OPEN

Model Homes

Evaluating Approaches to Patient-centered Medical Home Implementation

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Background: The patient-centered medical home (PCMH) model has been widely adopted, but the evidence on its effectiveness remains mixed. One potential explanation for these mixed findings is variation in how the model is implemented by practices.

Objective: To identify the impact of different approaches to PCMH adoption on health care utilization in a long-term, geographically diverse sample of patients.

Design: Difference-in-differences evaluation of PCMH impact on cost and utilization.

Subjects: A total of 5,314,284 patient-year observations from the HealthCore Integrated Research Database, and 5943 practices which adopted the PCMH model in 14 states between 2011 and 2015.

Intervention: PCMH adoption, as defined by the National Committee for Quality Assurance.

Measurements: Six claims-based utilization measures, plus total health care expenditures. We employ hierarchical clustering to organize practices into groups based on their PCMH capabilities, then use generalized difference-in-differences models with practice or patient fixed effects to estimate the effect of PCMH recognition (overall and separately by the groups identified by the clustering algorithm) on utilization.

Results: PCMH adoption was associated with a >8% reduction in total expenditures. We find significant reductions in emergency department utilization and outpatient care, and both lab and imaging services. In our by-group results we find that while the reduction in outpatient care is significant across all 3 groups, the reduction in emergency department utilization is driven entirely by 1 group with enhanced electronic communications.

Conclusion: The PCMH model has significant impact on patterns of health care utilization, especially when heterogeneity in implementation is accounted for in program evaluation.

Key Words: primary care, patient-centered medical home, health care costs, health care organizations and systems, health IT

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Growing health care costs have pressured insurers to move toward models that incentivize improved quality and reduced spending, including the patient-centered medical home (PCMH). The PCMH encourages practices to expand electronic and in-person access to clinicians, improve coordination of care and chronic condition management, and to expand use of health information technology.[1]

However, research on the PCMH has found mixed evidence on patient care and outcomes. A systematic review of early studies found only limited effects on patient experience and use of preventive services, with no evidence of reductions in total health care expenditures.[2] These findings were echoed by studies of early-adopter practices, one of which found no significant impacts on cost or utilization[3] and another which only found a reduction in emergency department (ED) visits for ambulatory care-sensitive diagnoses.[4] More recently, studies of the PCMH have found that adoption leads to reduced utilization of high-intensity medical services like ED and hospital visits among patients with chronic illnesses,[5,6] and improves quality of care for patients with chronic conditions.[7] Further studies have found reductions in ED utilization and costs in a wider array of patient populations.[8,9] Still, conflicting evidence continues to be generated about the PCMH model's effectiveness. A 2017 meta-analysis found no effect on primary care, ED visits or inpatient stays across a range of PCMH pilot programs.[10]

One potential reason for variation in PCMH effectiveness is heterogeneity in how the model is implemented. The PCMH recognition standards allow practices to self-select a subset of capabilities to adopt, leading to substantial differences across practices.[11] However, most studies have lacked the ability to pair data on PCMH capabilities with outcomes data, meaning that tests of the role of this heterogeneity have been limited. Previous attempts to incorporate data on variation in PCMH capabilities have used surveys[3,12] or relied on data sources other than the National Committee for Quality Assurance (NCQA) recognition scoring, including the Patient Aligned Care Teams initiative from the Veterans Health Administration.[13,14] One measure of PCMH implementation, the Patient Aligned Care Teams Implementation Progress Index (Pi^2) score, has been shown to be associated with reduced ambulatory care-sensitive hospitalizations and ED use.[15]

