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Effectiveness of Diabetes Interventions in the Patient-Centered Medical Home

Sarah A. Ackroyd, MPH¹ and Deborah J. Wexler, MD MSc²

¹University of Rochester School of Medicine and Dentistry Rochester, NY 14642

Abstract

The patient-centered medical home (PCMH) is an innovative care model for the provision of primary care that is being rapidly adopted in the U.S. with the support of federal agencies and professional organizations. Its goal is to provide comprehensive, patient-centered care with increased access, quality, and efficiency. Diabetes, as a common, costly, chronic disease that requires ongoing management by patients and providers, is a condition that is frequently monitored as a test case in PCMH implementations. While in theory a PCMH care model that supports patient engagement and between-visit care may help improve diabetes care delivery and outcomes, the success of this approach may depend largely upon the specific strategies used and implementation approach. The cost-effectiveness of diabetes care in the PCMH model is not yet clear. Interventions have been most effective and most cost-effective for those with the poorest diabetes management at baseline.

Keywords

diabetes; interventions; patient-centered medical home; quality improvement; cost-effectiveness

Introduction

The patient-centered medical home (PCMH) is an innovative care model that is being rapidly adopted in medical practices across the U.S. with the support of governmental, private, and professional organizations. Derived from the Chronic Care Model (1), the patient-centered medical home (PCMH) aims to enhance access, quality, and efficiency. The basic components of the PCMH include: connection with a personal physician embedded in a care team focused on whole person orientation, enhanced access to and continuity of care, identification, tracking, and management of patient populations, care planning and coordination, providing self-care support and community resources, and measuring performance and improvement (Table 1). U.S. national guidelines for the Patient-Centered Medical Home are set by the National Committee on Quality Assurance (NCQA), which accredits 3 different levels of medical home status based on the criteria above that are connected with payment incentives (2).

²Corresponding Author: Massachusetts General Hospital Diabetes Center and Harvard Medical School, 50 Staniford Street, Boston MA 02114, 617-726-8767 (phone); 617.726.6781 (fax), dwexler@partners.org.

Compliance with Ethics Guidelines

Human and Animal Rights and Informed Consent

This article does not contain any studies with human or animal subjects performed by any of the authors.

Conflict of Interest

Sarah A. Ackroyd and Deborah J. Wexler declare that they have no conflict of interest.

The patient-centered medical home model explicitly promotes improved chronic disease management. As a costly, prevalent chronic disease with well-established metrics requiring both physician monitoring and patient self-management, diabetes serves as a test for the effectiveness of the PCMH. Existing evidence for the effectiveness of the PCMH in diabetes care is encouraging but not definitively favorable (3). Most of the evidence from demonstration projects is in the form of single group retrospective reviews. Several demonstration projects have shown better diabetes health outcomes, improved patient satisfaction, and prevention of inpatient and emergency room visits (4). In contrast, a systematic review of care management programs for diabetes, most of which were carved out from primary care, found that improvements in metabolic outcomes were “trivial” (5). Furthermore, despite the large number of demonstration projects, many report their results in case-study or anecdotal reports rather than in peer-reviewed journals (6). The most significant findings of these projects often have to do with improved care delivery, rather than improvement in traditional intermediate diabetes outcomes per se.

In this review, we will first highlight evidence in the literature that supports different elements of the PCMH in diabetes care (Table 2), review recently reported results of the major PCMH demonstration projects that pertain to diabetes (Table 3), summarize cost evaluations, and look toward the future of the patient-centered medical home in diabetes care.

