Chronic Disease Outcomes From Primary Care Population Health Program Implementation

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Provisions of the Affordable Care Act support population health management (PHM) activities as part of fostering accountable care organizations (ACOs).[1] PHM activities are intended to shift the focus from individuals seeking care in face-to-face visits using fee-for-service payments to managing a panel of patients who seek care in a practice network using value-based payment or global budgeting models.[2] Advances in health information technology (IT) have increased the feasibility of population-level oversight of all patients in a network.[3-5] However, few studies have evaluated the impact of implementing a PHM program as part of routine care within primary care networks.[6-9]

The patient-centered medical home (PCMH) care model supports primary care physician (PCP)-led teams managing the preventive care and chronic disease management needs of patients.[10-12] This team-based model is intended to help PCPs manage competing time demands during office visits and helps ensure timely intervention when goals are not being met.[12] Adoption of clinical registries, promoted by Stage 3 Meaningful Use in the Health Information Technology for Economic and Clinical Health Act, seeks to use active surveillance to identify patients with measurable gaps in care to improve quality and/or safety of care.[13] These PHM activities often use nonphysician team members with established workflows for visit- and non–visit-based outreach.[14]

Although primary care practices represent a natural focus for such PHM work, especially when coupled with face-to-face visits, it is uncertain whether non–visit-based activities should reside solely within practices or whether this role may be appropriate for central coordination within an ACO's primary care network. To investigate these issues, we developed and implemented a PHM program for chronic disease management utilizing an established health IT clinical registry within a large heterogeneous primary care practice network. Some practices were assigned a central resource, referred to as population health coordinators (PHCs), to take on these PHM activities. Other practices were asked to assign practice staff to these tasks. We evaluated quality-of-care process

ABSTRACT

OBJECTIVES: We implemented a health information technology–enabled population health management program for chronic disease management in academic hospital–affiliated primary care practices, then compared quality-of-care outcome measures among practices assigned a central population health coordinator (PHC) and those not assigned a PHC.

STUDY DESIGN: Quasi-experimental.

METHODS: Central PHCs were nonrandomly assigned to 8 of 18 practices. They met with physicians, managed lists of patients not at goal in chronic disease registries, and performed administrative tasks. In non-PHC practices, existing staff remained responsible for these tasks. The primary outcome was difference-in-differences over the 6-month follow-up period between PHC and non-PHC practices for outcome measures for diabetes (low-density lipoprotein cholesterol [LDL-C], glycated hemoglobin [A1C], and blood pressure [BP] goal attainment), cardiovascular disease (LDL-C goal attainment), and hypertension (BP goal attainment). Secondary outcomes included process measures only (obtaining LDL-C, A1C, and BP readings) and cancer screening test completion.

RESULTS: The difference in the percentage point (PP) increase in outcome measures over follow-up was greater in PHC practices than non-PHC practices for all measures among patients with diabetes (LDL-C, 4.6 PP; A1C, 4.8 PP; BP, 4.7 PP), cardiovascular disease (LDL-C, 3.3 PP), and hypertension (BP, 2.3 PP) (adjusted *P* all <.001). Changes in cancer screening outcomes, which were not a focus of PHC efforts, were similar between PHC and non-PHC practices.

CONCLUSIONS: Use of central PHCs led to greater improvement in short-term chronic disease outcome measures compared with patients in practices not assigned a central PHC.

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and outcome measures over the first 6 months of the chronic disease management program. We hypothesized that practices assigned a central PHC would have greater performance increases in quality measures compared with practices that were not assigned a PHC.

TAKEAWAY POINTS

A population health management program using a health information technology tool can significantly improve process and outcome measures for patients with diabetes, cardiovascular disease, and hypertension.

- Utilizing central population health coordinators who work closely with practice personnel can lead to greater improvement in outcome measures.
- Our results support the use of central personnel working with practice-based staff on population health management programs, but longer-term follow-up is needed.

