

HOME BLOOD PRESSURE MEASUREMENT IN THE COVID-ERA

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April 22, 2021



ACKNOWLEDGEMENTS

- Drs. Laura Kuyper, Nadia Khan for contributing to the slide deck

DISCLOSURES

- Dr Birinder Mangat:
 - Speaker honoraria from Novo Nortis, Bausch, Valeant, Servier.
 - Clinical grant funding from Servier
 - No specific pharmacotherapy will be discussed in this presentation

LEARNING OBJECTIVES

- Understand the importance of out-of-office diagnosis of hypertension
- Discuss BP monitoring strategies during COVID-era
- Review the differences in office vs home BP measurement (HBPM)
- Understand the correct BP technique for each measurement method
- Discuss Hypertension Canada's Device Recommendations Program

BP MONITORING DURING PANDEMIC - CASE

- 46 yo M diagnosed with HTN prior to the COVID-19 pandemic
- Still not below target of $<135/85$ at last in-person visit → antihypertensives were increased
- During current telehealth visit he reports his home BPs over phone to you:
 - Uses hand-me-down home BP device borrowed from a family member -- older device that requires manual inflation
 - Provides you with 5 BP measurements taken over the last month, performed at random times
 - Often checks his BP at dinner table, with his young kids nearby

WHAT ARE YOUR RECOMMENDATIONS TO IMPROVE HIS HOME BP MEASUREMENT TECHNIQUE?

- A. Ensure his home BP device is recommended by Hypertension Canada
- B. Recommend checking BP in a.m. before breakfast and 2 hours after dinner, before taking meds
- C. Suggest sitting in a quiet location, ensure back supported, feet flat on ground
- D. Measure BP in non-dominant arm, or arm with higher BP if $> 10\text{mmHg}$ difference between arms is known
- E. All of the above

WHAT ARE YOUR RECOMMENDATIONS TO IMPROVE HIS HOME BP MEASUREMENT TECHNIQUE?

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- E. **All of the above**

BLOOD PRESSURE MANAGEMENT DURING COVID PANDEMIC

- More reliance on out-of-office BP measurement during pandemic
 - GP/specialist office visits scaled back
 - Appointments largely via Telehealth (may become more long term strategy)
 - Reliance on home BP measurement significantly increased

Gerke, S., Shachar, C., Chai, P.R. *et al.* Regulatory, safety, and privacy concerns of home monitoring technologies during COVID-19. *Nat Med* **26**, 1176–1182 (2020).

- Hypertension Canada currently recommends out-of-office measurement for diagnosis; office BP measurement for monitoring → however – recent evidence supports HBPM for monitoring also



Review

A New Algorithm for the Diagnosis of Hypertension in Canada

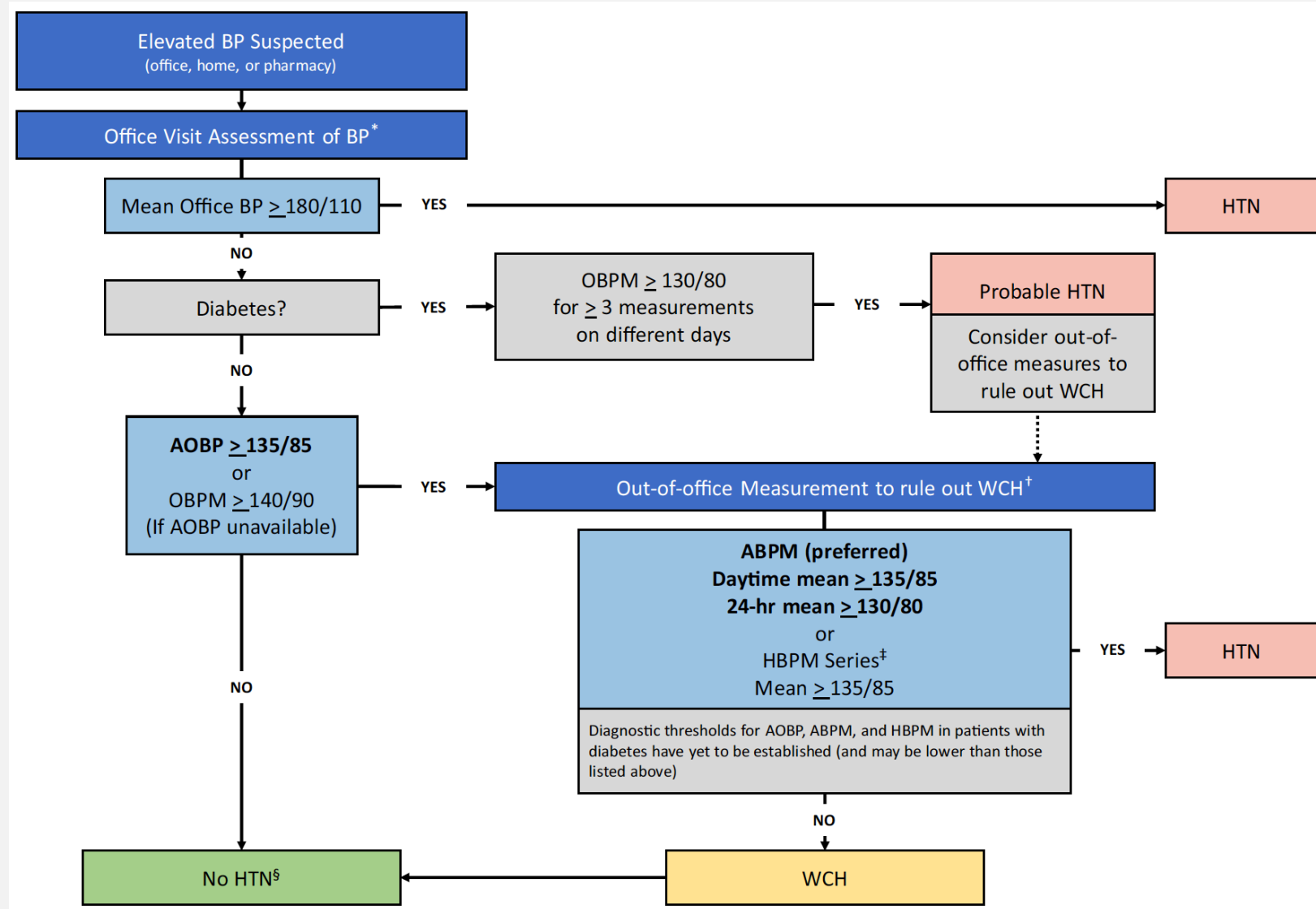
Lyne Cloutier, RN, PhD,^a Stella S. Daskalopoulou, MD, PhD,^b Raj S. Padwal, MD, MSc,^c
Maxime Lamarre-Cliche, MD,^d Peter Bolli, MD,^e Donna McLean, RN, NP, PhD,^f
Alain Milot, MD, MSc,^g Sheldon W. Tobe, MD, MSc(HPTE),^h Guy Tremblay, MD,ⁱ
Donald W. McKay, PhD,^j Raymond Townsend, MD,^k Norm Campbell, MD,^l
and Mark Gelfer, MD^m