Our research objectives were to provide additional evidence on the impact of the PCMH model on health care costs and utilization, and to assess whether heterogeneity in how the model is implemented can explain variation in estimates of the PCMH model's effectiveness. To pursue these goals, we studied the PCMH model using detailed recognition data to identify which capabilities practices had in place. Few papers to date have linked the NCQA capability data to patient outcomes.[16,17] We also employed a larger and more geographically diverse sample of patients and practices (over 5.3 million patient-years and nearly 6000 practices over 14 states) than has typically been available in studies of the PCMH model. In addition to finding evidence that PCMH implementation significantly reduced expenditures and utilization, we provide novel evidence that patients treated by practices emphasizing adoption of expanded electronic communications and access technologies may have experienced an especially large reduction in ED utilization. These findings have implications for payers debating whether to provide financial support for delivery system transformation efforts, and for the design of care delivery requirements in programs like the Comprehensive Primary Care Plus (CPC+) initiative.

METHODS

Data Sources

We combined 2 sources of data to assess the impact of the PCMH model on health care utilization: NCQA's detailed records of practice-level PCMH capabilities; and medical claims data from HealthCore Integrated Research Database, which contains medical administrative claims and health plan eligibility data from 14 Blue Cross/Blue Shield commercial health plans.

Our practice-level data were drawn from NCQA records and provide documentation on the capabilities each practice had in place at the time of recognition. We cannot ascertain whether a capability is newly adopted, only that it was present at recognition. Consequently, our identification strategy should overstate the extent to which recognition represents a change in capabilities and lead to conservative PCMH effect estimates. This study evaluated practices adopting the 2011 NCQA recognition standards, which were in use between 2011 and 2016. These guidelines were based on 6 standards divided into 27 elements, of which 6 are designated as high-importance, "must-pass" elements. The elements were further subdivided into 150 factors. We observed PCMH implementation at the factor level, which represents the most granular data available. The standards and elements are detailed in Appendix Table A, Supplemental Digital Content 1 (http://links.lww.com/MLR/C172).

Medical claims and health plan eligibility data were available for patients covered between 2006 and 2016. Our patient control variables included age, sex, health profile (Deyo-Charlson comorbidity index[18]) and indicators for diagnoses of chronic obstructive pulmonary disease, congestive heart failure, diabetes, or any malignancy in the last year. Our utilization outcomes were expressed as binary variables indicating any utilization of a given service in a year, and include inpatient admissions, ED visits, general physician visits, specialist visits, and the use of laboratory and diagnostic imaging services. We define general physician visits as those with a type of service for Evaluation and Management performed by a primary care physician (PCP). PCPs are identified by the following specialties: general physician, family physician, geriatrics, and internal medicine. We also captured inflation-adjusted, log-transformed health care expenditures to ensure that our results are robust to the use of continuous outcomes measures. Health care expenditures are calculated as actual reimbursements paid by both the insurer and patient (copays and coinsurance) for medical care and omit any pharmacy spending.

Sample Criteria

Starting with a sample of 13.1 million patients, we first identified all patients with 2+ claims for evaluation and management visits with a PCP identified as having achieved PCMH recognition during the study period, with 1 visit before and 1 after PCMH recognition. Second, we retained only patients with a full year of continuous enrollment before and after the date of PCMH recognition. These restrictions ensured that we had adequate data to use patient fixed effects in the regression analyses. Third, to attribute patients to a single clinician (and PCMH practice) of record, we excluded patients matched to multiple PCP NPIs. This one-to-one correspondence is necessary to determine the timing of PCMH recognition for each patient. Next, we excluded patients younger than 18, who were likely treated in different (pediatric) practice environments. This process generated a sample of 831,208 patients. These steps are summarized in Appendix Figure F, Supplemental Digital Content 1 (http://links.lww.com/MLR/C172). Finally, we excluded patient-year observations representing the year of recognition from our analyses to address disruption that may result from the PCMH implementation process,[19] consistent with other health policy evaluations.[20,21] This resulted in our final analytic sample of 5,314,284 patient-years.

