Curr Hypertens Rep (2013) 15:346–355
DOI 10.1007/s11906-013-0351-6

HYPERTENSION AND THE HEART (PW DE LEEUW AND AH GRADMAN, SECTION EDITORS)

The Role of Home Blood Pressure Telemonitoring in Managing Hypertensive Populations

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Published online: 27 April 2013

Abstract Hypertension is a common chronic disease affecting nearly one-third of the United States population. Many interventions have been designed to help patients manage their hypertension. With the evolving climate of healthcare, rapidly developing technology, and emphasis on delivering patient-centered care, home-based blood pressure telemonitoring is a promising tool to help patients achieve optimal blood pressure (BP) control. Home-based blood pressure telemonitoring is associated with reductions in blood pressure values and increased patient satisfaction. However, additional research is needed to understand cost-effectiveness and long-term clinical outcomes of home-based BP monitoring. We review key interventional trials involving home based BP monitoring, with special emphasis placed on studies involving additionally behavioral modification and/or medication management. Furthermore, we discuss the role of home-based blood pressure telemonitoring within the context of the patient-centered medical home and the evolving role of technology.

Keywords Hypertension · Blood pressure monitoring · Telephone · Home-based telemonitoring · Technology · Intervention · Behavioral modification · Medication management · Healthcare costs · Patient-centric care

Introduction

Hypertension is a chronic condition, affecting nearly one-third of American men and women [1]. Despite being the focus of much public health and a myriad of interventions implemented to promote improved patient self-management and hypertension control, the hypertension prevalence rate has remained stable for over a decade [2]. Though the prevalence of hypertension remains high, some interventions have proven successful at helping patients with self-management (Table 1).

Central to many successful interventions is home-based telemonitoring where a blood pressure (BP) monitor is placed

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Table 1 Highlighted home blood pressure telemonitoring interventions for managing hypertensive populations

Study	Study Design	Arms	Study Duration	Interventionist	Intervention Frequency	Sample Size	Demographics	Location	SBP Response	SBP Persistence
Hebert 2012 [24]	RCT	1)UC 2)HM alone 3) HM+9 monthly calls	9 months interven-tion. BP measure at 9 & 18 months	Nurse	9 & 18 months	N=416	*AA/H Age 60.8 yr (11.8) Black 59.1 % HTN Treated	1 CB 4 HBC New York	−7.0 mmHg (95 % CI −13.4, −0.6) at 9 months	Not measured
Bosworth 2009 [22]	RCT	1)UC 2)HM 3x/wk 3)BI every other month 4)combo of HM and BI	24 months	Nurse	HM- 3 times per week Nurse intervention every other month	N=636 24 months N =475 completed the study	Age 61 yr (12) Non-white 95 % HTN treated 60 % SBP (SD) at baseline 128 mm HG (18)	2 HBC		
Adie 2010 [56]	RCT	1)UC 2)HM (Motiva-tional interviewin-g with goal setting)	6 months	Not specified	7 days, 1, 2 and 4 months	N=56	1 month post TIA Age 62 yr SBP (SD) at baseline 145 mm HG (21)	Neurovascular Clinic or Stroke unit, UK	No difference in SBP at 6 months between treatment arms	Increased medication knowledge but no increase in medication uptake nor reduction in BP
Magid 2011 [28]	RCT	1)UC 2)HM+IVR+ Clinical Pharmacist medication manage-ment	6 months	Clinical Pharmacist	? based on uncontrolled BP and IVR entries	N=388	Age 72.5 yr SBP significantly higher at baseline for intervention vs usual care 150.5(19.5) vs 143.8 (16.8) mmHg	3 Healthcare Systems (VA, Kaiser and Eastern HealthCare System)	No difference in UC and Tx group in proportion achieving BP control (36 % vs 35.2 % p=0.89) Change in SBP greater for intervention pts vs UC especially in patients with SBP>150 mm HG tx vs UC (−23.3 vs-15.1 mm Hg= 0.047)	Not reported
Kim 2011 [27]	RCT	MIC LIC	15 months	Nurse	Varied by arm	N=359	*Korean Immigrants Age 51.9 (5.7), Female 52.9 %, HTN treated 57.4 %	CB Baltimore-DC	LIC and MIC achieved control at 3 months but average decrease was 0.13 mm HG (95 % CI 0.02, 0.11) and 0.15 mm Hg (95 % CI=0.21, 0.08)	1 year after BP controlled gained (MIC and LIC range 57.13 % and 69.87 %)
Kerry 2013 [26]	Prospective Parallel-group, open label RCT	1)UC 2)HM	12 months	Nurse for support until target pressure reached	3 BP readings daily 1 min apart x 1 week then 1 x wk. record readings. Nurse telephone at 3, 6 9 months	N=381	*London, UK BP>140/85 with stoke in last 9 months Age, yr 72.6 (11.4) Female 44.3 % Non white 27.3 % SBP (SD) at baseline 135.8 (20.7)	Outpatient & Inpatients Stroke Clinics	No difference in mean fall in BP between the groups at 12 months More medication changes in the intervention group.	Post hoc analysis greater reduction in SBP in pts with uncontrolled BP than in those with controlled BP

