

Home Blood Pressure Monitoring

SBU ALERT REPORT NO 2010-04 • 2010-10-20 • WWW.SBU.SE/ALERT



Summary and conclusions

SBU's appraisal of the evidence

Home blood pressure monitoring, as referred to in this assessment, is performed by patients themselves using automated devices at home. Office blood pressure monitoring refers to the conventional way of managing treatment by measuring blood pressure in a clinical setting.

- In people with hypertension, home blood pressure monitoring is equally effective as office monitoring to guide antihypertensive medications. Patients take prescribed medications to the same extent, and reductions in blood pressure are similar¹.
- Home blood pressure appears to be at least as accurate as office blood pressure in predicting risks of mortality and cardiovascular disease. However, home blood pressure monitoring is not shown to be better or worse than office monitoring in guiding treatment to reduce the risk of mortality and cardiovascular disease.
- Home blood pressure monitoring can save costs in health care since it lowers the number of clinic visits compared to conventional treatment of hypertension. The cost or cost-effectiveness of the method cannot be accurately analyzed due to a lack of knowledge on the long-term use of the method.
- Home blood pressure monitoring could have both advantages and disadvantages for the patient. Although the method can be more convenient, this must be weighed against the greater responsibility placed on the patient, which could induce anxiety or lead to other problems. Scientific evidence on these issues is, however, lacking. The use of home blood pressure monitoring should be preceded by an individual assessment of motivation and appropriateness.

¹ A prerequisite is that the target blood pressure is <135/85 mmHg in home blood pressure monitoring, compared to the normal reference value of <140/90 mmHg in office blood pressure monitoring.

Technology and target group

According to office blood pressure, approximately 1.8 million people in Sweden suffer from hypertension. This corresponds to 27% of the adult population. Medications and changes in lifestyle are used in treating hypertension with the intent to reduce the incidence of cardiovascular diseases, mainly stroke, heart failure, and myocardial infarction.

The conventional way to monitor blood pressure in managing treatment is to take several measurements in the physician's office. In recent years, however, it has become increasingly common for patients to self-monitor their blood pressure at home. An advantage of home blood pressure monitoring is that patients do not need to visit the physician's office every time their blood pressure needs to be measured. Other potential advantages are that home blood pressure monitoring can yield more reliable blood pressure values since it is possible to take readings at different times during the day, and stress reaction that leads to elevated blood pressure that some patients exhibit in the office can be avoided when measuring blood pressure at home. Potential disadvantages of the method include the greater responsibility placed on patients, which could induce anxiety, and also that some patients might change their treatment based on casual home measurements without doctor's guidance. Hence, not everyone with hypertension is a candidate for home blood pressure monitoring, and the use of the method should be preceded by individual assessment of motivation and appropriateness.

Home blood pressure monitoring, as referred to in this assessment, is performed by patients themselves using automated electronic devices. As a rule, these devices use an oscillometric determination of the blood pressure and the equipment consists of a cuff and an electronic monitor that are connected by an air tube. The monitor registers variations in pressure, ie, oscillations.

For blood pressures measured in the office the reference value for normal blood pressure is <140/90 mmHg. Since home blood pressures generally are lower than office blood pressures, the reference value for normal blood pressure at home is usually set as <135/85 mmHg.

Establishing a reference value for home blood pressure remains, however, a subject for research.

Primary questions

To determine the value of home blood pressure monitoring for patients with hypertension, this evaluation aims to answer the following questions:

- Can patients' blood pressure be reduced more effectively if home blood pressure monitoring is used to guide treatment?
- How well do patients comply with antihypertensive pharmacotherapy if home blood pressure monitoring is used to guide treatment?
- What kind of symptoms do the patients experience if home blood pressure monitoring is used in managing antihypertensive pharmacotherapy?
- What costs are associated with home blood pressure monitoring? What is the cost-effectiveness of the method?

To determine the value of home blood pressure monitoring as regards the risk of mortality and cardiovascular disease, this assessment aims to answer the following question:

- Regarding mortality and the risk of cardiovascular disease, does home blood pressure provide better prognostic information than blood pressures measured in the office?

