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The Hypertension Team: The Role of the Pharmacist, Nurse and Teamwork in Hypertension Therapy

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BACKGROUND

By 2025, it is predicted that more than 1.5 billion individuals worldwide will have hypertension, accounting for up to 50% of heart disease risk and 75% of stroke risk.[1] For several decades it has been well known that lowering blood pressure (BP) with lifestyle modification, medications, or both can substantially reduce a patient's subsequent risk for disease.[2] For each 10-mm Hg decrease in systolic BP, the average risk of heart disease mortality and stroke mortality decreases by 30% and 40%, respectively.[3] Despite clear benefits that treatment of hypertension reduces cardiovascular morbidity and mortality, only half of those with hypertension have adequate BP control.[4] There are many causes for poor BP control besides lifestyle choices including sub-optimal patient medication adherence[5-8] and failure to intensify therapy (clinical inertia) by clinicians.[9, 10] One of the most effective strategies to improve BP control is team-based care, especially with pharmacists and nurses.[11-13]

This paper was commissioned by the Editorial Board of the Journal of Clinical Hypertension for the American Society of Hypertension. We will review models of care delivery that are driving health-care reform. We will then review key historical papers involving team-based care strategies to improve blood pressure control with a focus on more recent controlled trials and systematic reviews. Because there are hundreds of publications on team-based care, this will not be an exhaustive review of the literature. Rather, this paper will focus on rigorously designed controlled clinical trials, studies involving contemporary technology, cost-effectiveness analyses and future models to improve BP control.

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The Chronic Care Model

The Chronic Care Model (CCM) was developed as a framework for redesigning healthcare and addressing deficiencies in the care of chronic conditions, such as hypertension. Its 6 domains are decision support, self-management support, delivery design, information systems, community resources, and healthcare systems. Optimizing and integrating these domains has been shown to lead to activated patients, responsive healthcare teams, and improved health services and treatment outcomes, and may be cost-effective (Figure 1).[14-22] This model emphasizes the role of patients with chronic conditions as being their own principal caregiver and the importance of provider, family, and community support in self-management.[14,23] In effect, patients are at the center of the care model with providers, family, and community interacting in different ways to influence and support health decisions. Collaborative care has been defined as: 1) collaborative definition of problems, 2) goal-setting, planning and action plans, 3) a continuum of self-management training and support services and 4) active and sustained follow-up.[14, 15, 17-21, 24, 25] This model of care recognizes a collaborative partnership between the patient, provider and the care team, each with their own expertise in managing that person's health, and who share in the decision making process. This collaborative partnership between patient and provider is important in supporting the patient's management of chronic disease over multiple encounters and adjustments in the treatment plan to achieve optimal care.

The Patient-Centered Medical Home and Teams

The patient-centered medical home (PCMH) was designed to replace episodic care based on illness and patient complaints in order to provide ongoing "whole-person" comprehensive chronic illness and preventive care.[26] The PCMH is endorsed by the American Academy of Family Physicians, American Academy Pediatrics, American College of Physicians, and is broadly advocated as a potential vehicle for improving health care quality and mitigating costs.[27-29] In support, the National Committee on Quality Assurance (NCQA) has developed a tiered set of recognition standards (Tables 1, 2). The PCMH emphasizes that patient care be organized around the needs of the patient, their relationship with their personal physician, and that physician-led teams may form and reform according to the needs of the patient.[24, 27] The physician delegates responsibility to other members of the team to perform a medication history, identify problems and barriers to achieving disease control, perform counseling on lifestyle modification and adjust medications following hypertension guidelines. Frequent communication by team members concerning goal-directed therapy allows the physician to address more acute problems and complications. There is early evidence that the PCMH can be used to improve healthcare delivery outcomes, increase physician satisfaction, and decrease the costs of healthcare.[30, 31] The personal relationship between the patient, physician, and the team has also been used to overcome barriers to care often seen in minorities or other vulnerable populations.[32]

Historical Context and Systematic Reviews

Several key studies published prior to 2000 will be discussed. A more comprehensive list of controlled trials of team-based care can be found in the systematic reviews which are also discussed below.

The first study of team-based care was published in Circulation in 1973 by McKenney et al.[33] Patients (n=50) were randomized to traditional pharmacy services or an intervention group. The community pharmacist evaluated patients and worked closely with two physicians in an urban health center in Detroit including visiting the clinic to review the medical records and the pharmacist made recommendations for changes in therapy. Patients in the intervention group were seen monthly for five months by appointment with the pharmacist in one of three community pharmacies. BP was measured in the physician's office and it deteriorated in the control group from 163/93 mm Hg to 166/101 mm Hg over the 5 months. However, BP improved in the intervention group from 157/99 mm Hg at baseline to 146/90 mm Hg (between group p<0.001). BP control deteriorated in the intervention group once the intervention was discontinued.

Bogden and colleagues (1998) evaluated the effect of a pharmacist working within a medical resident teaching clinic.[34] Patients with uncontrolled hypertension were randomized to either a control (n=46) or intervention (n=49) group. Systolic BP decreased 23 mm Hg in the intervention group and 11 mm Hg in the control group (p<0.001). BP control was achieved in 55% in the intervention group compared to 20% in the control group (p<0.001).

Borenstein et al. (2003) evaluated physician-pharmacist co-management of hypertension within an integrated healthcare system.[35] Patients were randomized to either the co-managed group (n=98) that attended a hypertension clinic run by pharmacists or usual care (n=99). Patients were seen every 2 to 4 weeks, with the pharmacist calling the physician at each visit with the recommended treatment plan based on an evidence-based algorithm. Systolic BP was reduced significantly more in the co-managed group than in the usual care group at 6, 9 and 12 months (22 vs. 9, 25 vs. 10 and 22 vs. 11 mm Hg, respectively, p<0.01 at all time points). More patients in the co-managed group (60%) achieved BP control than in the usual care group (43%, p=0.02).

One of the earliest published studies of nurses (Logan et al., 1979), was conducted in the patient's workplace and compared BP to a control group managed by the patient's family physician.[36] In contrast to the study by Borenstein et al, the nurses prescribed and changed drug therapy without physician approval while physicians reviewed the charts of nurse-managed patients on a weekly basis. The study involved 457 participants and nurse-managed patients were more likely to receive a new antihypertensive (95% vs. 63%, p<0.001), receive two antihypertensives (44% vs. 18%, p<0.001), more likely to adhere to the medication regimen (68% vs. 49%, p<0.005) and more likely to achieve goal BP at 6 months (49% vs. 28%, p<0.001).