Table 1 (continued)

Study	Study Design	Arms	Study Duration	Interventionist	Intervention Frequency	Sample Size	Demographics	Location	SBP Response	SBP Persistence
Chiu 2010 [23]	RCT	1) Nurse clinic (control group) visit every 8 week visit 2) Nurse clinic with 2–3 week TM (intervention group)	12 months	Nurse	Clinic visit every 2 months with phone call~every 2 weeks for intervention group	N=63	*Hong Kong Age 53.87 yr (7.65) Female 66.7 % HTN Treatment 45 % SBP (SD) at baseline 148.50 mm HG Control and 147.19 Study	HBC Hong Kong family care practice	At 8 weeks 75 % of people in intervention group had controlled SBP versus control group (25.8 % patients has controlled SBP	Not measured

Table Legend: MIC-biweekly telephone counseling; LIC-monthly telephone counseling; CB- Community Based; HBC-Hospital Based Clinic; RCT=Randomized Controlled Trial; AA=African American; H=Hispanic; HM=Self Home Blood Pressure Monitoring with telephone follow-up; BI=tailored Behavioral intervention; SBP=Systolic Blood Pressure; UC- Usual Care; CI-Confidence Interval; SD=standard deviations; *Previously diagnosed with uncontrolled hypertension

in a patient's home. In home-based telemonitoring, patients self-monitor their own vitals, such as BP and pulse rate, and communicate values to a healthcare provider or clinic either in person, with a self-kept log, or remotely via telephone or e-Health-related technology. It is estimated that half of hypertensive patients' households in the United States have a home-monitoring BP device for their general use [3].

As a mechanism to improve disease control and conserve resource utilization, home-based BP monitoring has become an increasingly attractive mechanism for chronic disease management. Relative to clinic-based BP monitoring, home-based monitoring may encourage more appropriate resource utilization by curtailing the need for unnecessary in-person clinic visits (e.g., visits solely for a BP check), while simultaneously initiating needed visits when a patient's BP is out of target range. Home-based monitoring may accelerate the speed at which a patient achieves their target BP goals. Patients can alter their health behaviors or have adjustments made in their medication regimen between visits, avoiding the need to wait months between visits for adjustments. Home-based monitoring may also alert the provider of new changes in a patient's health that may manifest with uncontrolled BP.

The use of home BP monitoring is consistent with the Patient Centered Medical Home (PCMH), a healthcare model that facilitates partnerships between patients, their providers, involving family members and ancillary clinical staff as appropriate [4–6]. In addition to traditional face-to-face clinic visits, the PCMH emphasizes patient-centered care that involves providing care outside the clinic as well, which has been linked to improve patient satisfaction and care provided in innovative ways [5, 7]. This link with improved patient satisfaction may also be true of home-based care; in addition to informing a supplementary measure of BP control, home-based telemonitoring may be preferred by patients. Telephone contact offers a medium enabling patients to be reached regardless of geographic location and has been shown to be effective in changing multiple patient behaviors [8–10]. Perhaps resulting from decreased transportation burden and time savings, home-based monitoring may be more convenient for patients[11] and may build feelings of control and support for chronic disease self-management [12]. This is in keeping with the tenets of the PCMH [5].