This assessment is not intended to compare the diagnostic accuracy of the different home blood pressure monitors available on the market.

Patient benefit

Eight randomized controlled trials were included to assess home blood pressure monitoring as measured by reduction in blood pressure, compliance with pharmacotherapy, and experienced symptoms. The studies compared the values from home blood pressure monitoring with values measured in the office or by using 24-hour ambulatory monitoring². In total, approximately 2700 patients were included.

The results from the literature review suggest that home blood pressure monitoring is equally effective as office monitoring when it comes to guiding antihypertensive pharmacotherapy. Assuming that the recommended tar-

get blood pressure levels are used, there is no difference between home and office monitoring as regards blood pressure reduction after 1 year (moderately strong scientific evidence ⊕⊕⊕○).

Two studies that investigated compliance with pharmacotherapy estimated that approximately 90% of all patients took their prescribed drugs. No difference was found between the group whose treatment was guided by home blood pressure monitoring and the group whose blood pressure was measured in the office (moderately strong scientific evidence ⊕⊕⊕○).

One of the included studies assessed the amount of symptoms, eg, dizziness, headache, and palpitations. During the course of the study, symptoms decreased equally in the groups receiving home blood pressure monitoring and office blood pressure monitoring.

Given the fact that blood pressure treatment is often life long the observation times in the studies are relatively short, and few studies report more than 1 year of follow-up. The method's long-term effects could not be assessed due to the absence of long-term results.

Home blood pressure monitoring can be more convenient, in part because the patient does not need to be as closely tethered to health services. The prerequisite for using the method is that patients are motivated and have the ability to learn to self-monitor their blood pressure appropriately. There are currently no dedicated programs available that address how to use and follow up home blood pressure monitoring. The method should be viewed as a complement to conventional office blood pressure monitoring.

Four observational studies have been included to appraise the value of home blood pressure monitoring regarding mortality and risk of cardiovascular disease. Average follow-up times in these studies varied from just over 3 years to 12 years. Three of the studies used regression analysis to calculate the correlation between blood pressure levels measured via home and office-based monitoring respectively, and mortality and/or prevalence of cardiovascular disease. In summary, the included studies suggest that home blood pressure is at least as accurate as office blood pressure to predict the risk of death or being affected by a cardiovascular event, eg, stroke or myocardial infarction (limited scientific evidence ⊕⊕○○). Based on these observational studies alone, however, no conclusions can be drawn on home blood pressure monitoring in guiding the treatment.

² 24-hour ambulatory monitoring involves using a portable device that registers blood pressure several times per hour for 24 hours.

Economic aspects

A home blood pressure monitor fitted for upper-arm measurement costs approximately 500 to 1500 Swedish kronor (SEK) including VAT. Possible differences in the direct costs of home and office blood pressure monitoring mainly involve the staff resources required by the different methods. Although home blood pressure monitoring can reduce the office workload by need for fewer visits, concurrently it requires extra time to check on the patient's use of the device and the results produced.

The included studies suggest that home blood pressure monitoring saves costs in health care. An accurate analysis of the costs and cost-effectiveness of the method cannot be presented due to the absence of established programs on using and following up home blood pressure monitoring, and because the long-term effects are unknown.

Four levels are used in grading the strength of the scientific evidence on which conclusions are based:

Strong scientific evidence (⊕⊕⊕⊕). Based on high- or medium-quality studies containing no factors that weaken the overall judgment.

Moderately strong scientific evidence (⊕⊕⊕○). Based on high- or medium-quality studies containing isolated factors that weaken the overall judgment.

Limited scientific evidence (⊕⊕○○). Based on high- or medium-quality studies containing factors that weaken the overall judgment.

Insufficient scientific evidence (⊕○○○). The evidence base is insufficient when scientific evidence is lacking, the quality of available studies is low, or studies of similar quality are contradictory.

