Hypertension

REVIEW

Innovative Remote Management Solutions for the Control of Hypertension

Simin Gharib Lee; Naomi D.L. Fisher

ABSTRACT: We stand at a critical juncture in the delivery of health care for hypertension. Blood pressure control rates have stagnated, and traditional health care is failing. Fortunately, hypertension is exceptionally well-suited to remote management, and innovative digital solutions are proliferating. Early strategies arose with the spread of digital medicine, long before the COVID-19 pandemic forced lasting changes to the way medicine is practiced. Highlighting one contemporary example, this review explores salient features of remote management hypertensive programs, including: an automated algorithm to guide clinical decisions, home (as opposed to office) blood pressure measurements, an interdisciplinary care team, and robust information technology and analytics. Dozens of emerging hypertension management solutions are contributing to a highly fragmented and competitive landscape. Beyond viability, profit and scalability are critical. We explore the challenges impeding large-scale acceptance of these programs and conclude with a hopeful look to the future when remote hypertension care will have dramatic impact on global cardiovascular health.

Key Words: algorithm ■ blood pressure ■ hypertension ■ office visits ■ pandemic ■ telemedicine

The traditional office visit model for managing hypertension is failing. Despite the availability of effective and affordable pharmacologic treatment for decades, control rates for hypertension are poor and stagnant.[1] Key causes are well-understood and include patient and provider inertia,[2] medication nonadherence,[3] and harmful lifestyle and metabolic factors like obesity, excess alcohol and dietary sodium consumption and sedentary living.[4] In addition, the time-honored system of measuring and treating patients based on office visit blood pressure (BP) is butting against capacity limitations, subpar measurement techniques in the clinic forced partly by time constraints, and data showing superiority of out-of-office recordings.[5] In response to all these factors, innovative health care delivery programs for hypertension are proliferating, gaining ground because of their flexibility and innovative features.[6]

Many patients and providers turned to remote monitoring during the COVID-19 pandemic, especially during lockdown stages. Remote monitoring pairs well with telehealth, enabling providers to lower costs while managing chronic conditions. It is particularly well suited for conditions like hypertension, diabetes, and obesity with measurable outcomes that can be tracked by patients at home.

This article provides an overview of remote hypertension management programs, including a review of influential predecessors, an in-depth description of a contemporary successful program, key design features and strategies for implementation, and challenges shaping future directions.

FORERUNNER SOLUTIONS TO COMPLETE REMOTE MANAGEMENT

Several notable models laid the foundation for contemporary remote hypertension management (Table). In 2000, Kaiser Permanente Northern California launched a program with groundbreaking features, including a patient registry; a clinical algorithm that recommended specific agents and doses; performance feedback; and in-person visits without copay for BP measurement.[7,8] Over its first 12 years, rates of

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Nonstandard Abbreviations and Acronyms

BP	blood pressure
EHR	electronic health record
RPM	remote patient monitoring
SMBP	self-measured BP

BP control across Kaiser Permanente Northern California increased from 44% to 90%, whereas rates of heart attacks and death from stroke fell by 24% and 42%.[7,8] This program was successfully expanded within Kaiser Permanente and to other systems with diverse patient populations.[9] The US Veterans Administration implemented its hypertension management program at around the same time. The Veterans Administration's electronic health record (EHR), deployed in 1982, was ahead of many contemporary EHR solutions in its ability to promote digital communication between patients and providers.[10] Patients were provided free BP monitors that transmitted home BPs electronically; providers received electronic treatment recommendations.[10] The Veterans Administration program saw an increase in BP control rates from 46% to 76% from 2000 to 2010.[11]

Paralleling these early successes, pharmacists gained prominence in hypertension management. Collaborative drug therapy management agreements allow pharmacists in most states to initiate, adjust, or discontinue drug therapy for many chronic diseases.[12,13] Several randomized-controlled hypertension trials have shown that community-based pharmacists successfully reduced BP, improved rates of control, and enhanced adherence.[14–18] Meta-analyses have found these interventions to be effective, but with substantial intervention heterogeneity.[16,19]

Victor et al[20] widened the concept of hypertension care delivery by teaming pharmacists with community barbers. In their randomized trial, barbershops with a pharmacist-led intervention reached target BP in 63.6% versus 11.7% in the active control group. Other efforts leveraged community resources in novel ways. Lifestyle and education interventions implemented in churches with Black congregations were effective in reducing BP and improving knowledge about hypertension.[21–23] Community health worker interventions have also been associated with enhanced home BP monitoring, improvements in control, linkage to care, treatment adherence, and overall cardiovascular risk reduction in low- and middle-income settings.[24–27]