Statistical Analysis

We analyzed the data on PCMH practices and patient utilization in 2 steps. First, we employed hierarchical agglomerative clustering to organize 11,149 practices into maximally similar groups (called "clusters") based on their PCMH capabilities. The clustering procedure grouped practices based on the 150 PCMH factors and reflect capabilities in place as of the practice's recognition date. Similar techniques have been used elsewhere in the health services literature to develop a typology of primary care practices.[17,22] The details of this procedure appear in the Technical

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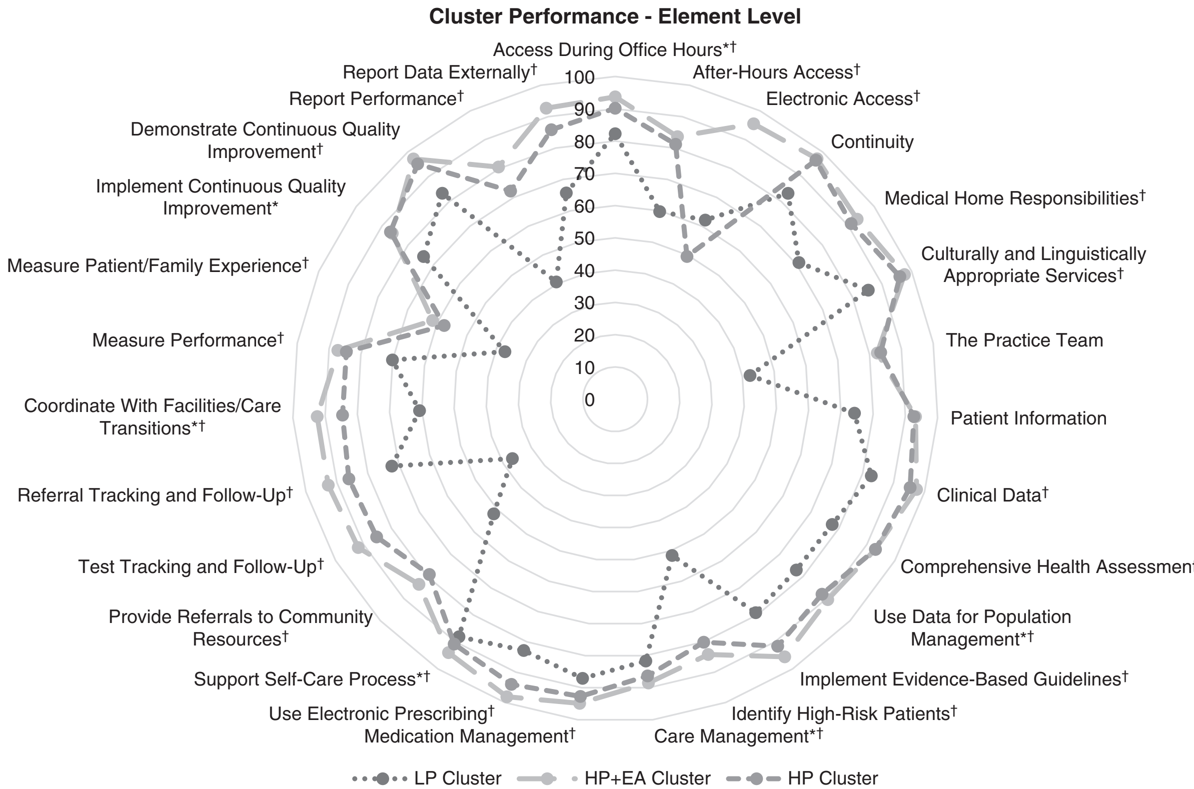

FIGURE 1. Plot displays each cluster's average score by element, with an average score of zero appearing at the center and 100% appearing at the perimeter. *Notes*: Scores reflect percent of patient-centered medical home attainment by element and cluster. *Each standard's must-pass element. †Significant differences between the high performing (HP) and high performing plus electronic access (HP+EA) clusters at $\alpha = 0.05/27 = 0.0019$. LP indicates low performance.