Rudd and colleagues (2004) conducted a randomized controlled trial (RCT) comparing nurse case-management (n=74) to a control group (n=76).[37] Nurses saw patients at baseline and provided education on use of an automated BP device, strategies to improve medication adherence and identification of adverse drug events. The nurses performed additional telephone contacts at 1 week and at 1, 2, and 4 months, independently made medication dosage increases, and contacted the physician to obtain permission to initiate any new BP medication. Of note, only patients randomized to nurse case management received portable BP monitors which could have further improved BP control independent of nurse functions due to greater patient self-monitoring. Systolic BP declined by 14.2 mm Hg in the intervention group and 5.7 mm Hg in the control group (p<0.01) at 6 months. Patients were taking significantly more medications in the intervention group and had significantly more medication changes (223 vs. 52, p <0.01) than the control group. Medication adherence at 6 months was 81% in the intervention group and 69% in the control group (p=0.03).

An interesting study conducted by Mundinger and colleagues evaluated care of several conditions including hypertension delivered by nurse practitioners compared to physicians.[38] Most patients were Hispanic immigrants and all patients were enrolled after an emergency department or urgent care visit who were randomized to either a nurse practitioner (n=806) or a physician (n=510). The nurse practitioners and physicians had interchangeable roles for prescribing, consulting, referring or admitting patients and the primary outcome was quality of life which was no different between groups. Diastolic BP was slightly better when provided by nurse practitioners compared to physicians (137/82 vs.

139/85 mm Hg, p=0.28 for systolic and p=0.04 for diastolic BP) over a period of one year after baseline.

Several systematic reviews have been conducted to evaluate various quality improvement strategies to improve BP control. Walsh and colleagues prepared a report for AHRQ and subsequently published their findings in 2006.[11] They identified 63 controlled studies of quality improvement (QI) strategies directed at improving hypertension control.[11] The majority of the studies combined several strategies and a taxonomy was developed for categorizing various QI approaches. Median systolic BP reductions for various approaches were: audit/feedback (1.3 mm Hg), provider education (2.7 mm Hg), provider reminder systems (6.8 mm Hg), self-management (3.6 mm Hg), patient education (8.1 mm Hg), and organizational change (10.1 mm Hg). These authors found that the only statistically significant effects occurred with organizational change, which included team-based care (37 comparisons) where they found a median reduction in systolic BP of 9.7 mm Hg and a 21.8% net increase in systolic BP control.

Another meta-analysis of pharmacy based interventions was performed by Machado et al. (2007).[39] These authors evaluated 13 studies that included 2200 individuals and found that pharmacists' interventions significantly reduced SBP (10.7 SD 11.6 mm Hg; p = 0.002), while controls remained unchanged.[39] These findings confirm the findings of other meta-analyses and systematic reviews.

Another meta-analysis of team-based care by Carter and colleagues (2009), evaluated the potency of either nurse or pharmacist-assisted management of hypertension.[12] This analysis found significantly greater likelihood of controlled BP in studies involving nurses (OR = 1.69; 95% CI=1.48-1.93), pharmacists within clinics, (2.17; 1.75-2.68) and community pharmacists (2.89; 1.83-4.55) compared to usual care. These authors attempted to isolate the components of team-based care that were most effective and found the reductions in systolic BP (in mm Hg) were: pharmacist recommended therapy to the physician (−9.3), patient education provided by nurse or pharmacist (−8.8), pharmacist performed the intervention (−8.4), medication adherence assessed (−7.9), nurse conducted the intervention (−4.8), treatment algorithm was used (−4.0).

In the most recent Cochrane review (2010) of quality improvement interventions used to improve control of BP in patients with hypertension,[40] 72 randomized RCTs were identified representing the following six intervention types: (1) self-monitoring; (2) educational interventions directed to the patient; (3) educational interventions directed to the health professional; (4) health professional (nurse or pharmacist) led care; (5) organizational interventions that aimed to improve the delivery of care; and, (6) appointment reminder systems. Self-monitoring was associated with modest net reduction in systolic (S) BP (Weighted Mean Difference (WMD) −2.5 mmHg, 95% CI: −3.7 to −1.3 mmHg) and diastolic (D) BP (WMD −1.8 mmHg, 95% CI: −2.4 to −1.2 mmHg). Trials of educational interventions directed at patients or health professionals appeared unlikely to be associated with large net reductions in BP by themselves. Appointment reminder systems were heterogeneous and results were not clear, but the majority of trials increased the proportion of individuals who attended follow-up visits by almost 2.5 times and in two small trials also led to improved BP control (odds ratio 1.85, 95% CI 1.37 to 2.44) favoring the intervention [40] The Cochrane review authors conclude that an organized system of registration, recall and regular review allied to a vigorous stepped care approach to antihypertensive drug treatment appears the most likely way to improve the control of high BP.[41] They also concluded that nurse or pharmacist led care was promising, with the majority of RCTs being associated with improved BP control and reduction in mean SBP and DBP.

Chisholm-Burns and colleagues (2010) conducted a meta-analysis and identified 298 studies trials in the US that evaluated pharmacist-provided direct patient care for various chronic conditions.[13] These authors found significant improvements in BP, HgA1c, low density lipoprotein cholesterol, adverse drug events, medication adherence, quality of life and patient knowledge ($p<0.05$).

In a recent systematic review and meta-analysis by Clark and colleagues (2011), of trials of nurse-led interventions for hypertension in primary care focused on establishing whether nurse prescribing is an important intervention.[42] Interventions that included a stepped treatment algorithm showed greater reductions in SBP (weighted mean difference −8.2 mm Hg, 95% CI −11.5 to −4.9) compared to usual care. However, this was not associated with higher achievement of BP targets. Nurse led clinics with structured prescribing algorithms in primary care settings also achieved greater reductions in SBP and DBP compared with usual care. Interestingly, when results were pooled, nurse led interventions significantly lowered SBP compared to usual care in African Americans participants, but there was little difference for other ethnic minority groups. In general, this review suggests that hypertension care led by a nurse leads to improvements in BP compared to doctor-led or usual care.[42]

Limitations of Previous Studies and Gaps in Knowledge

The above studies highlight the consistent benefit of team-based care for improving BP control. However, the authors of the systematic reviews and others identified several limitations in the published literature including:[43, 44] small patient sample sizes, single or few pharmacist or nurse interventionists, lack of a control group, lack of intention-to-treat analyses, and not controlling for potentially confounding covariates. Randomization does not always eliminate all differences between groups, particularly for studies with smaller sample size. Therefore, covariates such as gender, race, education, baseline BP and body mass index should be controlled in the analyses. Generally, studies were conducted at single sites, leading to potential contamination if the intervention included changing provider behavior and the clinician had patients in both control and intervention groups. An advantage of limited number of medical offices or intervention providers is the ability to maintain high fidelity of the intervention. However this might also make results less generalizable. Additionally, in some studies the measurement of BP was biased, because the measurement was made by the intervention provider or person invested in the results and thus not blinded. In other studies, unreliable BP measurements (e.g. routine office readings) were used as the outcome variable.

