Out-of-clinic blood pressure testing in primary care

Out-of-clinic blood pressure monitoring is increasingly regarded as a routine component of cardiovascular risk management. This is because it is a better predictor of cardiovascular events and mortality than clinic-based measurements. General practices that use this technique can provide patients with more accurate cardiovascular risk assessments and help them to make better decisions about their health. Prescribers are also able to titrate blood pressure treatment regimens more accurately using out-of-clinic measurements than if management was guided solely by clinic-based blood pressure assessments. Only validated devices are recommended for the measurement of blood pressure.

KEY PRACTICE POINTS:

- Out-of-clinic blood pressure measurements more accurately reflect a patient's true blood pressure than do clinic-based measurements and improve the quality of shared management decisions
- Consider out-of-clinic blood pressure testing to "rule-out" the possibility of white-coat hypertension before initiating antihypertensive treatment
- Out-of-clinic blood pressure testing can be used to more accurately guide management once antihypertensive treatment has been initiated
- Consider out-of-clinic blood pressure testing for patients with low cardiovascular risk, e.g. younger patients, where there is a clinical suspicion of masked hypertension

Out-of-clinic blood pressure testing includes 24-hour ambulatory testing, where the patient wears an automated device, as well as home-based measurements performed by the patient. Ambulatory blood pressure monitoring is available as an outpatient test by DHBs, privately by some cardiologists or devices may be purchased by general practices. Home blood pressure testing devices are relatively inexpensive and validated devices can be purchased by patients or practices.

Part 1: Should out-of-clinic blood pressure monitoring be a routine component of cardiovascular risk management?

Elevated blood pressure is perhaps the most common modifiable risk factor for cardiovascular and kidney disease encountered by general practitioners and practice nurses. Patients with increased blood pressure are at higher risk of stroke, myocardial infarction, heart failure, atrial fibrillation, kidney disease and cognitive decline.[1] An elevated systolic blood pressure has been calculated to account for almost two-thirds (62%) of an individual's stroke risk and half (49%) of their risk for coronary heart disease.[2]

A survey of New Zealand adults found that a significant number of people were taking antihypertensive medicines or had a systolic blood pressure that was ≥ 140 mmHg or a diastolic blood pressure ≥ 90 mmHg, i.e. the diagnostic criteria for hypertension.[3] With advancing age these numbers rise to almost 70% of males and 80% of females aged over 70 years.[3] Hypertension is more prevalent in New Zealand adult Māori males (36%) than males of Pacific (29%) or New Zealand European ancestry (28%).[3] In New Zealand adult females, hypertension is also more common among Māori (30%) and less common in those of New Zealand European ancestry (21%).[3]

Out-of-clinic testing increases the accuracy of blood pressure measurements

Once begun, antihypertensive treatment is generally life-long and often involves multiple medicines, thereby increasing the prevalence of polypharmacy and the risk of adverse effects. It is therefore important that treatment decisions for blood pressure are based on the best available information.

Clinic-based measurements often over-estimate blood pressure

Out-of-clinic blood pressure assessments can provide patients and clinicians with increased confidence that pharmacological treatment for elevated blood pressure is appropriate. This is because clinic-based measurements tend to over-estimate a patient's blood pressure (see: "Blood pressures vary depending on when and where measurements are taken").

In a group of 200 patients in the United Kingdom, blood pressure measurements were taken in primary care. The systolic blood pressure measured in the clinic was found to be on average 19 mmHg higher and the diastolic blood pressure 11 mmHg higher than that calculated by ambulatory measurements over a twenty-four hour period.[4]

The benefits of out-of-clinic blood pressure testing include:[5]

- A large number of reproducible measurements are recorded that are not affected by the presence of a health professional or the clinical setting
- The results of out-of-clinic blood pressure testing more accurately reflect the patient's day-to-day blood pressure than clinic measurements[6]
- Out-of-clinic blood pressure testing is more reliable at predicting cardiovascular morbidity and mortality
- Patients are provided with more accurate risk estimates upon which they can decide how to manage their health
- A reduction in the over and under-treatment of elevated blood pressure

