

Self-Measured Blood Pressure Monitoring Improves Outcomes: Recommendation of the Community Preventive Services Task Force



Community Preventive Services Task Force

TASK FORCE FINDING

The Community Preventive Services Task Force recommends self-measured blood pressure monitoring interventions to improve blood pressure outcomes in patients with high blood pressure. There is sufficient evidence of effectiveness for self-measured blood pressure monitoring interventions when used alone (i.e., patients receive self-measured blood pressure tools, training, and monitoring). There is strong evidence of effectiveness for these interventions when combined with additional support (i.e., patient counseling, education, or web-based support). The economic evidence indicates that self-measured blood pressure monitoring interventions are cost effective when they are used with additional support or within team-based care.

DEFINITION

Interventions with self-measured blood pressure (SMBP) monitoring support and promote the use of personal blood pressure (BP) measurement devices in the management and treatment of high BP. Patients are trained to use validated, and usually automated, BP measurement devices on a regular basis in familiar settings, typically their homes. Patients share BP readings with their healthcare providers during clinic visits, by telephone, or electronically. These measurements are monitored and used in treatment decisions to improve BP control.

Such SMBP monitoring interventions, often delivered as part of team-based care, may be combined with additional support in the form of:

- one-on-one patient counseling on medications and health behavior changes (e.g., diet and exercise);

- educational sessions on high BP and BP self-management; and
- access to electronic or web-based tools (e.g., electronic requests for medication refills, text or e-mail reminders to measure BP or attend appointments, direct communications with healthcare providers via secure messaging).

The U.S. Preventive Services Task Force (USPSTF) recommends screening for hypertension in adults aged ≥ 18 years with BP measured in the clinic and confirmed by ambulatory or home BP monitoring.¹ The USPSTF considers ambulatory BP monitoring to be the best method for diagnosing hypertension, but confirmation with home BP monitoring may also be acceptable.

BASIS OF EFFECTIVENESS FINDING

The Task Force finding is based on evidence from a systematic review of 52 studies, published in 2013 (Uhlig et al.,² search period from database inception through February 2013). The 2013 review evaluated effectiveness of SMBP monitoring interventions to manage high BP both when used alone and when combined with additional support. For studies evaluating SMBP monitoring used alone, Uhlig and colleagues conducted a meta-analysis and reported relative risks and weighted net outcome differences across multiple time points. Owing to the heterogeneity in clinical support methods used, Uhlig et al. reported only narrative results for SMBP monitoring combined with additional support. To better inform Task Force conclusions on health impact, the estimates reported by Uhlig and colleagues were transformed into absolute percentage point changes and net differences in BP readings using the latest time point available.

The finding of sufficient evidence of effectiveness for SMBP monitoring interventions when implemented alone is based on evidence from 26 studies with 28

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study arms. Patients in these studies received BP monitoring devices, were trained to use them, and shared BP readings with their healthcare providers. Results demonstrated consistent and meaningful improvements in BP compared with usual care. Results were significant at the 6-month time point and continued to be favorable at 12 months, although they were smaller in magnitude.³

The finding of strong evidence of effectiveness for SMBP monitoring interventions when combined with additional support is based on evidence from 25 studies with 29 study arms. These studies were categorized into three main groups based on the type of additional support used: one-on-one patient counseling or tele-counseling (11 studies); access to electronic or web-based tools (seven studies); and education on high BP and BP self-management (five studies). Half of these 25 studies used a team-based care arrangement in which healthcare providers worked alongside other professionals (e.g., nurses, pharmacists) to improve coordination of care and support for patients (14 studies with 17 study arms). Compared with usual care, results demonstrated consistent and meaningful improvements in BP, sustained at 12 months.⁴

BASIS OF ECONOMIC FINDING

Economic evidence indicates that SMBP monitoring interventions are cost effective when used with additional patient support or as part of team-based care. Although there was not enough evidence to determine cost effectiveness of the interventions when used alone, the averted cost of medication and outpatient visits exceeded the intervention cost. All monetary values reported in this paper are with reference to 2014 U.S. dollars.⁵

The economic review included 22 studies (search period through March 2015) conducted in the U.S. (13 studies); Europe (eight studies); and Japan (one study). No studies performed a cost–benefit analysis or reported intervention effects on productivity (e.g., work absences due to illness, overall performance when at work, number of working years). Costs per quality-adjusted life year (QALY) saved were estimated from total cost and reduction in systolic BP (SBP) reported in the studies, using two published translations of SBP reduction to QALY.