References

1. SBU. Måttligt förhöjt blodtryck, volym 1. En systematisk litteraturoversikt. Stockholm: Statens beredning för medicinsk utvärdering (SBU); 2004. SBU-rapport nr 170/1. ISBN 91-87890-97-6.
2. Parati G, Stergiou GS, Asmar R, Bilo G, de Leeuw P, Imai Y, et al. European Society of Hypertension Practice Guidelines for home blood pressure monitoring. *J Hum Hypertens* 2010.
3. Parati G, Stergiou GS, Asmar R, Bilo G, de Leeuw P, Imai Y, et al. European Society of Hypertension guidelines for blood pressure monitoring at home: a summary report of the Second International Consensus Conference on Home Blood Pressure Monitoring. *J Hypertens* 2008;26(8):1505-26.
4. Staessen JA, Thijs L, Fagard R, O'Brien ET, Clement D, de Leeuw PW, et al. Predicting cardiovascular risk using conventional vs ambulatory blood pressure in older patients with systolic hypertension. Systolic Hypertension in Europe Trial Investigators. *JAMA* 1999;282(6):539-46.
5. Bosworth HB, Olsen MK, Grubber JM, Neary AM, Orr MM, Powers BJ, et al. Two self-management interventions to improve hypertension control: a randomized trial. *Ann Intern Med* 2009;151(10):687-95.
6. Godwin M, Lam M, Birtwhistle R, Delva D, Seguin R, Casson I, et al. A primary care pragmatic cluster randomized trial of the use of home blood pressure monitoring on blood pressure levels in hypertensive patients with above target blood pressure. *Fam Pract* 2010;27(2):135-42.
7. Halme L, Vesalainen R, Kaaja M, Kantola I. Self-monitoring of blood pressure promotes achievement of blood pressure target in primary health care. *Am J Hypertens* 2005;18(11):1415-20.
8. Niiranen TJ, Kantola IM, Vesalainen R, Johansson J, Ruuska MJ. A comparison of home measurement and ambulatory monitoring of blood pressure in the adjustment of antihypertensive treatment. *Am J Hypertens* 2006;19(5):468-74.
9. van Onzenoort HA, Verberk WJ, Kroon AA, Kessels AG, Nelemans PJ, van der Kuy PH, et al. Effect of self-measurement of blood pressure on adherence to treatment in patients with mild-to-moderate hypertension. *J Hypertens* 2010;28(3):622-7.
10. Soghikian K, Casper SM, Fireman BH, Hunkeler EM, Hurley LB, Tekawa IS, et al. Home blood pressure monitoring. Effect on use of medical services and medical care costs. *Med Care* 1992;30(9):855-65.
11. Staessen JA, Den Hond E, Celis H, Fagard R, Keary L, Vandenhoven G, et al. Antihypertensive treatment based on blood pressure measurement at home or in the physician's office: a randomized controlled trial. *JAMA* 2004;291(8):955-64.
12. Verberk WJ, Kroon AA, Lenders JW, Kessels AG, van Montfrans GA, Smit AJ, et al. Self-measurement of blood pressure at home reduces the need for antihypertensive drugs: a randomized, controlled trial. *Hypertension* 2007;50(6):1019-25.
13. Reed SD, Li Y, Oddone EZ, Neary AM, Orr MM, Grubber JM, et al. Economic evaluation of home blood pressure monitoring with or without telephonic behavioral self-management in patients with hypertension. *Am J Hypertens* 2010;23(2):142-8.
14. Hansen TW, Kikuya M, Thijs L, Björklund-Bodegård K, Kuznetsova T, Ohkubo T, et al. Prognostic superiority of daytime ambulatory over conventional blood pressure in four populations: a meta-analysis of 7,030 individuals. *J Hypertens* 2007;25(8):1554-64.
15. Mancia G, De Backer G, Dominiczak A, Cifkova R, Fagard R, Germano G, et al. 2007 Guidelines for the Management of Arterial Hypertension: The Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *J Hypertens* 2007;25(6):1105-87.
16. Bobrie G, Chatellier G, Genes N, Clerson P, Vaur L, Vaisse B, et al. Cardiovascular prognosis of "masked hypertension" detected by blood pressure self-measurement in elderly treated hypertensive patients. *JAMA* 2004;291(11):1342-9.
17. Ohkubo T, Imai Y, Tsuji I, Nagai K, Kato J, Kikuchi N, et al. Home blood pressure measurement has a stronger predictive power for mortality than does screening blood pressure measurement: a population-based observation in Ohasama, Japan. *J Hypertens* 1998;16(7):971-5.
18. Shimada K, Fujita T, Ito S, Naritomi H, Ogihara T, Shimamoto K, et al. The importance of home blood pressure measurement for preventing stroke and cardiovascular disease in hypertensive patients: a sub-analysis of the Japan Hypertension Evaluation with Angiotensin II Antagonist Losartan Therapy (J-HEALTH) study, a prospective nationwide observational study. *Hypertens Res* 2008;31(10):1903-11.
19. Yasui D, Asayama K, Ohkubo T, Kikuya M, Kanno A, Hara A, et al. Stroke risk in treated hypertension based on home blood pressure: the Ohasama study. *Am J Hypertens* 2010;23(5):508-14.
20. Shimamoto K, Fujita T, Ito S, Naritomi H, Ogihara T, Shimada K, et al. Impact of blood pressure control on cardiovascular events in 26,512 Japanese hypertensive patients: the Japan Hypertension Evaluation