METHODS

Study Setting and Design

The study took place in the Massachusetts General Hospital Primary Care Practice-Based Research Network, consisting of 18 primary care practices. All practices in the network use electronic health records (EHRs) and have utilized a PHM health IT tool, TopCare (SRG Technology),[15] for preventive cancer screening since 2011.[5] In 2014, this PHM tool was expanded to include registries for patients with diabetes, cardiovascular disease (CVD), and hypertension (HTN). The tool identified network patients, assigned them to chronic disease registries, and tracked goal attainment in near real time. We developed a program for chronic disease management using central PHCs assigned to specific practices. We conducted a quasi-experimental evaluation of the program and compared quality-of-care process and outcome measures over the first 6 months (July 1, 2014, to December 31, 2014) of the PHM program for patients with diabetes, CVD, and HTN in practices assigned a central PHC (n = 8) or not (n = 10). Because all practices were already using the PHM tool for preventive cancer screening without central PHC input and this did not change during the study period, we also examined cancer screening outcomes as a way to control for the nonrandom assignment of the central PHC personnel. All practices also had the same financial incentives based on performance as defined by the patients meeting criteria for each registry.

Network and Chronic Disease Registry Participants

A validated automated algorithm was modified to be used in near real time to identify potential eligible adult (≥18 years) patients who had at least 1 visit to a study practice within the prior 3 years at baseline or had a visit during the 6-month follow-up period and were connected with a specific network physician or practice.[16,17] Patients were considered to have diagnosed diabetes (type 1 or type 2) using a previously validated algorithm.[6] Patients with CVD, including coronary artery disease, peripheral vascular disease, and cerebrovascular disease, were identified using EHR problem and procedure list terms and procedure codes for interventions, and patients with HTN were identified utilizing billing diagnosis codes and EHR problem list terms.[18] These algorithms were internally validated based upon blinded chart review of randomly selected patients (sensitivity and specificity >90%). Patients eligible for breast, cervical, and colorectal cancer screening were women aged 50 to 74 years without bilateral mastectomy, women aged 21 to 64 years without total hysterectomy, and men or women aged 52 to 75 years without total colectomy, respectively.[5] We excluded patients who switched between PHC and non-PHC practices during the follow-up period.

PHM Program With Central PHCs

PHM leaders hired and nonrandomly allocated 4 PHCs to work with 8 practices as part of a pilot project to centralize PHM efforts to improve quality of care. PHCs came from a variety of backgrounds in healthcare delivery and were selected based upon their having excellent communication skills and an ability to learn new electronic systems. The network did not have sufficient resources to implement a PHC in all 18 network practices. Among practices that expressed an interest in the program, PHCs were assigned so that practices reflected network diversity with regard to size, type (hospital-based, community-based, or community health center), and baseline quality scores. These decisions were made with a goal of equitably distributing available PHC resources within the network to get practice leader support and to maximize the impact of the program for practices with and without PHCs.

A training curriculum was developed for PHCs that included clinical instruction focused on chronic disease management and preventive health as well as the basics of health coaching and motivational interviewing. Additionally, PHCs were trained on optimal use of the clinical registry tool and the EHR and participated in a customized process improvement curriculum focused on process mapping and Plan-Do-Study-Act cycles.[19] PHCs shadowed clinical and nonclinical personnel to understand practice workflow. They executed administrative tasks, including appointment scheduling, ordering overdue laboratory testing, performing chart reviews, and obtaining home blood pressure (BP) values and outside tests or laboratory results. In addition, PHCs regularly met ("huddled") with physicians to review those patients who required clinical intervention to develop an action plan that could have included such elements as a call from a registered nurse to review medication compliance or titrate a statin or antihypertensive, initiation of home BP monitoring, scheduling an office visit to change treatment, or referring the patient to a diabetes specialist or nutritionist.

TABLE 1. At-Goal Criteria for Chronic Disease and Cancer Screening Process and Outcome Measures

Population	Measure	Process Measure[a]	Outcome Measure	
		Time Period	Based on Laboratory or BP Values	Based Upon Maximal Medical Therapy
Diabetes	LDL-C	1 year	<100 mg/dL	Moderate- or high-dose statin
	A1C	6 months	<9%	
	BP	6 months	SBP <140 mm Hg, DBP <90 mm Hg; or age ≥60 years, DBP <70 mm Hg[b]	≥3 drugs from different antihypertensive classes
Cardiovascular disease	LDL-C	1 year	<100 mg/dL	High-dose statin
Hypertension	BP	6 months	SBP <140 mm Hg, DBP <90 mm Hg; age ≥60 years, DBP <70 mm Hg; or age ≥60 years, SBP <150 mm Hg, DBP <90 mm Hg[b]	≥3 drugs from different antihypertensive classes
Breast cancer	Mammogram	2 years	N/A	N/A
Cervical cancer	Pap smear	3 years; 5 years (age 30-65 with HPV testing)	N/A	N/A
Colorectal cancer	Colonoscopy	10 years	N/A	N/A
	Sigmoidoscopy, barium enema, CT colonography	5 years		