Evidence for SMBP monitoring alone is inconsistent. Two studies reported decreased SBP and reduced total cost; two studies reported increased SBP and reduced total cost. One study reported reduced SBP but was judged cost ineffective because estimated cost per QALY saved (\$100,000 and \$144,000, based on

two methods) exceeded the conservative threshold of \$50,000.

The weight of evidence from eight studies indicates cost effectiveness of SMBP monitoring interventions when conducted with additional support or as part of team-based care. Cost per QALY estimates from four studies of SMBP monitoring with additional support were all below \$50,000 (medians of \$2,800 and \$4,000). The median cost per QALY saved from four studies of SMBP within team-based care were \$7,500 and \$10,800, based on two methods.

APPLICABILITY

Most included studies were conducted in the U.S. (23 studies) and Europe (18 studies), with the remaining studies conducted in Canada (six studies); Australia (two studies); Brazil (two studies); and South Korea (one study). SMBP monitoring interventions were mostly delivered in outpatient, general practice, or primary care settings (46 studies). Only a few studies delivered SMBP monitoring interventions in other settings such as community settings (five studies); a pharmacy (one study); at home (one study); or in the workplace (one study). Only three studies included more than 500 patients.

All patients who received SMBP monitoring interventions were trained to use BP monitors provided by the programs, and measured their BP at home. Most included studies provided patients with automated BP cuffs (38 studies). BP readings were taken by the patients themselves or by caretakers (52 studies). Patients' BP readings were delivered to healthcare providers during medical visits as self-recorded readings (23 studies); through electronic transmissions sent directly from BP devices to central databases that providers could access (15 studies); or by mail (five studies). Additional support was administered by trained healthcare providers (e.g., pharmacists, nurse practitioners, physician assistants, health educators), and content was tailored for individuals based on their reported BP readings.

The SMBP monitoring interventions combined with additional support were evaluated in study populations consisting primarily of adults aged 18–64 years, with an even distribution of men and women. Among the 40% of included studies that reported participant race/ethnicity, populations were primarily white/Caucasian (median, 72%; 15 studies). Two studies in which $\geq 75\%$ of the patients identified as African American found favorable BP outcomes.

In studies including patients whose BP was controlled at baseline, further improvements in BP were

shown at follow-up, indicating that SMBP monitoring interventions also help patients adhere to treatment when their BP is under control (six studies). Most studies included only patients with uncontrolled BP at baseline (36 studies). Four studies conducted in populations diagnosed with both high BP and diabetes observed greater improvements in BP compared with overall findings.

CONSIDERATIONS FOR IMPLEMENTATION

The Million Hearts[®] initiative released two action guides on SMBP monitoring interventions based on findings from Uhlig et al.²:

- “Self-Measured Blood Pressure Monitoring: Action Steps for Public Health Practitioners”⁶; and
- “Self-Measured Blood Pressure Monitoring: Action Steps for Clinicians.”⁷

The following considerations for implementation are drawn from information provided in these action guides.

Implementers need to consider the type of BP monitor used by patients. Most included studies (73%) provided patients with automated BP monitors; the action guides suggest monitors with an automated upper arm cuff validated by the Association for the Advancement of Medical Instrumentation, British Hypertension Society, and European Hypertension Society. Measurement frequency varied among included studies, and experts from the American Heart Association, European Hypertension Society, and British Hypertension Society recommend patients take two to three successive readings at least twice a day, once in the morning and once in the evening.

Although all included studies provided patients with BP monitors and training, some programs ask patients to provide their own BP monitors. If programs use this approach, patients should bring their BP monitors into the office to ensure they are using them properly.

