,³¹ calculated with automated diagnosis data from the baseline year. DxCG scores group and weight diagnoses into clinical groups with similar resource expectations. Because use of group visits and self-management support workshops was relatively low throughout, we used multivariate logistic regressions to estimate relative risk, adjusting for the same patient characteristics and baseline attendance. For e-HRA use, previsit outreach, and emergency follow-up, which were prevalent, we used a modified Poisson regression with robust standard errors to estimate the relative risk.³² We applied the same modified Poisson regression with robust standard errors for the COC Index, choosing cut points of 0.33 (median) and 0.66 (75th percentile). For all change component models (including the COC Index), we adjusted for patient age, sex, DxCG score, and baseline. We compared annualized utilization in 2007 for patients at the PCMH and 19 other clinics using a multivariate Poisson regression, adjusting for overdispersion and case mix (age, sex, and DxCG scores). Models were used to estimate adjusted rate ratios of annualized utilization in the implementation year between the PCMH and other patients. We estimated annualized costs in 2007 and differences between patients at the PCMH and 19 other clinics using a multivariate linear regression (adjusting for age, sex, and annualized 2006 costs) with an error term from a gamma distribution to adjust for heteroskedastic residuals.³³ All analyses were performed using SAS version 9.1 (SAS Inc, Cary, NC) and Stata version 10 (StataCorp, College Station, TX). Two-tailed tests with *P* <.05 were considered statistically significant.

RESULTS

Change Components

At baseline, PCMH patients were on average 2 years older than patients at the other 19 clinics (mean age 53.0 vs 50.7 years; *P* <.001) and were less likely to be male (43.4% vs 44.9%; *P* <.001), but their mean DxCG scores did not differ (*P* = .378). After controlling for case mix, PCMH patients engaged in 94% more e-mail threads during the intervention year, 12% more telephone calls, and 10% fewer phone calls

to the consulting nurse service compared with other patients (Table 2). PCMH patients also were more likely to use group visits (relative risk = 5.9), self-management support workshops (relative risk = 2.16), and the e-HRA (relative risk = 4.53). Compared with other patients, PCMH patients with well-care visits were 9.8 times more likely to have an e-mail in the prior 14 days. Similarly, patients seen in the emergency department were 1.89 times more likely to have a telephone call or e-mail within 3 days after the visit. After adjusting for baseline, we also observed a small statistically significant increase (9%) in continuity of care at the PCMH compared with patients at the 19 other clinics. (This latter analysis was limited to patients with 3 or more in-person visits in both years.)

Patient Experience

Of the 6187 adults randomly sampled at the PCMH and 2 control clinics, we could not contact 57 (1%) patients due to invalid address, death, severe illness, or language barrier; 162 (3%) declined to participate; and we were unable to locate 2547 (41%). Among 3421 patients who returned the baseline survey (response rate = 55%), we excluded 5 who returned 2 surveys and 63 living with another respondent. Sex distribution did not differ between respondents and nonrespondents to the baseline survey. However, respondents were on average almost 10 years older than nonrespondents; therefore, they were more likely to have Medicare insurance, had a higher DxCG score, and had a longer enrollment history. However, differences between respondents and nonrespondents were similar at the PCMH and control clinics. Among the 3353 baseline respondents, the mean age was 60 years (SD = 15 years), 62% were female, 84% white, 3% Hispanic, 77% had at least some college education, and 18% reported being in fair to poor health. At 12 months, 2686 of the baseline respondents also returned the follow-up survey (response rate = 80%). The remainder did not complete the survey because of death or severe illness (10), disenrollment (72), refusal (56), or nonresponse (529).

Table 3 shows that, compared with controls, respondents to the 12-month survey at the PCMH clinic were on average 2 years older and more highly educated, and reported better overall general health at baseline. Table 4 shows the average scores on the 7 patient experience measures at baseline. After adjusting for baseline differences in age, education, and self-reported health status, PCMH patients reported significantly better experience with their care at baseline in the quality of doctor-patient interactions and access to care (*P* <.05). No significant differences were seen in the other scales.