The economic case supporting home-based BP monitoring is mixed. Several studies have demonstrated that home-based BP monitoring, especially when coupled with behavioral interventions, may be cost-additive or cost-neutral to the healthcare system in the short-term [13–17]. It is generally posited that the initial expense will result in longer-term savings through cardiovascular disease reduction. However, this has not been well studied. One issue leading to the inadequacy of evidence regarding cost implications is the vast variability in terms of equipment price. A simple home

BP monitor costs approximately $40, while a BP monitor appropriate for telemonitoring usually costs about ten times that amount.

Home-based BP monitoring also provides a potentially better prognostic indicator of cardiovascular mortality than clinic-based monitoring [18]. The BP varies daily depending on an individual's physiological state and situational factors; the harmful effects of hypertension are presumed to be due to prolonged, elevated average BP [19, 20], accurate and longitudinal measurements are needed. There are many issues inherent to the accuracy of BP measurements ranging from "white coat syndrome" where a patient's BP values are artificially elevated due to anxiety over interaction with healthcare professionals – to inaccurate values obtained resulting from poor procedures in the clinic such as allowing insufficient resting times prior to obtaining clinic BP values. Similarly, the accuracy of home-based BP readings may also vary due to variation in method. A recent secondary analysis of a large, randomized, clinical trial compared strategies for home- or clinic-based BP monitoring to determine the optimal methodology for obtaining clinically meaningful BP measurements [21]. In the underlying trial, participants were asked to record BP values every other day at the same time. A minimum of three values over two weeks was required and only values spaced over 12 hours were included. Participants with values greater than one standard deviation above the norm were excluded. The study concluded that the best approach for correctly classifying BP control should be an average of several BP measurements including both measurements from the clinical and home-based settings [21].

This paper was commissioned for *Current Hypertension Reports* to discuss the role of home BP telemonitoring in managing adults with hypertension. We reviewed key papers describing interventional trials, with special emphasis placed on studies that included home BP monitoring and involved behavioral modification and/or medication management. Because there are numerous publications describing home-based BP monitoring [10, 22–30], this will not be a comprehensive literature review. Rather, this paper will highlight rigorously designed trials, expressly those published within the previous three years (e.g., 2010–2012). To identify manuscripts, we searched Medline via PubMed using the following selected MeSH terms: hypertension, ambulatory blood pressure monitoring, and telephone. Articles were limited to those in the English language, published from January 1, 2010 through October 1, 2012. Reviews and meta-analyses were excluded. We present a summary of findings from recent trials including a description of study design, the role of the interventionist, and specific methodological approaches. Specific methodological approaches include factors such as variation in frequency of home-based monitoring; transmitting that information; and when, how, and who intervenes with patients. We also make recommendations about future directions for home-based BP telemonitoring research and interventions.

The Professional Role of the Interventionist

Patient-centered hypertension management requires a team-oriented approach often involving multidisciplinary roles [31]. The professional role of the interventionist impacts the content and delivery of a hypertension management program. In recent trials, nurses with varying levels of training [10, 23, 24, 27, 32], and clinical pharmacists [28, 29] have each taken on this role with merits to each of these interventionist choices.

Across multiple chronic diseases, nurse-delivered interventions have demonstrated improved patient outcomes [10, 23, 27, 33, 34]. Nurses' training makes them particularly well suited to provide patient education and behavioral counseling, areas that are critical to interventions for many chronic diseases. Depending on the complexity of the program, appropriate nurse interventionists include licensed practical nurses (LPN), registered nurses (RN) and advanced nurse practitioners (NP). These nursing professionals are trained to address lifestyle and behavioral actions such as diet and exercise patterns, strategies for weight reduction, and smoking cessation, among others. Nurses at all practice levels are equipped to educate patients on proper home-based BP monitoring techniques, procedures for telemonitoring, and interpretation about appropriate BP thresholds. LPNs and RNs are typically not allowed to initiate, discontinue or modify pharmacotherapy. When there is a clinical indication requiring medication adjustments, the majority of nurses (i.e., LPNs and RNs) are reliant on involvement from a physician, pharmacist, or mid-level practitioner.