Appendix on Hierarchical Clustering, Supplemental Digital Content 1 (http://links.lww.com/MLR/C172).

We then used generalized difference-in-differences (DID) to estimate the effect of PCMH recognition on patient utilization and spending, identifying the impact using variation in the timing of adoption. Our approach is also referred to as a "two-way fixed effects" design, and is a common implementation of DID designs with repeated observations and staggered roll-out of treatment.[23] Of the initial sample of practices, we identified 5943 appearing in the claims data. Our regressions used linear models to examine the effect of PCMH adoption on utilization and expenditure outcomes 2 ways. First, we used the conventional approach from the PCMH literature, which treats the PCMH as an undifferentiated intervention. We then treated the 3 groups of practices identified by the clustering algorithm as separate interventions, each with its own DID term. By comparing these results, we were able to assess whether practices in the different groups varied in their impact on patient utilization. As a robustness check, we also estimated the PCMH effect on expenditures by service category. In addition, discussion of the parallel trends assumption for DID appears in the Technical Appendix on Parallel Trends, Supplemental Digital Content 1 (http://links.lww.com/MLR/C172).

All models included controls for age, age^2, sex, risk score, and comorbidity flags. We also included year fixed effects to adjust for secular trends in costs and utilization. We repeated all regressions using patient and practice fixed effects to control for unobserved, time-invariant characteristics, and present these results side-by-side. Finally, all regressions included heteroskedasticity robust SEs clustered at the patient/practice level to account for repeated observations. Finally, to address potential bias from self-selection of practices into the PCMH recognition process, our sample is limited to practices which eventually received recognition as medical homes during the study period. Previous research has indicated that practices that never adopted the PCMH model were systematically different from those that did.[17] As a result, comparing these 2 groups may erroneously attribute the impact of factors like differences in administrative capacity to the effect of PCMH adoption. Cluster analyses were performed using R version 3.4.4. Regression analyses used Stata version 15. In accordance with NCQA's Federalwide Assurance for the Protection of Human Subjects, NCQA made an independent determination that this work meets criteria for exemption under the Common Rule.

STUDY RESULTS

Hierarchical Clustering Results

To summarize the features of the 3 groups of practices (or "clusters"), we present scores for each of the 27 PCMH elements in Figure 1. These scores represent the percent of total possible

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points a practice attained within a given element. The plot displays each cluster's percentage score by element, with an average score of zero (no implementation of a given element) appearing at the center and 100% (complete implementation) appearing at the perimeter. One cluster (shown with a dotted line) is consistently the lowest-performing of the 3, in terms of PCMH capabilities. We refer to it as the low performance (LP) cluster. The other 2 clusters are consistently higher-performing, with a pronounced difference in performance on the "electronic access" element. We refer to these as the high performance (HP, indicated with short dashes) and high performance plus electronic access (HP+EA, shown with long dashes) clusters. A more detailed set of radar plots at the factor level are presented in Appendix Figures G–L, Supplemental Digital Content 1 (http://links.lww.com/MLR/C172), and the percent scores by element appear in Appendix Table B, Supplemental Digital Content 1 (http://links.lww.com/MLR/C172).

Figure 1 indicates that the HP+EA cluster outperforms the HP cluster on most PCMH elements. One element, however, stands out with a stark contrast between the 2 high-performing clusters: the difference between the HP+EA and HP clusters in Electronic Access is 46 percentage points. We also observe large differences between these clusters with respect to 2 additional factors: "Timely clinical advice by secure electronic message during office hours" and "Timely clinical advice using electronic system after hours." Although grouped under different Element-level headings, these factors are closely related to electronic communications abilities.

Patient Demographics

Table 1 presents summary statistics for patient characteristics and health care utilization and expenditures for the full sample and for each cluster identified using the approach described in the following section. The LP cluster stands out from the other 2 as being composed of slightly older and sicker patients, both in terms of comorbidity scores and the rates of specific comorbidities. These differences are also reflected in terms of typical utilization, with higher average annual spending and a greater probability of using high-intensity medical services such as inpatient admissions or ED visits.