IMPLEMENTATION OF AN IDEAL PROGRAM

Contemporary remote hypertension management is actively evolving from these foundations. The Mass General Brigham's Digital Care Transformation program provides an illustrative example. This initiative focuses on remote hypertension and dyslipidemia management within Mass General Brigham, an integrated health system in Boston, MA, through an end-to-end management solution including disease state

Table. Key Features of Prototypical Remote Hypertension Management Solutions

Solution	Key design features									
	Systematic patient identification	Clinical algorithm	Interdisciplinary team	Self-measured blood pressure monitoring	Medication titration	Titration by nonphysician providers	Access to health coaches	Fully remote (out of office)	Technology-enabled comprehensive care automation	Operational performance monitoring
Kaiser Permanente Northern California Hypertension Program 2013[8]	✓	✓	✓	✗	✓	✗	✗	✗	✗	✓
Veterans Administration Hypertension Program 2012[11]	✓	✓	✗	✓	✓	✗	✗	✗	✗	✓
Pharmacist-led barbershop–based hypertension program[20]	✗	±	✓	✗	✓	✓	✗	✓	✗	✗
TASMINH4 self-monitoring program 2018[44]	✗	✗	✗	✓	✓	✗	✗	✓	✗	✗
Livongo consumer digital health remote monitoring solution[77]	✗	✗	✗	✓	✗	✗	✓	✓	✗	✗
Ideal comprehensive remote hypertension management program	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

identification, patient engagement, device integration, education and lifestyle counseling, laboratory monitoring, and medication initiation and titration.[28–30] The process of developing this BP management solution began with forming a multidisciplinary working group. Key members of the coordinated team were hypertension specialists from the divisions of Endocrinology and Cardiology, internists from the Division of Primary Care and Quality team, and Population Health experts, including managers and nurses integral to primary care operations. The major objective for this team was the creation of a unified approach to the effective treatment of patients with hypertension in primary care and specialty clinics. As the program was implemented, an advisory committee of patients was invited to comment on program overall workflow, as well as on specific pieces like enrollment, device setup, and the library of teaching videos and written communications.

The Digital Medicine Program at Ochsner, founded in 2015, offers remote management of multiple chronic conditions. The program initially focused on hypertension and built an integrated practice unit of pharmacists and health coaches providing patients with education, medication titration, and lifestyle counseling by phone.[31]

Figure 1 highlights key features of remote hypertension management programs.

Interdisciplinary Care Team

Comprehensive remote hypertension management requires an interdisciplinary care team including nonphysician providers like clinical pharmacists, nurse practitioners, nurses, and care navigators. These teams work efficiently through collaboration and task shifting, a delegation process that moves clinical care tasks to nonphysicians to optimize workload distribution and human resources. Although classically applied in low- and middle-income countries in contexts of infectious disease and maternal health, this approach can help with cardiovascular risk reduction.[32,33]

Our experience showed that a team of nonlicensed navigators can be supervised by clinical pharmacists, nurse practitioners, and physicians. Navigators execute most of the tasks related to patient management in the program, supported by a technology platform. Navigators are trained through an internally developed video- and didactic-based curriculum over 8 to 12 weeks, including clinical teaching from physician leads, assigned reading, sessions with pharmacists on medications and side effects, shadowing,