Elements of PCMH that support better diabetes care and outcomes

Summary of care strategies

A recent meta-analysis of 48 cluster randomized trials and 94 patient-level randomized trials attempted to determine the effect of individual quality improvement strategies for diabetes (7). These strategies as studied were not necessarily embedded in PCMH models, nor were they necessarily implemented in isolation. Nonetheless, they provide some effect of the magnitude of benefit that might be expected on glycated hemoglobin (HbA1c) (Table 4). As expected, the effects are larger with higher baseline HbA1c. In a meta-regression in which trials with a given quality improvement strategy were omitted from the overall analysis, the authors determined the marginal effect of various strategies on HbA1c and found that team changes (0.33%), case management (0.21%), promotion of self-management (0.21%), clinician education (0.19%), patient education (0.21%), facilitated relay of information (0.12%), electronic patient registries (0.08%), and patient reminders (0.02%) remained significant in reducing HbA1c (effect size on HbA1c level indicated in parentheses). The top 3 strategies are major components of PCMH models, and the electronic registry is a tool to accomplish case management and several other PCMH interventions. The authors also examined non-glycemic outcomes and found these strategies were associated with increases in aspirin use, blood pressure medicine use, and lower low density lipoprotein cholesterol (LDL) (-0.10 mmol/L) and blood pressure ($-3.13/1.55$ mmHg).

Many of these specific strategies have been studied within PCMH models. In general, they are not used alone. The National Demonstration Project (NDP) on PCMH practice transformation found that practices best sustained the PCMH model when adopting multiple interdependent-components as a whole, rather than in increments (8). The downside of this approach is that while the model as a whole has been tested, there may be separable and resource-intensive components that are effective in and of themselves; failing to evaluate the most effective methods, or the individual components of those models which lead to better health care quality, may lead to excessive resource use in the pursuit of PCMH goals. Here, we describe in more detail the most effective interventions for diabetes care identified in the meta-analysis as implemented in PCMH models.

Diabetes Self-Management Education

Diabetes self-management education by a trained Certified Diabetes Educator (CDE) is the standard of care for patients with diabetes to increase their self-management skills and to encourage preventive care. Provision of this service within medical homes is one component of PCMH-based comprehensive diabetes care. A randomized controlled trial (RCT) in which patients received nurse CDE education over the course of 4 months showed moderate improvement in HbA1c, improved self-care, diabetes quality of life, and reduced frustration and distress over diabetes care (9). A similar RCT found that in addition to improved glycemic control, self-care, empowerment, and distress, patients who received training with an educator sustained their improvements after 6 months (10). Another RCT exploring different methods of diabetes self-management support following education found that patients who received any form of DSME demonstrated improved glycemic control, self-efficacy, empowerment, and distress. Continued support from staff and peers helped to maintain these improvements (11). Furthermore, a nested cohort in a randomized comparative effectiveness trial also found that patients in DSME programs experience higher diabetes-specific quality of life (12).

The CDE has an important presence on the health care team in many PCMHs. Several non-randomized studies examining diabetes care in the medical home observed improved HbA1c (13), LDL, fasting blood glucose, patient and provider satisfaction, and modest cost-effectiveness (14) in association with CDE visits. The medical home model encourages continuous education and follow-up, further supporting the role of the CDE on the health care team.

Team-Based Care

Patients with diabetes who receive team-based care generally have better outcomes in diabetes, cardiovascular, and renal health; indeed, team-based care is routine in specialized diabetes centers.

A meta-analysis of cluster and patient randomized controlled trials revealed that case management and team changes in the practice structure had among the strongest effects of any intervention on HbA1c, LDL, and blood pressure (7). A study evaluating a diabetes care team consisting of a diabetes specialist, dietitian, and a nurse CDE found that patients in a community health center demonstrated a higher percent of home self-monitoring of blood glucose testing, and enhanced pharmacological and nutritional management when working with the care team (15).

A team-based medical home program at the University of Utah used a team of health care professionals including a pharmacist and CDE and found that patients had improved quality measures and increased patient satisfaction with their diabetes care (16). A long-term demonstration of a team-structured level 3 PCMH in a network of federally qualified health centers studied a health care team consisting of a care coordinator/manager, on-site psychosocial services, and a CDE, who provided continuous education and development of self-management skills to patients. The results of this nine-year implementation study found that patients with diabetes benefited from the diabetes services offered, with the greatest improvements seen in those with mean HbA1c >9% (with improvement from 10.72% to 8.34%) at the outset and little deterioration over nine years in those with HbA1c 9% (17). In this intervention, health service utilization showed slight decreases in primary care visits in association with increasing outreach, education, and psychosocial services, suggesting real alteration in care processes in association with improved outcomes. Team-based care in the PCMH allows patients to receive comprehensive services to help manage their diabetes.