A1C indicates glycated hemoglobin; BP, blood pressure; CT, computed tomographic; DBP, diastolic blood pressure; HPV, human papillomavirus; LDL-C, low-density lipoprotein cholesterol; N/A, not applicable; SBP, systolic blood pressure.
[a]Patients also passed a process measure if they had a clinical exception (ie, terminal illness, competing comorbidity, or contraindication).
[b]The average of 3 most recent BP readings over 18 months was used if the most recent reading was not at goal.

PHM Program Without Central PHC Support

The remaining 10 network practices not assigned a PHC were provided training and support in use of the PHM IT tool. The staff in these practices remained responsible for managing administrative tasks.

Covariates and Process and Outcome Measures

Patient characteristics and laboratory, BP, and cancer screening data were obtained from an electronic central data repository.[20] Each registry tracked process metrics, including obtaining tests or readings, and outcome metrics, such as goal attainment.

Criteria for process and outcome measures are described in Table 1. Patients passed a process measure by obtaining a test in a given time period or if a clinical exception was entered in the PHM tool and EHR. For colorectal cancer screening, home fecal occult blood testing (FOBT) was an option for patients who refused other methods. However, because optical screening was the network's preferred approach and documentation of FOBT results in the EHR was poor, FOBT was not included in outcome assessment. Patients were at goal for outcome measures if they passed the process measure and either met a target laboratory or BP value or were on maximal medical therapy. HTN BP criteria are in accordance with Eighth Joint National Committee guidelines.[21]

The primary outcomes for this study were the difference-in-differences over the 6-month follow-up period between PHC and non-PHC practices for outcome measures for diabetes (low-density lipoprotein cholesterol [LDL-C], glycated hemoglobin [A1C], and BP goal attainment), CVD (LDL-C goal attainment), and HTN (BP goal attainment). As secondary outcomes, we examined difference-in-differences for chronic disease process measures (obtaining LDL-C, A1C, and BP readings) and test completion for breast, cervical, and colorectal cancer screenings. Additionally, we evaluated numerator factors (process/outcome at goal, on maximal medical therapy, clinical exceptions) that accounted for changes in our primary outcomes. Primary and secondary outcomes focused on patients who were in a registry at both baseline and follow-up time periods. We also performed sensitivity analyses that included all patients, even if present at only 1 time period (**eAppendix Table 1a** and **1b** [eAppendices available at **ajmc.com**]).

Statistical Analysis

We compared baseline patient and physician/practice characteristics between the PHC and non-PHC groups using χ^2 or *t* tests. For primary and secondary outcomes, we controlled for these characteristics (age, gender, language, race, insurance, practice type seen in [ie, community health center or not], practice PCMH recognition status, and patient–physician continuity)[17] using a logistic regression model with a time-by-PHC-practice interaction term and accounting for clustering among patients using the general

TABLE 2. Baseline Patient and Practice Characteristics Among Patients With Diabetes, Cardiovascular Disease, and Hypertension in Practices With and Without a PHC[a]