The cost of a BP monitor may be a barrier for some patients asked to provide their own device. In 2015, the costs for validated automated BP devices ranged from \$50 to \$100. Insurance benefits for BP monitors vary by payer, and Medicaid coverage varies by state. Medicare Part B does not cover home BP monitors and Medicare Part C is not required to cover home BP monitors, though it may be offered under supplemental coverage.

The type and cost of additional support provided with SMBP monitoring varied widely among included studies, making it difficult to determine whether one form of support was more effective than another. The action guides, however, note the following common elements of

successful SMBP monitoring support provided across the evaluated interventions: delivery by trained healthcare providers (e.g., pharmacists, nurse practitioners, physician assistants, health educators); regular patient communication of BP readings to providers; and establishment of a patient–provider “feedback loop” in which provider support and advice are personalized on the basis of patients’ reported information.

Reimbursement mechanisms for telemedicine, a potentially large component of some SMBP monitoring interventions, need to be considered before programs are widely implemented. Although face-to-face office visits remain an important form of interaction between patients and clinicians, other forms of care such as electronic and phone communication may be warranted. Other delivery and care models such as patient-centered medical homes, accountable care organizations, and telemedicine also should be considered.

EVIDENCE GAPS

More evidence is needed to answer the following questions:

- How effective are SMBP monitoring interventions that require patients to provide their own BP monitoring devices, as this is likely to occur more often in practice?
- What are the optimal frequencies for BP measurement by patients and clinicians?
- What forms of additional support are most effective?
- What is the role of telemedicine in SMBP monitoring interventions, and how does it affect the patient–provider interaction and medication management?
- How effective are SMBP monitoring interventions among diverse populations based on race/ethnicity, language skills, SES, health status/comorbidities, and age (children, adults, older adults)?
- What are the long-term benefits of SMBP monitoring interventions, including effects on morbidity and mortality?
- How effective are SMBP monitoring interventions in community and worksite settings? Do interventions in these settings strengthen community–clinical linkages?
- What are intervention costs when the cost of BP monitoring devices and materials (including software) is distributed over the duration of use?
- What are the returns on investment in SMBP monitoring interventions, based on the monetized value of benefits including reduced mortality and averted productivity losses?

REFERENCES

1. Siu AL. Screening for high blood pressure in adults: U.S. Preventive Services Task Force recommendation statement. *Ann Intern Med.* 2015;163(10):778–786. <https://doi.org/10.7326/M15-2223>.
2. Uhlig K, Patel K, Ip S, Kitsios GD, Balk EM. Self-measured blood pressure monitoring in the management of hypertension: a systematic review and meta-analysis. *Ann Intern Med.* 2013;159(3):185–194. <https://doi.org/10.7326/0003-4819-159-3-201308060-00008>.
3. Guide to Community Preventive Services. Cardiovascular Disease: Self-measured blood pressure monitoring interventions for improved blood pressure control – when used alone. <https://www.thecommunityguide.org/findings/cardiovascular-disease-self-measured-blood-pressure-when-used-alone>. Published June 2015. Accessed April 4, 2017.
4. Guide to Community Preventive Services. Cardiovascular disease: self-measured blood pressure monitoring interventions for improved blood pressure control – when combined with additional support. <https://www.thecommunityguide.org/findings/cardiovascular-disease-self-measured-blood-pressure-with-additional-support>. Published June 2015. Accessed April 4, 2017.
5. Jacob V, Chattopadhyay SK, Proia KK, et al. Economics of self-measured blood pressure monitoring: a Community Guide systematic review. *Am J Prev Med.* 2017;53(3):e105–e113.
6. CDC. Self-measured blood pressure monitoring: action steps for public health practitioners. https://millionhearts.hhs.gov/files/MH_SMBP.pdf. Published 2013. Accessed August 30, 2016.
7. CDC. Self-measured blood pressure monitoring: actions steps for clinicians. https://millionhearts.hhs.gov/files/MH_SMBP_Clinicians.pdf. Published 2014. Accessed August 30, 2016.