- Published in 2015 to address 2 major pitfalls of BP measurement in previous Hypertension Canada recommendations
 1. Reliance on auscultatory (manual) office BP measurements
 - Manual BP errors include hearing deficits, rounding errors, rapid cuff deflation; standardized manual technique usually not performed in routine practice
 2. Lack of early identification of white coat hypertension
 - Diagnosis of HTN using office BP alone will misclassify some patients as hypertensive → need for out-of-office measures
- New algorithm put forth for diagnosing HTN in Canada



DIAGNOSING HYPERTENSION

1. **Out of office** assessment is the preferred means of diagnosing HTN (ambulatory or home BP measurement)
2. **Office measurement should be automated** (AOBP), not manual



OUT-OF-OFFICE BP MEASUREMENTS IN DIAGNOSING HTN

- Out-of-office measurement identifies white coat hypertension (WCH) and masked hypertension (MH)
 - WCH – high office BP, normal out-of-office BP (no target organ damage)
 - Prevalence up to 30% of patients with high OBP (Huang et al J Hypertens 2017)
 - MH – normal office BP, high out-of-office BP (may have sig TOD – ie. LVH)
 - Prevalence up to 20% of untreated adults (Ogedegbe et al, Curr Hypertens Rep, 2010)
- 24-hour ambulatory BP monitoring (ABPM) is recommended over HBPM for diagnosis but HBPM can be used if ABPM not tolerated or available, patient preference



BP MONITORING IN HYPERTENSIVE PATIENTS

- Hypertension Canada currently recommends AOBP for BP monitoring in known hypertensives on treatment, except for patients with white coat HTN (then HBPM, ABPM is recommended)
- However → evidence mounting for utility of HBPM in monitoring
- Many GPs/specialists do rely on HBPM for monitoring – esp. during pandemic times!
 - Tec4Home BP study team (K. Tran et al.; in progress) surveyed Vancouver specialists during pandemic – 42% report increase in HBPM for monitoring, 31% less BP measurement, 12% not measuring BP!
 - Vast majority of hypertension visits reported in this survey were conducted either by phone or video (AOBP not performed!)



ADVANTAGES OF HBPM

- HBPM improves adherence to antihypertensive therapy (Pickering et al Hypertension 2008) → encourages patients' active involvement in their own care
- HBPM more practical than 24-hour ABPM, preferred by patients (Nasothimiou et al J Human Hypertens 2014)
- HBPM leads to overall better BP control compared to OBPM...

Efficacy of self-monitored blood pressure, with or without telemonitoring, for titration of antihypertensive medication (TASMINH4): an unmasked randomised controlled trial

www.thelancet.com Vol 391 March 10, 2018

*Richard J McManus, Jonathan Mant, Marloes Franssen, Alecia Nickless, Claire Schwartz, James Hodgkinson, Peter Bradburn, Andrew Farmer, Sabrina Grant, Sheila M Greenfield, Carl Heneghan, Susan Jowett, Una Martin, Siobhan Milner, Mark Monahan, Sam Mort, Emma Ogburn, Rafael Perera-Salazar, Syed Ahmar Shah, Ly-Mee Yu, Lionel Tarassenko, F D Richard Hobbs, on behalf of the TASMINH4 investigators**

