Ontario
Health Quality Ontario
Qualité des services de santé Ontario

OHTAC Recommendation: Twenty-Four-Hour Ambulatory Blood Pressure Monitoring in Hypertension

Ontario Health Technology Advisory Committee

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Background

Hypertension in Canada

Hypertension occurs when either systolic blood pressure (SBP), the pressure in the arteries when the heart contracts, or diastolic blood pressure (DBP), the pressure in the arteries when the heart relaxes between beats, are consistently high. Blood pressure that is consistently more than 140/90 mmHg (systolic/or diastolic) is considered high.

Because high blood pressure (hypertension) has no symptoms, it can go undiagnosed and untreated. Hypertension is a serious condition. If untreated, it can cause damage to the heart, blood vessels, kidneys, and other parts of the body, and lead to coronary heart disease, heart failure, and stroke.

Blood pressure (antihypertensive) medications are used to control and treat hypertension. The majority of hypertensive patients will require 2 or more antihypertensive medications to effectively treat and control their high blood pressure.

In Canada in 2006/2007, 22.7% of adult Canadians were living with diagnosed hypertension. The overall public health goal is to treat and manage patients with hypertension in order to avoid the adverse, long-term effects of this condition. The costs to the health care system related to the diagnosis, treatment, and management of hypertension were over $2.3 billion (Cdn) in Canada in 2003.

The 24-hour ambulatory blood pressure monitoring (ABPM) device consists of a standard, inflatable cuff attached to a small computer weighing about 500 grams. The technology is noninvasive and fully automated. The device takes blood pressure measurements every 15 to 30 minutes over 24 to 28 hours, thus providing extended, continuous blood pressure recordings even during a patient's normal, daily activities. Information on the multiple blood pressure measurements are downloaded to a computer for interpretation.

The ABPM device avoids 2 of the pitfalls of conventional (in-clinic) blood pressure measurement (CBPM), which uses a cuff and mercury sphygmomanometer:

- observer bias (the phenomenon of measurement error when the observer overemphasizes the expected results), and
- white coat hypertension (the phenomenon of blood pressure being high when measured in the office or clinic, but normal when measured outside of the medical setting).

OHTAC Findings

The research questions of the Health Quality Ontario evaluation were:

1. Is there a difference in patient outcome and treatment protocol when using 24-hour ABPM versus CBPM for uncomplicated hypertension?
   Is there a difference between the 2 technologies when white coat hypertension is taken into account?
2. What is the cost-effectiveness and budget impact of 24-hour AMBP versus CBPM for uncomplicated hypertension?

The OHTAC Recommendation that "*for diagnosed patients in whom there is clinical suspicion for white coat hypertension (i.e., ongoing discrepancy between in-clinic blood pressure and nonclinic measured blood pressure, 24-hour ABPM should be made available"* was based on a review of the clinical and economic evidence.

The recommendations support the following beneficial effects of 24-hour ABPM:

- improved blood pressure control compared to CBPM;
- reduced risk of cardiovascular events compared to CBPM;
- no increased adverse events; and
- cost-effectiveness and cost-savings to the health care system.

The evidence-based analysis was able to build upon previous work, which did not widely recommend the technology or concluded that there was insufficient evidence to draw a conclusion. This includes previous work conducted by the National Institute for Health and Clinical Excellence (NICE) in the United Kingdom. and by the Agency for Healthcare Research and Quality (AHRQ) in the United States. Specifically, the beneficial effect on cardiovascular events which was based on 1 randomized controlled trial introduced a postrandomization selection bias by excluding white coat hypertensives in only the 24-hour ABPM group. From a methodological standpoint, the comparison of the intervention and the control group in our analysis produced a conservative estimate of effect. A potential increased beneficial effect on cardiovascular events would have been detected had the study design not been biased. From a clinical standpoint, 24-hour ABPM demonstrated an ability to remove patients with white coat hypertension from further study. This is because in patients who were found to be hypertensive using CBPM at the time of entry into the study, 22% of patients randomized to the ABPM group were subsequently found to have a normal blood pressure using 24-hour ABPM and were dropped from the study. Under real world conditions, the use of a 24-hour ABPM device would reduce inappropriate treatment of patients with white coat hypertension.

