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COMMENTARY

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Scaling up the use of home blood pressure monitoring in the management of hypertension in low-income countries: A step towards curbing the burden of hypertension

Valirie Ndip Agbor MD[1] | Mazou N. Temgoua MD[2] | Jean Jacques N. Noubiap MD[3]

[1]Ibal Sub-Divisional Hospital, Oku, North West region, Cameroon

[2]Department of Internal Medicine and Specialties, Faculty of Medicine and Biomedical Sciences, University of Yaoundé 1, Yaoundé, Cameroon

[3]Department of Medicine, Groote Schuur Hospital and University of Cape Town, Cape Town, South Africa

Correspondence
Jean Jacques N. Noubiap, Department of Medicine, Groote Schuur Hospital and University of Cape Town, Observatory, Cape Town, South Africa.
Email: noubiapjj@yahoo.fr

1 | INTRODUCTION

Hypertension is the leading risk factor for cardiovascular disease and deaths worldwide. It is estimated that at least 1 billion adults have hypertension globally, and that every year hypertension is associated with more than 9 million death.[1,2] Low-income countries (LICs) are disproportionally affected, with about one in three adults in these countries being hypertensive.[3] In sub-Saharan Africa, for instance, the prevalence of hypertension has been on a steady rise from 9.7% to 27.4% and 30.8% during the years 1990, 2000, and 2010, respectively.[3] The rising prevalence of hypertension in LICs contrasts with persistently low awareness, treatment, and control rates.

Clinic-based blood pressure (BP) measurement (CBPM) has been the traditional standard for the diagnosis of hypertension and monitoring of response to treatment in clinical practice for decades. However, its limitations in the diagnosis, monitoring of 24-hour BP variations, and prediction of cardiovascular events have led to the development of out-of-office BP monitoring techniques and their use in routine clinical practice in high-income countries. Yet, the potential impact of out-of-office BP measurement in bending the burden of hypertension through improved diagnosis, monitoring, and control remains unknown in LICs.

2 | CLINICAL-BASED BP MEASUREMENT

Even though CBPM is simple and convenient to use, it has some drawbacks including a high rate of patient misclassification attributed to masked or white-coat hypertension (WCH),[4] the inability to obtain serial measurements during a 24-hour period,[5] and a poor correlation with end-organ damage and cardiovascular events.[6] To get around the white-coat effect in clinical practice, it had been suggested to measure BP using the validated automated devices in an isolated room, before the patient gets to the doctor's office.[7] In this light, it was demonstrated that automated devices do not increase the prevalence of WCH.[8,9] Still, CBPM is limited by its inability to determine 24-hour BP, which is a better predictor of end-stage organ damage and cardiovascular events.[10,11]

These limitations of CBPM have led to the development of out-of-office BP monitoring techniques such as 24-hour ambulatory BP monitoring (ABPM) and home BP monitoring (HBPM), even though their use, especially in LICs, has been principally in clinical trials. The superiority of ABPM and HBPM over conventional office BP monitoring in the diagnosis, treatment, evaluation, and prediction of cardiovascular events cannot be overemphasised.[12,13] It has been suggested that for optimal BP control and consequently prevention of cardiovascular events, the BP profile of each hypertensive patient be determined based on 24-hour ABPM or HBPM, and their antihypertensive drug regimen tailored accordingly.[14,15]

3 | ADVANTAGES OF OUT-OF-OFFICE BP MONITORING OVER CBPM

Aside from their ability to record multiple BP values during 24 hours and in the usual environment of every patient,[13] HBPM and ABPM are superior to CBPM in diagnosing WCH and masked hypertension.[11,15,16] Patients with a raised BP value on CBPM but a normal ABPM or HBPM value and who are not taking antihypertensive drugs are said to have WCH.[6] In a recent community-based case-control study in Kenya including 1248 participants, CBPM significantly

overestimated the prevalence of hypertension while missing about half of the participants with true hypertension diagnosed by ABPM.[17] Even though WCH is associated with mild cardiovascular risk, studies have failed to demonstrate a benefit of antihypertensive treatment in preventing cardiovascular events in patients with WCH.[18] Therefore, treatment of this condition is unjustified, except in the context of target organ damage, although regular follow-up is warranted.[18] Thus, out-of-office BP measurement techniques are critical for the identification of patients with WCH who do not need treatment. It therefore prevents unnecessary treatment expenditures in these patients.