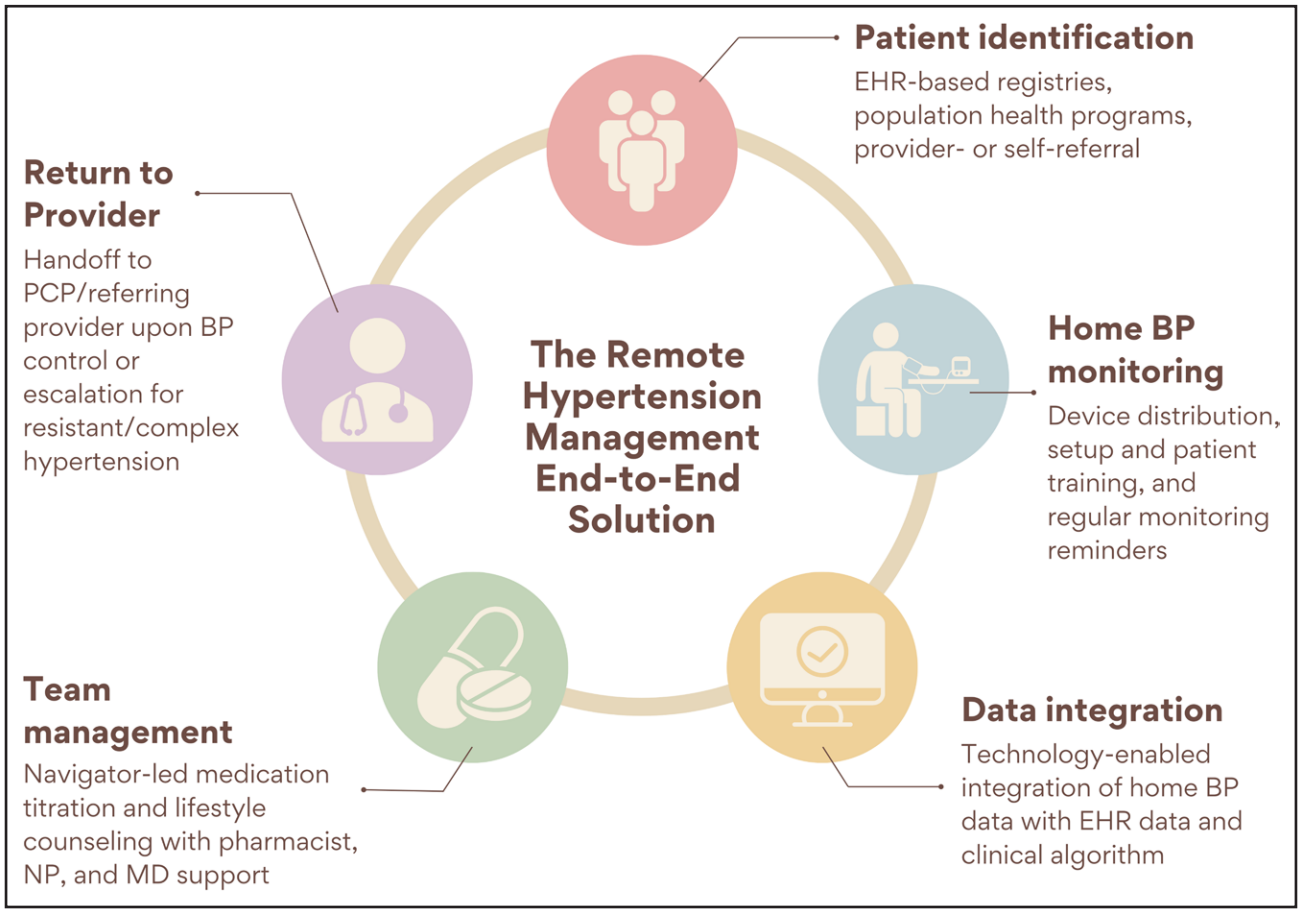

Figure 1. Key elements of the ideal remote hypertension management end-to-end solution.
MD denotes physician. BP indicates blood pressure; EHR, electronic health record; NP, nurse practitioner; and PCP, primary care provider.

role-playing and mastering scripts, and checklists. Pharmacists and nurse practitioners facilitate prescriptions and laboratory orders; physicians serve as backup, oversee complex cases, and continually revise the algorithm as needed. Primary care providers play a crucial role in the program by helping plan the process, encouraging patient participation, and providing continuity of care.

Robust Technology Infrastructure

Remote hypertension management programs today depend on a strong technology infrastructure that is easy to use and integrates seamlessly and securely with the EHR. To address this need and to lay the groundwork for scaling its operation, we found a highly customizable customer relationship management solution using Microsoft Dynamics 365 to be useful. Such a system can be developed from both technical and clinical expertise. After iterative improvement upon an initial minimum viable product, the customer relationship management system enabled improvements in patient data collection (through electronic survey tools to capture essential data like medications and pregnancy status), BP monitor integration (receiving and analyzing transmitted home BPs), and patient engagement and multi-channel communication (direct email, patient portal, or text messaging via software). Additional features include task automation (eg, automatic reminders to assist with setting up a home BP monitor, to remind patients to measure BP, or to obtain laboratory testing for monitoring) and operational performance monitoring.[34] Together, these technological enhancements are integral to efficient, customizable, and scalable solutions.