Twenty-four-hour ABPM is cost-effective and results in cost-savings to the health care system based on external and internal studies. Through consultation with clinical experts, it is anticipated that routine use of 24-hour ABPM would result in 2 fewer in-office physician visits over 6 months, as related to hypertension diagnosis or monitoring, when compared to CBPM. As a result, it is anticipated there would be savings in physician costs of about $44 (Cdn) per patient over the first 6 months (i.e., initial diagnosis and repeated blood pressure measurements). There would be a corresponding increase in the cost for the device of approximately $30 (Cdn) to $69 (Cdn) per test (estimated here as 1 test per patient per 12 months). Note that the device cost per test depends on the volume of tests performed (i.e., $30 (Cdn) per test could only be achieved by a high-volume testing centre). Currently, these devices are not insured in Ontario. Patients who have been referred by their family physician to use this technology tend to pay approximately $40 (Cdn) to $70 (Cdn) for use of the device.

The incremental cost-effectiveness ratio of 24-hour ABPM compared to CBPM is approximately $30 (Cdn) per quality-adjusted life year if the test is provided to patients only when their blood pressure measurements are raised or not in control. If the test is given once annually to all patients suspected of having hypertension, the incremental cost-effectiveness ratio is approximately $4,160 (Cdn) per quality-adjusted life year. In both scenarios, 24-hour ABPM is found to be cost-effective. The budget impact in Ontario over the next 5 years (i.e., FY2011 to FY2015) of providing 24-hour ABPM to patients only for elevated blood pressure readings, or when blood pressure is not in control, is a cost savings of about $19 million (Cdn) per year. However, if the test is given once annually to anyone suspected of having hypertension, the budget impact is an additional $37 million (Cdn) per year.

Short-Term Follow-Up Studies (Length of Follow-Up Less Than or Equal to 1 Year)

- Based on very low quality of evidence, there is no difference between the 2 technologies for nonfatal cardiovascular events.
- Based on moderate quality of evidence, ABPM resulted in improved blood pressure control among sustained hypertensives compared to CBPM.
- Based on low quality of evidence, ABPM resulted in hypertensive patients being more likely to stop antihypertensive therapy and being less likely to proceed to multi-drug therapy compared to CBPM.
- Based on low quality of evidence, there is a beneficial effect of ABPM on the intensity of antihypertensive drug use compared to CBPM.
- Based on moderate quality of evidence, there is no difference between the 2 technologies in the number of antihypertensive drugs used.
- Based on low to very low quality of evidence, there is no difference between the 2 technologies in the risk of a drug-related adverse event or a noncardiovascular event.

Long-Term Follow-Up Study (Mean Length of Follow-Up of 5 Years)

- Based on moderate quality of evidence, there is a beneficial effect of ABPM on total combined cardiovascular events compared to CBPM.
- Based on low quality of evidence, there is a lack of a beneficial effect of ABPM on nonfatal cardiovascular events compared to CBPM; however, the lack of a beneficial effect is based on a borderline result.
- Based on low quality of evidence, there is no beneficial effect of ABPM on fatal cardiovascular events compared to CBPM.
- Based on low quality of evidence, there is no difference between the 2 technologies for the number of patients who began multi-drug therapy.
- Based on low quality of evidence, there is a beneficial effect of CBPM on control of blood pressure compared to ABPM. This result is in the opposite direction than expected.
- Based on moderate quality of evidence, there is no difference between the 2 technologies in the risk of a drug-related adverse event.