Masked hypertension is defined as a normal BP value on CBPM in untreated patients but with an elevated BP value on ABPM. This condition is seen in 10% to 30% of patients considered normotensive on CBPM, reaching 36.3% in patients with prehypertension.[8,19,20] Identification of patients with masked hypertension is important, as it is associated with an elevated cardiovascular risk similar to sustained hypertension.[20] Without an adequate BP measurement technique, the burden of hypertension in individuals with masked hypertension can only increase, as these individuals will remain undiagnosed and untreated and consequently develop a cardiovascular event or end-organ damage in the future. Out-of-office BP monitoring is therefore recommended in patients with a normal BP value on CBPM but with signs of target organ damage such as microalbuminuria, left ventricular hypertrophy, elevated postexertional BP, prehypertension, and occasional BP elevations.[19,20]

Furthermore, ABPM and HBPM are better in assessing efficacy of antihypertensive drugs compared with CBPM.[6,21] Finally, compared with CBPM, the BP values of ABPM and HBPM are reproducible and better correlate with cardiovascular risk, preclinical target organ damage, and cardiovascular events.[10,11,14,22,23] Twenty-four–hour ABPM has the unique role of identifying abnormal nocturnal BP patterns,[24] which is an independent predictor of cardiovascular events.[17,25]

In spite of the aforementioned advantages, the use of out-of-office BP monitoring in LICs is still far below standard, partly because of the cost of monitoring[8,21,24] and a deficiency in knowledge on the pros and cons of these methods. When these methods are employed in the diagnosis and surveillance of hypertension, they are more cost-effective in the long run when compared with CBPM by reducing the number of unnecessary return visits and antihypertensive drugs in chronic users.[18,26,27] In a controlled randomized trial by Soghikian and colleagues,[28] HBPM reduced the cost of hypertension care by 29% compared with CBPM. Also, Fukunaga and colleagues[27] estimated that medical costs could be reduced by $1.53 million per 1000 Japanese patients with mild hypertension per 5 years when HBPM is incorporated into the management of hypertension. Furthermore, Funahashi estimated that $9.3 billion could be saved from hypertension-related cost if HBPM was broadly implemented in Japan.[26] In the same light, researchers have ascertained that ABPM is cost-effective compared with CBPM in the management of hypertension. For instance, Krakoff[29] found that ABPM reduced medical costs in patients with mild hypertension by 3% to 14% when compared with CBPM. Pierdomenico and colleagues[30] reported that when ABPM was used as a secondary diagnostic modality in patients with hypertension, there was an associated savings of $110.819 every 2 years during a 6-year period compared with an annual screening with CBPM.

4 | HOW ABPM AND HBPM DIFFER

Despite the advantages of out-of-office BP measurement listed above, ABPM and HBPM do not produce the same results. In fact, the daytime systolic BP recorded by these methods differ 20% of the time and seems to depend on age and specific antihypertensive treatments.[5] Furthermore, studies have shown that compared with ABPM, HBPM has a lesser efficacy in the diagnosis of WCH and might actually not be void of this condition.[31] In addition, ABPM is the only method capable of recording the asleep BP and short-term BP variability.[20] For these reasons, the European Society of Hypertension released a position paper in 2013 to provide evidence for use of ABPM in clinical practice.[8] This paper recommends ABPM for the diagnosis of WCH and masked hypertension, identification of 24-hour BP pattern, and assessment of antihypertensive treatment.[8,32] Also, in the same year, guidelines from the National Institute for Health and Care Excellence (NICE) recommended that patients with a BP ≥140/90 mm Hg be confirmed with an ABPM.[32]

However, it has been shown that both methods are similar in predicting cardiovascular events and evaluating response to treatment.[11] HBPM is less costly, more available than ABPM, more convenient for patient use, has a similar diagnostic and prognostic power with ABPM, and has greater potential in achieving optimal BP control and treatment compliance in well-informed and cooperative patients.[5] HBPM has therefore been recommended in situations where ABPM is unavailable, is uncomfortable for the patient, or not feasible because of cost.[9] Self-monitoring has been shown to be pivotal in the management of patients with chronic diseases such as diabetes. In fact, self-monitoring of blood glucose helps in diagnosing glycemic extremes, thereby facilitating treatment adjustment to achieve long-term glycated hemoglobin goals.[33] In addition, it reduces morbidity and mortality by permitting patients to immediately confirm glycemic extremes, facilitates patient education, and improves glycemic control in the long run.[33] A wide availability of self–blood glucose monitoring devices at affordable costs has ameliorated the morbidity and mortality rates associated with diabetes in LICs. Based on the aforementioned advantages of HBPM, it seems to be a better alternative to ABPM in the diagnosis and treatment monitoring of patients with hypertension in LICs, and stepping up its use could be crucial in ameliorating the burden of hypertension in these countries.

5 | HOW CAN HBPM BE IMPLEMENTED IN LICS?