- 1182 hypertensive participants, not controlled, in UK across 142 primary care clinics, enrolled in study to assess 3 BP monitoring strategies:
 - self-monitoring of BP
 - self-monitoring of BP with telemonitoring
 - Readings sent to automated service alerting pts to high/low/insufficient BPs
 - usual care (AOBP-guided Tx)
- After 1 year, BP lower in both self-monitoring groups compared to usual care group (self-monitoring groups also taking more meds)
- "Self-monitoring can be recommended for the ongoing management of HTN"

MEAN BP AT BASELINE, 6 MOS, 12 MOS – LOWER IN SELF-MONITORING GROUPS COMPARED TO USUAL CARE

	Baseline	6 months	12 months	6-month adjusted mean difference (95% CI, p value*) vs usual care	12-month adjusted mean difference (95% CI, p value*) vs usual care
Systolic blood pressure (mm Hg)					
Telemonitoring group	153.2 (14.3); n=389	139.0 (16.8); n=338	136.0 (16.1); n=327	-3.7 (-5.9 to -1.5), p=0.0012	-4.7 (-7.0 to -2.4), p<0.0001
Self-monitoring group	152.9 (13.6); n=391	140.4 (15.7); n=349	137.0 (16.7); n=328	-2.1 (-4.3 to 0.1), p=0.0584	-3.5 (-5.8 to -1.2), p=0.0029
Usual care group	153.1 (14.0); n=393	142.5 (15.4); n=358	140.4 (16.5); n=348
Diastolic blood pressure (mm Hg)					
Telemonitoring group	85.5 (10.0); n=389	79.8 (9.9); n=338	78.7 (9.7); n=328	-1.2 (-2.4 to -0.01), p=0.0482	-1.3 (-2.5 to -0.02), p=0.0482
Self-monitoring group	85.1 (10.5); n=391	80.3 (10.7); n=349	77.8 (10.1); n=328	-0.1 (-1.3 to 1.07), p=0.8421	-1.5 (-2.7 to -0.2), p=0.0209
Usual care group	86.0 (10.3); n=393	81.1 (10.9); n=358	79.9 (10.7); n=348

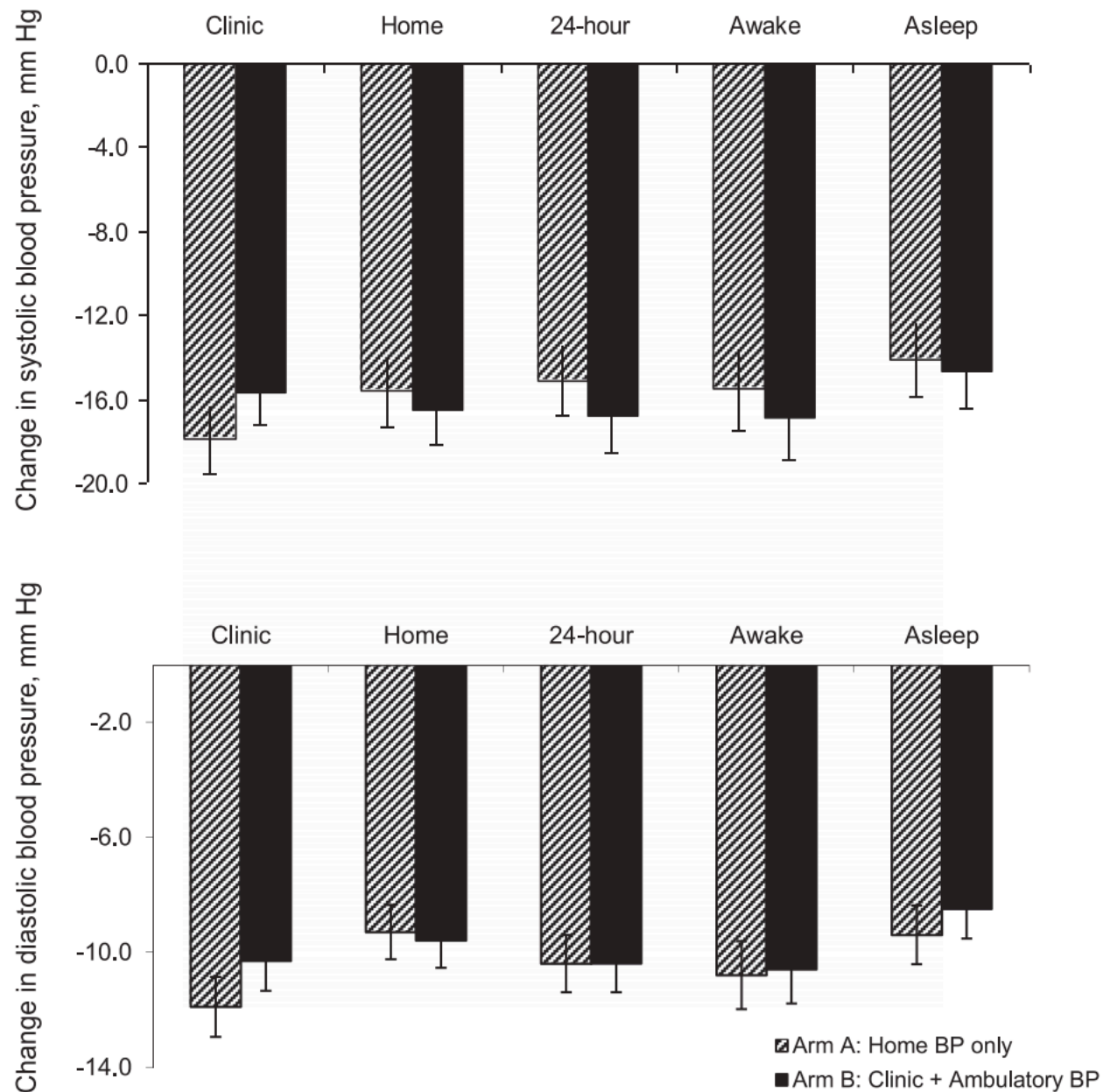
Data are mean (SD), unless otherwise stated. *Significant at p<0.017.