Comparing 12 months with baseline, PCMH patients reported significantly higher scores on 4 of the 7 patient experience subscales (Table 4). In the control clinics, significantly higher scores were detected on 2 subscales. After adjusting

■ **Table 2.** Contrast in Adjusted Change Components at the PCMH and 19 Other Clinics

Change Component	PCMH Clinic (n = 8094)		19 Other Clinics (n = 228,510)		Comparison of Processes of Care at 12 Months Between PCMH and 19 Other Clinics ^a
	Baseline Adjusted Rate (SE)	12-Month Adjusted Rate (SE)	Baseline Adjusted Rate (SE)	12-Month Adjusted Rate (SE)	
E-mail and telephone contacts (per patient per year)^b					
Secure e-mail threads	0.83 (0.02)	2.25 (0.03)	0.70 (0.004)	1.16 (0.01)	1.94*
Telephone encounters	2.07 (0.02)	2.76 (0.03)	1.93 (0.01)	2.47 (0.01)	1.12*
Consulting nurse calls	0.95 (0.01)	1.04 (0.02)	0.83 (0.003)	1.16 (0.004)	0.90*
Care processes (% of patients per year)^c					
Group visit attendance	0.02 (0.01)	0.28 (0.04)	0.02 (0.01)	0.07 (0.01)	5.90*
Self-management support workshop enrollment	0.02 (0.01)	0.08 (0.02)	0.02 (0.01)	0.04 (0.01)	2.16*
Health risk assessment completion	0.82 (0.09)	25.4 (0.47)	1.79 (0.04)	5.70 (0.05)	4.53*
Previsit outreach (well-care visits only) ^d	6.37 (1.89)	31.2 (3.64)	0.88 (0.17)	2.77 (0.28)	9.83*
Emergency/urgent care follow-up ^e	22.6 (1.73)	55.1 (2.24)	24.4 (0.59)	29.3 (0.57)	1.89*
Continuity of Care Index^f					
≥0.33	69.0 (1.13)	68.4 (1.13)	65.2 (0.24)	62.8 (0.24)	1.09*
≥0.66	23.3 (1.04)	26.8 (1.08)	26.6 (0.22)	24.9 (0.22)	1.09**

PCMH indicates patient-centered medical home.
^a* indicates $P < .001$ and ** indicates $P < .05$.
^bFor secure e-mail threads and telephone contacts, adjusted rates and rate ratios at 12 months were estimated from a Poisson regression model adjusting for overdispersion and patient's age, sex, and DxCG score.
^cFor group visit and self-management support workshop attendance, adjusted percentages were estimated from a logistic regression model adjusting for patient's age, sex, and DxCG score. For the remaining 4 care processes, adjusted percentages were estimated from a modified Poisson regression model with robust standard errors adjusting for patient's age, sex, and DxCG score. The adjusted relative risks at 12 months comparing PCMH and other clinics were obtained from the respective models adjusting for patient's age, sex, DxCG score, and care process measure at baseline.
^dRestricted to adults who had a well-care visit in 2006 and 2007 with no visit in the 30 days prior.
^eRestricted to adults who had an emergency department visit in 2006 and 2007.
^fRestricted to adults at the PCMH who had at least 3 primary care visits in 2006 and 2007.

for age, educational attainment, self-reported health status, and baseline experience, PCMH patients reported significantly better care experiences on 6 of 7 subscales than controls, particularly for care coordination, access, and patient activation and involvement.

Staff Burnout

Baseline surveys were administered to all staff at the PCMH (n = 46) and 2 control clinics (n = 86), with the response rate higher at the PCMH than at the control clinics (87% vs 70%). At 12 months, follow-up surveys were administered to 99 clinical staff, and 82 responded (response rate = 83%). The percentage of respondents who were age 55 years or older was greater at the PCMH than at the control clinics, but no significant differences were seen in the percentage

who were female or the proportion who were physicians or physician assistants (Table 5).

At baseline, reports of emotional exhaustion did not differ significantly between the PCMH and control clinics, with one-third of all staff reporting high emotional exhaustion. At 12 months, emotional exhaustion was less frequent at the PCMH clinic, with only 10% reporting high burnout compared with 30% of controls. When physicians and physician assistants were examined separately, emotional exhaustion was similar at baseline for the PCMH and control clinics (mean 24.9% vs 28.3%; $P = .60$) but substantially less at the PCMH at follow-up (mean 14.2% vs 35.2%; $P < .001$).