Systematic Patient Identification

Identifying patients with hypertension is the first step in controlling their BP; ideally several pathways for identification and subsequent enrollment will be enabled. Direct provider referrals are facilitated if they involve a simple EHR order. A second population stream can enter via EHR/registry screens. The EHR also allows the identification of patients with undiagnosed hypertension; one set of criteria for screening includes ≥2 readings ≥140 or ≥90 mm Hg at 2 separate visits, or any stage 2 reading in the past 12 months.[35] Finally, Population Health teams supporting primary care practices are a valuable screening resource, and self-referrals should also be considered.

Standardized inclusion criteria can be permissive or restrictive, depending on resources. One suggested starting set would include patients followed actively in the system (≥1 ambulatory visit within the preceding 3 years) with documented uncontrolled hypertension (systolic BP ≥135 mm Hg and/or diastolic BP ≥85 mm Hg on at least 2 of the 3 most recent outpatient clinic visits in the preceding 2 years, or average 24-hour ambulatory BP ≥130/80 mm Hg). Key exclusion criteria are: age younger than 26 years because of dependency on parents' insurance, confirmed or anticipated pregnancy, cognitive impairment, terminal medical illness, arm size exceeding cuff-capability, and chronic kidney disease stages 4 and 5. Baseline renal function and electrolytes are obtained if the patient's most recent values were more than 12 months prior.[36]

Out-of-Office BP Measurements

As management moves out of the physician's office, home BPs are becoming indispensable. Current US guidelines recommend out-of-office BP to confirm the diagnosis of hypertension and titrate medication, in conjunction with telehealth counseling or clinical interventions,[4] because of the dynamic nature of BP, high prevalence of white-coat hypertension, and better predictive value of out-of-office pressures.[37–40] Although ambulatory BP monitoring is considered the gold-standard for out-of-office measures, it is underutilized and poorly suited for remote management programs because it involves bulky, cumbersome monitors that often disturb patients and waken them from sleep, and 2 office visits per study.

In comparison, self-measured BP (SMBP) is easier for most patients and likely as good at predicting outcomes,[37–40] although definitive confirmatory evidence is lacking. European guidelines recommend home BP monitoring as the best and preferred method for long-term follow-up of untreated hypertension.[49] The pioneering Telemonitoring and Self-Management in the Control of Hypertension trial showed that self- monitoring and guided self-titration of medications significantly improved BP control.[41] Results were positive in more medically complex populations[42] and both with and without telemonitoring.[43] SMBP plus additional support (eg, counseling, web-based support, or education) has generally proven more effective than usual care in lowering BP[44]; incorporation of SMBP into broader interventions has also been suggested to enhance control.[45,46] This evidence has prompted advancements in technology and software programs, which can now support analysis of large volumes of home BP readings and incorporate a range of metrics.[34] The evolution of SMBP use in remote hypertension management is summarized in Figure 2. Notably, the field is young; long-term studies examining outcomes with medication titration dependent upon home BPs are not yet available.

SMBP must be standardized to provide meaningful and rigorous data, starting with validated devices (for lists see stridebp.org, medaval.ie, and validatebp.org).[47] Only a minority of automated cuff devices for home use globally have been validated for accuracy.[48] For efficient and unbiased management of hypertension, home BPs should be transmitted automatically. Because cell phones are ubiquitous compared with home Wi-Fi, devices that transmit via cellular signal will accommodate more diverse populations. Digital devices with upper arm cuffs are strongly recommended over wrist