Table 2: Mean blood pressure at baseline, 6 months, and 12 months for each group

Home Blood Pressure Monitoring Alone vs. Combined Clinic and Ambulatory Measurements in Following Treatment-Induced Changes in Blood Pressure and Organ Damage

George S. Stergiou,¹ Nikos Karpettas,¹ Antonis Destounis¹, Dimitris Tzamouranis,¹
Efthimia Nasothimiou,¹ Anastasios Kollias,¹ Leonidas Roussias,¹ and Ioannis Moyssakis²

- 2014 study devised to determine whether HBPM is as reliable as combined AOBP/ABPM in monitoring drug treatment and preclinical target organ damage in hypertensive patients
- 145 untreated subjects with elevated BP randomized to treatment initiation and titration of antihypertensives based on either a combination of AOBP/ABPM or HBPM alone
- Average follow up 13 months
- No sig. difference among either group in treatment-induced change in LV mass index on echo (primary outcome), measures of arterial stiffness, urinary albumin excretion or BP control rates



At end of follow up:

Fig. BP lowering seen with all 3 measurement methods (home, clinic, ambulatory)

No sig. difference in BP lowering between HBPM and AOBP/ABPM measurement groups

Figure 2. Blood pressure changes during the study assessed using the 3 measurement methods in the 2 study arms ($P < 0.001$ for all changes, nonsignificant differences between arms; error bars for standard error).

PROPER HBPM TECHNIQUE



- Use Hypertension Canada validated device
- Use arm with highest BP if > 10 mmHg difference, otherwise non-dominant arm
- Should be seated with arm at heart level, resting for 5 mins, with back and feet supported
- Take measurements before breakfast and 2 hours after dinner, before meds
- Discard first reading, average of second 2 readings, morning and evening for 7 days (1-2 min intervals between BP readings)
- Record BP measurements to smart phone app or written in an organized way!

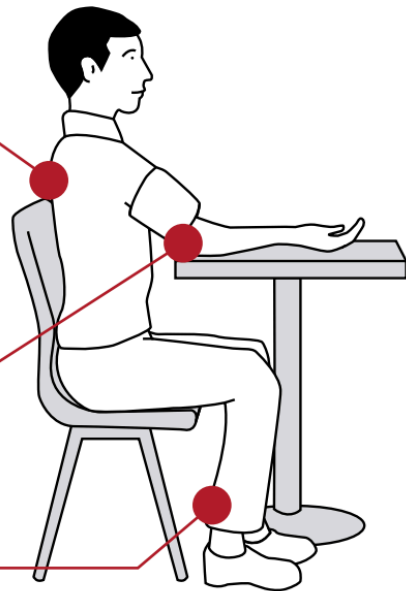
CORRECT BP MEASUREMENT TECHNIQUE

BLOOD PRESSURE MEASUREMENT TECHNIQUE



Accurate diagnosis begins with accurate measurement:

- ✓ Sitting position
- ✓ Back supported
- ✓ Arm bare and supported
- ✓ Use a cuff size appropriate for your arm
- ✓ Middle of the cuff at heart level
- ✓ Lower edge of cuff 3 cm above elbow crease
- ✓ Do not talk or move before or during the measurement
- ✓ Legs uncrossed
- ✓ Feet flat on the floor



Hypertension: What You Need to Know



Knowledge is power! Get the facts on hypertension – what causes it, how it's treated, what your numbers mean, and much more.

[LEARN MORE ABOUT HYPERTENSION](#)

hypertension.ca/hypertension-and-you

SAMPLE HOME BP LOG – DOWNLOADABLE FROM HYPERTENSION CANADA WEBSITE



Every year, with your health care professional, review the technique for measuring your blood pressure properly, and check that your device is in good condition.