Regression Results

In the tables that follow, we present the estimates for the PCMH effect on utilization (which are interpretable as percentage point changes in probability of any visit/service) and total expenditures (interpretable as percent changes in spending). Results using practice and patient fixed effects are presented side-by-side, but generally produce qualitatively similar results. For statistically significant results, the percentage point estimates are translated into percent changes as compared with baseline rates of the specified outcome. In the text that follows, we present results from our preferred, patient fixed effects specification.

Overall PCMH Effects

Table 2 presents the results for the overall effect of PCMH adoption on care utilization and spending. We find no effect of PCMH adoption on inpatient utilization. For all other

TABLE 1. Summary of Patient Characteristics

	Total		LP Cluster		HP+EA Cluster		HP Cluster	
	N = 5,313,917		N = 427,174		N = 4,195,442		N = 691,301	
Characteristics	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Patient characteristics								
Age (average)	52.34	16.13	54.58	16.37	52.13	16.07	52.25	16.25
Sex (% female)	54.5		54.8		54.4		55.2	
Deyo-Charlson comorbidity score	0.59	1.25	0.68	1.34	0.57	1.23	0.60	1.25
Congestive heart failure (%)	2.0		2.6		2.0		2.1	
Chronic obstructive pulmonary disease (%)	10.4		12.2		10.2		10.4	
Malignancy (%)	5.5		5.8		5.4		5.3	
Diabetes complications (%)	2.8		3.3		2.7		3.0	
Percent with any use								
Inpatient visit	7.3		8.3		7.2		7.0	
Emergency department visit	13.0		15.0		13.0		14.0	
General physician visit*	74.0		72.0		74.0		74.0	
Specialist visit†	66.0		67.0		66.0		65.0	
Imaging service	56.0		58.0		56.0		55.0	
Lab service	76.0		76.0		76.0		76.0	
Mean use, conditional on > 0								
Inpatient visit	1.33	0.90	1.35	0.98	1.33	0.89	1.33	0.92
Emergency department visit	1.32	0.95	1.35	1.01	1.31	0.93	1.35	1.07
General physician visit*	2.83	2.33	2.97	2.46	2.80	2.30	2.95	2.44
Specialist visit†	4.09	4.26	4.15	4.20	4.06	4.22	4.20	4.47
Imaging service	3.79	3.68	3.94	3.83	3.77	3.67	3.78	3.66
Lab service	4.65	5.14	4.62	4.90	4.66	5.16	4.63	5.16
Total costs	$6358	$22,633	$6902	$22,595	$6284	$22,573	$6470	$23,006

*Defined as an evaluation and management visit to a general practice, family practice, internal medicine, or geriatric medicine.
†Defined as an evaluation and management to physicians other than general practice, family practice, internal medicine or geriatric medicine.
HP indicates high performing; HP+EA, high performing plus electronic access; LP, low performing.

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TABLE 2. Patient-centered Medical Home Adoption Effect on Utilization, Overall Estimates

Outcome	Patient Fixed Effects	Practice Fixed Effects
Inpatient visit	0.0003 (0.0007), 0.47%	0.0003 (0.0007), 0.37%
Emergency department visit	−0.0024*** (0.0009), −1.85%	−0.0033*** (0.0011), −2.54%
General physician visit	−0.0141*** (0.0011), −1.91%	−0.0225*** (0.0038), −3.04%
Specialty visit	−0.0069*** (0.0011), −1.05%	−0.0100*** (0.00234), −1.52%
Imaging service	−0.0064*** (0.0012), −1.14%	−0.0080*** (0.0020), −1.43%
Lab service	−0.0117*** (0.0010), −1.54%	−0.0171*** (0.0028), −2.25%
Log total cost	−0.0833*** (0.0050)	−0.111*** (0.0177)
Fixed effects	Patient	Practice
N	5,314,284	5,314,284

Reported coefficients are for overall PCMH indicator. SEs appear in parentheses, and percent change is calculated by dividing the percentage point coefficient estimate by average outcome rate. Results exclude observations with partial patient-year or which occurred during the PCMH recognition year. Regression model also adjusted for year (2006–2016), age, age^2, sex, comorbidity index, COPD, CHF, malignancy, and diabetes.