	Diabetes (n = 12,316)		Cardiovascular Disease (n = 12,591)		Hypertension (n = 41,184)	
	PHC (n = 4206)	Non-PHC (n = 8110)	PHC (n = 4027)	Non-PHC (n = 8529)	PHC (n = 14,461)	Non-PHC (n = 26,723)
Age in years, mean (SD)	62.7 (13.4)	64.5 (13.7)	70.0 (12.3)	71.9 (12.2)	63.5 (13.2)	65.9 (13.7)
Gender, female	49.5%	45.1%	20.9%	37.5%	54.5%	48.7%
Race						
White	71.1%	64.3%	87.1%	84.8%	81.8%	78.6%
African American	11.1%	11.2%	4.7%	4.9%	7.5%	7.6%
Asian	8.4%	5.7%	3.7%	3.0%	5.1%	3.8%
Hispanic	7.1%	16.4%	2.8%	5.6%	3.8%	8.2%
Other/unknown	2.3%	2.4%	1.6%	1.7%	1.9%	1.8%
Language, English	88.9%	78.8%	93.5%	90.3%	93.3%	88.4%
Insurance						
Commercial	48.2%	42.1%	36.4%	32.4%	53.4%	46.8%
Medicare	38.8%	42.9%	56.2%	60.2%	37.6%	43.4%
Medicaid	11.8%	13.8%	6.8%	6.9%	8.1%	8.8%
Self-pay	1.2%	1.1%	0.5%	0.6%	0.9%	0.9%
Patient–physician connectedness status[b]						
Physician-connected	94.2%	92.7%	95.1%	92.5	94.8%	92.9%
Practice-connected	5.8%	7.3%	4.9%	7.5%	5.2%	7.1%
Practice type, community health center	41.4%	30.6%	37.4%	17.8%	31.7%	18.9%
PCMH-recognized practice	22.3%	17.3%	26.2%	18.7%	22.0%	16.9%

PCMH indicates patient-centered medical home; PHC, population health coordinator.
[a]All *P* values comparing PHC and non-PHC patient characteristics <.05.
[b]Patients were connected to a) a physician or to b) a practice if unable to connect to a specific physician using near real-time attribution algorithm based upon a previously validated retrospective algorithm.[16,17]

estimating equations approach (PROC GENMOD, SAS version 9.4, SAS Institute; Cary, North Carolina). The Partners Institutional Review Board approved the use of data collected as part of routine care with a waiver of informed consent.

RESULTS

At baseline, among 160,123 patients in the primary care network, there were 12,316 patients with diabetes (4206 in PHC and 8110 in non-PHC practices); 12,591 patients with CVD (4027 in PHC and 8529 in non-PHC practices); and 41,184 patients with HTN (14,461 in PHC and 26,723 in non-PHC practices) present at both baseline and follow-up. For each condition, patients from PHC practices were younger, more likely to be female, more likely to be white and less likely to be Hispanic, more likely to speak English, more likely to have commercial insurance and less likely to have Medicare, more likely to be connected to a specific physician, and more often seen in a community health center (**Table 2**). Patients eligible for breast, cervical, and colorectal cancer screening demonstrated similar differences (**eAppendix Table 2**).

Primary Outcomes for Chronic Disease Populations

Performance on outcome measures increased more over the 6-month follow-up period for patients in PHC practices compared with patients in non-PHC practices for all measures (**Table 3**). Among patients in PHC practices, all baseline measures were lower compared with patients in non-PHC practices, but at the end of follow-up, outcome measures were higher for 3 of 5 chronic disease measures (diabetes BP, diabetes A1C, and CVD LDL-C). The largest percentage point (PP) differences in the change in proportion of patients at goal over follow-up between PHC and non-PHC practices were among patients with diabetes (LDL-C, 9.1 PP PHC vs 4.5 PP non-PHC change; BP, 2.8 PP vs –2.0 PP change; A1C, 6.0 PP vs 1.3 PP change). The difference-in-differences was also significantly greater in PHC practices for LDL-C goal attainment in patients with CVD (9.0 PP vs 5.7 PP) and for BP goal attainment in patients

TABLE 3. Proportion of Patients at Goal for Process and Outcome Measures for Chronic Diseases and Cancer Screening in PHC and Non-PHC Practices at Baseline and at End of Follow-Up Period