When combined with measures to ameliorate patient education on hypertension and improve lifestyle modification and adherence to medications, HBPM stands out as a valuable tool in the treatment

of hypertension.[29,34,35] These measures should therefore be taken into account when implementing HBPM. In 2012, Cacciolati and colleagues[36] conducted a community-based cohort study of 1814 participants to assess the feasibility of HBPM in a group of elderly patients 65 years and older. They found an HBPM success rate of 96% at the start of the study and a 94% success rate after a year of follow-up. In addition, age, low educational status, and autonomy were factors associated with HBPM failure in these individuals. This study suggests that special attention should therefore be paid to individuals with low educational status, which is not uncommon in LICs. The European Society of Hypertension recommends initial screening of out-of-office BP using HBPM, especially when ABPM is not readily available.[8] We suggest that every patient with elevated BP on CBPM or normal BP with signs of target organ damage, occasional BP spikes, and prehypertension on CBPM undergo HBPM for an initial diagnosis of hypertension and treatment surveillance after proper patient counseling. Hypertensive patients whose BP values are difficult to control should be considered for 24-hour ABPM. The governments of LICs in association with nongovernmental organizations should allocate resources to increase the availability of validated automated HBPM devices at affordable costs.

6 | CONCLUSION

Out-of-office BP monitoring has a crucial role to play in the diagnosis, treatment, and monitoring of hypertension and prediction of adverse cardiovascular events. In addition, it is cost-effective in the long run. Even though ABPM has shown superiority over HBPM, HBPM seems to be the preferred method in LICs due principally to its cost-effectiveness, wide availability, ability to increase patient compliance to treatment, and consequently its potential to achieve optimal BP control. HBPM devices should be made available as has been done for self–blood glucose monitoring devices. Scaling up the use of HBPM in association with measures to improve patient education, lifestyle modification, and medication adherence in LICs could be an important strategy to improve hypertension treatment and control in these settings.

COMPETING INTERESTS

The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS

JJNN and VNA conceived the study. VNA drafted the first manuscript. JJNN, VNA, and MNT revised the manuscript for intellectual content. All authors approved the final version of the article.

REFERENCES

1. Lim SS, Vos T, Flaxman AD, et al. A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *Lancet*. 2012;380:2224-2260.
2. A global brief on hypertension: silent killer, global public health crisis. World Health Organization. http://ish-world.com/downloads/pdf/global_brief_hypertension.pdf. Accessed January 16, 2017.
3. Adeloye D, Basquill C. Estimating the prevalence and awareness rates of hypertension in Africa: a systematic analysis. *PLoS One*. 2014;9:e104300.
4. Jin Y, Bies R, Gastonguay MR, Stockbridge N, Gobburu J, Madabushi R. Misclassification and discordance of measured blood pressure from patient's true blood pressure in current clinical practice: a clinical trial simulation case study. *J Pharmacokinet Pharmacodyn*. 2012;39:283-294.
5. Gosse P, Coulon P. Ambulatory or home measurement of blood pressure? *J Clin Hypertens (Greenwich)*. 2009;11:234-237.
6. Verberk WJ, Kroon AA, Kessels AGH, de Leeuw PW. Home blood pressure measurement: a systematic review. *J Am Coll Cardiol*. 2005;46:743-751.
7. Ogedegbe G, Pickering TG, Clemow L, et al. The misdiagnosis of hypertension. *Arch Intern Med*. 2008;168:2459-2465.
8. O'Brien E, Parati G, Stergiou G, et al. European Society of Hypertension position paper on ambulatory blood pressure monitoring. *J Hypertens*. 2013;31:1731-1768.
9. Yano Y, Bakris GL. Recognition and management of masked hypertension: a review and novel approach. *J Am Soc Hypertens*. 2013;7:244-252.
10. Fuchs SC, de Mello RGB, Fuchs FC. Home blood pressure monitoring is better predictor of cardiovascular disease and target organ damage than office blood pressure: a systematic review and meta-analysis. *Curr Cardiol Rep*. 2013;15:413.
11. Bliziotis IA, Destounis A, Stergiou GS. Home versus ambulatory and office blood pressure in predicting target organ damage in hypertension: a systematic review and meta-analysis. *J Hypertens*. 2012;30:1289-1299.
12. Kjeldsen SE, Hedner T, Syvertsen JO, Lund-Johansen P, Hansson L; NORDIL Group. Nordic Diltiazem. Comparison of home and office blood pressure in treated hypertensives in the Nordic Diltiazem (NORDIL) Study. *Blood Press*. 2002;11:371-376.
13. Bonafini S, Fava C. Home blood pressure measurements: advantages and disadvantages compared to office and ambulatory monitoring. *Blood Press*. 2015;24:325-332.
14. International Society for Chronobiology; American Association of Medical Chronobiology and Chronotherapeutics; Spanish Society of Applied Chronobiology, Chronotherapy, and Vascular Risk; Spanish Society of Atherosclerosis; Romanian Society of Internal Medicine, Hermida RC, Smolensky MH, Ayala DE, Portaluppi F. 2013 ambulatory blood pressure monitoring recommendations for the diagnosis of adult hypertension, assessment of cardiovascular and other hypertension-associated risk, and attainment of therapeutic goals. *Chronobiol Int*. 2013;30:355-410.
15. Watanabe Y, Halberg F, Otsuka K, Cornelissen G. Toward a personalized chronotherapy of high blood pressure and a circadian overswing. *Clin Exp Hypertens*. 1993;2013:257-266.
16. Yano Y, Bakris GL. Recognition and management of masked hypertension: a review and novel approach. *J Am Soc Hypertens*. 2012;7:244-252.
17. Etyang AO, Warne B, Kapesa S, Munge K, Bauni E, Cruickshank JK, et al. Clinical and epidemiological implications of 24-hour ambulatory blood pressure monitoring for the diagnosis of hypertension in kenyan adults: a population-based study. *J Am Heart Assoc*. 2016;5:e004797.
18. Pessanha P, Viana M, Ferreira P, Bertoquini S, Polónia J. Diagnostic value and cost-benefit analysis of 24 hours ambulatory blood pressure monitoring in primary care in Portugal. *BMC Cardiovasc Disord*. 2013;13:57.
19. Redmond N, Booth JN, Tanner RM, et al. Prevalence of masked hypertension and its association with subclinical cardiovascular disease in