CHF indicates congestive heart failure; COPD, chronic obstructive pulmonary disease.

*$P<0.1$.

**$P<0.05$.

***$P<0.01$.

service categories, we find significant reductions, regardless of whether patient or practice fixed effects are included. PCMH adoption led to a 1.9% reduction in ED utilization (95% confidence interval, 0.49%–3.2%). Use of imaging fell by 1.1% (0.72%–1.6%) and utilization of laboratory services fell by 1.5% (1.3%–1.8%). The bottom row of Table 2 presents the results for the effect on total health care expenditures and point to an 8.3% reduction (7.4%–9.3%) in costs. Consistent with the expected PCMH effect, specialist utilization fell. Surprisingly, general physician use fell as well.

PCMH Effects by Cluster

Table 3 presents cluster-specific results for the PCMH effect. Analyzing the PCMH as a single intervention obscures variation for several key outcomes. The zero effect on inpatient admissions concealed a small increase in hospitalizations among patients in the LP cluster. Moreover, the reductions in ED utilization were concentrated in the HP+EA cluster (which emphasized electronic communications) and the effect was larger than in the overall estimates (2.3%; 95% confidence interval, 0.93%–3.7%). The reductions in general physician and specialist utilization were largest in the LP cluster as well, with the smallest reductions in the HP cluster. That pattern is reversed for use of imaging and lab services, where the HP cluster practices experienced the largest reductions. With respect to changes in spending, patients in LP cluster practices experienced an average reduction of 8.7% (7.0%–10.4%) in annual costs, whereas patients in the HP cluster saw an 8.4% (6.9%–9.9%) reduction and HP+EA practices saw reductions of 8.3% (7.3%–9.3%).

Robustness Analysis: PCMH Impact on Expenditures

The results presented above describe how PCMH adoption impacts the probability of having any utilization of a given health care service. However, the PCMH could impact the intensity of utilization as well. To test this hypothesis, we repeat the analyses using log-transformed expenditures by category to assess the impact on intensity of utilization. The pattern of results is qualitatively similar to those using the binary outcomes: we find significant reductions in expenditures for ED and office visits and labs and imaging, but no impact on hospitalization costs; and the reduction in ED spending is concentrated in the HP+EA cluster. We present these results in Appendix Tables C and D, Supplemental Digital Content 1 (http://links.lww.com/MLR/C172).

DISCUSSION

The clustering approach presented in this study pointed to 3 groups of practices: 1 cluster made up of practices at a relatively low level of PCMH implementation, and 2 clusters with more extensive adoption of PCMH capabilities. In the high-implementation pair, the HP+EA cluster consistently generally achieved higher levels of PCMH adoption than HP, with an especially large gap in terms of adoption of electronic communications capabilities. These heterogeneous findings suggest that the subset of capabilities practices adopt plays an important role in how care is organized and utilized.

In prior research,[17] clustering analysis pointed to starkly different approaches to implementation among the highest-performing practices: one cluster focused on “physician-facing” features like decision-supports; while another emphasized “patient-facing” capabilities like population health management. One important difference between these studies is that while the prior analysis focused on early adopters using the 2008 NCQA guidelines, this study employs the set of revised standards published in 2011. The combination of streamlined recognition standards and a greater accumulation of experience with the medical home model may have led to a more standardized approach.