	PHC Practices			Non-PHC Practices			
	July 1, 2014	Dec 31, 2014	PP Difference	July 1, 2014	Dec 31, 2014	PP Difference	DID[a]
Outcome Measures for Chronic Diseases							
Diabetes: LDL-C	62.2%	71.1%	9.1	67.9%	72.4%	4.5	4.6[b]
Diabetes: BP	77.8%	80.6%	2.8	81.0%	79.0%	−2.0	4.8[b]
Diabetes: A1C	67.2%	73.2%	6.0	69.4%	70.7%	1.3	4.7[b]
CVD: LDL-C	69.0%	78.0%	9.0	70.1%	75.8%	5.7	3.3[b]
HTN: BP	74.3%	78.0%	3.7	76.7%	78.1%	1.4	2.3[b]
Process Measures for Chronic Diseases							
Diabetes: LDL-C	84.5%	88.9%	4.4	86.6%	87.2%	0.6	3.8[b]
Diabetes: BP	88.5%	91.7%	3.2	91.0%	88.8%	−2.2	5.4[b]
Diabetes: A1C	80.5%	84.5%	4.0	82.7%	81.4%	−1.3	5.3[b]
CVD: LDL-C	79.5%	85.1%	5.6	80.8%	83.3%	2.5	3.1[b]
HTN: BP	84.1%	88.0%	3.9	85.6%	86.7%	1.1	2.8[b]
Process Measures for Cancer Screening							
Breast cancer	90.7%	91.2%	0.5	92.0%	92.9%	0.9	−0.4[c]
Cervical cancer	92.4%	93.0%	0.6	91.3%	92.8%	1.5	−0.9[b]
Colorectal cancer	85.5%	86.8%	1.3	87.8%	89.5%	1.7	−0.4[b]

A1C indicates glycated hemoglobin; BP, blood pressure; CVD, cardiovascular disease; DID, difference-in-differences; HTN, hypertension; LDL-C, low-density lipoprotein cholesterol; PHC, population health coordinator; PP, percentage point.
[a]*P* values adjusted for age, gender, language, race, insurance, practice type seen in (community health center or not), practice patient-centered medical home recognition status, and patient–physician continuity.
[b]Adjusted $P < .001$.
[c]Adjusted $P = .01$.

with HTN (3.7 PP vs 1.4 PP). All differences in performance among patients in PHC and non-PHC practices persisted after adjustment for baseline characteristics ($P < .001$).

Change in Process Measures for Chronic Disease Populations

Patients in PHC practices also had greater improvement in process measures compared with those in non-PHC practices (Table 3). Among patients with diabetes, the increase in the proportion of patients at goal for the process measures for LDL-C (4.4 PP vs 0.6 PP), BP (3.2 PP vs −2.2 PP), and A1C (4.0 PP vs −1.3 PP) was greater in PHC practices. Among patients with CVD, the increase in patients at goal for the LDL-C process measure (5.6 PP vs 2.5 PP) was greater in PHC practices. Among patients with HTN, the increase in patients at goal for the BP process measure (3.9 PP vs 1.1 PP) was greater in PHC practices. All differences remained significant after adjusting for baseline patient characteristics ($P < .001$).

Change in Process Measures for Cancer Screening

In contrast to outcomes for chronic disease measures on which the central PHCs focused their work, differences in cancer screening (breast, cervical, colorectal) measures were similar in PHC and non-PHC practices (Table 3). These screening rates increased slightly in both PHC and non-PHC practices, with small differences in the magnitude of PP increase favoring non-PHC practices (breast, 0.5 PP vs 0.9 PP; cervical, 0.6 PP vs 1.5 PP; colorectal, 1.3 PP vs 1.7 PP).

Factors That Accounted for Changes in Outcomes Over Time

To assess what accounted for greater changes in outcomes in PHC compared with non-PHC practices, we examined numerator factors contributing to goal attainment (**Table 4**). PHC practices were more successful in increasing the proportion of patients reaching the targeted clinical value for LDL-C, BP, and A1C outcomes.

DISCUSSION

We developed and implemented a PHM program for chronic disease management using a health IT tool within a large diverse primary care network. We compared outcomes among practices that were assigned central personnel to support administrative tasks with practices that used local staff with central training and support only. Over the first 6 months of the program, practices, regardless of whether they were assigned a central PHC or not, experienced improvements in most process and outcome measures for diabetes, CVD, and HTN. However, practices with PHCs achieved larger

TABLE 4. Numerator Factors Contributing to Proportion of Patients at Goal in PHC and Non-PHC Practices