Project group

- **Eva Drevenhorn**, RN, PhD, Primary Health Care, Region Skåne
- **Fredrik Nyström**, MD, Professor, Linköping University Hospital, Linköping
- **Johan Wallin**, Project Manager, SBU, wallin@sbu.se
- SBU Staff: Pernilla Östlund, Assistant Project Manager, Karin Rydin, Literature Searcher, Lena Wallgren, Project Assistant

Scientific reviewers

- **Karin Manhem**, MD, Associate Professor, Sahlgrenska University Hospital, Gothenburg
- **Tomas Thulin**, MD, Associate Professor, Lund

with Angiotensin II Antagonist Losartan Therapy (J-HEALTH) study, a prospective nationwide observational study. *Hypertens Res* 2008;31(3):469-78.

21. Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 2008;336(7650):924-6.

Excluded studies

22. Broege PA, James GD, Pickering TG. Management of hypertension in the elderly using home blood pressures. *Blood Press Monit* 2001;6(3):139-44.
23. Den Hond E, Staessen JA, Celis H, Fagard R, Keary L, Vandenhoven G, et al. Antihypertensive treatment based on home or office blood pressure – the THOP trial. *Blood Press Monit* 2004;9(6):311-4.
24. Friedman RH, Kazis LE, Jette A, Smith MB, Stollerman J, Torgerson J, et al. A telecommunications system for monitoring and counseling patients with hypertension. Impact on medication adherence and blood pressure control. *Am J Hypertens* 1996;9(4 Pt 1):285-92.
25. Green BB, Cook AJ, Ralston JD, Fishman PA, Catz SL, Carlson J, et al. Effectiveness of home blood pressure monitoring, web communication, and pharmacist care on hypertension control: a randomized controlled trial. *JAMA* 2008;299(24):2857-67.
26. Márquez-Contreras E, Martell-Claros N, Gil-Guillén V, de la Figuera-Von Wichmann M, Casado-Martínez JJ, Martín-de Pablos JL, et al. Efficacy of a home blood pressure monitoring programme on therapeutic compliance in hypertension: the EAPACUM-HTA study. *J Hypertens* 2006;24(1):169-75.
27. McManus R, Mant J, Roalfe A, Oakes R, Bryan S, Pattison H, et al. Targets and self monitoring in hypertension: randomised controlled trial and cost effectiveness analysis. *BMJ* 2005;331(7515):493.
28. Mühlhauser I, Sawicki PT, Didjurgeit U, Jörgens V, Trampisch HJ, Berger M. Evaluation of a structured treatment and teaching programme on hypertension in general practice. *Clin Exp Hypertens* 1993;15(1):125-42.
29. Ogbuokiri JE. Self-monitoring of blood pressures in hypertensive subjects and its effects on patient compliance. *Drug Intell Clin Pharm* 1980;14(6):424-7.

