



## Optimal automated unobserved office blood pressure protocol: only 6-minutes and two readings may be needed.

Myles N. Moore<sup>1</sup>, Andrew Black<sup>2</sup>, Nathan Dwyer<sup>2</sup>, Ella Hoban<sup>1</sup>, Mark Nelson<sup>1</sup>, Dean S. Picone<sup>1</sup>, Martin G. Schultz<sup>1</sup>, Panagiota Veloudi<sup>1</sup>, James E. Sharman<sup>1</sup>

<sup>1</sup>Menzies Institute for Medical Research, University of Tasmania, Hobart, AUSTRALIA <sup>2</sup>Royal Hobart Hospital, Hobart, Australia



### Introduction & Aims

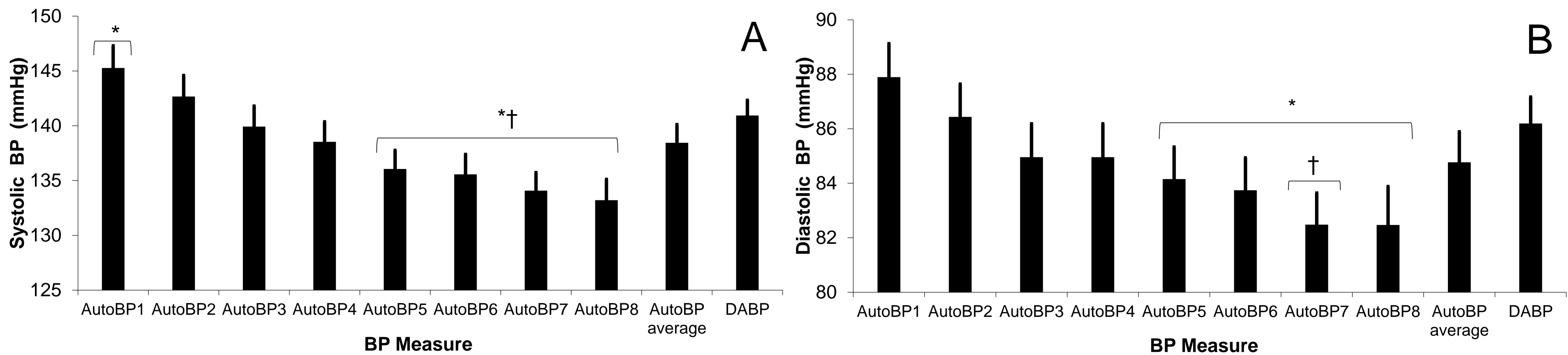
- Blood pressure (BP) assessments through traditional clinic BP measures may provide misleading results with regard to BP control.
- Automated office BP (AutoBP) is an alternative method to determine BP control that is recommended by international BP guidelines.<sup>1,2</sup>
- There is variability among AutoBP protocols regarding the number of measures (e.g. 3 to 8) and measurement duration (e.g. 5 to 30 minutes) and the best AutoBP protocol is unknown.
- This study aimed to identify the optimal AutoBP protocol to determine BP control in the shortest duration with the fewest readings.

### Methods

- 117 participants with uncontrolled hypertension were referred to a specialist BP clinic, and underwent both AutoBP and 24-hour Ambulatory BP (ABP) measures.
- AutoBP was measured with in a quiet room with the participant alone in the room. Eight BP measures were taken at 2-minute intervals (total 15-minute protocol).
- The same BP device (Mobil-o-graph, IEM) was used for both AutoBP and 24-hour ABP.
- Concordance was examined between AutoBP and daytime ABP.
- Intra-class correlation coefficient (ICC) and Bland-Altman plots assessed the agreement between AutoBP and daytime ABP.
- Hypertension threshold was defined as systolic daytime ABP  $\geq 135$  mmHg and/or diastolic daytime ABP  $\geq 85$  mmHg, and AutoBP hypertension at three varying thresholds:  $\geq 140/\geq 90$  mmHg,  $\geq 135/\geq 85$  mmHg and  $\geq 130/\geq 80$  mmHg.
- The most concordant AutoBP defined the 'optimal AutoBP protocol' using a combination of all methods including smallest mean difference, and highest ICC, area under the receiver-operator characteristic curve (AUC), sensitivity (true positive rate for detecting hypertension) and specificity (true negative rate for detecting hypertension).

### Results

- Participants were aged  $61.5 \pm 12.5$  years, 53% female, with a BMI of  $29.6 \pm 5.6$  kg/m<sup>2</sup>. Most were on one or more antihypertensive and/or lipid lowering medication (89%). 53% had never smoked.