My target blood pressure at home is less than:

/ mmHG
systolic diastolic

I use my: Right Arm Left Arm

Date		Time	Comments	Heart Rate (beats/min)	BP Reading #1		BP Reading #2	
					Systolic	Diastolic	Systolic	Diastolic
June 15	Sample Morning	8:00 a.m.	Meds at 9 a.m.		138	82	135	80
	Sample Evening	8:00 p.m.	Upset		157	92	154	90
	Day 1 Morning							
	Day 1 Evening							

WHEN IN CLINIC: UNATTENDED AUTOMATED OFFICE BP (AOBP) MEASUREMENT IS PREFERRED OVER MANUAL MEASUREMENT

- More closely approximates ABPM than manual office BPs (mitigates white coat effect)¹⁻³
 - Systolic AOBP may be >10mmHg lower than manual (Rinfret et al Can J Cardio 2017)
- Is more predictive of end organ damage than manual office BPs (LV mass index, proteinuria and carotid intima-media thickness)⁴⁻⁶

Automated Office (unattended, AOBP)
Oscillometric (electronic)



1. Beckett L, et al. *BMC Cardiovasc Disord* 2005;5:18;
2. Myers MG, et al. *J Hypertens* 2009;27:280-6;
3. Myers MG, et al. *BMJ* 2011;342:d286;
4. Campbell NRC, et al. *J Hum Hypertens* 2007;21:588-90;
5. Andreadis EA, et al. *Am J Hypertens* 2011;24:661-6;
6. Andreadis EA, et al. *Am J Hypertens* 2012;25:969-73.

AOBP MEASUREMENT TECHNIQUE

- BP should be taken in both arms at least once, higher arm used for AOBP thereafter
- Use HC validated automated device
- Choose cuff with appropriate bladder size – width 40% of arm circumference, length 80-100% of arm circumference
- Should be unattended in quiet room, feet on floor, back supported, no specified period of rest prior to measurements
- 3-6 measurements should be taken with 1-2 minute intervals between each measurement

THRESHOLDS AND TARGETS

Patient Population

Hypertension Canada
High risk Patient*

Diabetes mellitus**

Moderate-to-high risk
(TOD or CV risk
factors)**

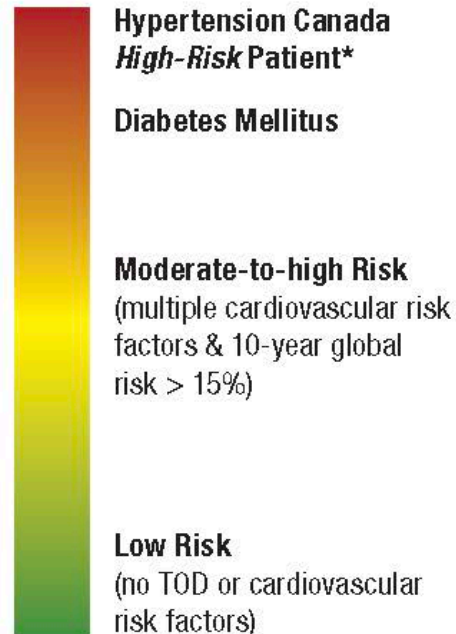
Low risk (No TOD or
CV risk factors)**

THRESHOLDS AND TARGETS



Populations and stratification

Hypertension Canada stratifies patients by cardiovascular risk and, based on that risk, there are different thresholds and targets for treatment.



* Hypertension Canada High-Risk Patient

Individuals with one or more of the following clinical indications should consent to intensive management:

- ✓ Clinical or sub-clinical cardiovascular disease
- OR**
- ✓ Chronic kidney disease (non-diabetic nephropathy, proteinuria <1g/d, *estimated glomerular filtration rate 20-59 mL/min/1.73m²)
- OR**
- ✓ Estimated 10-year global cardiovascular risk ≥15%
- OR**
- ✓ Age ≥75 years

Thresholds and Targets

In patients with documented hypertension, attaining blood pressure targets

BP treatment target

mHg	SBP mmHg
120	N/A
130	< 80
140	< 90
160	< 90

* BP treatment thresholds at

**BP treatment thresholds at

IMPORTANT NOTE ON BP MEASUREMENT IN ACHIEVING INTENSIVE BP TARGETS (SBP <120)

BP Measurement in SPRINT: Automated Office BP (AOBP)

- Visit BP was the average of 3 seated office BP measurements obtained using an automated measurement device: Omron 907XL.
- Appropriate cuff size was determined by arm circumference.
- Participant was seated with back supported and arm bared and supported at heart level.
- Device was set to delay 5 minutes to begin 3 BP measurements – research staff was trained to push start button and leave exam room during the 5 minute delay and measurements, during which time participant refrained from talking.
- BP was also measured 1 min after standing at screening, baseline, 1, 6, and 12 months, and annually thereafter. While standing, participants were asked about symptoms of hypotension.

WHICH DEVICE FOR HOME OR OFFICE?? HYPERTENSION CANADA RECOMMENDED BP DEVICE PROGRAM

- HC program allows you to confidently buy devices that are validated in studies
- Includes office, home, and ambulatory BP monitors in the list

What type of blood pressure monitor should I buy?

The blood pressure monitor you purchase should be proven accurate, and the monitor's cuff must properly fit your upper arm. Your health care professional can recommend a monitor and measure your arm to select the right cuff size. You should bring your monitor to your health care professional annually to have it checked for accuracy.

To help you in your purchasing decisions, Hypertension Canada provides a list of recommended monitors which have been proven accurate in research studies at hypertension.ca. Many of these recommended devices will carry the symbols shown to the right on their packaging.