30. Pierce JP, Watson DS, Knights S, Gliddon T, Williams S, Watson R. A controlled trial of health education in the physician's office. *Prev Med* 1984;13(2):185-94.
31. Rogers MA, Small D, Buchan DA, Butch CA, Stewart CM, Krenzer BE, et al. Home monitoring service improves mean arterial pressure in patients with essential hypertension. A randomized, controlled trial. *Ann Intern Med* 2001;134(11):1024-32.
32. Stahl SM, Kelley CR, Neill PJ, Grim CE, Mamlin J. Effects of home blood pressure measurement on long-term BP control. *Am J Public Health* 1984;74(7):704-9.
33. Tobe SW, Hunter K, Geerts R, Raymond N, Pylypchuk G. IMPACT: Investigation of Medical Professionals and Patients Achieving Control Together. *Can J Cardiol* 2008;24(3):205-8.
34. Vetter W, Hess L, Brignoli R. Influence of self-measurement of blood pressure on the responder rate in hypertensive patients treated with losartan: results of the SVATCH Study. Standard vs Automatic Treatment Control of COSAAR in Hypertension. *J Hum Hypertens* 2000;14(4):235-41.
35. Zarnke KB, Feagan BG, Mahon JL, Feldman RD. A randomized study comparing a patient-directed hypertension management strategy with usual office-based care. *Am J Hypertens* 1997;10(1):58-67.
36. Bo M, Comba M, Canade A, Brescianini A, Corsinovi L, Astengo MA, et al. Clinical implications of white-coat effect among patients attending at a lipid clinic. *Atherosclerosis* 2008;197(2):904-9.
37. Fagard RH, Van Den Broeke C, De Cort P. Prognostic significance of blood pressure measured in the office, at home and during ambulatory monitoring in older patients in general practice. *J Hum Hypertens* 2005;19(10):801-7.
38. Ohkubo T, Asayama K, Kikuya M, Metoki H, Obara T, Saito S, et al. Prediction of ischaemic and haemorrhagic stroke by self-measured blood pressure at home: the Ohasama study. *Blood Press Monit* 2004;9(6):315-20.
39. Sega R, Facchetti R, Bombelli M, Cesana G, Corrao G, Grassi G, et al. Prognostic value of ambulatory and home blood pressures compared with office blood pressure in the general population: follow-up results from the Pressioni Arteriose Monitorate e Loro Associazioni (PAMELA) study. *Circulation* 2005;111(14):1777-83.
40. Stergiou GS, Baibas NM, Kalogeropoulos PG. Cardiovascular risk prediction based on home blood pressure measurement: the Didima study. *J Hypertens* 2007;25(8):1590-6.

SBU evaluates healthcare technology

The Swedish Council on Health Technology Assessment (SBU) is a national governmental agency that assesses healthcare technologies. SBU analyzes the benefits, risks, and costs of different methods and compares the scientific facts to prevailing practices in Sweden. SBU's goal is to provide stronger evidence for everyone engaged in shaping the delivery of health services.

The SBU Alert reports are produced in collaboration with experts from the respective subject areas, the National Board of Health and Welfare, the Medical Products Agency, the Swedish Association of Local Authorities and Regions, and a special advisory panel (the Alert Advisory Board).

This assessment was published in 2010. Findings based on strong scientific evidence usually continue to apply well into the future. However, findings based on insufficient, limited, or contradictory evidence might have already been replaced by more recent findings.

The complete report is available in Swedish.

The Alert Advisory Board

Jan-Erik Johansson, Chairman, Professor
 Christel Bahtsevani, PhD
 Lars Borgquist, Professor
 Bo Carlberg, Associate Professor
 Jane Carlsson, Professor
 Per Carlsson, Professor
 Björn-Erik Erlandsson, Professor
 Mårten Fernö, Professor
 Stefan Jutterdal, Director of Improvement
 Viveca Odling, Professor
 Anders Rydh, Associate Professor
 Anders Tegnell, PhD
 Jan Wahlström, Professor Emeritus
 Anna Åberg Wistedt, Professor

SBU Board Subcommittee

Susanna Axelsson, David Bergqvist, Håkan Ceder,
 Tove Hellerström, Jan Liliemark, Nina Rehnqvist,
 Måns Rosén, Ewalotte Ränzlöv, Juliette Säwe

Publisher: Måns Rosén, Director, SBU
 Program Manager: Jan Liliemark, SBU
 Graphic Production: Elin Rye-Danjensen, SBU