The DID analysis of the clusters provides an opportunity to study whether different approaches to implementation impact patient outcomes. Like prior research, we find significant reductions in ED visits in PCMH practices. Our results advance the literature by noting that this reduction was driven entirely by the HP+EA cluster, the high-performing practices which emphasized electronic communications. One possible mechanism for this change is that expanding electronic access, particularly

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TABLE 3. Patient-centered Medical Home Adoption Effect on Utilization, By Cluster

	Inpatient Visit		Emergency Department Visit		General Physician Visit	
Coefficient	**Patient FE**	**Practice FE**	**Patient FE**	**Practice FE**	**Patient FE**	**Practice FE**
LP cluster × post	0.0020* (0.00116), 2.50%	0.0016 (0.00132)	−0.0002 (0.00151)	−0.00003 (0.00208)	−0.0193*** (0.00190), −2.68%	−0.0263*** (0.00815), −3.65%
HP + EA cluster post	0.0002 (0.000681)	0.0001 (0.000735)	−0.0030*** (0.000912), −2.31%	−0.0040*** (0.00111), 3.08%	−0.0146*** (0.00108), −1.97%	−0.0228*** (0.00374), −3.08%
HP cluster × post	0.0002 (0.000977)	0.0002 (0.00108)	0.0002 (0.00131)	−0.001 (0.00210)	−0.0079*** (0.00163), −1.07%	−0.0186** (0.00736), −2.51%
	Specialist visit		Imaging service		Lab service	
	Patient FE	Practice FE	Patient FE	Practice FE	Patient FE	Practice FE
LP cluster × post	−0.0072*** (0.00190), −1.07%	−0.0151*** (0.00466), −2.25%	−0.0058*** (0.00196), −1.00%	−0.0086** (0.00411), −1.48%	−0.0069*** (0.00179), −0.91%	−0.0101* (0.00599), −1.33%
HP + EA cluster post	−0.0076*** (0.00111), −1.15%	−0.0096*** (0.00224), −1.45%	−0.0062*** (0.00119), −1.11%	−0.0074*** (0.00185), −1.32%	−0.0121*** (0.00105), −1.59%	−0.0175*** (0.00263), −2.30%
HP cluster × post	−0.0020 (0.00166)	−0.0095** (0.00464), −1.46%	−0.0083*** (0.0017), −1.51%	−0.0117*** (0.0035), −2.13%	−0.0121*** (0.00155), −1.59%	−0.0187*** (0.00505), −2.46%
			Log total costs			
	Patient FE	Practice FE	Patient FE	Practice FE	Patient FE	Practice FE
LP cluster × post			−0.0868*** (0.0087)	−0.131*** (0.0353)		
HP + EA cluster × post			−0.0829*** (0.00513)	−0.106*** (0.0149)		
HP cluster × post			−0.0836*** (0.00765)	−0.129*** (0.0353)		
N	5,314,284	5,314,284	5,314,284	5,314,284	5,314,284	5,314,284

Reported coefficients are for the main effect estimate, expressed as interactions between cluster assignment and postimplementation period timing. SEs appear in parentheses, and percent change is calculated by dividing the percentage point coefficient estimate by average outcome rate. Results exclude observations with partial patient-year or which occurred during the PCMH recognition year. Regression model also adjusted for year (2006–2016), age, age^2, sex, comorbidity index, COPD, CHF, malignancy, and diabetes.

CHF indicates congestive heart failure; COPD, chronic obstructive pulmonary disease; FE, fixed effect; HP, high performing; HP + EA, high performing plus electronic access; LP, low performing.

*$P < 0.1$.

**$P < 0.05$.

***$P < 0.01$.

after hours, might offer a substitute for some ED visits. The reduction in ED utilization associated with adoption of electronic communications capabilities suggests that there may be focused approaches to adoption that emphasize particularly high-value subsets of PCMH improvements.