In defense of investigators, the funding sources for team-based care interventions prior to 2000 was limited and large, rigorously trials were difficult to conduct. With increased interest in translation and health care reform, such funding has become available and recent and ongoing studies are addressing some of the key gaps in our understanding of team-based care including:

There remain numerous gaps in our understanding of team-based care, some of which will be addressed in more recent and ongoing studies we discuss below. Some of these gaps in the literature include:

1. Most studies had durations of 12 months or less and longer-term effectiveness was not evaluated.
2. Little information was available on the sustainability of the intervention once it was discontinued.

3. Because typical team interventions might change provider behavior, it is not known how much the positive effects on BP diffuse to other patients in the practice who are not directly involved in the study intervention. Understanding the larger contextual, organizational impacts of such team interventions is essential, particularly when trying to instigate individual provider quality improvement feedback or use of “pay for performance” strategies.
4. Very few cost-effectiveness analyses have been published and the relative costs and benefits must be better defined. We do not have an adequate understanding of what outcomes should be measured in cost analyses, nor what would be considered a reasonable return on investment.
5. Few studies have actually evaluated a typical team that might be formulated in primary care practices, that might not have access to in-house or clinical pharmacists or nurses or payment systems that would allow clinicians to provide this type of care. Alternatively, larger integrated healthcare organizations might be able to form multi-provider teams that include social workers, nutritionists, and hypertension specialists.
6. There is no information on when the patient care team should engage a hypertension specialist or how the specialist could be integrated into this team.
7. The most efficient utilization of team members has rarely been evaluated. When and how to engage the specific expertise of various team members needs better definition. Few studies have examined the use and acceptability of nurses and pharmacists following medication algorithms to make direct medication changes.
8. Several studies of team-based care have used various technologies and/or self-monitoring. However, far more research is needed to evaluate web-based approaches, the use of social media and other strategies to better engage patients in their own care.
9. Models for reimbursement and subsequent sustainability of programs have not been adequately examined.

Contemporary and Ongoing Studies 2005-2014

More recent studies have begun to address some of the limitations of previous studies and gaps in the literature of team-based care. This section will briefly review some of these key studies.

A. Randomized trials of pharmacists—Lee and colleagues conducted the Federal Study of Adherence to Medications in the Elderly (FAME), which was a multiphase study conducted at Walter Reed Army Medical Center in 200 patients taking 4 or more various medications, 92% of whom had hypertension.[45] Following a run-in phase, all patients received a comprehensive pharmacy program to improve adherence including education and a pre-packaged medication adherence aid (blister packs). After 3-8 months in Phase 1, subjects were randomized to usual care or continued pharmacy care for an additional 6 months. Patients randomized to usual care once again received traditional pill bottles with 90 day supply. Patients randomized to pharmacy care continued to receive follow-up every 2 months by the pharmacists plus medication blister packs to improve adherence. Following the Phase 1 period with blister packs and pharmacy care, systolic BP improved from 133.2 + 14.9 mm Hg to 129.9 + 16.0 mm Hg (p=0.02). However during phase 2, systolic BP deteriorated back to baseline in those returning to usual care (133.3 + 21.5 mm Hg) but improved further in those receiving the continued intervention (124.4 + 14.0 mm Hg, p=0.005 between groups). It is unclear from this study whether the unit dose packaging, the pharmacist or both contributed to the success of the intervention.

Carter and colleagues conducted a cluster, randomized trial (randomized clinics) with 179 patients enrolled into a 9-month study intervention.[46] Research nurses measured BP at baseline, 2, 4, 6 and 9 months. Ambulatory 24-hour BP was measured at baseline and 9 months. Pharmacists employed in the medical offices made specific recommendations to physicians and patients to improve BP control. The majority of recommendations were to intensify medications.[47] The mean adjusted difference in systolic BP was 8.7 (95% CI: 4.4, 12.9) mm Hg in favor of the intervention group, and the difference in diastolic BP was 5.4 (CI: 2.8, 8.0) mm Hg. The 24-hour BP levels were a mean systolic BP reduction of 8.8 (CI: 5.0, 12.6) mm Hg and diastolic BP 4.6 (CI: 2.4, 6.8) mm Hg in the intervention group compared to the control group. BP goal was achieved in 89% of patients in the intervention group and 53% in the control group (adjusted odds ratio 8.9; CI: 3.8, 20.7; p<0.001). After this study was completed, these investigators performed a retrospective evaluation of a sample of 103 of these patients who agreed and re-consented had BP values at baseline and 9 months during the intervention and then at 18 and 27 months after baseline (9 and 18 months following discontinuation of the intervention).[48] This sample of patients was similar to the larger study sample. By 27 months (18 months after the intervention was discontinued), systolic BP was 132.7 + 11.5 and 143.0 + 12.2 mm Hg (p<0.001) and BP control was 59% and 31% in the intervention and control groups, respectively (p=0.0048). This study suggests that the relatively short-term intervention had long-lasting effects.

In a second cluster, randomized trial (Carter et al.) was conducted in six family medicine medical offices in Iowa.[49] The study randomized the offices to control or intervention groups and 402 patients with uncontrolled hypertension entered the six month study period. Clinical pharmacists on the staff of these offices made drug-therapy recommendations to physicians based on national guidelines. Research nurses performed BP measurements and 24-hour BP monitoring. The adjusted difference in systolic BP was −12.0 (95% CI: −24.0, 0.0, p<0.05) mm Hg between intervention and control group at 6 months. The 24-hour BP levels showed similar differences between groups. BP was at goal in 29.9% of patients in the control group and 63.9% in the intervention group (adjusted odds ratio 3.2; CI: 2.0, 5.1; p<0.001). These authors also conducted a retrospective evaluation to determine whether the intervention effect could be sustained once it was discontinued.[50] Even after 18 months following discontinuation of the intervention BP was 130.0 + 16.0 mm Hg in the intervention group and 138.1 + 20.4 mm Hg in the control group (p=0.0023). BP was at goal in 67% of patients in the intervention group and 36% of those in the control group (p<0.001). This study also suggests that this 6-month pharmacist intervention had long-lasting effects, probably related to medication adjustments that resulted in persistent BP control.

Recently Bosworth and colleagues have initiated a VA funded study focusing on cardiovascular disease (CVD) risk with a focus on medication management (e.g., BP, a1c, lipids, blood clotting) and behavioral outcomes (e.g., medication adherence, exercise), administered by a pharmacist over the telephone. This study will take place within two VA primary care clinics. The intervention is tailored to the needs of vulnerable high risk patients and addresses multiple CVD-related behaviors and medication management risk. The study will enroll 500 patients with cardiovascular disease who will be randomized to either the education control group or the intervention group. Patients randomized to the intervention group will receive a clinical pharmacist-administered intervention, which focuses on behavioral and a medication management. Given the national prevalence of CVD and the dismal rates of risk factor control, interventions such as the one proposed could improve secondary prevention of CVD in the VA.