Improving cardiovascular risk assessment

The intensity of cardiovascular interventions should be proportional to a patient's cardiovascular risk.[7] Cardiovascular risk assessments that incorporate out-of-clinic blood pressure measurements provide a better starting point for discussions about lifestyle and, where appropriate, pharmacological treatment, than do risk assessments based solely on clinic-based measurements. Out-of-clinic blood pressure testing also allows clinicians to more accurately assess blood pressure in patients who they suspect of being at increased cardiovascular risk, e.g. a young Māori adult with a strong family history of chronic kidney disease.

Calculating cardiovascular risk from out-of-clinic blood pressure measurements

Current cardiovascular risk prediction models are based on clinic-based blood pressure measurements. This can be problematic for clinicians using out-of-clinic blood pressure measurements with cardiovascular risk calculators, as out-of-clinic blood pressures are generally lower than clinic-based measurements and it has been suggested that clinicians adjust for this. There is little evidence to guide this practice, however, an Australian group of experts recommends adding 5 mmHg to systolic and diastolic measurements.[5]

Detecting white-coat hypertension

Out-of-clinic blood pressure testing can reduce inappropriate blood pressure treatment by detecting patients with white-coat hypertension. White-coat hypertension occurs when a patient with otherwise normal blood pressure has elevated blood pressure due to the anxiety associated with measurement in a clinical setting.

White-coat hypertension occurs in 13% of the general population,[5] and is more common in females and in people who do not smoke.[8] As many as one-third of adult patients diagnosed with hypertension, using clinic-based measurements, can be

expected to have normal blood pressure on reassessment with out-of-clinic testing.[5]

Patients with white-coat hypertension are recommended to have annual blood pressure assessments, depending on their cardiovascular risk,[5] and regular HbA_{1c} measurements.[8] These patients are at increased risk of left ventricular hypertrophy and type 2 diabetes,[8] largely due to metabolic abnormalities, e.g. impaired glucose metabolism and elevated body mass index (BMI).[9]

Detecting masked hypertension

Masked hypertension is the reverse of white-coat hypertension and occurs when out-of-clinic blood pressure measurements are ≥ 135/85 mmHg and clinic-based measurements are < 140/90 mmHg.[10] People with masked hypertension often have subclinical cardiovascular disease.[8]

The prevalence of masked hypertension is reported to be between 10 and 17% of the general population, up to 29% of people with untreated diabetes and as many as half of people with treated hypertension or exercise hypertension may have masked hypertension.[5]

Clinical suspicion of masked hypertension should be increased in any patient with normal blood pressure in the clinic but with a family history of early-onset cardiovascular disease, e.g. onset prior to age 60 years, or evidence of target organ damage on investigation consistent with hypertension,[5] e.g.:

- Albuminuria or proteinuria
- Left ventricular hypertrophy
- Peripheral artery disease
- Retinal haemorrhage

Using out-of-clinic monitoring to guide treatment for hypertension

Out-of-clinic monitoring can be used to titrate doses of antihypertensive medicines, once treatment has been initiated, in patients who are confirmed to be adherent to treatment.

Blood pressures vary depending on when and where measurements are taken

Hypertension in adults is generally defined as a clinic-based systolic blood measurement that is ≥ 140 mmHg and/or a diastolic blood pressure measurement ≥ 90 mmHg.[1,6] With advancing age, however, increasing arterial stiffness and decreased peripheral resistance mean that diastolic pressure cut-offs are not recommended when diagnosing hypertension in older patients.[13]

Single measurements of blood pressure are often taken in primary care due to time pressures. However, it is recommended that when clinic blood pressure measurements are used to calculate a patient's cardiovascular risk that the average of two seated measurements be taken,[7] at least two minutes apart, ideally from both arms.