While optimal hypertension management requires lifestyle change, for many patients the medication management is the cornerstone of BP control. This necessitates an interventionist with an indepth understanding of both behavioral and pharmacotherapy and an advanced scope of practice to provide medication management when indicated. These interventionists include Nurse Practitioners and Clinical Pharmacists.

Nurse practitioners (NP) are advanced practice registered nurses with additional training enabling them to prescribe or manage pharmacotherapy. Like LPNs and RNs, Nurse Practitioners (NPs) are trained to provide preventive care and to engage patients in self-care. Because nursing scopes of practice are state-regulated, care provided by NPs varies widely. In certain institutions, such as the Veteran Affairs (VA) healthcare system, NPs follow federal guidelines enabling more autonomy. NPs diagnose and manage acute and

chronic conditions while emphasizing health promotion and disease prevention. Their services involve ordering, conducting, and interpreting diagnostic and laboratory tests; prescribing pharmacologic agents and non-pharmacologic therapy; and teaching and counseling.

Clinical pharmacists have obtained a doctoral degree in pharmacy and typically complete post-graduate residency and/or fellowship training, making them experts in the therapeutic use and monitoring of medications [35]. Like the NP with additional training and scopes of practice, Clinical Pharmacists are able to prescribe and manage pharmacotherapy. Clinical pharmacists are source of counsel regarding safe, appropriate, and cost-effective medications use [36, 37]. State regulations dictate whether pharmacists can practice independently or collaboratively with physicians. Operating under a defined scope of practice, pharmacists may initiate, discontinue, or adjust pharmacotherapy based on clinical indications [29, 35–37]. Complementing other health disciplines, clinical pharmacists are equipped to address medication-related issues such as providing patient education, managing side effects, and improving non-adherence. Clinical pharmacist-administered behavioral and medication management interventions have been shown to improve blood pressure control and the management of other chronic conditions including reducing cardiovascular risk [35]. To date though, most of the evidence supporting pharmacist-driven interventions has been provided in a traditional community-based setting rather than through telemonitoring [38–43]. As a result of the unique expertise and capabilities of differing professions, the intervention content may be guided by the interventionist's professional role. Successful interventions are designed with alignment between the professional role of the interventionist, targeted health behaviors, intervention content, and outcome goal. Notwithstanding, though a NP or pharmacist may be appear to be ideal interventionist with their pharmacotherapy privileges, cost-effectiveness is a major factor as LPNs and RNs may require significantly less monetary resources.

A central tenet in the PCMH construct is the use of care teams. This means involving a multidisciplinary team of professionals – encompassing nurses, pharmacists, physicians, and others – with the patient at the core. This team structure enables healthcare professionals to leverage their specific skillset to the fullest. For example, pharmacists may facilitate medication adherence, while also providing other lifestyle self-management programs and provide medication adjustments.

Behavioral Modification +/− Medication Management

A number of randomized controlled trials (RCTs) have been conducted involving elements of home-based BP telemonitoring. Studies vary extensively in terms of content frequency of self-monitoring, frequency of reporting home-monitored values, clinicians' involvement, duration, and setting. Most commonly, interventions for home-based BP telemonitoring include an educational component, behavioral modification, and/or medication management. Trials involving a behavioral component, either alone or in tandem with medication management, have been deemed the most effective [44]. A principle difference is whether interventions use behavioral modification alone, or behavioral modification coupled with medication management. We highlight key studies using each of these approaches.