Care Coordination/Case Management

Care coordination is one of the core elements of the medical home that encourages better, comprehensive patient care. Current and past medical home projects have used various methods to increase coordination of care for patients. These include but are not limited to: reminders for preventive foot and eye appointments, follow-up communication to patients, and joint appointments with educators, nutritionists, social workers, or other health care providers. Many medical homes offer enhanced communication outside of in-person appointments. This care coordinator role is often performed by a nurse care manager, health coach, or other non-physician clinician, whose responsibility is to provide continuous communication and follow-up with patients through telephone or electronic means between visits (18–20).

An RCT conducted in 14 primary care clinics in Washington State introduced a nurse-guided collaborative care coordinator who aimed to improve co-morbid risk factors and quality of life in patients with depression and chronic diseases, including 213 patients with diabetes. The intervention found that patients in the intervention group had improved control of HbA1c, LDL, systolic blood pressure, patient satisfaction, and quality of life (21). Non-randomized studies conducted in PCMH settings found similar results with the diabetes care coordinator being associated with reductions in glycemic control (17, 22) and improvements in CVD risk factors (20, 23) and preventive care measures (24, 25).

Specialty providers as members of the care team

A further aspect of care coordination that was not studied in the meta-analysis includes incorporation of specialty services into primary care. Pharmacist-supported medication management is another effective component of team-based diabetes care that may be an important addition to a basic PCMH model. Pharmacists work with patients in a variety of ways in medical home settings including: providing assistance with prescription dosing, education, and use and meeting with patients to discuss diabetes goals. Existing evidence for their benefit in diabetes outcomes is supported by case studies and retrospective chart reviews (11, 26–31). Pharmacist services in a PCMH have been associated with improved glycemic control (26, 28), better prescription error management, a higher proportion of patients meeting diabetes care measures, enhanced quality, and decreased spending on diabetes care services (32, 33). A randomized control trial of 44 patients with diabetes and depression in a non-medical home setting studied the impact of a pharmacist visit in addition to usual care visits on diabetes outcomes. The pharmacist led individual and group sessions to teach patients behavioral and pharmacological interventions to control their diabetes and cardiovascular risk factors. The study found that patients in the pharmacy visit group achieved better glycemic control and improved management of cardiovascular risk factors but experienced no change in levels of depression (11).

Behavioral health services in the medical home provide patients the opportunity to seek support and treatment in the same setting in which they receive primary medical care. Patients with diabetes experience higher levels of depression, anxiety, and distress compared to adults without diabetes (34, 35). The medical home model provides an opportunity to coordinate these services, often called “collaborative care.” As noted briefly above, in an RCT studying collaborative care, nurse care managers provided guideline based, patient-centered co-management of depression and chronic disease to high-risk patients. The study found that patients who were managed for both conditions had improved diabetes, CVD, and depression indicators compared to usual care (21). Other medical home settings have employed comprehensive teams with social workers, psychiatrists, therapists and behavioral health interns to address depression and psychosocial concerns in diabetes patients (17, 36).

Electronic Record Capabilities

Although the electronic medical record and registries do not appear to be the most effective quality improvement intervention in meta-analysis, they are a necessary tool for implementation of more effective strategies of population management. Most effective medical home models include the use of an integrated electronic health records system (EHR). A study in Pennsylvania clinics found that practices with successfully implemented medical homes had well-established and high-functioning electronic health records, compared to less successful clinics that lacked advanced EHR technology (37). The most advanced EHRs include those that create registries of patients with diabetes and then monitor, benchmark, and record progress on patients who may need additional services.

The Geisinger health system underwent a major PCMH transformation in 2005 in which one of the main structural overhauls included use of an advanced electronic health records system. Geisinger used the EHR to benchmark diabetes care progress, issue reminders to patients, audit physicians to improve quality, and derive registries identifying those patients who were at high risk. The group found that after implementing the advanced EHR, patients had improved blood pressure, glycemic control, vaccination rates, and a composite of nine diabetes metrics (38). Despite the lack of RCT evidence for the EHR, non-randomized studies have demonstrated its positive role as the sine qua non of population management and coordination of care, though the way in which the registry is used—the workflow and its implementation—are as important as the existence of the tool itself.