As clinic-based blood pressure measurements are generally higher than out-of-clinic measurements a lower threshold is used to stratify blood pressure with ambulatory or home-based testing (Table 1).[6]

Table 1: Definitions of hypertension by measurement method[1,6]

Measurement method	Systolic (mmHg)		Diastolic (mmHg)
Clinic	≥ 140	and/or	≥ 90
Ambulatory			
▪ Daytime or awake	≥ 135	and/or	≥ 85
▪ Night-time or asleep	≥ 120	and/or	≥ 70
▪ 24-hour	≥ 130	and/or	≥ 80
Home-based	≥ 135	and/or	≥ 85

A pharmacist-led study of 348 patients who were randomised to receive home-monitoring of blood pressure or usual care reported that significantly more patients (54%) who received home-monitoring achieved treatment goals compared to patients receiving usual care (35%).[11] Furthermore, the patients who undertook home monitoring of blood pressure achieved, on average, 12 mmHg larger reductions in systolic blood pressure and 6 mmHg larger reductions in diastolic pressure, compared with patients receiving usual care.[11] Patients who participated in home-monitoring received more intensive treatment for hypertension.[11] Patient satisfaction with treatment, on average, was higher among those who participated in home-monitoring compared with patients who received usual care.[11]

Investigating treatment resistant hypertension

Resistant hypertension can have a variety of causes such as excessive alcohol consumption, high sodium intake, underlying endocrine disorders, or pseudohypertension, i.e. elevated blood pressure readings caused by arterial incompressibility due to atherosclerosis. Out-of-clinic blood pressure testing can confirm the presence of sustained elevations in blood pressure in patients who are confirmed to be adherent to treatment, thus signifying the need for further investigation.

Pseudohypertension should be considered in older patients who appear to have treatment resistant hypertension but develop symptoms consistent with hypotension with increasing doses of antihypertensive medicine. Osler's manoeuvre has been proposed to detect pseudohypertension. If the patient's radial artery is firm on palpation, despite the blood pressure cuff being above systolic pressure, this is a positive Osler's manoeuvre which is suggestive of pseudohypertension. However, the ability of Osler's manoeuvre to detect pseudohypertension in clinical practice is poor.[12]

For information on the management of elevated blood pressure see: "Hypertension in adults: The silent killer", BPJ 54 (Aug, 2013).

Part 2: How to perform out-of-clinic blood pressure testing

Patient education is essential before using out-of-clinic of blood pressure testing. The procedure should be explained to patients, training with the device provided and written instructions given for the patient to take away.

The auscultatory method of determining blood pressure is preferred in patients with unstable atrial fibrillation as variations in ventricular filling time, stroke volume and contractility may result in blood pressure variability.[14] Some automated blood pressure monitoring devices, however, are able to detect the presence of atrial fibrillation and these appear to have a high level of accuracy.[14]

Deciding whether to use ambulatory or home monitoring of blood pressure testing

Ambulatory blood pressure testing is considered to be the gold standard for confirming elevated blood pressure,[1] and detecting white-coat or masked hypertension.[5] Studies also report that left ventricular hypertrophy and carotid arterial wall thickness and other markers of organ damage correlate more closely with elevated ambulatory blood pressure than clinic-based measurements.[6] Ambulatory blood pressure testing is subject to variability, however, like other techniques for blood pressure testing.

Home-based testing of blood pressure is recommended when ambulatory blood pressure testing is not available.[5] Home-based testing also has several advantages, compared to ambulatory blood pressure testing (Table 2).