Recommended by
Recommandé par
Hypertension Canada
Gold | Or



Recommended by
Recommandé par
Hypertension Canada
Silver | Argent

The Hypertension Canada blood pressure device recommendation listing: Empowering use of clinically validated devices in Canada

Raj Padwal MD¹  | Angelique Berg² | Mark Gelfer MD³ | Karen Tran MD⁴ |
Jennifer Ringrose MD¹  | Marcel Ruzicka MD⁵ | Swapnil Hiremath MD⁵ |
for the Accuracy in Measurement of Blood Pressure (AIM-BP) Collaborative

- Accuracy in Measurement of Blood Pressure Collaborative (AIM-BP) → this group created HC recommended BP device listing
- Created to evaluate and ensure optimal blood pressure measurement and access to validated devices across Canada
 - Previous skepticism about automated devices due to number of low-quality, inaccurate devices being sold
 - Fewer than 15% of devices sold internationally are validated!
- Specific to Canada – reflects our device market and ensures manufacturers continually re-validate machines

TAKE HOME MESSAGES



- Out-of-office measurements recommended for diagnosing HTN
- Home BP measurement becoming more prevalent, evidence is mounting, for their use in BP diagnosis AND monitoring
- Ensure proper technique for home and office BP measurement
- Use a validated device – Look for the Hypertension Canada Recommendation logo





BC Renal Tools to Support Home Blood Pressure Monitoring

Acknowledgements

The BC Kidney Care Committee Home Blood Pressure Monitoring Working Group

Patient Partners:

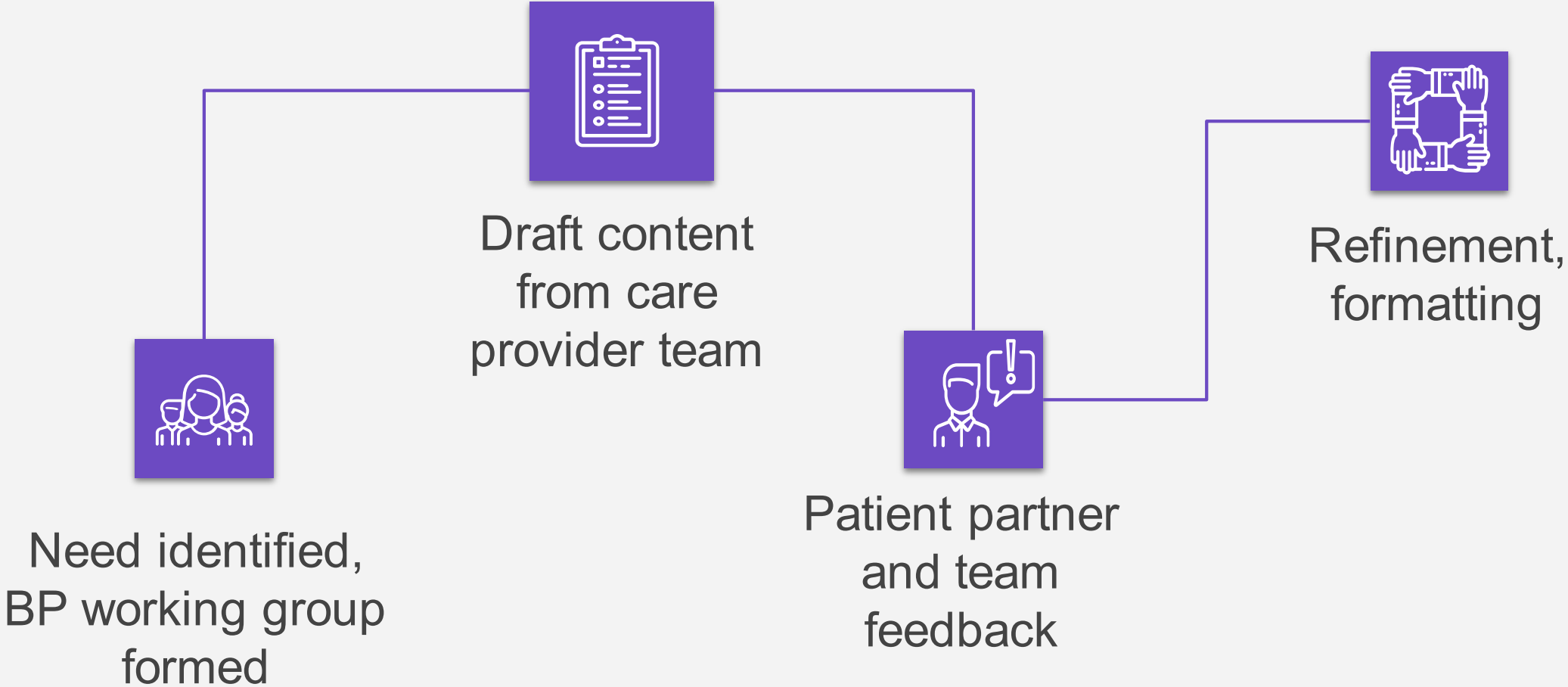
Elyse Gawley
Tamara Graham
Phaydy Phanouvong
Paul Watson
Paul Zambas

Clinicians and support:

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Julie Loverin
Dr. Judith Marin
Kristin Mole
Kiyomi Renville
Janet Williams
Alexis Whatley



Resource Development



Complementary staff and patient tools



Taking Your Blood Pressure at Home



What is blood pressure and why is it important?