Behavioral Modification Alone

Hebert and colleagues designed a study to address BP control using behavioral modification alone among 416 minority patients at one community clinic and four hospital-based outpatient clinics in Harlem, New York [24]. A RN interventionist provided face-to-face counseling with patients, focused on home-based BP telemonitoring, BP diaries, nutritional education, and strategies to improve medication adherence. The participants were African American or Hispanic patients with a history of uncontrolled hypertension receiving care at one large private academic medical center, two medium-size municipal hospitals, or one private community hospital. The intervention persisted for nine months with "periodic" telephone-based contacts and a follow-up BP measurement at 18 months. Patients were randomized to one of three arms: 1) usual care; 2) home BP monitoring plus one in-person counseling session and nine months of telephone follow-up; or 3) home BP monitoring alone. Overall, the study found that home BP monitoring alone was no more effective than usual care. However, when home BP monitoring occurred in tandem with nurse-administered telemonitoring, there was an 8.2-mmHg reduction in systolic BP at the end of the intervention in the nurse group over usual care. The improvement dissipated by the 18-month follow-up measurement [24]. However, there was not data on the cost of the program. Similarly, Bosworth et al., conducted a RCT at two university-affiliated primary care clinics in Durham, North Carolina [22]. The study randomized 636 patients with hypertension, not necessarily out of control at baseline to receive either: 1) usual care; 2) bi-monthly tailored nurse-administered telephone intervention targeting hypertension-related behaviors; 3) BP monitoring with 3 BP recordings weekly; 4) or a combination of the two interventions. A board certified registered nurse administered the intervention. Compared to the usual care group, at 12 months the mean systolic BP was 1.6 mmHg lower in the behavioral group, 3.7 mmHg lower in the home BP monitor group, and 3.3 mmHg lower in the combined group. By 24 months the improvements persisted only in the combined group relative

to the usual care group. Relative to usual care, the adjusted 24 month difference −3.9 mmHg was among patients in the combined intervention. Findings were similar for diastolic BP changes over time. The authors concluded that this signifies the synergistic effect of the home monitoring and behavioral interventions on improving BP over time [22]. The authors reported that the interventions are cost-additive to the health-care system in the short term. Intervention costs were estimated at $90 (S.D., $2) for home blood pressure monitoring, $345 (S.D., $64) for the behavioral intervention ($31 per telephone encounter), and $416 (S.D., $93) for the combined intervention.

In a European study, Kerry and colleagues recruited 381 participants from stroke clinics [26]. Participants were first visited in their homes and then randomly assigned to receive either usual care or home-based monitoring. Participants in the home-based monitoring group were given a blood pressure monitor, trained on its use, and provided with nurse-administered telephone support. While the intervention group had better control than the usual care group, the difference was not statistically significant. The mean difference in systolic reduction between the groups was 0.3-mmHg at 12 months. Though this subtle change may not be clinically meaningful, it suggests that short-term improvements in BP control can be achieved with behavioral modification alone [26].

These studies suggest that behavioral modification, unaccompanied by medication management, can be effective in controlling BP. However, patient interaction with an interventionist is critical for success. This interaction provides the underpinning for behavioral modification and informs medication management, both of which are critical elements in effective BP control.

Behavioral Modification+Medication Management

Many home-based telemonitoring interventions supplement behavioral modification with medication management to promote BP control. The Hypertension Intervention Nurse Telemedicine Study (HINTS) trial assessed three telephone-based interventions in a four-arm design, consisting of: 1) nurse-administered, behavioral management intervention; 2) nurse-administered, physician-directed medication management intervention; 3) combined behavioral management and medication management intervention; and 4) usual care [32]. Approximately 593 participants with poor BP control over the last 12 months were recruited from primary care clinics associated with the Durham, North Carolina VA Medical Center. The behavioral intervention consisted of 12–14 minute telephone calls, reinforced with mailed hand-outs, addressing hypertension knowledge and evidence-based recommendations regarding hypertension-related behaviors, including salt intake, weight, stress reduction, smoking cessation, and alcohol use. When certain medication-related triggers were activated, the nurse notified the study physician and provided a medication recommended change. The physician made suggestions and medication adjustments as indicated. The nurse subsequently communicated recommendations to patients and followed up with the patient three weeks later. Outcome measures were assessed at 6-month intervals over 18 months. Both the behavioral management and medication management alone showed nearly 13 % improvements at 12 months. These improvements were not sustained at 18 months. Improvements were greater for patients with poor baseline BP measures. For these patients, BP in the combined intervention group decreased 14.8-mmHg [32]. The authors suggest that identifying patients most likely to benefit from resource intensive programs may be prudent [32]. The authors concluded overall and subgroup samples, average intervention costs were similar in the 3 study arms, and at 18 months, there were no statistically significant differences in direct VA medical costs or total VA costs between treatment arms and usual care.