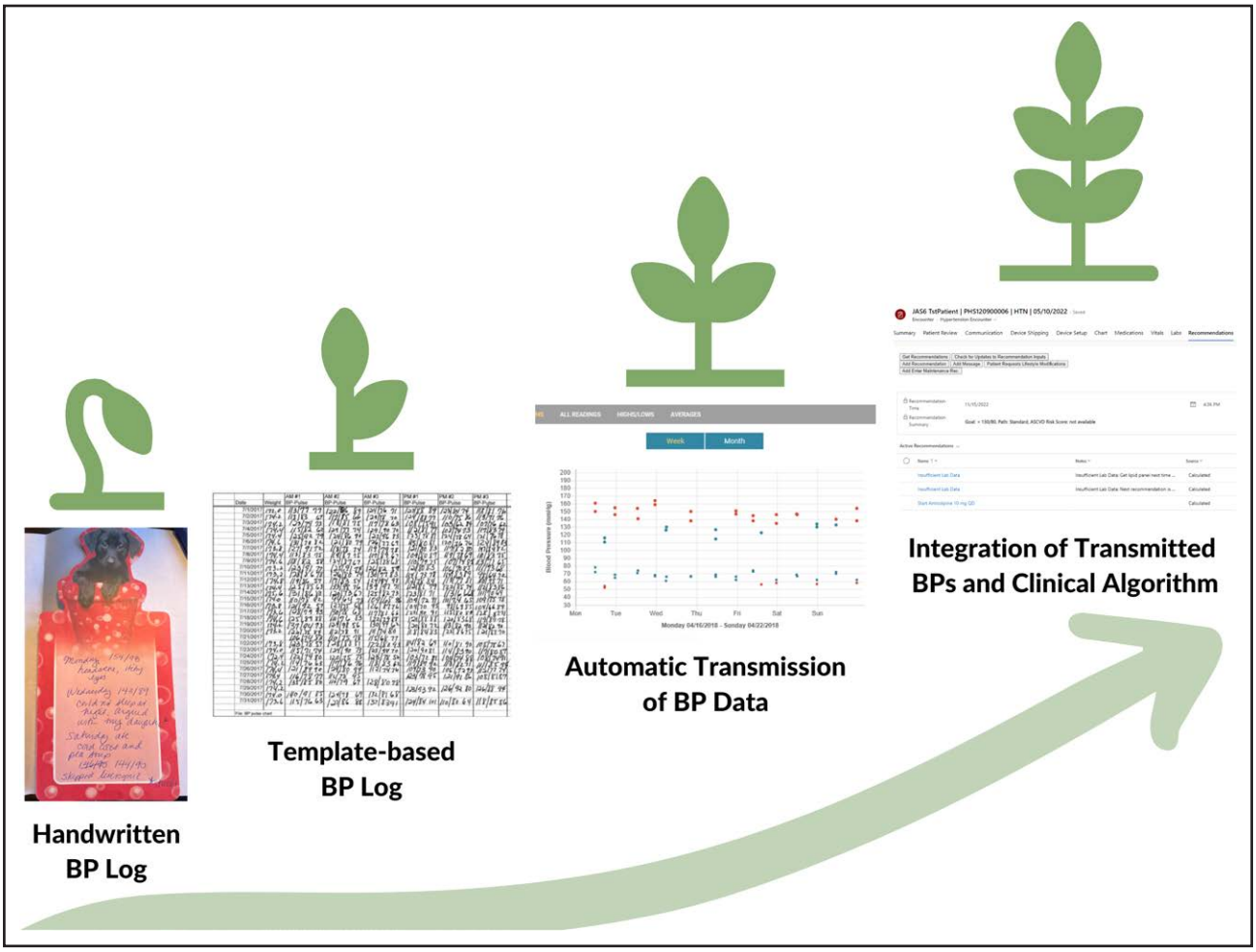

Figure 2. The evolution of self-measured blood pressure (BP) monitoring.
In the simplest and perhaps most common method, home BPs measured at random or during symptomatic times are transcribed by patients onto note pads. A more detailed version of self- recorded BPs displays numerous pressures, systematically logged. The advance of automated digital transmission of scheduled BP data has helped eliminate bias and improve accuracy. Finally, the most comprehensive systems integrate transmitted BP data into a clinical algorithm for customized treatment.

cuffs and manual sphygmomanometers. Patients must be taught proper setup and technique. Patient navigators can successfully teach patients through a combination of written, verbal, and video materials. We recommend following most guidelines in asking patients to measure BP twice daily in duplicate, morning and evening, always before medications.[4,49,50]

Clinical Algorithm

Upon enrollment into a remote managment program, patients should measure home BP for 1 week to obtain a baseline. If average home BP is at or below goal with high office pressures, these patients are appropriately diagnosed with white-coat hypertension (if not taking antihypertensive medication) or white-coat effect (if taking medication). Patients with baseline home BP above goal (sustained hypertension) enter active management. A computer program provides navigators with recommended titration steps according to an algorithm built upon the 2017 American Heart Association/American College of Cardiology hypertension guidelines.[4]