B. Controlled trials of nurse interventions—There is a reasonable and growing body of literature that nurses can significantly improve hypertension outcomes. As mentioned previously, a recent review of studies from 2005-2009 was conducted of 33 randomized controlled trials that included an intervention delivered by nurses, nurse prescribers, or nurse practitioners designed to improve blood pressure, compared with usual care. Compared with usual care, interventions for hypertension achieved higher degrees of blood pressure targets when they included a stepped treatment algorithm by a nurse, nurse prescribing, or a nurse leading telephone monitoring.[42]

Case management by a nurse-led team has been shown to be efficacious strategy to improve management of cardiovascular risk factors including hypertension management in many studies.[51, 52] Nurses, for example, have demonstrated successful strategies for improving blood pressure by serving as a bridge to physician care and by adhering more strictly to management algorithms, including many counseling features that may not necessarily be within the time frame of a busy physician in practice.[12, 37, 52-57] More recent studies that involved nurses within team-care are discussed below.

Extending Beyond Traditional Clinical Settings

Improving patients' hypertension management behaviors, and medication adherence, while critically important, can be complex and time-consuming. In a typical primary care setting time limitations, competing demands, the burden of co-morbid illness, along with inadequate mechanisms for follow-up, all constitute barriers to effective hypertension risk factor management. Perhaps for these reasons, prior interventions that sought to influence physician medication prescribing in a clinic setting have been mostly ineffective. Most aspects of hypertension risk reduction, however, do not require a physical examination, and BP can be measured at home, thus much of the care of hypertension could be accomplished outside of the traditional confines of office-based clinical care. Telemedicine or remote monitoring in patients' homes has been offered as a plausible solution to improving ambulatory medical care. However current reimbursement models do not encourage these in-person and remote primary care interventions.

Telemetry can be used to transmit BP measurements taken at home into a data repository where it can be used to generate paper reports or linked to other data systems. Telemedicine refers to interactive communications which can be as simple as telephone based-care, or interactive video and digital technologies, enabling direct communication between patients and their care team from remote sites. Automated interactive voice response (IVR) uses computer technology to telephone patients, collect data, and provide tailored interventions based on their responses. Team-based applications of these technologies are described below.

A. Telephone Interventions—Clinical inertia, the phenomenon of physicians failing to intensify medication regimens at encounters with patients who have uncontrolled risk factors, has been cited to potentially account for a significant proportion of CVD events,[10, 58] suggesting that alternative methods for interventions may be needed. Also, clinic visits are primarily focused on symptom management, leaving little time for comprehensive risk factor management. An intervention that is delivered in patients' homes may be more successful in non-symptom based approaches to healthcare.

Telephone contact offers one possibility to reduce healthcare barriers. Telephone contact has been shown to be effective in changing multiple patient behaviors.[59-62] Telephone interventions also allow more patients to be reached and these interventions may be more acceptable and convenient than in-person interventions.[63] Delivering an intervention by telephone may enhance the interventions' cost-effectiveness, primarily due to reduced intervention costs and reduced visit rates coupled with the clinicians' ability to follow a much larger panel over which to spread fixed intervention costs than would be possible with an in-person intervention. Thus, the use of telephones to implement the intervention allows individualized, personal interaction at minimal cost and without the time and transportation barriers that accompany in-person programs. This personal interaction allows the intervention to be adapted and tailored to participants' current concerns, health goals, and specific barriers to achieving these goals.

Bosworth et al completed the Take Control of Your Blood Pressure Study (TCYB) in which hypertensive patients (n=636) were randomized to one of four groups: usual care; a nurse-administered behavioral intervention; home BP monitors alone; or, a combination of the behavioral intervention and home BP monitors. Patients were highly adherent in recording their home BP values. A majority of the 318 patients in the nurse arm received all 12 intervention encounters and completed the 24-month follow-up. Patients randomized to the combined group had the greatest improvement in BP control (70% to 83% at 24 months; 17% relative usual care; *p*=.01 and SBP (improved by 6 mm Hg relative to the control group) at 24 months.[54] The average cost of the combined intervention was $416 per patient over 24 months.[54] In sub-analyses, at 24 months, in the combined intervention, non-whites had sustained lower SBP as compared to usual care (7.5 mm Hg; p<0.02).[64]

B. Health Information Technology Interventions—Dramatic advances in health information technology (HIT), including electronic health records (EHRs), and high speed communications, provides new opportunities for improving the care of chronic conditions, including hypertension. HIT is an integral part of proposed models to reform healthcare, including the Chronic Care Model,[17, 19, 65] and the Patient-Centered Medical Home.[27-29, 66] Additionally, the Institute of Medicine's blueprint for meeting the *Crossing the Quality Chasm*[67] goals for delivering of state-of-the art health care suggests that patients should receive care when they need it and in many forms, have unfettered access to their own medical information and that there should be active collaboration and information exchange between clinicians". In this section we describe results of studies that have used these new technologies as tools and strategies to support team-based care for hypertension.

Artinian offered free BP screenings to African Americans at various community sites and those with uncontrolled BP and a land-line telephone were randomized to enhanced usual care (UC), including education and identifying resources for receiving medications and clinical care, or this intervention plus home BP monitoring (HBPM), and nurse managed telemetry.[68] Nurse-telemetry patients were asked to measure their BP 3 times a week. Subjects uploaded BP data by attaching the HBPM to a modem unit which automatically dialed a data repository managed by a service independent from the patient's regular clinical care. Formatted BP reports were reviewed by a registered nurse who called the patient and provided medication and lifestyle counseling. Doctors received a copy of the telemetry report, and they could request the patient come in for an appointment if needed. At 12 months the telemetry nurse group had significantly decreased systolic BP compared to enhanced usual care (net difference −5.5 mm Hg (P=.04)) with non-significant differences for diastolic BP. Change in BP control was not reported. The cost of the telemetry service was $1.50 a day. Nurse telephone feedback and counseling took between 7 and 16 minutes per call, which initially occurred weekly, then monthly during the last months of the intervention.

Bosworth[56] has recently completed and Margolis[69] has an ongoing study that combines HBPM with a modem to send BP data, combined with nursing care (Bosworth) or pharmacist management (Magolis). Bosworth examined which of three interventions was most effective in improving BP control over 18 months.[70] Eligible patients were randomized to either usual care or 1 of 3 telephone-based intervention groups: (1) nurse-administered behavioral management, (2) nurse- and physician-administered medication management, or (3) a combination of both. The intervention telephone calls were triggered based on home BP values transmitted via telemonitoring devices. Behavioral management involved promotion of health behaviors. Medication management involved adjustment of medications by a study physician and nurse based on hypertension treatment guidelines. Both the behavioral management and medication management alone showed significant improvements in BP control, 12.8% (95% CI: 1.6%, 24.1%) and 12.5% (95% CI: 1.3%, 23.6%), respectively, at 12 months, but there was no difference not at 18 months. In a subgroup analyses, among those with poor baseline BP control, systolic blood pressure decreased in the combined group by 14.8 mm Hg (95% CI: −21.8, −7.8) at 12 months and 8.0 mm Hg (95% CI: −15.5, −0.5) at 18 months, relative to usual care.