A recent study conducted by Magid and colleagues randomized 388 hypertensive patients to usual care or a multimodal intervention which included patient education, home BP monitoring, home BP reporting to interactive voice response system, and telephone-based counseling by a clinical pharmacist for BP management [28]. A physician initiated and titrated antihypertensive medications with oversight from the study pharmacist. Patients with elevated BP for two out of their most previous three BP measurements were enrolled from three healthcare systems located in Denver, Colorado including integrated healthcare systems. On average, patients were taking two anti-hypertensive medications, approximately half had diabetes or chronic kidney disease, and between 11 and 13 % were current smokers. Baseline BP measurements were higher in the intervention groups than the usual care group. At six-months, BP reductions were greater for the intervention compared to the usual care group (−13.1 vs. −7.1-mmHg, for systolic; −6.5 vs. −4.2-mmHg, for diastolic) [28]. Medication adherence rates were similar between the groups, but participants in the intervention arm had greater therapy intensification (increase in medication dose or additional medications added). Although it is unclear which aspects of the intervention were most effective, this study suggests that a multimodal intervention improves BP control more than usual care alone [28].

These studies suggest that multidisciplinary teams, involving nursing and pharmacy professionals, can facilitate patient self-management via home-based

telemonitoring for successful BP reduction and control. As home-based telemonitoring gains traction as a routine part of primary care delivery, the evolving role of technology must be considered in order to successfully reach, engage, and communicate with patients to facilitate hypertension self-management and home-based telemonitoring.

The Evolving Role of Technology

Technology, both for BP monitoring and patient communication, is rapidly evolving. As a result, novel approaches to home-based BP telemonitoring will advance. The interventions that we highlight primarily use telephones. Many patients today use mobile phones, often 'smart' phones with Internet capabilities. In addition to the traditionally used telephone call approach, interventions may now include as delivery mechanisms, a short message service, also known as text messaging [12], e-mail, or smart phone and tablet enabled software applications or 'apps'. Logan and colleagues found in a RCT that self-care messages delivered via a smartphone immediately after a home-based BP reading, improved blood pressure control in the intervention group by −9.1 mmHg [45]. In addition, 51 % of the intervention subjects achieved a target of <130/80 mmHg compared with 31 % of control subjects.

Additional technological mediums include telehealth kiosks to facilitate "home-based" telemonitoring in settings such as senior centers and community pharmacies [46, 47], web-based [48, 49], and e-mail [50]. A recent web-based 3-arm RCT conducted in an integrated health system randomly assigned patients to usual care, home BP monitoring and web site training only, or home BP monitoring and Web site training plus online pharmacist management. The study found that adding web-based pharmacist care to home BP monitoring and web training significantly increased the percentage of patients with controlled BP [48, 49]. Another study using e-mail effectively reduced salt intake with the objective of improving BP. During this study, participants were sent ten emails over a 4-week period informing them about salt contact of foods, methods for salt reduction and encouraged a salt-reduced diet. Patients were also instructed to self-report their BP via a home monitor [50]. Lastly, online social media is another evolving forum for potential interventions [51]. Patients increasingly expect to be able to communicate with their providers via email and web-based messaging and interventions may naturally stem from this interaction [52, 53]. However, research leveraging online social media and hypertension self-management is still in its infancy.

These novel approaches are promising, and may increase access to patients living in rural areas. Future studies must consider the evolving technological landscape, their patient population, clinical goals, and how to best capitalize on the wide variety of available technological resources to promote behavior change [54]. Nevertheless, caution must also be exercised to ensure equal access to care. Patients who are of older age, lower socioeconomic status, or with lower education levels may be less willing to participate in technology-intensive interventions [55].