This algorithm, seated at the core of the program, evolved from a simple document into a digital clinical decision support tool.[36] Nonpharmacologic interventions are always addressed first, including coaching and guidance for weight loss, dietary sodium and potassium, alcohol restriction, and physical activity, enhanced with appropriate internal referrals (eg, for nutrition or weight management). The algorithm then provides detailed step-by-step automated directions for medication initiations, titrations, and discontinuations. Management is standardized along separate clinical pathways customized for optimal treatment of discrete subpopulations (Figure 3A). Patients in the standard pathway are started on calcium channel blockers first unless contraindicated, followed by ARBs (angiotensin receptor blockers), with thiazide-type diuretics typically third. Mineralocorticoid receptor antagonists or beta blockers are used fourth line as appropriate. Patients with uncontrolled hypertension and diabetes

mellitus, renal impairment, or moderately increased albuminuria receive ARBs or ACE (angiotensin-converting enzyme) inhibitors, followed by calcium channel blockers. Regimens are escalated frequently and regularly until goal BP is reached (target <130/80, with <135/85 mm Hg for those who are frail or ≥80 years). Combination pills are prescribed whenever possible after doses are stabilized. This is one measure to increase adherence; others include prescribing only generic medications, prioritizing once-daily medications, and discussing adherence with patients who have persistent hypertension.

Customization and continual algorithm improvement based on evolving guidelines and findings should be supported. Most recently, in an effort to deliver flexible care during the COVID-19 pandemic, the algorithm was adapated to the constraints of lockdown and social isolation.[51] Calcium channel blockers replaced ARBs and ACE inhibitors as first-line agents for all groups, as they do not require blood work for titration (Figure 3B). Safety measures are also built in: BPs that cross preset safety thresholds are shared via alerts to clinicians. An algorithmic approach is applied for ordering labs which are regularly monitored, with reports automatically alerting providers of critical values. Upon reviewing clinical data, the pharmacist, under a collaborative drug therapy management agreement, makes medication changes via electronic prescribing.

Tracking and Reporting Outcomes

Positive clinical and operational outcomes should spur widespread implementation of remote BP programs. To date, most outcome data from these programs relate to BP itself (eg, percentage of patients reaching target, and BP reduction), a widely accepted surrogate for cardiovascular outcomes. Operational outcomes (eg, number of phone calls or titrations) are also key metrics determining success, and we recommend investing resources to enable advanced analytics and tracking of these outcomes. Among patients who reached maintenance in the Mass General Brigham program, mean home BP reduction was as high as 20/11 mm Hg ($P<0.001$).[30,51] Outcomes related to patient engagement differed by study. In an early pilot (patients were encouraged by their doctors during visits), the engagement rate exceeded 90%.[28] With expansion and more patients referred by their doctors through the EHR, the dropout rate has grown to nearly one-third.[29] A subset of participants who became unreachable or dropped out were interviewed by a team doctor to learn about the barriers, challenges, likes and dislikes of the program.[30] Of those, patients reached felt their condition was under control, preferred to work directly with their provider, were not comfortable with additional medications, or stated the program was not convenient. This analysis highlights areas for improvement in education, provider coordination, and patient engagement. Further research is needed to understand the drivers of patient participation and withdrawal in order to optimize these key metrics.

Patients in Ochsner Digital Medicine Program (compared with controls receiving usual care) recorded more BP measurements, had more frequent interactions with the integrated care team, and increased adherence.[52] They achieved greater BP control and lower systolic BP variability, with higher levels of satisfaction at 6 months.[31,53,54] Task shifting within these care teams resulted in a 29% reduction of primary care provider clinic visits for hypertension over the same period.[53]

KEY CHALLENGES

Getting Started: Helpful Tools

Starting a remote hypertension management program can be daunting. As adoption of remote solutions throughout health care has accelerated, government agencies and professional societies have developed practical guidance tools to help providers in clinical and community settings catalyze the first steps. Two such resources are Center for Disease Control's Hypertension Control Change Package as part of the Million Hearts Initiative[55] and targetbp.org, a national initiative formed by the American Heart Association and the American Medical Association.[56]