Quality of Care

In the baseline year, 68.9% and 67.6% of adult patients

Evaluation of Patient-Centered Medical Home

Table 3. Demographic Characteristics of Patients Surveyed at the PCMH and 2 Control Clinics

Characteristic	PCMH Clinic	Control Clinics	P ^a
Completed 12-mo survey, n	1024	1662	
Age at baseline, mean (SD), y	61.4 (14.8)	58.8 (14.2)	<.001
Age groups in years, n (%)			
21-34	53 (5.2)	92 (5.5)	
35-44	81 (7.9)	179 (10.8)	
45-54	183 (17.9)	365 (22.0)	
55-64	240 (23.4)	427 (25.7)	
65-74	236 (23.0)	337 (20.3)	
75-85	231 (22.6)	262 (15.8)	<.001
Sex, n (%)			
Female	625 (61.0)	1042 (62.7)	.39
Educational attainment, n (%)			
High school or less	129 (12.6)	418 (25.2)	
Some college	304 (29.7)	641 (38.6)	
College graduate or postgraduate	566 (55.3)	587 (35.3)	
Unknown	25 (2.4)	16 (1.0)	<.001
Race, n (%)			
White	871 (85.1)	1394 (83.9)	
Nonwhite	127 (12.4)	229 (13.8)	
Unknown	26 (2.5)	39 (2.3)	.57
Ethnicity, n (%)			
Hispanic	24 (2.3)	62 (3.7)	.06
Self-reported health status at baseline, n (%)			
Excellent or very good	516 (50.4)	614 (36.9)	
Good	327 (31.9)	632 (38.0)	
Fair or poor	125 (12.2)	344 (20.7)	
Unknown	56 (5.5)	72 (4.3)	<.001

PCMH indicates patient-centered medical home.

^aP values are from χ^2 test comparing percentages and from t test comparing means between the PCMH and control clinics.

enrolled at the PCMH clinic and the 19 other clinics, respectively, qualified for at least 1 quality indicator (mean = 2.5; range = 0, 15). PCMH patients qualified for slightly fewer indicators than those at other clinics (mean = 1.80 vs 1.88), but this difference was not statistically different. **Table 6** compares the performance of the 4 composite measures created by aggregating these indicators. At baseline, we found that the PCMH clinic performed better on each of the composite measures compared with 19 other clinics ($P < .001$). For example, the average percentage of indicators achieved across patients at the PCMH clinic (“the patient average”) was 68% compared with 64% at other clinics. Regardless of the composite measure chosen, we found statistically significant improvements at the PCMH clinic ranging from 3.7% to

4.4% during the intervention year. Significant improvements (2.0%-2.7%) also were seen at the comparison clinics. Despite being higher at baseline, composite quality gains at the PCMH clinic were between 1.2% and 1.6% greater ($P < .05$) than those for patients enrolled in the other 19 clinics.

Utilization and Costs

Table 7 reports adjusted estimates for health services utilization in the implementation year (2007) for enrollees at the PCMH clinic compared with adults enrolled at the other 19 clinics. In comparison, PCMH patients received 6% fewer of the longer in-person primary care visits but 8% more specialty care visits ($P < .001$). PCMH patients also had 29% fewer emergency department visits than patients at other

Table 4. Comparison of Patient Experience at the PCMH and 2 Control Clinics at Baseline and 12-Month Follow-up

Patient Experience Subscales	PCMH Clinic (n = 1024)			Control Clinics (n = 1662)			Adjusted Mean Difference in 12-Month Scores Between Clinics ^{a,c}
	Baseline Mean	12-Month Mean	Mean Difference (12-Month vs Baseline) ^{a,b}	Baseline Mean	12-Month Mean	Mean Difference (12-Month vs Baseline) ^{a,b}	
Ambulatory Care Experiences Survey (ACES) Short Form^d							
Quality of doctor-patient interactions	86.1	88.0	1.52*	81.8	83.0	0.54	2.12**
Shared decision making	85.6	87.9	0.96	83.1	83.3	-0.18	2.76**
Coordination of care	81.3	84.4	2.82**	78.0	79.4	0.32	3.38***
Access	87.3	88.4	0.54	82.1	82.5	0.08	3.48***
Helpfulness of office staff	92.1	92.5	0.07	89.8	90.0	-0.19	1.36
Patient Assessment of Chronic Illness Care Survey (PACIC)^d							
Patient activation/involvement	77.4	82.0	4.06***	73.8	76.0	2.08*	3.30**
Goal setting/tailoring	69.1	74.7	4.74***	65.4	67.9	2.27**	3.10*

PCMH indicates patient-centered medical home.

^a* indicates $P < .05$, ** indicates $P < .01$, and *** indicates $P < .001$.

^b P value from paired t test for the average difference in scores between 12-month and baseline scores across all patients in the clinic.

^cAdjusted mean difference and P value from linear regression comparing average 12-month score adjusting for age, educational attainment, self-reported health status at baseline, and baseline patient experience between the PCMH and control clinics.

^dThe ACES Short Form and PACIC questions (scored on 6-point and 5-point Likert scales, respectively) were totaled within the subscales and then transformed to 100-point summary scores.

clinics ($P < .001$). Overall inpatient admissions did not differ significantly between the PCMH and other clinics, but patients at the PCMH clinic had 11% fewer hospitalizations for ambulatory-care-sensitive conditions ($P < .001$).