Decision Determinants

A decision-making framework has been developed by OHTAC that consists of 7 guiding principles for decision making, as well as a decision-making tool called the Decision Determinants (DD) tool. The framework includes the evaluation of 4 explicit main criteria (overall clinical benefit, value for money, feasibility of adoption into health system, and consistency with expected societal and ethical values). For more information on the Decision-Making Framework, please visit: http://www.hqontario.ca/en/mas/tech/pdfs/2011/guide_decision.pdf and http://www.hqontario.ca/en/mas/ohtac_decision_frame.html.

Table 1: Decision Determinants Criteria Considerations for Twenty-Four-Hour Ambulatory Blood Pressure Monitoring—Short Term Studies (Less Than or Equal to One Year)

Decision Criteria	Sub-Criteria	Considerations and Questions for OHTAC to Consider
Overall Clinical Benefit	**Effectiveness**	**What is the effectiveness, cost-effectiveness, and safety of 24-hour ABPM compared with CBPM for uncomplicated hypertension?** **Patient Outcomes** • nonfatal cardiovascular events—**no statistically significant difference** (RR, 0.84; 95% CI, 0.23–3.07) • (VERY LOW QUALITY) (2 RCTs) (n = 555) • noncardiovascular events—**no statistically significant difference** (RR, 1.74; 95% CI; 0.42–7.20) (VERY LOW QUALITY) (2 RCTs) (n = 555) • control of blood pressure—**statistically significant** increased likelihood for ABPM (RR, 1.72; 95% CI, 1.18–2.52) (MODERATE QUALITY) (1 RCT) (n = 136) **Drug-Related Outcomes** • stopping therapy—**statistically significant** increased likelihood for ABPM (RR, 3.61; 95% CI, 2.11–6.18) (LOW QUALITY) (1 RCT) (n = 419) • need for multi-drug therapy—**statistically significant** increased risk for CBPM (RR, 1.57; 95% CI, 1.20–2.06) (LOW QUALITY) (1 RCT) (n = 419) • number of drugs used—**no statistically significant difference** (MD, 0.19; 95% CI, −0.15 to 0.53) (MODERATE QUALITY) (1 RCT) (n = 136)

Decision Criteria	Sub-Criteria	Considerations and Questions for OHTAC to Consider
		• intense drug therapy—**statistically significant** increased risk for CBPM (MD, 0.34; 95% CI, 0.20–0.48) (LOW QUALITY) (1 RCT) (n = 419)
	Safety	• drug-related adverse events—**no statistically significant difference** (RR, 0.63; 95% CI, 0.29–1.38) (LOW QUALITY) (2 RCTs) (n = 555) • Discomfort from the cuff
	Burden of Illness	In 2006/2007, 22.7% of adult Canadians were living with diagnosed hypertension.
	Need	The alternative is CBPM.
Consistency With Expected Societal/Ethical Values	**Expected Societal Values**	Unknown
	Expected Ethical Values	Unknown
Value for Money	**Economic Evaluation and Feasibility**	The cost-effectiveness of providing 24-hour ABPM to patients only when their blood pressure measurement is raised or not in control is $30 (Cdn) per QALY. If 24-hour ABPM is provided to any patient suspected of having hypertension, but limited to testing once annually, the cost-effectiveness is $4,160 (Cdn) per QALY. Both strategies are cost-effective.
Feasibility of Adoption into Health System	**Organizational Feasibility**	By providing 24-hour ABPM to patients only when their blood pressure measurement is raised or not in control, it is anticipated the Ministry of Health and Long-Term Care will *save* an average of $19 million (Cdn) per year for the next 5 years. However, if 24-hour ABPM testing is provided annually to any patient suspected of having hypertension, the *additional* costs to the Ministry would be about $37 million (Cdn) per year over the next 5 years.

Abbreviations: ABPM, ambulatory blood pressure monitoring; CBPM, conventional (in-clinic) blood pressure measurement; CI, confidence interval; MD, mean difference; QALY, quality-adjusted life years; RCT, randomized controlled trial; RR, relative risk.