**Figure 1: Systolic (A) and diastolic blood pressure (BP; B) over the 15-minute automated office BP (AutoBP) protocol comparing eight measures, and 15-minute AutoBP average to daytime ambulatory BP (DABP). Data represented as mean  $\pm$  standard error of the mean; \*, denotes  $p < 0.05$  compared with DABP; †, denotes  $p < 0.05$  compared with AutoBP1.**

**Table 1: Comparing concordance of varying AutoBP protocols to daytime ABP (n=117).**

AutoBP measures	Systolic daytime ABP (hypertension $\geq 135$ mmHg)			Diastolic daytime ABP (hypertension $\geq 85$ mmHg)		
	Mean difference (mmHg); p-value	ICC (95% CI)	AUC	Mean difference (mmHg); p-value	ICC (95% CI)	AUC
AutoBP 1	4.6 $\pm$ 20.7; 0.02	0.567 (0.378, 0.698)	0.721 $\pm$ 0.048	1.7 $\pm$ 11.1; 0.10	0.727 (0.607, 0.811)	0.775 $\pm$ 0.043
AutoBP 1-2	3.0 $\pm$ 15.1; 0.03	0.752 (0.642, 0.828)	0.773 $\pm$ 0.045	1.0 $\pm$ 8.7; 0.22	0.831 (0.757, 0.883)	0.833 $\pm$ 0.037
AutoBP 1-3	1.6 $\pm$ 13.9; 0.22	0.799 (0.710, 0.860)	0.779 $\pm$ 0.043	0.26 $\pm$ 8.2; 0.70	0.852 (0.786, 0.897)	0.842 $\pm$ 0.036
AutoBP 2-3	0.3 $\pm$ 14.9; 0.84	0.796 (0.706, 0.858)	0.772 $\pm$ 0.044	-0.4 $\pm$ 8.5; 0.60	0.850 (0.784, 0.896)	0.848 $\pm$ 0.036
AutoBP 2-4	-0.6 $\pm$ 14.6; 0.66	0.798 (0.708, 0.860)	0.775 $\pm$ 0.043	-0.7 $\pm$ 8.4; 0.40	0.854 (0.789, 0.898)	0.857 $\pm$ 0.035
AutoBP 2-5	-1.7 $\pm$ 14.4; 0.20	0.792 (0.701, 0.856)	0.767 $\pm$ 0.044	-1.0 $\pm$ 8.3; 0.20	0.856 (0.792, 0.900)	0.855 $\pm$ 0.035
AutoBP 2-6	-2.5 $\pm$ 14.4; 0.06	0.791 (0.699, 0.855)	0.771 $\pm$ 0.043	-1.3 $\pm$ 8.2; 0.08	0.856 (0.793, 0.900)	0.856 $\pm$ 0.035
AutoBP 2-7	-3.1 $\pm$ 14.3; 0.02	0.789 (0.694, 0.854)	0.766 $\pm$ 0.044	-1.7 $\pm$ 8.1; 0.03	0.858 (0.794, 0.902)	0.857 $\pm$ 0.035
AutoBP 2-8	-3.5 $\pm$ 14.5; 0.01	0.782 (0.682, 0.849)	0.767 $\pm$ 0.044	-1.8 $\pm$ 8.1; 0.03	0.856 (0.790, 0.901)	0.859 $\pm$ 0.035

Abbreviations: ABP, ambulatory blood pressure; AUC, area under the curve; AutoBP, automated office blood pressure; BP, blood pressure; CI, confidence interval; ICC, intra-class correlation coefficient. Green highlight is the optimal AutoBP protocol with the closest concordance to daytime ABP. All data presented as mean  $\pm$  standard deviation, unless specified.

**Table 2: Comparing accuracy of BP control from varying AutoBP protocols at three hypertension thresholds compared to the daytime ABP hypertension threshold (n=117).**

AutoBP measures	Daytime ABP (Hypertension: systolic BP $\geq 135$ mmHg and/or diastolic BP $\geq 85$ mmHg)								
	AutoBP $\geq 130 / \geq 80$ mmHg			AutoBP $\geq 135 / \geq 85$ mmHg			AutoBP $\geq 140 / \geq 90$ mmHg		
	Spec	Sens	Systolic and/or diastolic AUC	Spec	Sens	Systolic and/or diastolic AUC	Spec	Sens	Systolic and/or diastolic AUC
AutoBP 1	23.3%	89.7%	0.5649	33.3%	82.8%	0.5804*	48.3%	70.5%	0.6287
AutoBP 1-2	33.3%	95.4%	0.6437	46.7%	82.8%	0.6471	51.7%	67.0%	0.6730
AutoBP 1-3	36.7%	93.1%	0.6489*	50.0%	80.5%	0.6523	62.1%	63.6%	0.6833
AutoBP 2-3	36.7%	88.5%	0.6259	56.7%	78.2%	0.6741	66.7%	62.1%	0.6437
AutoBP 2-4	40.0%	88.5%	0.6425	63.3%	75.9%	0.6960	66.7%	57.5%	0.6207
AutoBP 2-5	46.7%	85.1%	0.6586	63.3%	72.4%	0.6787	66.7%	55.2%	0.6092*
AutoBP 2-6	50.0%	82.8%	0.6638	63.3%	71.3%	0.6729	76.7%	52.9%	0.6477
AutoBP 2-7	46.7%	81.6%	0.6414	63.3%	67.8%	0.6557	75.9%	52.3%	0.6477
AutoBP 2-8	43.3%	81.6%	0.6247	63.3%	67.8%	0.6557	75.9%	51.1%	0.6420

Abbreviations: ABP, ambulatory blood pressure; AUC, area under the curve; AutoBP, automated office blood pressure; BP, blood pressure; sens, sensitivity; spec, specificity \*, denotes  $p < 0.05$  compared to AutoBP 2-3 AUC. Green highlight is the optimal AutoBP protocol for which there is no clear cut point with strong sensitivity and specificity for predicting hypertension.

### Conclusions

An optimal AutoBP protocol that has good concordance with daytime ABP can be achieved with two measures taken within six minutes (removing the first reading taken immediately on seating).