Recently reported outcomes of Patient-Centered Medical Home Demonstrations

Many of the well described and extensively evaluated demonstration programs incorporate the elements that have been well documented to improve diabetes care (Table 3). Bojdziewski et al. previously reviewed a variety of demonstration projects that included diabetes measures in their evaluation (4). Here we highlight recent publications from four recent demonstrations (Table 4), referencing both the original reports and descriptive reviews where appropriate. The following demonstration projects were selected because they were evaluated over longer periods and included process and impact measures rather than solely reporting intermediate clinical outcomes. These long-term measures may provide us a better picture of the function of a patient-centered medical home with respect to diabetes care.

Geisinger Health System

The Pennsylvania-based Geisinger Health System patient-centered medical home model, formally known as the Personal Health Navigator (PHN), is a well-documented demonstration study. Key features of their comprehensive medical home model include the use of an advanced EHR, allowing patient and physician tracking, benchmarking, population management, and online portals for additional patient communication; increased access through the “Personal Health Navigator” (PHN), a feature which offers patients 24-7 access, consistent follow-up, and specialized evidence-based care plans which include “bundled” measures designed to manage chronic diseases, including diabetes; and highly collaborative team-based care with a nurse care coordinator (19, 38).

It is important to note that Geisinger offered this program initially to Medicare-eligible members who had the opportunity to opt in to the PHN model. Many of their analyses are derived from this population, and outcomes in are compared between those who opted in versus those who did not; case mix differs between the populations, confounding results. Within the context of this limitation, a report published in 2010 found that PHN groups had

an 18% reduction in inpatient stays ($p < 0.01$) and 36% reduction in readmissions ($p < 0.02$) compared to non-PHN groups (39). A more recent evaluation found the PHN was associated with significant improvements in prevention of amputations patients with diabetes (on the basis of a small number of events). End-stage renal disease (ESRD) claims appeared to be more common in PHN compared to non-PHN members in crude analyses, as did myocardial infarction (MI) and stroke claims. After adjusting for the location of care over several years of follow up, ESRD appeared to be less common and MI and stroke appeared not to differ significantly between PHN and non-PHN groups (23). In a survey sent to PHN and non-PHN patients, PHN patients were more likely to report positive changes in care experience and quality and less likely to go to the ER for health care compared to non-PHN respondents (40). Despite the limitations of the non-randomized evaluation, the Geisinger research group has provided a comprehensive illustration of how the medical home can enhance chronic disease management and work towards improving long-term outcomes in patients; it appears that the benefit of the model may be in organization of care as much as in outcomes.

HealthPartners

One of the largest networks of patient-centered medical homes is part of HealthPartners, based in Minnesota. In their care redesign, HealthPartners invited Minnesota primary care clinics to apply to become a certified health care home (HCH), requiring the following elements: continuous access and communication, electronic registry management, care coordination, chronic care plans with family involvement, and continuous improvement initiatives in health outcomes and cost-effectiveness. They performed multiple retrospective evaluations with data collected from surveys administered to patients and from EHR data. Different comparison groups were used in each of their independent evaluations (41). Their first evaluation found that patients with diabetes had cost savings, a reduction in ER visits and hospitalizations, and improved HbA1c, LDL, aspirin use, and smoking cessation rates (42). A more recent evaluation of 102 of the HCH-certified clinics found that over the course of the 3 year transformation, HCH-certified clinics improved from 22.0 to 24.4% (mean change 2.1%, SD= 5.5%, $P = 0.001$) on the rate of patients reaching all 5 diabetes measures (HbA1C <7%, BP <130/80 mm Hg, LDL < 100 mg/dL, taking aspirin, not smoking) and from 37.5 to 41.6% (mean change 4.4, SD = 7.5%, $P = .001$) on vascular measures (20). HealthPartners found an annual 1–3% increase in patient satisfaction, starting from a lower baseline, at 21 HealthPartners sites that became level 3 PCMHs during the study period compared to non HealthPartners community sites. The transformation process rapidly brought the lower performing sites up to the background community rate at comparator sites in most cases (41).