The cost results followed the same patterns as utilization, except for primary care costs, which were approximately \$16 more per patient per year for adults at the PCMH clinic than for those at other clinics, despite the fact that PCMH patients had fewer primary care visits. Specialty care also cost \$37 more for the PCMH clinic, although the difference was borderline significant ($P = .06$). However, we estimated that emergency department costs were \$54 less for the PCMH clinic. Totaling costs across all components of care, we found no statistically significant overall cost differences between the PCMH and other clinics.

DISCUSSION

In its first year of implementation, the PCMH demonstration delivered primary care very differently than 19 other clinics. In particular, adults at the PCMH experienced fewer in-person primary care visits (6%) than did patients in other clinics, but significantly more secure e-mail message exchanges (94%) and telephone calls (12%) with their care teams.

Slight increases also were seen in continuity of primary care, despite the necessity to repanel 25% of the patients to other physicians. We also witnessed early adoption of many of the PCMH change components including previsit outreach, emergency department follow-up, group visits, self-management support workshops, and e-HRA use.

Consistent with expectations,³⁴ we saw fewer out-of-office urgent contacts including telephone advice to consulting nurses (10%) and fewer emergent and urgent care visits (29%)—and early indications of a difference in the rate of hospitalizations for ambulatory-care-sensitive conditions (11%).³⁰ Unlike preliminary data from another PCMH demonstration that focused on Medicare enrollees,³⁵ we detected no reduction in the rate of all-cause admissions. This may be because discharge rates in the local area are in the bottom decile compared with other geographies across the country,³⁶ making such reductions unlikely. Alternatively, this effect may be most pronounced among older Medicare patients or because of differences in how the PCMH was designed and implemented. One unexpected and as-yet unexplained finding was the 8% greater use of specialty care visits compared with controls. The interface between a PCMH and specialty care may be particularly challenging, and we are studying this further.

Evaluation of Patient-Centered Medical Home

Table 5. Comparison of Staff Burnout at the PCMH Clinic and 2 Control Clinics at Baseline and 12-Month Follow-up

Characteristic	Baseline Survey			12-Month Follow-up Survey		
	PCMH Clinic (n = 40)	Control Clinic (n = 64)	P ^a	PCMH Clinic (n = 35)	Control Clinics (n = 47)	P ^a
Demographics, %						
Female	89.7	87.7	.76	88.6	80.0	.30
Age ≥55 y	35.9	14.3	.01	47.1	25.0	.04
Job category, %						
Physicians/physician assistants	30.8	16.1	.09	31.4	25.5	.60
Other clinical staff ^b	69.2	83.9		68.6	72.3	
MBI subscales, %^c						
Emotional exhaustion						
Mean (SD)	19.6 (11.4)	20.9 (10.4)	.60 ^d	12.7 (8.8)	21.0 (12.1)	<.01 ^d
High	33.3	34.5	.47	9.7	30.0	.02
Moderate	11.1	20.0		9.7	22.5	
Low	55.6	45.5		80.6	47.5	
Depersonalization						
Mean (SD)	3.4 (3.8)	3.9 (4.7)	.59 ^d	2.3 (3.0)	4.0 (4.1)	.06 ^d
Moderate or high ^e	25.0	23.2	.84	18.8	28.6	.33
Lack of personal accomplishment ^f						
Mean (SD)	5.9 (7.2)	6.0 (5.4)	.91 ^d	4.2 (3.3)	6.7 (5.7)	.02 ^d
Moderate or high ^e	25.0	19.6	.55	10.0	27.5	.07

PCMH indicates patient-centered medical home; MBI, 22-item Maslach Burnout Inventory.

^aχ² test, unless otherwise noted.

^bIncludes registered nurses, licensed practical nurses, medical assistants, pharmacists and technicians, laboratory technicians, physical and occupational therapists, nutritionists, and psychologists.

^cThe MBI questions are scored on a 5-point Likert scale and totaled within the subscales. The emotional exhaustion (9 questions), depersonalization (5 questions), and personal accomplishment (8 questions) subscales range from 0 to 54, 0 to 30, and 0 to 48, respectively.

^dTwo-sample *t* test assuming unequal variance.

^eThe moderate and high categories were aggregated because of small sample sizes.

^fThe MBI personal accomplishment subscale has been reverse coded so that a higher score implies greater burnout.