African Americans: results from the Jackson Heart Study. *J Am Heart Assoc*. 2016;5:e002284.
20. Grossman E. Ambulatory blood pressure monitoring in the diagnosis and management of hypertension. *Diabetes Care*. 2013;36:S307-S311.
21. Billups SJ, Moore LR, Olson KL, Magid DJ. Cost-effectiveness evaluation of a home blood pressure monitoring program. *Am J Manag Care*. 2014;20:e380-e387.
22. Stergiou GS, Siontis KCM, Ioannidis JPA. Home blood pressure as a cardiovascular outcome predictor: it's time to take this method seriously. *Hypertens*. 1979;2010:1301-1303.
23. Verberk WJ, Kroon AA, Jongen-Vancraybex HA, de Leeuw PW. The applicability of home blood pressure measurement in clinical practice: a review of literature. *Vasc Health Risk Manag*. 2007;3:959-966.
24. Giorgini P, Weder AB, Jackson EA, Brook RD. A review of blood pressure measurement protocols among hypertension trials: implications for "evidence-based" clinical practice. *J Am Soc Hypertens*. 2014;8:670-676.
25. Kollias A, Stergiou GS, Dolan E, O'Brien E. Ambulatory arterial stiffness index: a systematic review and meta-analysis. *Atherosclerosis*. 2012;224:291-301.
26. Funahashi J, Ohkubo T, Fukunaga H, et al. The economic impact of the introduction of home blood pressure measurement for the diagnosis and treatment of hypertension. *Blood Press Monit*. 2006;11:257-267.
27. Fukunaga H, Ohkubo T, Kobayashi M, et al. Cost-effectiveness of the introduction of home blood pressure measurement in patients with office hypertension. *J Hypertens*. 2008;26:685-690.
28. Soghikian K, Casper SM, Fireman BH, et al. Home blood pressure monitoring. Effect on use of medical services and medical care costs. *Med Care*. 1992;30:855-865.
29. Krakoff LR. Home blood pressure for the management of hypertension: will it become the new standard of practice? *Expert Rev Cardiovasc Ther*. 2011;9:745-751.
30. Pierdomenico SD, Mezzetti A, Lapenna D, et al. "White-coat" hypertension in patients with newly diagnosed hypertension: evaluation of prevalence by ambulatory monitoring and impact on cost of health care. *Eur Heart J*. 1995;16:692-697.
31. Hond ED, Celis H, Fagard R, et al. Self-measured versus ambulatory blood pressure in the diagnosis of hypertension. *J Hypertens*. 2003;21:717-722.
32. Katalin M, Corina U, Zsuzsanna J. Ambulatory blood pressure monitoring—clinical practice recommendations. *Acta Medica Marisiensis*. 2016;62:350-355.
33. Klonoff DC. Benefits and Limitations of self-monitoring of blood glucose. *J Diabetes Sci Technol*. 2007;1:130-132.
34. Abdullah A, Othman S. The influence of self-owned home blood pressure monitoring (HBPM) on primary care patients with hypertension: a qualitative study. *BMC Fam Pract*. 2011;12:143.
35. Milot JP, Birnbaum L, Larochelle P, et al. Unreliability of home blood pressure measurement and the effect of a patient-oriented intervention. *Can J Cardiol*. 2015;31:658-663.
36. Cacciolati C, Tzourio C, Dufouil C, Alpérovitch A, Hanon O. Feasibility of home blood pressure measurement in elderly individuals: cross-sectional analysis of a population-based sample. *Am J Hypertens*. 2012;25:1279-1285.

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