Pennsylvania Chronic Care Initiative (PCCI)

The Southeastern Pennsylvania-based primary-care office PCMH project aimed to increase quality of care and improve diabetes measures in a population of nearly 10,000 patients with diabetes. Practices participating in the redesign varied in size, payer mix, and academic affiliation. The initiative included use of care managers and practice coaches, quality reporting, electronic registries, and a staff learning collaborative (43). After the first implementation year, PCCI noted significant improvement in diabetes measures, including HbA1c, and in cardiovascular risk factors, including blood pressure and cholesterol (4, 43). In addition, all practices in the group received NCQA status with a significant increase in patients meeting diabetes self-management goals, and preventive screening and treatments, including eye and foot exams, microalbumin screen, pneumococcal vaccine, smoking cessation, and aspirin, statin, and blood-pressure medicine use (24, 43). Notably, physicians and practices received internal incentive payments for meeting infrastructure criteria and achieving NCQA recognition.

Recent analyses of this initiative examined different structural features which improved the success of the medical home adoption, citing the highest performing practices with an 8.8, 19.5, 14.9% absolute improvement in meeting diabetes standards for HbA1c <7%, BP <130/80 mm Hg, and LDL <100mg/dL, respectively. Higher performing practices had advanced EHR systems with reporting, benchmarking, and registry functions, advanced communication, strong leadership within a team structure, and a shared vision amongst the practice (37). While the study demonstrated encouraging results, the design was retrospective, and based on self-reported data, with no comparison group.

Group Health Cooperative

The Seattle, Washington based PCMH redesign at Group Health Cooperative began in 2006. After a prototype model improved access and productivity at the expense of physician burnout, declines in clinical quality, and increased health care utilization, Group Health underwent a whole practice transformation that implemented a team model with augmented non-physician staffing, reduced physician panel size (from 2,300 to 1,800) and increased visit length (from 20 to 30 minutes) (44). Key components of the redesign included an online patient portal, visit summaries, increased communication and follow up, increased access to primary care physicians and specialists, and quality and safety-based reimbursement. Initial evaluations were done using a quasi-experimental model, with a single clinic as the experimental group compared with 19 other non-PCMH clinics in the network (45). The group reported encouraging results at one and two years, citing improved patient experience, provider satisfaction, quality measures, fewer hospitalizations and emergency visits and cost-savings (44, 45), though the costs and utilization results of this new model were not borne out in longer-term analyses as outlined below.

Cost effectiveness of the PCMH model for diabetes care

One of the aims of the patient-centered medical home model is to increase value by improving quality and lowering cost. It is not clear whether the PCMH model can lower the cost of care in diabetes populations. Some programs cite cost savings (44, 46–48). The Geisinger group found that medical home members enrolled in their Medical Advantage insurance plan experienced lower costs in proportion to the duration in the medical home, modeling a cost savings of about 7.1% per year (49). Another study looked at how different components of the medical home affected diabetes-related costs and reported that formal quality improvement, performance measurement, and individual feedback were associated with \$245 lower total diabetes-related costs per patient per year, finding that higher level decision support saved \$26 for every 10% increase in practice decision support services and counseling reminders saved \$337.93 in inpatient costs per patient per year (46).

By contrast, other programs report increased cost with diabetes care management in a PCMH model, including some with increased emergency room and hospitalization costs (22, 50). An initial two-year follow-up of the Group Health Cooperative medical home found a reduction in inpatient admissions, emergency room visits, and primary care visits in the overall population that was associated with a significant average reduction in cost of \$10.30 per patient per month, translating to \$1.50 savings per \$1 spent on care (44). However, a recent analysis of the same project which focused on diabetes costs in the medical home found cost neutrality, with decreased cost of specialty care and pharmacy services balanced by increased cost of primary care visits, emergency room visits, and inpatient hospitalizations in the diabetes population (50).