	PHC Practices			Non-PHC Practices			
	July 1, 2014	Dec 31, 2014	PP Difference	July 1, 2014	Dec 31, 2014	PP Difference	DID
Diabetes: LDL-C			9.1			4.5	4.6
Meets target value	55.3%	58.3%	3.0	60.2%	61.6%	1.4	1.6
On maximal Rx	6.7%	7.7%	1.0	7.4%	8.2%	0.8	0.2
Numerator exception	0.0%	5.1%	5.1	0.3%	2.6%	2.3	2.8
Diabetes: BP			2.8			–2.0	4.8
Meets target value	72.5%	73.1%	0.6	74.3%	70.6%	–3.7	4.3
On maximal Rx	5.3%	5.8%	0.5	6.7%	7.2%	0.5	0.0
Numerator exception	0.0%	1.7%	1.7	0.1%	1.3%	1.2	0.5
Diabetes: A1C			6.0			1.3	4.7
Meets target value	67.2%	70.3%	3.1	69.1%	68.9%	–0.2	3.3
Numerator exception	0.0%	2.9%	2.9	0.3%	1.8%	1.5	1.4
CVD: LDL-C			9.0			5.7	3.3
Meets target value	58.9%	61.7%	2.8	60.3%	62.0%	1.7	1.1
On maximal Rx	10.1%	10.0%	–0.1	9.7%	10.3%	0.6	–0.7
Numerator exception	0.0%	6.3%	6.3	0.0%	3.4%	3.4	2.9
HTN: BP			3.7			1.4	2.3
Meets target value	72.0%	75.0%	3.0	73.8%	74.3%	0.5	2.5
Maximal Rx	2.3%	2.8%	0.5	2.9%	3.1%	0.2	0.3
Numerator exception	0.0%	0.3%	0.3	0.0%	0.7%	0.7	–0.4

A1C indicates glycated hemoglobin; BP, blood pressure; CVD, cardiovascular disease; DID, difference-in-differences; HTN, hypertension; LDL-C, low-density lipoprotein cholesterol; PHC, population health coordinator; PP, percentage point; Rx, prescription.

increases in quality than practices that did not receive this support. Patients in PHC practices were more likely to be at clinical goal, not just to have had the tests performed. The PHCs did not focus on cancer screening, and during the same time period there were similar changes in cancer screening rates between PHC and non-PHC practices.

Prior study findings have demonstrated that chronic disease management programs can improve outcomes of care for patients with diabetes,[6,9,22-24] CVD,[25] and HTN,[26-28] but few studies have evaluated PHM programs in routine clinical practice. Research studies involve additional personnel and support that are often not available to practices. Prior studies have evaluated the impact of pharmacy-led programs,[9,25,28] nurse- or case manager–led programs,[22,27,29] and population-level clinical registries[6] to improve outcomes for a single chronic condition. Our study presents the results of a natural experiment following implementation of a PHM program in routine practice for multiple chronic diseases.

Our study examined the first 6 months after implementing a chronic disease PHM program and showed increases in quality of care across all practices and for each chronic disease. We believe these positive results reflect a combination of functioning teams within practices, a sophisticated registry tool, and financial incentives supporting clinically meaningful outcomes. However, we do not know about possible comparable changes in quality in the time period prior to implementing this program. Thus, we cannot say with certainty that the increases seen during the 6-month period following implementation of this program were due solely to the program itself. It is likely that the large increases in most outcomes for the chronic disease measures were partially due to the intervention.

Practices with central PHCs demonstrated larger improvements in chronic disease outcome measures than practices without PHCs. These differences were impressive, especially given the small changes in preventive cancer screening, not a focus of this intervention, during the same time period. These results support investing in central organizational infrastructure with personnel who can receive specialized training and develop focused expertise in population-based chronic disease management. How best to optimize the roles and functions for those involved in PHM remains to be determined.[30] Practice personnel primarily focus on visit-based care, but the non–visit-based functions of central PHCs could be performed by practice staff as envisioned for PCMHs.[12] However, a central organizational structure may promote the transfer of optimal workflow among heterogeneous practices, and non–visit-based activities in addition to the constant stream of outpatient office visits may overwhelm stressed primary care teams.[31,32]

Limitations

The main limitation of this study is that practices were not randomly assigned to receive a central PHC. Rather, we nonrandomly allocated our PHCs based on practice type, size, location, and willingness to include a PHC in their workflow. Differences in patient populations or practice personnel and their willingness to implement PHM could account for the larger increases in PHC practices we observed for process and outcome measures. However, we adjusted for patient and practice characteristics, including PCMH recognition status, in our multivariable models and all differences persisted. If the differences were due to motivation in practice personnel between PHC and non-PHC sites, we also would have expected to see larger differences in breast, cervical, and colorectal cancer screening rates even though the PHCs did not focus on these registries. However, differences in cancer screening were similar (range of PP differences, 0.4-0.9 favoring non-PHC practices).