Magid in a recently published study coupled IVR with pharmacist care-management.[71] Patients with hypertension, receiving antihypertensive medication, and with uncontrolled BP were identified using electronic medical records (EHRs) and invited to a screening visit. Those with uncontrolled BP at the screening visit were randomized to receive IVR enhanced pharmacist care management or usual care (UC). The IVR pharmacist care group received computer calls weekly asking them to enter their BP using the touch-tone keypad. They received feedback as to their average BP and the opportunity to listen to a hypertension-related educational message. Clinical pharmacists reviewed home BP data, EHR medication adherence, and made medication changes if needed using a pre-approved protocol. Pharmacists contacted patients by telephone and patients' physicians by progress note in the EHR. After 6 months BP control was not significantly different between the 2 groups, however systolic BP was significantly lower in the IVR pharmacist group (net change −6.0 mm Hg, P=.006), but differences between groups deteriorated, and based on chart review of BP measurements 6 months after the intervention was completed (12 months after baseline). Over 90% of the patients uploaded at least one set of BP measurements, but information on persistence of communications was not provided. A potential concern with IVR is hang-ups; however the pharmacist attempted to call the patient if the patient did not respond after repeated IVR attempts and a reminder. A particular strength of this IVR pharmacist approach was that the pharmacist only needed to interact with patients with uncontrolled BP. Cost of the intervention was not reported. IVR systems vary greatly in costs depending on the sophistication of the computer model, logic systems used, length of the interactions, and number of follow-up attempts made if the patients are not initially contacted.

Shea in the IDEATel study randomized underserved ethnically diverse older patients with diabetes to either receive a nurse-telemedicine unit or usual care.[72, 73] The telemedicine unit computer had four functions: synchronous videoconferencing, Web access, and home BP and glucose monitors that could be connected to the unit. Communications were enabled via a modem connected to telephone line. Nurse case managers trained in diabetes care and supervised by diabetologists provided care via videoconference visits, secure-e-mail, clinical data review, computer reminders, alerts, and automated quality assurance reports, and patient chat groups. For patients not at recommended targets for diabetes, including BP, a change in management was recommended to the patient's physician by e-mail, fax, or phone. Those receiving the telemedicine-nurse intervention had significant decreases in both systolic and diastolic BP compared to usual care at the 1 and at 5 year follow-up assessments (net change at 5 years – 4.3 mm Hg (−1.9,−6.7) and −2.6 mm Hg (−1.5,−3.7) respectively).

Bove enrolled inner-city (Temple University Medical Center) predominantly African Americans and rural Caucasians (Geisinger Medical Center) with a > 10% risk of cardiovascular disease.[74] Patients were randomized to receive either research nurse management with 4 visits in one year or this plus receipt of telemedicine computer and access to a personal health record in which they could review their medication list and laboratory results, upload HBPM, weight, and pedometer data weekly, and receive secure messages. Patients received by telemedicine computer system and mail, and their physicians by fax, summaries of their BPs, lipids, and their overall CVD risk and recommended targets, which were discussed at the 4 nurse management visits. All patients reduced their BP and risk of CVD, however there was no difference between intervention groups. While physicians received faxed reports of BP, nursing care was not integrated directly into patient care.

C. Personal Health Records and Patient Web Portals—Patient-controlled electronic personal health records and secure patient Web portals linked to EHRs offer patients and health care teams opportunities to share health data and communicate asynchronously. Grant et al randomized primary care practices and their patients with diabetes and an HbA_{1c} >7.0% to receive a Web-based personal health record designed for the study or usual care (UC).[75] These authors found that encouraging patients with diabetes to use the module did not lead to significant decreases in BP or improvements in BP control. However the module was developed specifically for the study, providers were not used to using this module, and patients did not receive team care assistance from a pharmacist or nurse.

Green and colleagues conducted the Electronic Communications and Home BP Monitoring Study (e-BP) in an integrated healthcare system with an existing EHR linked to a secure patient Web portal.[76] This study randomized patients with uncontrolled hypertension, access to the Web, and an e-mail address to either (1) UC, (2) this plus a HBPM and a onetime training session on use of the existing patient Web portal and encouragement to use these tools to communicate with their physician to get their BP in control, or (3) this plus Web-based collaborative pharmacist care – using the existing patient shared EHR including asynchronous secure e-mail communications. Pharmacists used an approved protocol to make medication changes, contacted the patient's physician for clinical concerns or any medication issues not addressed in the protocol, and documented all care processes in the EHR. Patients receiving the HBPM-Web only intervention had a small, but significant decrease in systolic BP (net change −2.9 mm Hg, P=.02) but diastolic BP and BP control was not significantly improved compared to UC. In contrast, patients receiving Web-pharmacist care had significant decreases in systolic and diastolic BP, and improved BP control compared to both UC and Web only (compared to UC, net change systolic and diastolic BP −8.9 mm Hg (P<.001) and −3.5 mm Hg (P<.001) and net improvement in BP control was 25% (P<.001)). Medication intensification and secure e-mail significantly increased in the Web-pharmacist group. Long-term changes in BP after the intervention ended and cost-effectiveness are being studied. Of note, in the e-BP study, HBPM data was not electronically uploaded into the EHR. Patients had to manually enter their BP measurements into secure e-mail messages. EHRs have the capacity to interface with telemetry data, but we are unaware of this being done currently in clinic settings. The e-BP study provides evidence that HBPM and the ability to send secure e-mail to your health care team, may lead to small improvements in BP, however combining this with team care led to more robust changes.

Similarly in an Evidence Report and Technology Review, Barriers and Drivers of Health Information Technology Use for the Elderly, Chronically Ill, and Underserved, sponsored by the Agency for Healthcare Research and Quality (AHRQ), information technology interventions were consistently effective if they included "complete feedback loops".[77] Complete feedback loops included monitoring of the patient's current status, interpretation of this based on treatment goals, adjustments of the management plan, communicating of the recommendations back to the patient, and this cycle being repeated at appropriate intervals.

This type of complete feedback loop is particularly well supported by team-based care. Saver and colleagues are currently conducting a study testing whether use of a HBPM with data sent to an EHR via a patient owned personal health record (HealthVault), combined with team-care delivered by a nurse, can be used to improve BP control in patients with diabetes and uncontrolled hypertension.