Changes in utilization resulted in no detectable net difference in mean total healthcare costs among individuals enrolled at the PCMH clinic compared with other patients. We estimated that significant investment of an estimated \$16 per patient per year was made in primary care (particularly for staffing), but it appears that this investment was recouped quickly (within 12 months), thanks to shifts in patients' care utilization, particularly in savings from less use of emergency care.

We also detected improvements in most aspects of patients' experience of care that we measured, including patient involvement in their care, goal setting and tailoring, and care coordination. We believe that these findings are relatively robust to Hawthorne effects, because patients were not generally informed of the practice redesign. Although the changes in patient experience seen were relatively small, they are notable

given the extent of patient repaneling, the number of practice changes implemented, and the fact that practice changes were made throughout the year.

In addition to systemwide improvements in quality, we found greater improvements in the composite measures of clinical quality at the PCMH, indicating improvements across multiple conditions and clinical situations. This finding is consistent with the PCMH objective of comprehensiveness, approaching care improvement from a patient-centered rather than a disease-centered perspective. During the implementation, all clinics were pressed to improve quality and patient experience, which may have narrowed our ability to detect larger changes comparing the PCMH and control clinics.

With fewer and longer in-person visits and more designated time to do outreach, primary healthcare teams seemed able at 12 months to integrate e-mail messages, telephone visits,

■ **Table 6.** Comparison of Changes in Composite Quality-of-Care Measures^a at the PCMH and 19 Other Clinics

Site	Patient Average, %	Performance, %		
		100 ^b	75	50
PCMH clinic (n = 5442)				
Baseline (2006)	68.1	51.0	56.9	75.9
Implementation (2007)	72.1	54.6	61.3	79.8
Change from 2006 to 2007 ^{c,d}	4.0*	3.7*	4.4*	3.9*
19 Other clinics (n = 148,727)				
Baseline (2006)	63.8	44.4	51.0	72.3
Implementation (2007)	66.5	46.4	53.7	74.9
Change from 2006 to 2007 ^{c,d}	2.6*	2.0*	2.7*	2.7*
Mean difference of changes from 2006 to 2007 between clinics^e	1.4**	1.6***	1.6***	1.2***

PCMH indicates patient-centered medical home.

^aSee Appendix D for definitions of composite quality measures.

^bThe 100% performance measure is sometimes called the “all-or-none” measure.

^c* indicates $P < .001$, ** indicates $P < .01$, and *** indicates $P < .05$.

^d P value from paired t test for the average change in percentages between baseline and implementation years across patients qualifying for the measures in the clinic.

^e P value from 2-sample t test assuming unequal variances for the average difference in changes from baseline to implementation years between the PCMH and other clinics.

■ **Table 7.** Contrast in Adjusted Utilization and Costs (per Patient per Year) in Implementation Year (2007) at the PCMH Clinic and 19 Other Clinics

Utilization or Cost	PCMH Clinic (n = 8094)	19 Other Clinics (n = 228,510)	Comparison of Utilization and Cost at 12 Months Between PCMH and 19 Other Clinics ^a
Utilization (contacts per member per year), adjusted rate (SE)^b			Adjusted Rate Ratio
Primary care contacts	2.70 (0.03)	2.88 (0.01)	0.94*
Specialty care contacts	2.32 (0.03)	2.16 (0.01)	1.08*
Emergency department/urgent care contacts	0.32 (0.007)	0.45 (0.002)	0.71*
Inpatient admissions (ACSC)	0.012 (0.0003)	0.013 (0.0001)	0.89*
Inpatient admissions (total)	0.10 (0.002)	0.10 (0.001)	1.03
Costs (dollars per member per year), adjusted mean (SE)^c			Adjusted Difference
Primary care costs	\$582 (\$7)	\$566 (\$2)	\$16**
Specialty care costs	\$1140 (\$21)	\$1104 (\$10)	\$37
Emergency department/urgent care	\$238 (\$6)	\$292 (\$4)	-\$54*
Inpatient costs (total)	\$2183 (\$108)	\$2174 (\$59)	\$9
Total costs	\$6089 (\$102)	\$6107 (\$61)	-\$17

ACSC indicates ambulatory-care-sensitive conditions; PCMH, patient-centered medical home.

^a* indicates $P < .001$ and ** indicates $P < .05$.

^bFor utilization, adjusted rates and rate ratios were estimated from a Poisson regression adjusting for overdispersion and patient’s age, sex, and DxCG score at baseline (2006).

^cFor costs, the adjusted means and differences in costs were estimated from a linear regression with an error term from a gamma distribution adjusting for patient’s age, sex, and baseline costs (2006).