One of the challenges of evaluating costs in diabetes may be that savings accrue over the very long term, while investments are ongoing. A recent paper tried to estimate long-term health and cost outcomes in diabetes patients using the Archimedes model to project costs

and outcomes among patients with HbA1c>9%. This comprehensive cost analysis revealed that the PCMH model may be cost-effective, with a projected favorable investment in health care at \$7,898 per quality-adjusted life year for all ages, and may be cost-saving for patients aged 50–64. The model assumes that usual adverse events in patients with uncontrolled diabetes would be avoided if care in a PCMH controlled their glycemia by means of a 49% improvement rate in HbA1c at a cost of \$20 per patient per month (47). The results must be interpreted in light of these assumptions in a small, high-risk segment of the population that may or may not derive benefit from the PCMH approach.

Conclusions

Taken together, randomized trial, observational, and meta-analytic evidence suggest that various components of the PCMH alone and in combination will yield improvements in diabetes care measures, though these improvements may be modest and will not necessarily lower costs. The most effective strategies are education and promotion of self-management, team changes that promote care management, and electronic patient registries used in the service of those care strategies (7). Though the effects on HbA1c, LDL, and blood pressure are often small, over a large population they may yield benefit. Longer observation periods may be required to realize the benefits of PCMH restructuring (51).

The transition to a Patient-Centered Medical Home model can be challenging. The National Demonstration Project found that many practices experienced “change fatigue,” or exhaustion from the change in processes in the office, resulting in staff burnout, turnover, and financial distress. At the conclusion of their study, the NDP recommended the following requirements for a sustainable PCMH transformation: adequate financial resources, tailored redesign to each specific practice, assistance to physicians in transformation, staff monitoring and progress, flexible technology implementation, and creating a flexible and realistic implementation plan (8). Smaller physician-owned practices lacked many of the components cited for success in PCMH transformation (52). If PCMH implementation is undertaken without allotting sufficient time for physicians and other health care providers to carry out their new tasks, quality may suffer and burnout may result, as demonstrated by the early Group Health Cooperative prototype.

Research in PCMH implementation in diabetes can be enhanced by using the many different implementations to study the effects of the model, incorporating different study designs that minimize bias compared to the usual uncontrolled retrospective analyses common in this field. A variety of non-randomized study designs have been employed in clinical settings to improve the level of evidence generated. One idea is to use information technology to allow patient-level randomization to different PCMH components, and evaluating individual exposures. Alternative non-randomized study designs include concurrently controlled cohort studies in which two groups from different sites are derived and compared during the same time period or an interrupted time-series design. While imperfect and subject to systematic error (53, 54), alternative study designs offer a method to evaluate PCMH implementation in the clinical practice where randomized-controlled designs may not be feasible. The CDC’s Natural Experiments for Translation in Diabetes (NEXT-D) research network is an important model for using ongoing implementations to gather better evidence (<http://www.cdc.gov/diabetes/projects/next-d.htm>).

While diabetes is often the condition in which PCMH achievements are measured, the PCMH model is being implemented to promote care of the whole patient with a more favorable use of human and financial capital. In the short term, one of the clearest benefits of the PCMH, if implemented well, is its ability to improve patient and provider satisfaction, as has been seen in several of the demonstrations listed above and in type 1 diabetes, in

which the PCMH structure was found to offer enhanced well-being for families with children with type 1 diabetes, with reduced work and financial stress after receiving services in a family-patient centered medical home for 12 months (55). Effective implementation requires leadership, setting specific aims and/or goals, involving all staff members in the planning and implementation, and keeping team morale and enthusiasm high during the transition (56). Under these conditions, the PCMH model can improve care while improving its organization. A large sample of randomly selected patients in the Seattle project reported that after 1–2 years of receiving care in the medical home, they reported receiving better quality care in coordination, access, and goal-setting areas. Providers in this study had lower reported levels of burn-out and better rates of meeting twenty-one Healthcare Effectiveness and Data Information System indicators compared to non-medical home practices (44). Following the evidence for the most effective interventions in diabetes will allow the PCMH model to meet the challenges in caring for this large, clinically complex, and expensive population.