It is unknown the degree to which web-based communication coupled with a web-based, tailored disease management and education program improves risk factor control beyond traditional telemedicine disease management provided by health care personnel. To this end, Bosworth and his colleagues are carrying out a study involving a telemedicine intervention to improve achieving goals for cardiovascular risk factors, particularly improvements in systolic blood pressure, among individuals who have had a myocardial infarction. To evaluate this intervention, 450 patients with a recent myocardial infarction and hypertension will be enrolled into a 3-arm randomized, controlled trial. The first arm (n = 150) will receive home blood pressure (BP) monitors plus a nurse-delivered, telephone-based tailored patient education intervention and will be enrolled into Heart360, the American Heart Association's interactive web-based health monitoring tool. The second arm (n=150) will also receive home BP monitors plus a tailored patient education intervention and be enrolled in Heart360. However, the patient education intervention will be delivered via a web-based program and will cover identical topics as the nurse-delivered intervention. Both arms will be compared with a control group receiving standard care (n = 150). All participants will have an in-person assessment at baseline and at the completion of the study, including standardized measurements of BP, low-density lipoprotein (LDL-C), and HbA1c (in diabetic subjects). The study will compare the cost, scalability and effectiveness of two interventions modes compared to use care.[78]

D. Texting and Smart Phone Web Communications—Patients can increasingly access the Web via smart phones using wireless or high speed radio wave connections. Texting services, however require only standard radio wave connections, and can be accessed using Short Message Services. Both provide new opportunities for patients to communicate with their health care team. Park in a small quasi-experimental study conducted in Korea, provided obese patients with hypertension access to a Web site via a computer or usual care.[79] Patients entered BP, weight, and other data into the Web site from their computer or a cell phone weekly. A supervised research nurse reviewed the data and sent back tailored feedback to the patient via both the Web site and via cell phone using a Short Message Service and text messages. After 8 weeks, systolic and diastolic BP and weight were significantly decreased in the active group compared to controls (net change −9.1 mm Hg ($P<.05$), −7.2 mm Hg ($P<.05$), and −1.6 kg ($P<.05$) respectively). We are unaware of any studies that are currently using Smart Phones (such as the i-Phone or Android) applications as a tool for team-care based hypertension care, however we expect that any virtual care that health care systems currently provided over the Web could be used on Web enabled phone or other types of electronic communications systems.

E. Technology and Potential Disparities—It is important to note that some people do not have access to, or the financial resources to purchase computers, Web access, or land line and cellular telephones. Additionally some people cannot use technology tools or services because of low literacy or lack of translation between different languages. Careful attention to the needs of these groups will be needed, or the disparities that already exist in relation to computer access, hypertension control, and cardiovascular outcomes will worsen.[80] Finkelstein and colleagues have developed and are testing low cost computers that are linked to monitoring devices and remote communications that can be use by people with low literacy skills.[81] Other options include allowing patients to have walk-in access to kiosks at clinics and if needed being assisted by medical assistants, or enlisting community health workers or family member caretakers (such as the children of elderly people) to assist with self-monitoring and electronic communications at communities centers or home. Alternatively, patients frequently access computers at local libraries, community centers or other locations. Patients might also have different preferences for the types of communications they prefer.

F. Technology and the Future of Team Care—Demand for new patient-centered HIT applications for improving patient self-care and virtual communications between patients and their health care team is increasing. New and ongoing studies will help to learn the most effective approaches for improving hypertension care. Smart phones, cell phones, blue tooth, texting, personal health records, patient portals, electronic computer games are basically the same – computers linked to electronic communications. Depending on user-needs, all have the potential to be used for self-monitoring and communications between patients and healthcare teams. Electronic games could be used to assist patients with self-care management – monitoring BP, medication adherence, and lifestyle change. HIT can be translated and used in all languages and adapted to assist people with disabilities.

Larger healthcare systems are increasingly acquiring patient Web portals for a variety of business reasons other than just improving hypertension care. However adoption of these systems in smaller community practices may lag because of the investment required and the inability to recoup this as a billable service. Incentives made possible by the HITECH bill, the PCMH and Accountable Care organizations provide new opportunities for use of these technologies to enhance team care.

Summary of technological issues

Studies that have utilized HIT and high speed communication technologies provide new ways for patients and their health care teams to electronically share BP measurements, medications, and lifestyle behaviors information, outside of office visits allowing opportunities for providing feedback and adjustment of care plans. Results that have combined electronic technologies with team care havehad the most positive results, but the studies are heterogeneous. Little is known about the optimal dose of strategies and their cost-effectiveness. Additionally there is no information on the long-term benefits of technology enhanced team interventions, to what degree BP control is maintained over time, whether continuous or booster interventions are needed, and their long-term effect on cardiovascular outcomes, quality of life, and the costs of health care. Results from ongoing and new studies will provide important information on the most efficacy and value of these strategies.

Cost-effectiveness analyses

From the perspective of the health care system, with BP reduction as a goal, understanding the relationships between interventions and medical costs and their effects on blood pressure is necessary in making informed program funding decisions. From the perspective of the patient, time is a limited resource that should be expended on activities that yield improvements in health outcomes. However, there have been few studies to examine the short and longer-term cost effectiveness team-based interventions to improve hypertension care. Short-term costs include the costs of the intervention, and offsets or additional costs as realized by changes in healthcare utilization. Long-term costs take into account benefits and costs accrued over time in terms of programmatic costs (depending on whether team care is provided one time, intermittently, or ongoing), and hypertension-related outcomes, where from a patient and societal perspective most benefit would be expected to occur. We review below studies that have reported either direct costs or cost-effectiveness of team-based interventions to improve hypertension control.

Investigators from the V-STITCH estimated that the mean annual total intervention cost per patient was $112 and ranged from $61 to $259 per patient depending on the nurse's salary, the number of patients that the nurse can manage, and what indirect costs are allocated to the intervention.[82] Nonetheless, even at the maximum value, the intervention cost represents, at most, 3% of the total cost that a given hypertensive veteran incurs over a 2-year period. Lastly, intervention cost could be lowered substantially if a less expensive care provider was used to implement the behavioral intervention. The TCYB study demonstrated statistically and clinically significant reductions in blood pressure with a tailored behavioral intervention when combined with home blood pressure monitoring. However, these interventions are cost-additive to the health care system. Thrice-weekly blood pressure monitoring resulted in patient time costs that surpassed the cost of the intervention.[83]

These results support the findings of two previous studies that showed that a telephone-based hypertension intervention can be implemented at reasonable cost and be potentially cost-effective. In study of Friedman et al,[60] an interactive computer-based telecommunication system was used to communicate with patients in their homes between office visits. They estimated a 6-month intervention cost of $32.50 per patient, which would be $96 in 2005 dollars. As effectiveness measures, their telephone intervention use led to an improvement in medication adherence and reduction in SBP. In a study by Bertera et al, usual care was compared with telephone counseling or face-to-face counseling.[84] Patients in either counseling arm received counseling sessions every 3 weeks for 6 months that covered a number of hypertension-education issues. The average cost per patient was $39, which, given that this study was published in 1981, is not comparable to the behavioral intervention cost of more recent studies.[84]

Okamoto and Nakahiro performed a cost analysis in 330 patients and found no difference in clinic visit costs between pharmacist-managed hypertension ($242.46) and physician-managed hypertension ($233.20).[85] They estimated a cost of $1.18 for each 1.0 mm Hg reduction in systolic blood pressure. However, this study did not measure or assign costs to any interactions between physicians and pharmacists. They also used acquisition costs for medications that were adjusted for discounts and did not reflect real drug prices.