Complex Hypertension Cases

Not all patients with hypertension can be easily managed by algorithmic care. Hypertension PLUS (HTN-PLUS) is a management program designed specifically to control BP in patients with true or apparent (eg, due to nonadherence) resistant hypertension.[57] Patients with resistant hypertension are escalated to HTN-PLUS if their BP is uncontrolled despite maximum tolerated doses of at least 3 antihypertensive medications including a diuretic. HTN-PLUS includes a nursing call to review contributing causes like nonadherence, obstructive sleep apnea and nonsteroidal anti-inflammatory drug excess, and screening for primary aldosteronism. The nurse also reviews blood pressure measurement technique with patients, including proper timing, arm, and body positioning. If it is determined that proper technique was not used, patients repeat a set of values to create a baseline BP for the HTN-PLUS program. In early months, HTN-PLUS has successfully managed BP remotely in about half of patients.[57]

Cost and Sustainability

Ultimately, economics will play perhaps the major role in the dissemination of digital health solutions. Profitability is a critical challenge for sustaining and scaling any program. Health care providers offering these services must be able to meet their cost needs with appropriate reimbursement or cost coverage, and cost effectiveness

Figure 3. Clinical algorithms for remote management of hypertension.
A, Clinical algorithm for remote management of hypertension before the COVID-19 pandemic.[51] **B**, Adapted clinical algorithm for remote management of hypertension during the COVID-19 pandemic.[51] Systolic blood pressure (SBP), diastolic BP (DBP), and chronic kidney disease (CKD) defined by estimated glomerular filtration rate <60 mL per minute per 1.73 square meters of body surface area. *At this stage of the algorithm, screening for secondary causes of hypertension (including plasma renin activity and aldosterone concentration) was undertaken to guide treatment. If screening was negative and electrolytes permitted, mineralocorticoid receptor antagonist (MRA) was preferred. Otherwise, beta blocker was prescribed. If screening was positive, referral to hypertension specialist was made. †Antihypertensive classes requiring laboratory monitoring were initiated and titrated at conservative dosing schedules. ACE indicates angiotensin-converting enzyme; BB, beta blocker; ARB, angiotensin receptor blocker; CCB, calcium channel blocker; TD, thiazide-type diuretic; and TLD, thiazide-like diuretic..

data will provide objective support for a program's success. Companies offering digital solutions to a health care system will require earnings to surpass costs, in order to attract investment and for growth and development. There are countless participants in this digital landscape including provider and payer-based programs,

tech companies, pharmacies, and aggregators. Some programs focus only on hypertension while a broader group promises multi-condition solutions (Figure 4).

Business solutions and payment reform will be required to drive the market towards widespread acceptance. Reimbursement pathways for clinicians are evolving rapidly, with growth in applications of Centers for Medicare & Medicaid Services' fee-for-service remote patient monitoring (RPM). Separate reimbursement codes cover initial device set-up and patient education, daily recordings, and treatment and management services. Private insurers set their own terms, but Centers for Medicare & Medicaid Services policies require an established patient-physician relationship (waived during the public health emergency), patient consent to receive RPM services, and the secure uploading of data for at least 16 out of 30 days. Private vendors offering packages to help practices establish RPM programs are plentiful. An economic review of RPM for chronic diseases demonstrated the variability of cost-effectiveness depending on clinical context, investment, and organizational processes, and found RPM for hypertension is highly cost effective.[58]

Accessibility and Health Equity

Because remote hypertension programs rely on remote monitoring, technology to integrate home BP data into a clinical workflow, and a multi-channel communication infrastructure, there is real risk that the most vulnerable will be excluded from access. Concerns about widening the digital divide and health inequities are real as resources are invested into hypertension care delivery innovation. Indeed, 21 million Americans lack access to broadband internet technology;[59] even during the rapid telemedicine adoption during COVID-19 pandemic, at least 25% of Medicare beneficiaries continued to lack access to broadband internet and other tools needed to engage with virtual care. Most susceptible were those of low socioeconomic status, age older than 85, and communities of color.[60] Some studies, however, suggest that SMBP can help reduce hypertension-related disparities and improve equity.[30,61,62] In low income and remote areas, programs built around home BPs eliminate the need for patients to miss work or family care, find transportation to a doctor's office and pay for frequent visits to control their hypertension. As the expansion of remote hypertension care continues, scrutiny of new models will need to ensure equitable and affordable access to care.