Limitations of Previous Studies and Gaps in Knowledge

We emphasize several key studies from a body of literature showing that home-based BP telemonitoring interventions are helpful tools for promoting BP control.[56] Despite the breadth of work that has been done, there remain several gaps in our understanding of the role and effectiveness of home-based telemonitoring in improving BP control. Featured below are four key gaps in existing literature:

- Length of Outcome Measure: For most patients, BP control is a life-long endeavor, yet most interventions had relatively short durations for outcome measures (e.g., 12 months or less). A minority of studies looked at longer-term outcomes, spanning to 24 months [32, 57]. The long-term effectiveness and clinical benefit of interventions must be evaluated in order to understand whether improvements in BP are sustained over time. Moreover, future work could examine "booster" interventions to facilitate longer-term BP control.
- Sustainability: The interventions discussed were part of a specific research program. At the conclusion of a research intervention, little is reported about how effective interventions are translated into clinical practice. A focus on implementation beyond the initial study is important. This is particularly critical as many healthcare organizations transition to a patient-centered medical home model.
- Intervention Components: Most interventions are multimodal, involving many components working in concert for effective BP control. To inform a better understanding of what works well, authors should report detailed information about the logistics of intervention implementation. For example, our understanding is limited about the optimal frequency of BP monitoring and reporting, the ideal degree of intensity of interventionist contact, and median telephone contact time. This information is central to understanding intervention implementation, sustainability, and cost.
- Cost: While there have been several cost-effectiveness analyses of home-based BP telemonitoring interventions

[13–17], they are often based on limited data. Because of sparse information about long-term BP control and healthcare utilization, the relative costs and benefits must be better defined. This is particularly true for the type of interventionist where costs may vary significantly. More comprehensive analyses are needed to determine whether these interventions produce a positive return on the initial investment.

Conclusion

Managing hypertension has been a significant health need for over a decade [2]. The climate of healthcare and availability of technology are evolving, and approaches to treating hypertension must evolve in parallel. Primary care providers are increasingly in short supply, the severity of that shortage is expected to continue [58], and there is a growing emphasis on reducing healthcare costs. Thus, the use of clinicians such as nurses and pharmacists will be instrumental in the delivery of effective, cost-conscious care. As the healthcare climate shifts to a Patient Centered Medical Home model [5], involving information technology and shared communication with the ultimate goal of truly patient-centric care, much patient-centered care occurs outside of a traditional office-based care setting. Home-based telemonitoring of chronic diseases, such as hypertension, fulfills a critical role in this framework.

Home-based BP telemonitoring places the emphasis on patient involvement. It equips patients with the knowledge, skills, and technology needed to manage their care. When supplemented with nurse, nurse practitioner, or clinical pharmacist- mediated support, patients can be guided to successfully achieve BP control while avoiding unnecessary office visits. This eases the burden on primary care providers, empowers the patient, and is more convenient for patients.

Despite the utility of home-based telemonitoring for BP control, more evidence is needed to support the extent of its effectiveness. Specifically, more evidence is needed regarding the cost effectiveness, the long-term impact of home-based BP monitoring, and the optimal use of emerging technologies on clinical outcomes. Home-based BP telemonitoring interventions must take advantage of rapidly advancing technology, both for communication and BP monitoring, while taking into account the needs and preferences of the patient population served. At its core, home-based BP telemonitoring facilitates patient participation in their own chronic disease management, placing patients at the center of care. Such interventions will become increasingly important as the climate and structure of healthcare continue evolving.

Acknowledgments Dr. Zullig is supported by funding from the National Cancer Institute (5R25CA116339). Dr. Bosworth was supported by a research career scientist award from the VA Health Service Research and Development (VA HSR&D 08–027). Dr. Shaw was supported by Health Services Research and Development Service, Department of Veterans Affairs, Office of Academic Affiliations (TPP-21-021). The content is solely the responsibility of the authors and does not necessarily represent the views US Department of Veterans Affairs.

Conflict of Interest L.L. Zullig declares that she has no conflict of interest.

S.D. Melnyk declares that she has no conflict of interest.

K. Goldstein declares that she has no conflict of interest.

R.J. Shaw declares that he has no conflict of interest.

H.B. Bosworth declares that he has no conflict of interest.

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