Evaluation of Patient-Centered Medical Home

and proactive care activities into their everyday workflow. We showed a significant decline in provider burnout even among our small group of physicians. PCMH staff reported less than half the rates of emotional exhaustion compared with the controls at 12 months, and dramatically lower rates among physicians. This finding may be especially meaningful because burnout motivates many providers to leave primary care. Qualitative studies of PCMH provider experience revealed that after the first year they were experiencing a more supportive work environment, stronger connections to patients and to each other, and a greater sense of accomplishment from providing better care across multiple dimensions of quality (J. T. Tufano, MHA, J. D. Ralston, MD, MPH, P. Tarczy-Hornoch, MD, R. J. Reid, MD, PhD, unpublished data).

The main strength of our evaluation is that we had access to comprehensive data regarding a wide range of outcomes. The main limitations are the quasi-experimental evaluation design with the intervention conducted at a single clinic and the variable response rate to our surveys. We attempted to limit threats to internal validity by adjusting for baseline differences, but residual selection bias is possible. In addition, our evaluation was performed during the implementation year when practice changes were being made. We also recognize that the results may not be generalizable to other settings, particularly those located outside integrated systems and without electronic medical records. Similarly, due to the largely capitated nature of Group Health's enrollment and its largely salaried physicians, the applicability to fee-for-service settings is unclear. Furthermore, because the PCMH pilot included introducing and promoting many redesign components, we are unable to determine what intervention components were responsible for the effects.

CONCLUSION

Evaluation of a 12-month demonstration of a PCMH in an integrated group practice demonstrated significant improvements in patients' and providers' experiences and in the quality of clinical care. Despite the significant monetary investment in the PCMH redesign, the costs were recouped within the first year.

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Evaluation of Patient-Centered Medical Home

■ Appendix A. PCMH Change Components

Category	Component	Design Principle ^a	Description	PCMH Specific ^b	Evaluation Measure ^c
Structural Changes	Smaller physician poster sizes	1	Physician panel sizes reduced to 1800 by hiring more physicians and redistributing patients	✓	
	Increased in-person visit duration	1	Standard visit length increased from 20 to 30 minutes	✓	
	Increased care team staffing levels	1,2	Increased staffing for physician assistants, nurses, medical assistants, and clinical pharmacists	✓	
	Colocation of primary care team members	1,2	Team members colocated to facilitate communication and coordination	✓	
	Telephone call management	1,4,5	Call system implemented to direct incoming calls to care team at patient's request	✓	
	Consulting nurse call rerouting	1,4,5	Incoming consulting nurse service calls rerouted directly to care team during office hours	✓	✓
	Scheduled "desktop medicine" time	2,3,4	Dedicated time introduced for managing inbaskets, patient e-mail, phone calls, and outreach	✓	
Point-of-Care Process Changes	Care team "communications hub"	1,2	Nurse designated as team communications hub for team to facilitate coordination	✓	
	Physician/medical assistant pairing	1,2	Physician and medical assistants paired and meet regularly during day to plan daily activities	✓	
	Team role transparency for patients	1,3	Scripted messaging introduced for care team to inform patients of their role in supporting physician	✓	
	Motivational interviewing and brief negotiation	2,3	Physicians and team members trained in motivational interviewing and brief negotiation skills	✓	
	Promotion of patient Web portal functions of EMR	3,4,5	Patients actively encouraged to register for use of the Web portal to e-mail providers, book appointments and view lab results, visit summaries, and health information		
	Previsit chart review, outreach, and visit planning	2,3	Care team systematically reviews schedules to plan for upcoming visits. If necessary, patient contacted to clarify visit expectations	✓	✓
	Real-time specialist consultations via EMR	2,3,5	EMR messaging used for real-time specialist consultations during primary care visits	✓	
	Shared collaborative care plan	2,3	Collaborative care plans created with patient and viewable through patient EMR Web portal	✓	
	Promotion of e-mail visits	4,5	Patients encouraged to e-mail care team as an alternative or complement to inperson visits. E-mail also promoted for previsit outreach and after-visit follow-up		✓
	Promotion of telephone visits	4,5	Patients encouraged to phone care team as an alternative or complement to in-person visits. Telephone calls also promoted for previsit outreach and after-visit follow-up		✓
	EMR "best practice alerts"	3,5	Care team reviews EMR-generated clinical best practice alerts before visit		
EMR "health maintenance reminders"	3,5	Care team reviews EMR-generated screening and prevention reminders before visit			

(Continued)

■ MANAGERIAL ■

■ Appendix A. PCMH Change Components (Continued)