Two of the previously mentioned cluster randomized trials (Carter and colleagues) [46, 49] of a pharmacist intervention were combined to evaluate cost-effectiveness.[86] The study included 496 patients, 244 in the control group and 252 in the intervention group. The total time spent by physicians in the intervention group was higher than in the control group (67.02 (SD = 46.29) vs. 53.74 (SD = 48.47) minutes, $p< 0.001$) due to nearly 17 minutes spent on collaboration. Overall, pharmacists in the intervention group spent 114.34 (SD = 43.42) minutes per patient over six months. Relative to control, the physician-pharmacist collaboration intervention cost an average of $249.60 more per patient resulting in an incremental cost over six months of $1,009.3 per additional patient with blood pressure control and $26.6 per one mm Hg reduction in systolic blood pressure. The cost to achieve goal BP in one additional patient was $1,009.30. This study was one of the most comprehensive regarding all costs and suggested the costs of the intervention were higher than other reports. However, the authors concluded that these costs were reasonable when considering the presumed reductions in costs associated with avoided cardiovascular events.

Team-based interventions that used new technologies have a wide range of costs depending on whether the technology was developed for the intervention or already in place. In the IDEATel study telemedicine units cost $3425 (year 2002).[72] However costs of telemetry have since come down, and use existing technologies such as Skype or Face-time might be much less costly.

Magid did not report the cost of delivering the IVR (interactive voice recognition) intervention.[71] IVR systems vary greatly in costs, depending on the amount sophistication of the computer model, logic systems used, and length of the interactions, and number of follow-up attempts made if the patients is not contacted. Modem-based or Web BP telemetry used to upload measurements from home to a data repository and collate into reports, also incur additional costs, which are usually less than IVR, but vary mainly based on equipment requirements.

In the Electronic Communications and Home BP Monitoring (e-BP) Trial by Green, it cost $400 per patient to deliver the pharmacist intervention over 12 months, this included the costs of the home BP monitors and pharmaceutical care, incremental costs and cost-effectiveness analyses are currently being conducted. In the e-BP study the patient-shared EHR and secure e-mail systems were already in place prior to the study and no additional technology resources were required to deliver the Web-based pharmacist intervention. However, for a clinic to set-up a system like this, start-up costs might be substantial. Many of the commercially available EHRs have the capacity to add a patient Web portal or secure e-mail, but these features costs extra money, require staff training, patient promotion, and technical support to be fully functional. Patient-controlled EHRs generally incur no costs to patients, but adding EHR portals, disease management applications, and secure communications need to be paid for. Patient Web portals however can be used for a variety of care processes, and along with the new definitions of Meaningful Use of EHRs and the HITECH bill, provide incentives for health care systems and clinic to adopt their use.

Because of the heterogeneity of these studies it is difficult to draw any definitive conclusions as to the cost-effectiveness of team-based interventions to improve hypertension control or to compare costs related to type of interventionist or delivery mode. However lessons might be gleaned from other team-based QI interventions.

Implementation of the PCMH with augmented physician-nurse and pharmacist teams led to overall decreases in health care costs, improvement in composite quality measures, and improved patient and physician satisfaction after 2 years.[30] This study was conducted in an integrated health care system which already had many of the resources already needed to effectively implement collaborative care, however both nursing and pharmacist staffing was increased to more effectively implement collaborative care. The Medicare Care Coordination (MCC) demonstration projects, which tested the cost effectiveness of 15 care management programs for Medicare patients with multiple co-morbidities had mostly negative findings.[87] Only 2 programs were cost-effective. Change in patient behaviors and quality of life were minimal. Medication adherence and physiologic outcomes were not reported. The 2 successful programs made more frequent contact with patients, taught patients to take their medications correctly, and had more opportunities to interact directly with the patients' physicians. Similarly, Coleman and Wagner found that interventions to improve chronic illness were more effective when closely integrated with the patient's source of primary care.[88]

More research on the long-term benefits and cost-effectiveness of team care interventions are needed before the business case can be constructed and policy changed. However, it is clear that fee-for-service clinics and physicians who do not receive re-imbursements for using a nurse, pharmacist, or other team member, would be unlikely to be able to implement a quality improvement program to test this model, unless they received government subsidies, were a PCMH demonstration site, or were incentivized by being part of an Accountable Care organization.

The Future of team-based care for hypertension: Proposed models care

Once an intervention has been determined to be reasonable in terms of costs and effectiveness, this leads to the question of who should pay for the intervention. Patients may be willing to pay for the intervention if they perceive that they are receiving better care and because of the convenience it provides. However, patients are unlikely to be willing to cover the entire cost. Providers do not have an incentive to provide the intervention since, currently; they are not reimbursed for it. The only environments at this time that potentially have an incentive are capitated, integrated healthcare systems like the VA and Kaiser. Without long-term evidence that team care decreases health care costs, insurers may have little incentive for adopting this model. However other factors may come to bare, such as regulatory agencies who rank plans by their success in management of chronic care (including hypertension control), employer purchasers who might be willing to choose an insurance product or pay more if care potentially reduces sick days. Alternatively, if patient and physician demand exert large influence on Medicare, Medicaid, and other publically assisted health care programs, there may be increased willingness to cover team-based care, such as already funded by Medicare Part D that provides payment for medication therapy management.[89]

The movement towards the patient-centered medical home will result in a shift from an acute care model, or illness model, to a model for managing chronic conditions proactively or a wellness model. Such care will not only affect the traditional team but also those who schedule patients so that scheduling can accommodate continuity with the hypertension management team. The team must be supported by strategies to track patients and populations, identify patients whose BP is not controlled, remind them of their upcoming office visit and contact them when they do not show up for an appointment. The patient-centered medical home also requires electronic record support for patients so that they can examine their records, have access to schedule their own appointments, email providers and receive web-based support. The patient-centered medical home incentives made possible by the HITECH bill, the PCMH and Accountable Care organizations provide new opportunities for use of these technologies to enhance team care.

We propose a model in which the minimum team would be a physician, nurse or pharmacist but should also include social workers, nutritionists, hypertension specialist, and community health workers for specific patients. The model would include the primary care physician who is responsible for diagnosis and evaluation of hypertension for potential secondary causes, additional risk factors and target organ damage. The physician would also conduct periodic physical examinations and follow-up assessments for target organ damage. If at any point new signs or symptoms develop the physician should evaluate the patient. Highly complex patients, those with resistant hypertension despite multiple manipulations of appropriate therapy and those with suspected secondary causes, should be referred to the hypertension specialist.