Because intervention practices were provided more personnel to improve quality of care, it is possible that the greater improvement observed in PHC practices was due to the additional personnel, rather than the centralized organization and use of these resources. We focused our analyses on patients present in each disease registry at both baseline and follow-up, which did not include patients newly diagnosed or who left our network during follow-up. In sensitivity analyses that included all patients, the difference-in-differences between PHC and non-PHC practices were similar to our primary analyses (eAppendix Table 1a and 1b). PHC practices had lower performance at baseline and, therefore, more room for improvement. However, not only did PHC practices have improvements of a larger magnitude, but they actually surpassed performance in non-PHC practices for most measures. Lastly, beginning in January 2015, the PHC program was expanded to all primary care practices in our network, so this evaluation focused on the initial 6-month pilot period. Additional follow-up will assess expanding the program to non-PHC practices and the ability to sustain outcomes over time.

CONCLUSIONS

Interest in PHM activities has been spurred by new financial models using value-based payment, advances in health IT, and reorganizing delivery of primary care to support highly functioning teams.[33-35] Prior to implementing our PHM chronic disease program, our network had made progress through implementing a novel IT tool[5] and helping practices achieve PCMH recognition.[35] As part of this program's implementation, we changed traditional Healthcare Effectiveness Data and Information Set metrics used for pay-for-performance contracts to a model that was all-payer and all-patient, and incorporated clinically relevant metrics (such as giving credit for HTN control for patients already on 3 separate medicine classes regardless of blood pressure targets) as defined by the registry tool itself. These incentives were tied to individual practice PCP and staff incentives using existing monies associated with contractual insurer agreements.

Our study results demonstrated that a PHM program using a health IT tool improved process and outcome measures for patients with diabetes, CVD, and HTN over short-term follow-up. Further, utilizing central PHCs who worked closely with practice personnel led to greater improvement in outcome measures in those practices' patients compared with patients in practices not assigned central coordinators. This supports the use of central personnel working with practice-based staff on PHM programs, but longer-term follow-up is needed to assess outcomes over time. New funding mechanisms are needed to support such practice- and network-based efforts to improve population-based chronic disease management. ■

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eAppendix Table 1a. Proportion of patients at goal for chronic disease process and outcome measures in PHC and non-PHC practices at baseline and end of follow-up period including all patients present in each registry (patients not required to be present at both baseline and follow-up)

	PHC Practices			Non-PHC Practices			Difference in Differences*
	7/1/2014	12/31/2014	Difference	7/1/2014	12/31/2014	Difference	
Diabetes: LDL	2833/4759 (59.5%)	3187/4514 (70.6%)	11.1%	5926/9071 (65.3%)	6181/8656 (71.4%)	6.1%	5.0%
Diabetes: BP	3544/4759 (74.5%)	3666/4514 (81.2%)	6.7%	7095/9071 (78.2%)	6971/8656 (80.5%)	2.3%	4.4%
Diabetes: A1C	3011/4759 (63.3%)	3321/4514 (73.6%)	10.3%	5986/9071 (66.0%)	6146/8656 (71.0%)	5.0%	5.3%
CVD: LDL	3021/4681 (64.5%)	3423/4421 (77.4%)	12.9%	6546/10,009 (65.4%)	6947/9242 (75.2%)	9.8%	3.1%
HTN: BP	10,915/15,824 (69.0%)	11,799/15,705 (75.1%)	6.1%	20,859/28,933 (72.1%)	21,955/28,784 (76.3%)	4.2%	1.9%

* Adjusted p-values all $p<0.001$, adjusted for age, gender, language, race, insurance, practice type seen in [community health center or not], practice PCMH recognition status, and patient-physician continuity

eAppendix Table 1b. Proportion of patients at goal for process measures for chronic diseases and cancer screening in PHC and non-PHC practices at baseline and end of follow-up period including all patients present in each registry (patients not required to be present at both baseline and follow-up)