Importantly, the solutions described in this review primarily focus on the American landscape. Yet, hypertension is a global disease. Because health care systems, economies, and cultural attitudes towards health are so tremendously varied around the world, each country's response will necessarily have to be structured in line with local institutions and socioeconomic contexts. Positive interventions incorporating community health workers in low- and middle-income countries have focused mainly on behavior change for promoting BP control.[24] Residents in rural China who were randomized to a large-scale intervention involving trained village doctors saw significant improvements in BP control compared with enhanced usual care.[63] These providers initiated and titrated medications according to a standardized protocol under medical supervision and provided patient coaching. A review of community-based care programs for hypertension mangment in sub-Saharan Africa identified 12 reports of designs that departed from conventional facility-based treatment. These programs have grown in part from models built for the treatment of HIV and tuberculosis.[64] All offered different elements of task shifting or

Figure 4. The hypertension remote monitoring landscape.
The market landscape for hypertension remote monitoring companies and programs is large and complex, comprising an array of comprehensive programs, services, products, and devices. Provided by: Manatt Health, November 3, 2022.

task sharing, but doctors played a substantial role in the majority. Although most reported significant reductions in BP, studies were marked by high attrition rates and high risk of bias; work is urgently needed to assess optimal future care models in these settings.

LOOKING TO THE FUTURE

Remote management programs are positioned to catalyze several important waves of innovation in the next phase of hypertension care delivery. One critical domain on the cusp of transformation is the measurement of BP. After decades, traditional BP cuffs may soon be displaced by cuffless technology. The commercialization of affordable, validated cuffless BP devices for patient use is close and will solve several challenges with SMBP, including the time and effort required for repeated testing, biased patient sampling, and alarm reactions to cuff inflation which can increase patient anxiety and BP. Proven accuracy will be critical for acceptance. Continuous monitors collect BP readings at home, during daily activities and while asleep, over periods of weeks, months, and years, providing patients and providers with a dynamic, rich set of data to help guide therapy.[65,66] These features promise to make hypertension easier to treat and ultimately to control.

Remote management programs can also serve as a funnel for novel therapies, such as device-based renal denervation. These therapies override medication nonadherence, and their efficacy appears durable to at least 3 years.[67–69] Renal denervation is a viable option that deserves its place within clinical algorithms for the management of hypertension.

Artificial intelligence and machine learning applications represent another innovation on the horizon. An artificial intelligence-based chatbot in the University of Pennsylvania's program triaged patient messages accurately and reduced clinicians' message burden.[70] As artificial intelligence/machine learning technology advances, it will undoubtedly facilitate remote hypertension management at scale. However, the human element will remain important[71]; care teams will continue to perform the essential functions of building trust, maintaining engagement, and boosting adherence through increasingly valued patient input and participation in decision making.[72,73]

Regulatory agencies and payers must be forward-thinking as we emerge from the COVID-19 pandemic. Providers were permitted to treat out-of-state patients with virtual visits under loosened licensing restrictions during the public health emergency. These allowances made sense then, and still do now, although business models based on facility fees may reduce profitability of virtual visits. Yet in many cases these expansions have already been rescinded, requiring an intense and innovative reexamination of policy.[74]

From a very wide lens, remote management programs for hypertension will require thoughtful and rigorously studied solutions throughout our growing digital health care ecosystem.[75] The National Academy of Medicine is developing a comprehensive framework for advancing progress in digital health. Drawing from lessons learned from the COVID-19 pandemic, the authors suggest nothing short of an entire overall system architecture to serve as a foundation for the future of digital health care.[76]

CONCLUSIONS

Dismal hypertension control rates globally underlie a public health challenge of enormous magnitude. In concert with the growing digital health movement, programs that manage hypertension remotely are multiplying. We are at a critical juncture in health care delivery. There is no turning back to traditional office-based treatment of high BP.

All successful remote management programs must deliver safe and effective clinical guidance and improve BP control. To gain widespread use in digital health care delivery, they must be profitable and scalable. And we believe they must involve both providers and patients on a personal level, providing education and encouraging engagement.

Remote hypertension management programs are part of an increasingly complex landscape of digital care. The current environment is fragmented, competitive and disjointed, and a migration toward complete remote management of hypertension may feel foreign and risky. Yet, scalable innovative solutions are essential, and their evolving success supports cautious optimism. Working to create a future of health care where remote, digital management is commonplace may well result in monumental improvements in global cardiovascular health.

ARTICLE INFORMATION

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