Blood pressure is a measure of how hard the blood pushes against the walls of your arteries as it moves through your body. This force makes blood flow possible, delivering nutrients and oxygen to organs and tissues throughout the body.^{1,2}



Your blood pressure reading is based on two numbers:³

- 1. Systolic blood pressure (first or top number):** tells how much pressure your blood is exerting against your artery walls when the heart beats
- 2. Diastolic blood pressure (second or bottom number):** tells how much pressure your blood is exerting against your

BC Kidney Care Guideline: Supporting Home Blood Pressure Monitoring

Mar 31, 2021

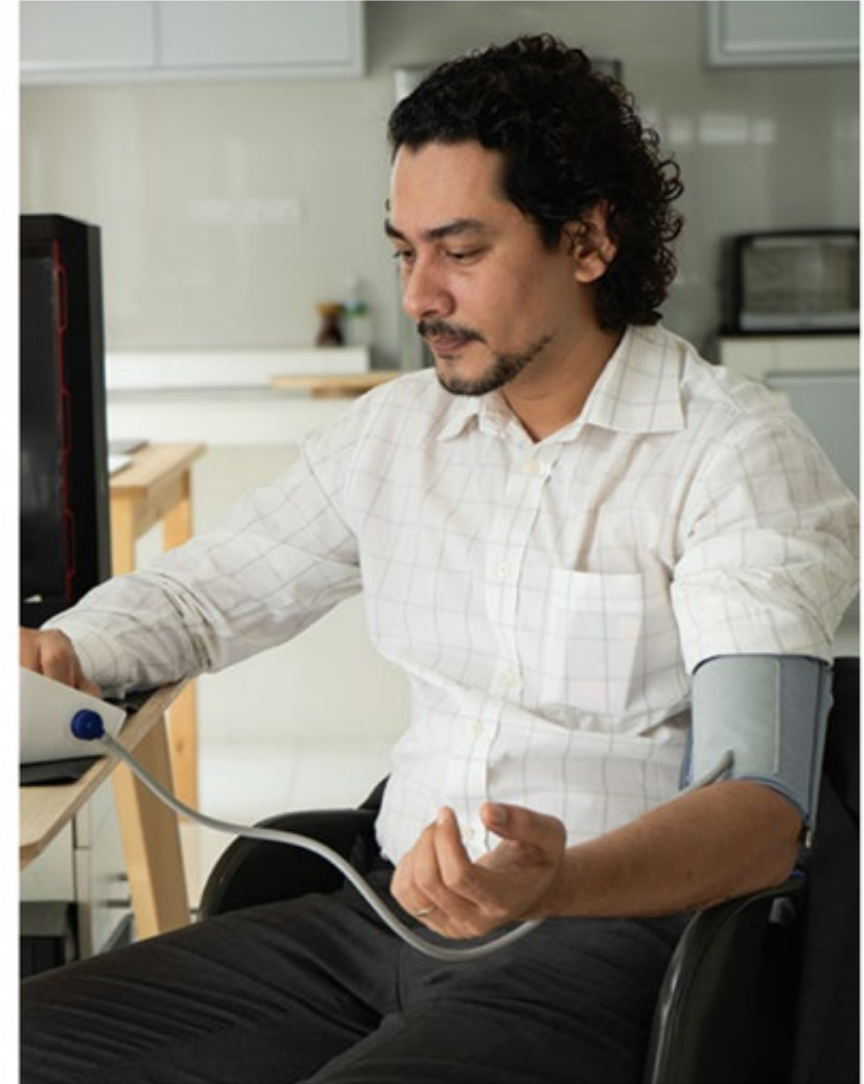
Contents

1.0	Scope	2
2.1	Rationale for Home Blood Pressure Monitoring	2
2.2	Recommendations.....	3
2.2.1	Patients appropriate for home BP monitoring	3
2.2.2	Purchasing a BP device.....	3
2.2.3	Educating patients on how to take & record their BP	5
2.2.4	Checking the BP monitor	6
2.2.5	Frequency and timing of taking BP	7
2.2.6	Follow-up of out-of- range BP readings.....	8
2.0	References.....	10
3.0	Sponsors	10

Content of the guides

This guideline provides recommendations on:

- (a) Patients appropriate for home BP monitoring
- (b) Purchasing a BP device
- (c) Educating patients on taking and recording their BP
- (d) Checking the BP device
- (e) Frequency and timing of taking BP
- (f) Follow-up of out-of-range readings



Target population

Most patients with chronic kidney disease can also benefit from monitoring their BP at home assuming they are willing and able to take their own BP or have a care giver who can take their BP

That is, **everyone!**

KCC patients who are a **priority** for home BP monitoring include:

- Patients who have chronic kidney disease (CKD); AND
- Hypertension or concerns about their BP; AND
- Are willing and able to take their own BP or have a care giver who can take their BP



Purchasing the right machine

- Hypertension Canada ratings
- Finding the right cuff (size and shape)
- Situations for those with special needs
- Financial considerations

4. It is important that the cuff fit properly (to prevent under or over estimation of the BP).

Measure the patient's arm circumference (in the middle of the upper arm at the midpoint between the shoulder and elbow).