Table 2: Decision Determinants Criteria Considerations for Twenty-Four-Hour Ambulatory Blood Pressure Monitoring—Long-Term Study (Longer Than One Year)

Decision Criteria	Sub-Criteria	Considerations and Questions for OHTAC to Consider
Overall Clinical Benefit	**Effectiveness**	**What is the effectiveness, cost-effectiveness, and safety of 24-hour ABPM compared with CBPM for uncomplicated hypertension?** **Patient Outcomes** • total combined cardiovascular events—**statistically significant** increased risk for CBPM (RR, 1.76; 95% CI, 1.03–3.02) (MODERATE QUALITY) (1 RCT) (n = 1,298)

Decision Criteria	Sub-Criteria	Considerations and Questions for OHTAC to Consider
		• fatal cardiovascular events—**no statistically significant difference** (RR, 1.01; 95% CI, 0.33–3.10) (LOW QUALITY) (1 RCT) (n = 1,298) • nonfatal cardiovascular events—**nonsignificant** increased risk for CBPM (LOW QUALITY) (1 RCT) (n = 1,298) • control of blood pressure—**statistically significant** increased likelihood for CBPM (RR, 0.90; 95% CI, 0.81–0.99) (LOW QUALITY) (1 RCT) (n = 1,298) **Drug-Related Outcomes** • need for multi-drug therapy—**no statistically significant difference** (RR, 1.01; 95% CI, 0.86–1.19) (LOW QUALITY) (1 RCT) (n = 1,298)
	Safety	• drug-related adverse events—**no statistically significant difference** (RR, 0.87; 95% CI, 0.58–1.32) (MODERATE QUALITY) (1 RCT) (n = 1,298) • discomfort from the cuff
	Burden of Illness	In 2006/2007, 22.7% of adult Canadians were living with diagnosed hypertension.
	Need	The alternative is CBPM.
Consistency with Expected Societal/ Ethical Values	**Expected Societal Values**	Unknown
	Expected Ethical Values	Unknown
Value for Money	**Economic Evaluation and Feasibility**	The cost-effectiveness of providing 24-hour ABPM to patients only when their blood pressure measurement is raised or not in control is $30 (Cdn) per QALY. If 24-hour ABPM is provided to any patient suspected of having hypertension, but limited to testing once annually, the cost-effectiveness is $4,160 (Cdn) per QALY. Both strategies are cost-effective.
Feasibility of Adoption into Health System	**Organizational Feasibility**	By providing 24-hour ABPM to patients only when their blood pressure measurement is raised or not in control, it is anticipated that the Ministry of Health and Long-Term Care will *save* an average of $19 million (Cdn) per year for the next 5 years. However, if 24-hour ABPM testing is provided annually to any patient suspected of having hypertension, the *additional* costs to the Ministry would be about $37 million (Cdn) per year over the next 5 years.

Abbreviations: ABPM, ambulatory blood pressure monitoring; CBPM, conventional (in-clinic) blood pressure measurement; CI, confidence interval; MD, mean difference; QALY, quality-adjusted life years; RCT, randomized controlled trial; RR, relative risk.

OHTAC Recommendations

In considering the above ratings, OHTAC weighted in favour of recommending 24-hour ABPM in light of improved blood pressure control compared to CBPM (moderate quality), reduced risk of cardiovascular events compared to CBPM (moderate quality), no increased adverse events (up to moderate quality), and cost-effectiveness and cost-savings to the health care system.

Therefore, the OHTAC recommendations were the following:

- Current use of CBPM should be optimal and in accordance with established guidelines.
- For diagnosed patients in whom there is clinical suspicion for white coat hypertension (i.e., ongoing discrepancy between in-clinic blood pressure and nonclinic measured blood pressure), 24-hour ABPM should be made available.
- Adequate education, training, and quality assurance of the optimal use of the ABPM device is required for clinical and technical personnel, and for patients. To achieve this, the technology should be made available only in health care clinics with teams or facilities with expertise in hypertension.