This proposed care model would require extensive communication between the team members. Protocols, policies and procedures for communication, triage and referral back to the physician so information transfers are coordinated and complete should be developed and understood. Accurate and complete medical record documentation to support team communication will be critical, and scalability would require the use of electronic medical records

A nurse or pharmacist with expertise in hypertension would provide education and counseling and probably ongoing case management for most patients, especially those who have achieved and maintain control of their BP. Education would include thorough discussions about all lifestyle modifications, smoking cessation and how to empower the patient to implement these strategies. The nutritionist, if available, would provide extensive counseling about diet and weight loss strategies. If a nutritionist is not available, the nurse who specializes in hypertension management can provide these services. For patients taking BP medication, a nurse would also be able to modify medications and adjust dosages. The pharmacist in the office could also assist with medication management, titration for patients not at goal, designing drug and monitoring regimens for specific patients and algorithm development for the practice. The office pharmacist could assist with management of patients with multiple co-existing conditions, and those with complex drug regimens who are at risk for adverse reactions and drug-drug interactions. The pharmacist could also counsel patients about proper medication use, administration, storage and adverse reactions that might occur. While they are not frequently considered as team members, community pharmacists could also assist with such monitoring.[33, 90, 91] Additionally electronic communications (both telephone and Internet enabled) is likely to be an increasing part of team-care, with home BP monitoring, behavioral support, improved access via synchronous and asynchronous communications as a key part of improving the efficiency[76, 92] and effectiveness of hypertension care, making it possible for the team to function at separate sites virtually.

Patients with hypertension frequently have other chronic conditions, and secondary to increasing rates of obesity, progressively at younger ages. When multiple chronic conditions are combined with substance abuse, poverty, low levels of education and/or low enculturation, health outcomes worsen and care costs rise rapidly. Team care as envisioned in the PCMH incorporates whole-person care that takes into account all of the patient's chronic conditions, preventive care needs, and social factors that mitigate the delivery of optimal and efficient care. Moving from a disease-specific model to a patient-centered model that includes team-based care is believed by many to be a key aspect of health care reform.

SUMMARY

While this review is not exhaustive, there is strong body of evidence that teams are effective in treating blood pressure. Team-base care provides new opportunities for hypertension care to be more patient-centered by providing care that is more personalized, timely, collaborative, and patient- empowering and allows physicians more time to manage more complex and urgent issues as they arise. There is also a growing focus on the PCMH and use of technology to improve access to care.

The challenges moving forward include not only improving access, but ensuring the access is of high quality. Technology needs to be rigorously evaluated and not viewed as a panacea. Further work is needed to better understand and evaluate patients' and providers' preference for communication. Policy implications of team-based care will need to be addressed. For example: how are teams and technology used to improve access to the primary care reimbursed? What is a reasonable return on investment (ROI)? What are appropriate indicators of cost effectiveness? and How should these constructs be evaluated? We encourage further dialogue and research to address these issues. Additionally, much more research is needed, to determine the effects of team-based care on specific populations, optimal dose and intensity of interventions, and whether ongoing or booster interventions are needed. More comparative studies are needed to determine the most efficient, effective, and personalized methods for providing ongoing team-based care for hypertension. Results from ongoing studies will provide important information on the refinements to this model, lead to increased feasibility of large scale implementation, and confirm whether expected long-term effectiveness and cost- effectiveness benefits are realized.

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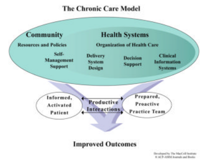
The Chronic Care Model
Community
Resources and Policies
Health Systems
Organization of Health Care
Self-Management Support
Delivery System Design
Decision Support
Clinical Information Systems
Informed, Activated Patient
Productive Interactions
Prepared, Proactive Practice Team
Improved Outcomes

Figure 1.

Table 1

National Center on Quality Assurance (NCQA) Content and Scoring of Practices on Progress Towards the Patient-Centered Medical Home

Standard 1: Access and Communication	Points	Standard 6: Test Tracking	
A. Has written standards for patient access and communication*	4	A. Tracks tests and identifies abnormal results systematically**	7
B. Uses data to show it meets its standards for patient access and communication*	5	B. Uses electronic systems to order and retrieve tests and flag duplicate tests	6
Total points:	9	Total points:	13
Standard 2: Patient Tracking and Registry		Standard 7: Referral Tracking	
Functions		A. Tracks referrals using paper-based or electronic system**	4
A. Uses data system for basic patient information (mostly non-clinical data)	2	Total points:	4
B. Has clinical data system with clinical data in searchable data fields	3		
C. Uses the clinical data system	3		
D. Uses paper or electronic-based charting tools to organize clinical information**	6		
E. Uses data to identify important diagnosis and conditions in practice**	4		
F. Generates lists of patients and reminds patients and clinicians of services needed (population management)	3		
Total points:	21		
Standard 3: Care Management		Standard 8: Performance Reporting and Improvement	
A. Adopts and implements evidencebased guidelines for three conditions **	3	A. Measures clinical and/or service performance by physician or across the practice**	3
B. Generates reminders about preventive services for clinicians	4	B. Survey of patients' care preferences	3
C. Uses non-physician staff to manage patient care	3	C. Reports performance across the practice or by physician**	3
D. Conducts care management, **including care plans, assessing progress, addressing barriers**	5	D. Sets goals and takes action to improve performance	3
E. Coordinates care/follow-up for patients who receive care in inpatient and outpatient facilities	5	E. Produces reports using standardized measures	2
		F. Transmits reports with standardized measures electronically to external entities	1
Total points:	20	Total points:	15
Standard 4: Patient Self-Management		Standard 9: Advanced Electronic	
Support		Communications	
A. Assesses language preference and	2	A. Availability of Interactive Website	1

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other communication barriers			
B. Actively supports patient selfmanagement**	4	B. Electronic Patient Identification	2
		C. Electronic Care Management Support	1
Total points:	6	Total points:	t:c>
Standard 5: Electronic Prescribing	Points		
A. Uses electronic system to write prescriptions	3		
B. Has electronic prescription writer with safety checks	3		
C. Has electronic prescription writer with cost checks	2		
Total points:	5		

** indicates Must Pass Elements; Adapted from NCQA.[93]

Table 2

NCQA Scoring and Levels of Certification for the Patient Centered Medical Home

Level of Qualifying	Points	Must Pass Elements at 50% Performance Level
Level 3	75-100	10 of 10
Level 2	50-74	10 of 10
Level 1	25-49	5 of 10
Not recognized	0-24	<5

Levels: Level 3 is the highest level recognized by NCQA. Level is determined by the total points plus the “must pass” elements. A lower level of recognition will be awarded if all “must pass” elements are not met, regardless of total points. Practices with a score of ≤24 or <5 “must pass” elements will not be recognized within the context of the Patient-Centered Medical Home.[93]