- a. Multiply by 40% to get the right width of the bladder cuff.
- b. Multiply by 80% to get the right length of the bladder cuff (bladder length should cover 80% - 100% of arm circumference).



<https://targetbp.org/patient-measured-bp/implementing/smbp-selecting-the-right-cuff-size/>

https://www.uptodate.com/contents/definition-and-diagnosis-of-hypertension-in-children-and-adolescents?search=blood%20pressure%20cuff%20size&source=search_result&selectedTitle=2~150&usage_type=default&display_rank=2#H12



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Hypertension Canada
Gold | Or



Recommended by
Recommandé par
Hypertension Canada
Silver | Argent

For larger arms that are significantly wider near the shoulder than the elbow, consider a cone-shaped or "contour" cuff (specialized cuffs are more expensive than standard cuffs). Standard cylindrical cuffs can produce inaccurate measurements.⁵



Measuring and recording BP

BLOOD PRESSURE MEASUREMENT

When you measure your blood pressure:

- ✓ Sitting position
- ✓ Back supported
- ✓ Arm bare and supported
- ✓ Use a cuff size appropriate for your arm
- ✓ Middle of the cuff at heart level
- ✓ Apply cuff according to manufacturer's instructions
- ✓ Do not talk or move before or during the measurement
- ✓ Legs uncrossed
- ✓ Feet flat on the floor



When should I take the readings?

- ✓ Before breakfast and 2 hours after dinner
- ✓ After emptying bladder and bowel if needed
- ✓ No tobacco, no caffeine in the hour before
- ✓ Before taking your medication
- ✓ After a 5 minute rest
- ✓ No exercise 30 minutes before

What device should I use?

- ✓ Electronic device that is validated as accurate
 - See Hypertension Canada's Recommended devices at hypertension.ca
 - Ask your pharmacist for an appropriate cuff size
 - Devices that carry the logos to the right



- Step by step instructions, links to videos
- Link to the excellent Hypertension Canada resources

Date		Time	Comments	Heart Rate (beats/min)	BP Reading #1		BP Reading #2	
					Systolic	Diastolic	Systolic	Diastolic
June 15	Sample Morning	8:00 a.m.	Meds at 9 a.m.		138	82	135	80
	Sample Evening	8:00 p.m.	Upset		157	92	154	90
	Day 1 Morning							
	Day 1 Evening							
	Day 2 Morning							
	Day 2 Evening							

Calibrating (Read: **Checking**) the BP machine

- Staff guide gives situations to check a patient's machine

AND

- Instructions, what is deemed acceptable

Checking your blood pressure monitor



It is important to have your device checked to make sure it is measuring your blood pressure accurately. Take it to your doctor's office, kidney care clinic or community pharmacy.

The doctor, nurse or pharmacist will compare the measurement taken on your device with the measurement taken on the device in the office/clinic/ pharmacy. Readings don't have to match exactly. Your health care provider will tell you if it is working properly.

Take your device to be checked:

- Before you use it the first time; and
- At least once per year (more if the manufacturer recommends); and
- If it gets dropped or damaged



Blood pressure target:

My blood pressure target is:

Date:

Establishing a BP target

- **All KCC patients** should have an individualized BP target
 - The nephrologist or NP can help set this
- I think this is the **most important** step in this whole document
- Individualized and also periodically reviewed

What do I do if my blood pressure is out of range (low or high)?

Different people have different blood pressure targets depending on their health conditions and other factors. Your exact target should be discussed with your kidney care team. This target may change over time. If you are recovering from a serious illness or hospitalization, ask your care team to review your target.



When to contact your kidney care team or primary care provider:

If your blood pressure is less than 10 mm Hg above or below target (top or bottom number) over several readings and days, bring this up at your next appointment with your kidney care team or primary care provider.

If your blood pressure is more than 10 mm Hg above or below target (top or bottom number) over several readings and days, contact your kidney care team or primary care provider. Do not wait for your next appointment.

Follow up of out of range values

The next most important part!

- If you get an unusually high or low reading, wait 5 minutes and test again.

Implementation plan

- Resource development
- 'Demo' BP monitors (Thank you KFoC!!)
- Staff and clinic prep
- Roll out
 - Existing patients
 - New patients
- Monitoring and refinement
- Evaluation





Evaluation Plan: Home Blood Pressure Monitoring Initiative

BC's Kidney Care Clinics

DRAFT Apr 7, 2021

Contents

1.0	Background	1
2.0	Project Description	2
2.1	Problem Statement	2
2.2	Goals, Objectives & Timelines of Home BP Monitoring Initiative	2
2.3	Home BP Monitoring Initiative Logic Model	3
3.0	Evaluation Plan	4
	Appendix 1: Patient Survey	7
	Appendix 2: KCC team Survey	10

A close-up of the LEGO character Emmet from 'The LEGO Movie'. He is a yellow minifigure with brown hair, wearing an orange and white striped shirt. He is holding a blue tool. The background is a colorful, stylized cityscape.

**EVERYTHING
IS AWESOME,
EVERYTHING
IS COOL WHEN
YOU'RE PART
OF A TEAM.**

Emmet

THE LEGO MOVIE

Thank You!!

- Dr. Mangat for sharing your expertise!
- KCC Home BP Monitoring Working Group
- All of you for attending!