Table 2: Comparison between 24-hour ambulatory and home-based blood pressure testing[5, 15]

24-hour ambulatory blood-pressure is able to detect	The advantages of home-based blood pressure testing
■ Surges in morning blood pressure ■ Short-term variations in blood pressure	■ Better tolerated by patients ■ Home-monitoring devices cost less than ambulatory devices ■ Increasing patient engagement resulting in improved motivation and adherence to treatment

How to perform ambulatory blood pressure testing

Ambulatory blood pressure devices are normally worn for 24 hours on a belt or in a pouch with a tube connecting to a sphygmomanometer on the patient's dominant upper arm.[6] Blood pressure measurements are taken at regular intervals, often every fifteen minutes during the day and every 30 minutes overnight.[6] Patients are asked to wear the device during a normal day, but to refrain from strenuous exercise, and, when the cuff is inflated to stop moving and talking and to keep their arm still with the cuff at the level of the heart (see below).[6] The height of the cuff is especially important if it necessary to use a device with a wrist cuff. The patient should note any events that might affect their blood pressure as well as meals, medicines, rising and going to bed and any symptoms they might experience, e.g. dizziness.[6]

How to perform home-based blood pressure testing

Home blood pressure testing involves patients measuring their own blood pressure in their home, with the direction of a health professional. Advise patients to take measurements at approximately the same time in the morning and evening, over the course of a week.

The optimal conditions for home blood pressure measurements are a quiet room, following five minutes of seated rest, with the patient's feet flat on the floor, legs uncrossed, upper arm bare, back and arm supported in a relaxed position with the cuff at heart level.[5] Advise patients to take measurements after voiding and before any medicines, food or vigorous exercise.[5] Caffeine and tobacco smoke can increase blood pressure and measurements are best at least 30 minutes before or after these stimulants.[5] Two consecutive measurements for systolic and diastolic pressure should be recorded, one minute apart. Patients should note anything that may affect blood readings, e.g. a poor night's sleep.

If orthostatic hypotension is suspected request that patients perform a baseline recording and then two blood pressure measurements 1 minute and 3 minutes after standing.[5]

Blood pressure measurements should not be taken when patients are:[5]

- Stressed
- Uncomfortable
- In pain
- Affected by extremes of temperature, e.g. in a poorly heated home during winter

Which devices can be used to take out-of-clinic measurements?

Only validated devices (see below) should be used to measure out-of-clinic blood pressure. Devices for home monitoring will ideally have:[5]

- Automatic inflation
- Memory storage to eliminate recording errors
- An appropriate cuff size for the patient; a cuff that is too small will overestimate blood pressure and a cuff that is too large will underestimate blood pressure

Devices which measure blood pressure at the brachial artery are considered to be more reliable than those which record at the patient's wrist or finger.[5] It may be necessary to use a validated wrist device if the patient has a large arm circumference.[5]

Mobile phone apps are available that claim to be able to measure blood pressure without the use of a blood pressure cuff. These apps are not validated and are not recommended for the diagnosis or management of hypertension.[16]

Home-monitoring blood pressure devices validated for use by the British Hypertension Society can be purchased from: **www.omronhealthcare.co.nz**. Different cuff sizes are available and devices will typically alert users if measurements are usable or need to be repeated. The devices provide an average for the last three readings taken within a ten minute period. 24-hour ambulatory devices also validated by the British Hypertension Society can be purchased from: **online.ebos.co.nz**

The possible adverse effects of out-of-clinic blood pressure testing

Home blood pressure testing may cause adverse responses in some patients. For example, patients with elevated blood pressure may become anxious due to continually high readings which may adversely affect subsequent readings. Other patients may become obsessed with their blood pressure and take an excessive number of recordings. There is also the possibility that some patients may adjust their treatment regimen in response to readings without consulting with a health professional.[8] The high cuff pressure may cause discomfort for patients with either undiagnosed severe hypertension or severe hypertension that is resistant to treatment.

Conclusion

There is increasing recognition internationally that out-of-clinic blood pressure monitoring has an important role to play in guiding the management of elevated blood pressure.[1,6] Health professionals who adopt this technique are likely to reduce over-treatment and promote shared decision making with patients. As life expectancy increases and there is more focus on individualised care, it is only a matter of time before out-of-clinic blood pressure monitoring becomes a routine part of primary care.

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