	PHC Practices			Non-PHC Practices			Difference in Differences
	7/1/2014	12/31/2014	Difference	7/1/2014	12/31/2014	Difference	
Diabetes: LDL	3850/4759 (80.9%)	4007/4514 (88.8%)	7.9%	7585/9071 (83.6%)	7526/8656 (86.9%)	3.3%	4.6%*
Diabetes: BP	4041/4759 (84.9%)	4185/4514 (92.7%)	7.8%	7979/9071 (88.0%)	7846/8656 (90.6%)	2.6%	5.2%*
Diabetes: A1C	3603/4759 (75.7%)	3828/4514 (84.8%)	9.1%	7108/9071 (78.4%)	7060/8656 (81.6%)	3.2%	5.9%*
CVD: LDL	3521/4681 (75.2%)	3762/4421 (85.1%)	9.9%	7685/10,009 (76.8%)	7702/9242 (83.3%)	6.5%	3.4%*
HTN: BP	12,797/15,824 (80.9%)	13,907/15,705 (88.6%)	7.7%	23,979/28,933 (82.9%)	25,186/28,784 (87.5%)	4.6%	3.1%*
Breast Cancer	13,627/15,193 (89.7%)	13,917/15,356 (90.6%)	0.9%	17,943/19,683 (91.2%)	18,110/19,638 (92.2%)	1.0%	-0.1%†
Cervical Cancer	27,947/30,709 (91.0%)	27,761/30,281 (91.7%)	0.7%	32,761/36,440 (89.9%)	32,961/36,055 (91.4%)	1.5%	-0.8%*
Colorectal Cancer	19,750/23,391 (84.4%)	19,418/23,557 (82.4%)	-2.0%	30,790/35,689 (86.3%)	30,326/35,545 (85.3%)	-1.0%	-1.0%*

* Adjusted $p<0.001$, † Adjusted $p = 0.01$, p-values adjusted for age, gender, language, race, insurance, practice type seen in [community health center or not], practice PCMH recognition status, and patient-physician continuity

eAppendix Table 2. Patient and practice characteristics among patients eligible for breast, cervical, and colorectal cancer screening in PHC and non-PHC practices at baseline

	Breast Cancer (n = 33,408)		Cervical Cancer (n=62,511)		Colorectal Cancer (n=53,620)	
	PHC (n=14,346)	Non-PHC (n=18,702)	PHC (n=28,438)	Non-PHC (n=34,073)	PHC (n=21,151)	Non-PHC (n=32,469)
Age, mean (SD)	60.8 (6.7)	61.7 (6.9)	43.6 (11.9)	42.7 (12.4)	61.9 (6.4)	62.8 (6.5)
Gender, female	100%	100%	100%	100%	61.0%	53.0%
Race						
White	84.2%	78.5%	77.3%	68.2%	84.4%	80.3%
African American	5.2%	6.2%	5.8%	6.6%	5.1%	5.9%
Asian	5.5%	4.8%	8.3%	6.9%	5.4%	4.3%
Hispanic	3.2%	8.5%	6.2%	16.0%	3.0%	7.5%
Other/Unknown	2.0%	1.9%	2.2%	2.4%	2.2%	2.1%
Language, English	94.1%	88.3%	94.3%	85.8%	94.2%	89.6%
Insurance						
Commercial	68.6%	62.1%	83.5%	78.7%	67.3%	61.8%
Medicare	22.1%	26.9%	3.3%	3.5%	24.0%	28.3%
Medicaid	8.3%	10.0%	11.4%	15.5%	7.8%	8.9%
Self-Pay	1.0%	1.0%	1.8%	2.3%	1.0%	1.0%
Patient-Physician Connectedness Status						
Physician-connected	93.9%	93.5%	86.3%	86.6%	94.1%	93.3%
Practice-connected	6.1%	6.5%	13.7%	13.4%	5.9%	6.7%
Practice type, community health center	25.5%	18.5%	17.8%	32.4%	26.6%	17.7%
Patient Centered Medical Home recognized practice	19.6%	15.9%	18.5%	29.3%	22.2%	15.8%