Category	Component	Design Principle ^a	Description	PCMH Specific ^b	Evaluation Measure ^c
Patient Outreach Changes	Chronic disease and prevention outreach using quality deficiency reports	3,5	Systematic review of quality “exception report” that tracks care deficiencies for each patient. Care team contacts patient to address these issues (eg, elevated BP, overdue Pap smear)		
	“Birthday reminder” mailings	3,5	Birthday reminders mailed to patients around their birthday, alerting them about prevention or chronic disease needs		
	Promotion of group visits	3	“Patients encouraged to join group visits. Groups comprise patients with common health interests (eg, older adults, persons with diabetes) and led by patient’s primary care physician		✓
	Promotion of chronic disease self-management support workshops	3,5	“Living Well with Chronic Conditions” workshops promoted to develop skills necessary for patients to self-manage health issues and work more effectively with care team		✓
	Systematic follow-up of emergency visits and hospital discharges by care team	2,3	Patients visiting ED, urgent care, or hospital systematically identified and phoned by care team to coordinate follow-up care	✓	✓
	New patient outreach	1,5	New patients systematically identified and invited for a welcome visit	✓	
	Pharmacy outreach	3,5	Clinical pharmacists systematically review patients on select medications who are poorly controlled. Outreach made to discuss medication adherence, intensification, or changes		
	Abnormal test result outreach	3,5	Abnormal test results systematically reviewed and patients contacted if necessary		
	e-HRA	1,3,5	Promotion of e-HRA to document health history and identify range of health needs		✓
	Management Process Changes	Daily team huddles	1,2,3,4,5	Teams meet daily to review issues, share successes and failures, problem solve, and plan	✓
Use of “visual display systems”		1,2,3,4,5	Performance reports and graphs are posted for team members to systematically review	✓	
Rapid process improvement cycles		1,2,3,4,5	Performance reports are used at huddles to check and adjust priority practice changes	✓	
Physician compensation model		1,5	Exemption from RVU-based variable compensation model for physicians	✓	

BP indicates blood pressure; ED, emergency department; e-HRA, electronic health risk assessment; EMR, electronic medical record; PCMH, patient-centered medical home; RVU, relative value unit.

^aFor definition of design principles, see Table 1.

^bChecked components developed as part of the medical home. The remaining components were available across all clinics, but their use was intensively promoted at the medical home.

^cEvaluation measures for the PCMH change components.

Evaluation of Patient-Centered Medical Home

■ Appendix B. Definition of PCMH Change Component Measures

PCMH Care Process	Denominator ^a	Numerator
Secure e-mail threads	Adult enrollees	No. of message threads in year
Telephone encounters	Adult enrollees	No. of telephone encounters in year
Consulting nurse calls	Adult enrollees	No. of consulting nurse calls in year
Group visits	Adult enrollees	Attended 1 or more primary care group visits in year (y, n)
Self-management support workshop enrollments	Adult enrollees	Attendance at 1 or more workshops in year (y, n)
HRA completions	Adult enrollees	Completed 1 or more HRAs in year (y, n)
Previsit outreach (well-care visits only)	Adult enrollees with well-care visit in year (and no in-person visit in prior 30 days)	Secure e-mail thread in the 14 days before a well-care visit (y, n)
Emergency department follow-up	Adult enrollees with emergency department visit in year	Secure e-mail thread or telephone encounter within 3 days of an emergency department visit (y, n)

HRA indicates health risk assessment; PCMH, patient-centered medical home.

^aAdult enrollees are defined as enrollees at Group Health who had at least 6 months of enrollment in the baseline year (2006) and were enrolled in December 2006 as well as at least 3 months of enrollment in the implementation year (2007).