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Table 1

NCQA Standards and Elements for PCMH Certification

NCQA PCMH Standards	Elements
Enhance Access and Continuity	Access during office hours and after hours, electronic access [*] , continuity, medical home responsibilities, culturally and linguistically appropriate services, the practice team [*]
Identify and Manage Patient Populations	Use data for population management [*] , collect patient information and clinical data, perform a comprehensive health assessment
Plan and Manage Care	Implement evidence-based guidelines, identify high-risk patients [*] , provide care management [*] , medication management [*] , and electronic prescribing
Provide Self-Care Support and Community Resources	Support self-care process [*] , provide referrals to community resources [*]
Track and Coordinate Care	Test tracking and follow-up, referral tracking and follow-up, coordinate with facilities/care transitions [*]
Measure and Improve Performance	Measure performance and patient/family experience, implement quality improvement report performance and data, use certified EHR technology [*]

* Elements with evidence of effectiveness, detailed in Table 2.

Table 2

Essential Components of the PCMH in Diabetes Care

PCMH Component	Evidence Available
Diabetes Self-Management Education	9 [*] , 10 [*] , 11 [*] , 12, 14
Team-Based Care	7 [*] , 15, 16, 17
Care Coordination & Case Management	17, 20, 21 [*] , 23–25
Specialty Care Team Members	
• Pharmacists Services	11 [*] , 26–33
• Behavioral Health	17, 21 [*] , 36
Electronic Health Records	37, 38

* Randomized-controlled trials

Table 3

Key PCMH Components in highlighted PCMH demonstration projects

Demonstration	Results	Key PCMH Components
Geisinger Health System (Pennsylvania)	<ul style="list-style-type: none"> • 18% reduction in inpatient stays and 36% reduction in readmissions (39) • Reduced ESRD (23) 	<ul style="list-style-type: none"> • Advanced EHR with patient and physician tracking and communication • Personal Health Navigator: care coordination and follow-up • Evidence-based care plans with • Nurse Care Coordinator services
HealthPartners (Minnesota)	<ul style="list-style-type: none"> • Cost savings and reduced hospitalizations and ER visits (42) • Improved diabetes and cardiovascular measures (20) • Improved patient satisfaction (41) 	<ul style="list-style-type: none"> • Enhanced communication mechanisms between providers and patients • Electronic registry management • Family-centered care plans • Care coordination
Pennsylvania Chronic Care Initiative (Southern Pennsylvania)	<ul style="list-style-type: none"> • Improvement in diabetes and cardiovascular risk factors (4, 43) • Increased preventive measures and appointments including screening, self-management, eye and foot exams, vaccination rates, smoking cessation, and preventive medication use (24, 43) 	<ul style="list-style-type: none"> • Care managers and practice coaches for coordination • Quality reporting • Electronic registry management • Team-based structure with strong leadership and staff learning collaborative
Group Health Cooperative (Seattle, WA)	<ul style="list-style-type: none"> • Improved quality measures • Reduction in hospitalizations and ER visits • Cost-savings • Improved patient and provider satisfaction (44, 45) 	<ul style="list-style-type: none"> • Team model with higher proportions of non-physician staff • Longer appointment times • Online patient portals • Enhanced communication and follow-up • Increased patient access to physicians

Table 4

Ranking of Quality Improvement Strategies for lowering HbA1c based on meta-analysis *

Rank	Intervention	Number of trials	Mean difference in HbA1c (95% CI)
1	Promotion of self-management	60	-0.57 (-0.83 to -0.31)
2	Team changes	47	-0.57 (-0.71 to -0.42)
3	Case management	57	-0.50 (-0.65 to -0.36)
4	Patient education	52	-0.48 (-0.61 to -0.34)
5	Facilitated relay of clinical data	32	-0.46 (-0.60 to -0.33)
6	Electronic patient registry	27	-0.42 (-0.61 to -0.24)
7	Patient reminders	21	-0.39 (-0.65 to -0.12)
8	Audit and feedback	8	-0.26 (-0.44 to -0.08)
9	Clinician education	15	-0.19 (-0.35 to -0.03)
10	Clinician reminders	18	-0.16 (-0.31 to -0.02)
All		120	-0.37 (-0.45 to -0.28)

* Effects were greater with baseline HbA1c > 8.0% and less in HbA1c < 8.0%

Adapted from Tricco et al (7).