Consistent with expectations that the PCMH model would reduce utilization of higher-intensity services, we observe a reduction in specialist visits, with the effect concentrated among patients attributed to the LP and HP+EA practices. We also see large, significant reductions in general physician visits. When considered alongside recent work documenting major reductions in primary care visits during our study period,[24] this fact suggests that PCMH practices may be leading this trend. Reassuringly, we do not see increases in ED visits or inpatient admissions (outside of the marginal increase in the LP cluster) accompanying this reduction. However, without detailed data on health (as opposed to utilization) outcomes, it is difficult to draw strong conclusions about how this reduction in utilization impacts patient welfare. Moreover, in these analyses we focus on in-person, physician encounters. Some of the reduction in physician visits may be attributable to substitution either between types of providers (ie, patients being seen by nonphysician providers) or types of encounters (ie, patients using secure electronic communications, rather than in-person visits).

With respect to this study's implications for primary care policy, the findings on reductions in overall spending following PCMH recognition are particularly noteworthy. All 3 clusters experienced reductions in spending of over 8% in the analyses using patient fixed effects. This effect appears to be driven by reductions in outpatient spending, both in terms of physician fees and the use of labs and imaging. Although prior research has pointed to high fixed and variable costs associated with PCMH recognition, these costs vary widely, with 17-fold variation in per-patient PCMH maintenance costs (from $8 to $136 annually).[25] The large reductions in total costs documented here suggest that payers may benefit from continued support for PCMH implementation and call for further research into how to adopt and maintain PCMH infrastructure in the most cost-effective manner. This paper highlights the need to document and evaluate variation in how primary care reforms are implemented, and which approaches provide the highest value.

Although we analyzed data from patients enrolled in PCMH practices, this study has implications for other models for primary care transformation as well. The CPC+ initiative, for example, provides a narrow set of minimum care delivery requirements for practices to be eligible. However, practices have broad latitudes on how to structure care beyond those

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parameters. Our finding that practices emphasizing electronic access drove the reduction in ED utilization suggests that not all approaches to care delivery are equally effective, and that identifying and sharing best practices may be crucial to understanding the success or failure of such programs.

This paper has several limitations. Although the sample size of patients and practices is large and geographically diverse, it includes claims data from only a single payer and cannot address how the impact of PCMH implementation may vary with the proportion of a patient panel affected. Although the HealthCore Integrated Research Database sample is similar to other commercially insured populations, the findings may not translate to practices with larger volumes of Medicaid or Medicare patients. In addition, this study focuses on health care utilization rather than health outcomes per se. As a result, any impacts on utilization or spending must come with the caveat that there may be unobserved consequences for patient health. With respect to the estimation approach, the 2 sets of specifications presented use patient and practice fixed effects. Because the patient fixed effects models can control for time-invariant aspects of patient health status that might otherwise bias our results, we prefer these (generally more conservative) estimates of the PCMH effect. The practice fixed effects control for time-invariant features such as the location of the practices but will not address the impact of, for example, changing patient mix within a practice. Finally, our approach relies on identifying patterns of PCMH adoption and incorporating these patterns into regression analyses, rather than trying to estimate what the impact of hypothetical combinations of PCMH capabilities might be. Thus, the results should be interpreted as the overall effect of a given approach to PCMH implementation, rather than the marginal effects of the individual features that differentiate the clusters.

CONCLUSIONS

One factor potentially driving the variation in estimates of the impact of the PCMH is the substantial heterogeneity in how the model is implemented. Our results suggest that the path practices take to PCMH recognition matters for patient utilization and spending outcomes. We find large reductions in spending associated with PCMH implementation, along with reductions in ED visits and the use of other health care services. This reduction in ED utilization was concentrated among practices which emphasized the adoption of expanded electronic communications tools. Although further research is needed to document whether the reductions in utilization has any effect—positive or negative—on patient health, this work demonstrates the potential of primary care transformation efforts like the PCMH model to reduce costs and utilization, and the need to carefully study the approaches practices take to transformation.

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