■ **Appendix C. Quality Indicators Included in Composite Measures**

Measure	Description	No. of Eligible Patients (n = 154,169)
Asthma: appropriate medication use	Percentage of adults age 18-56 years identified as having persistent asthma and who were appropriately prescribed medication (eg, inhaled corticosteroids, leukotriene modifiers)	2527
Breast cancer screening	Percentage of women age 40-69 years who had a mammogram to screen for breast cancer	65,353
Cervical cancer screening	Percentage of women age 21-64 years who received 1 or more Pap tests to screen for cervical cancer	70,994
Chlamydia screening in women	Percentage of women age 16-24 years who were identified as sexually active and who had at least 1 test for Chlamydia	5226
Colorectal cancer screening	Percentage of adults age 50-80 years who had a screening with fecal occult blood testing, flexible sigmoidoscopy, double-contrast barium enema, or colonoscopy for colorectal cancer	104,841
Cholesterol management for patients with cardiovascular conditions: LDL-C screening	Percentage of adults age 18-75 years who had an acute myocardial infarction, coronary artery bypass graft, percutaneous transluminal coronary angioplasty, or ischemic vascular disease diagnosis who had LDL-C screening	4865
Cholesterol management for patients with cardiovascular conditions: LDL-C <100 mg/dL	Percentage of adults age 18-75 years who had an acute myocardial infarction, coronary artery bypass graft, percutaneous transluminal coronary angioplasty, or ischemic vascular disease diagnosis who had good LDL-C control (<100 mg/dL)	4865
Controlling high blood pressure	Percentage of adults age 18-85 years who had a diagnosis of hypertension and whose blood pressure was adequately controlled (<140/90 mm Hg)	34,974
Chronic obstructive pulmonary disease: use of spirometry	Percentage of adults age 40 years and older with a new diagnosis or newly active chronic obstructive pulmonary disease who received appropriate spirometry testing to confirm the diagnosis	3555
Depression: antidepressant medication management—effective acute-phase treatment	Percentage of adults age 18 years and older who were diagnosed with a new episode of major depression and were treated with antidepressant medication, and who remained on an antidepressant medication treatment for at least 84 days (12 weeks)	6461
Depression: antidepressant medication management—effective continuation-phase treatment	Percentage of adults age 18 years and older who were diagnosed with a new episode of major depression and treated with antidepressant medication, and who remained on an antidepressant medication treatment for at least 180 days (6 months)	6461
Diabetes mellitus: A1C testing	Percentage of adults age 18-75 years with diabetes (type 1 and type 2) who had A1C testing	17,185
Diabetes mellitus: A1C >9.0%	Percentage of adults age 18-75 years with diabetes (type 1 and type 2) who had poor A1C control (>9.0%)	17,185
Diabetes mellitus: retinal examination	Percentage of adults age 18-75 years with diabetes (type 1 and type 2) who had an eye exam (retinal) performed	17,185
Diabetes mellitus: LDL-C screening	Percentage of adults age 18-75 years with diabetes (type 1 and type 2) who had LDL-C screening	17,185
Diabetes mellitus: LDL-C <100 mg/dL	Percentage of adults age 18-75 years with diabetes (type 1 and type 2) who had good LDL-C control (<100 mg/L)	17,185
Diabetes mellitus: nephropathy monitoring	Percentage of adults age 18-75 years with diabetes (type 1 and type 2) who had a nephropathy screening test (or evidence of nephropathy)	17,185

(Continued)

Evaluation of Patient-Centered Medical Home

■ Appendix C. Quality Indicators Included in Composite Measures (Continued)

Measure	Description	No. of Eligible Patients (n = 154,169)
Persistent medication monitoring: ACEIs/ARBs	Percentage of adults age 18 years and older who received at least a 180-day supply of ambulatory medication therapy for ACEIs or ARBs with at least 1 serum potassium and either a serum creatinine or a blood urea nitrogen test	27,631
Persistent medication monitoring: digoxin	Percentage of adults age 18 years and older who received at least a 180-day supply of ambulatory medication therapy for digoxin with at least 1 serum potassium and either a serum creatinine or a blood urea nitrogen test	1392
Persistent medication monitoring: diuretics	Percentage of adults age 18 years and older who received at least a 180-day supply of ambulatory medication therapy for diuretics with at least 1 serum potassium and either a serum creatinine or a blood urea nitrogen test	26,277
Persistent medication monitoring: anticonvulsants	Percentage of adults age 18 years and older who received at least a 180-day supply of ambulatory medication therapy for anticonvulsants with at least 1 serum drug concentration monitoring test for the prescribed drug	1447
Rheumatoid arthritis: use of DMARD	Percentage of adults age 18 years and older who were diagnosed with rheumatoid arthritis and who were dispensed at least 1 ambulatory prescription for a DMARD	978

A1C indicates glycosylated hemoglobin; ACEIs, angiotensin-converting enzyme inhibitors; ARBs, angiotensin receptor blockers; DMARD, disease-modifying antirheumatic drug; LDL-C, low-density lipoprotein cholesterol.

■ Appendix D. Definition of Composite Quality Measures

Measure	Definition
Patient average	Percentage of qualifying indicators that were achieved by each patient
100% Performance	Percentage of patients achieving success on all qualifying indicators
75% Performance	Percentage of patients achieving success on 75% or more on the indicators for which they qualify
50% Performance	Percentage of patients achieving success on 50% or more on the indicators for which they qualify