Module 6:
Blood Pressure Measurement

Diagnosis and Follow-Up of Hypertension

Case Development & Disclosures

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CHEP:
Continuing Education Committee

- Sol Stern, MD CCFP
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Learning Objectives

Upon completion of this activity, participants should be able to:

1. To describe the new CHEP recommendations and algorithm for the diagnosis of hypertension

2. To outline the rational for and the methods for using automated office blood pressure measurements.

3. Define White Coat Hypertension, Masked Hypertension, and Masked UnControlled Hypertension (MUCH)

4. To describe tools for helping learners acquire and teach the knowledge and skills for blood pressure measurement.

Statement of Need

"My greatest challenge as a health care provider in the diagnosis and follow-up of patients with hypertension is

_____ "

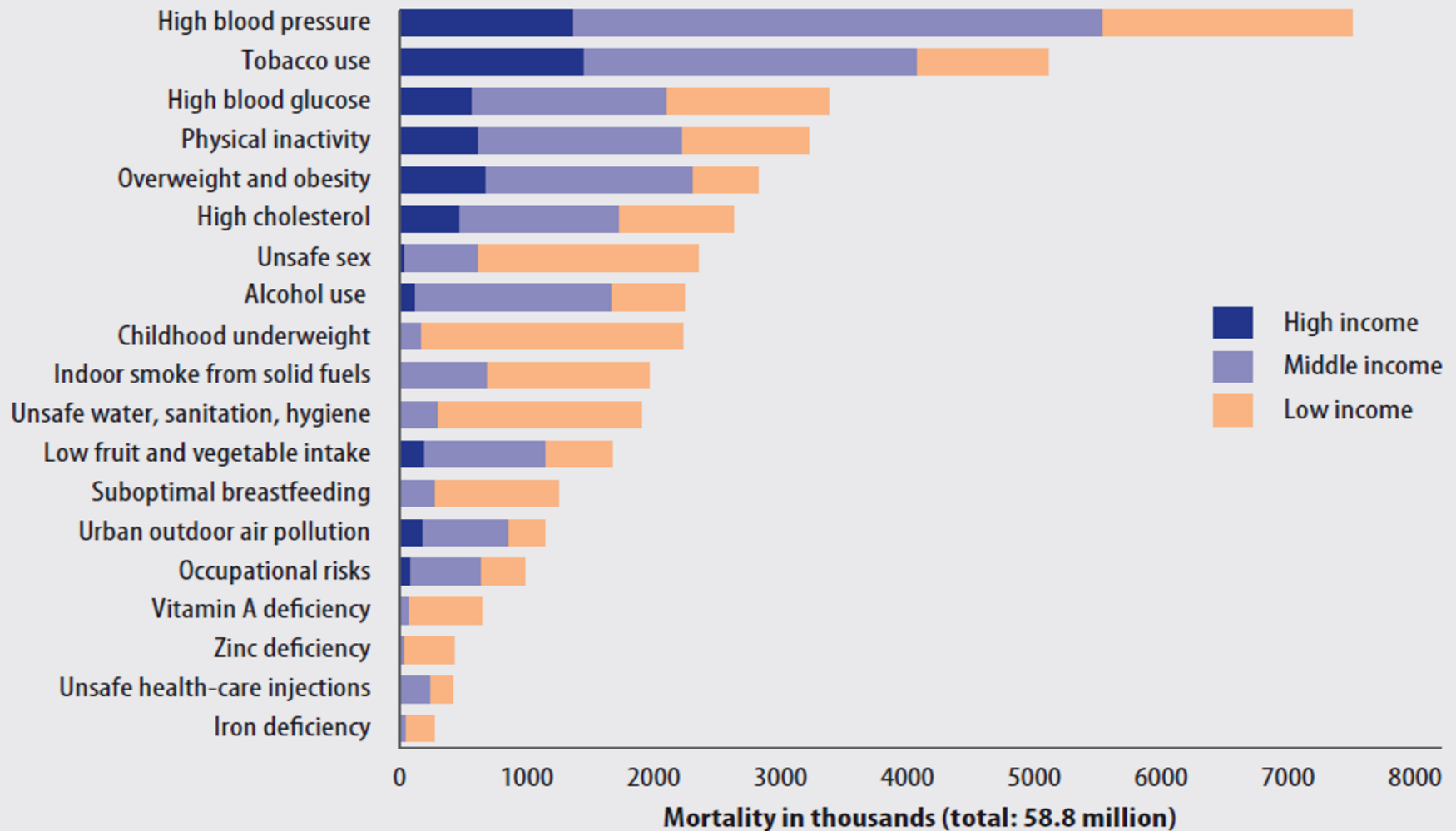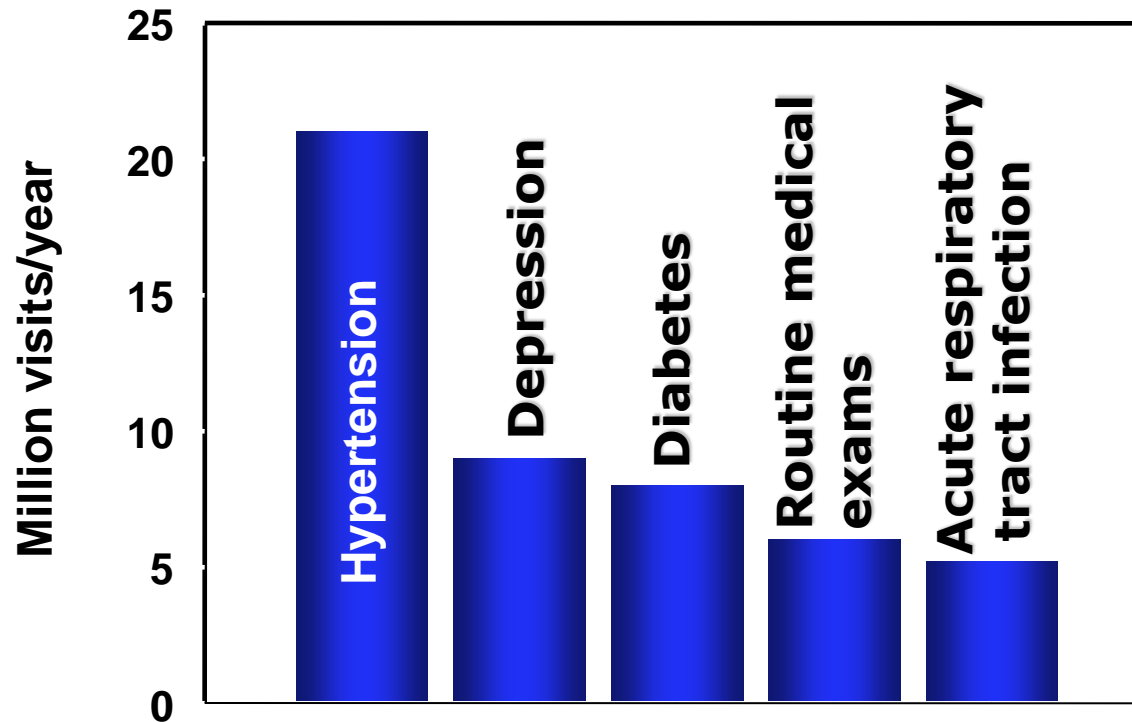# Module 6: Diagnosis and Follow up of Hypertension

Mariam

Mariam is a 62 year old patient who sees you because of high blood pressure found when she measured her blood pressure at the drug store.

Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks

Figure 6: Deaths attributed to 19 leading risk factors, by country income level, 2004.

Legend:
- High income
- Middle income
- Low income

Risk factors (top to bottom): High blood pressure, Tobacco use, High blood glucose, Physical inactivity, Overweight and obesity, High cholesterol, Unsafe sex, Alcohol use, Childhood underweight, Indoor smoke from solid fuels, Unsafe water, sanitation, hygiene, Low fruit and vegetable intake, Suboptimal breastfeeding, Urban outdoor air pollution, Occupational risks, Vitamin A deficiency, Zinc deficiency, Unsafe health-care injections, Iron deficiency

Mortality in thousands (total: 58.8 million)

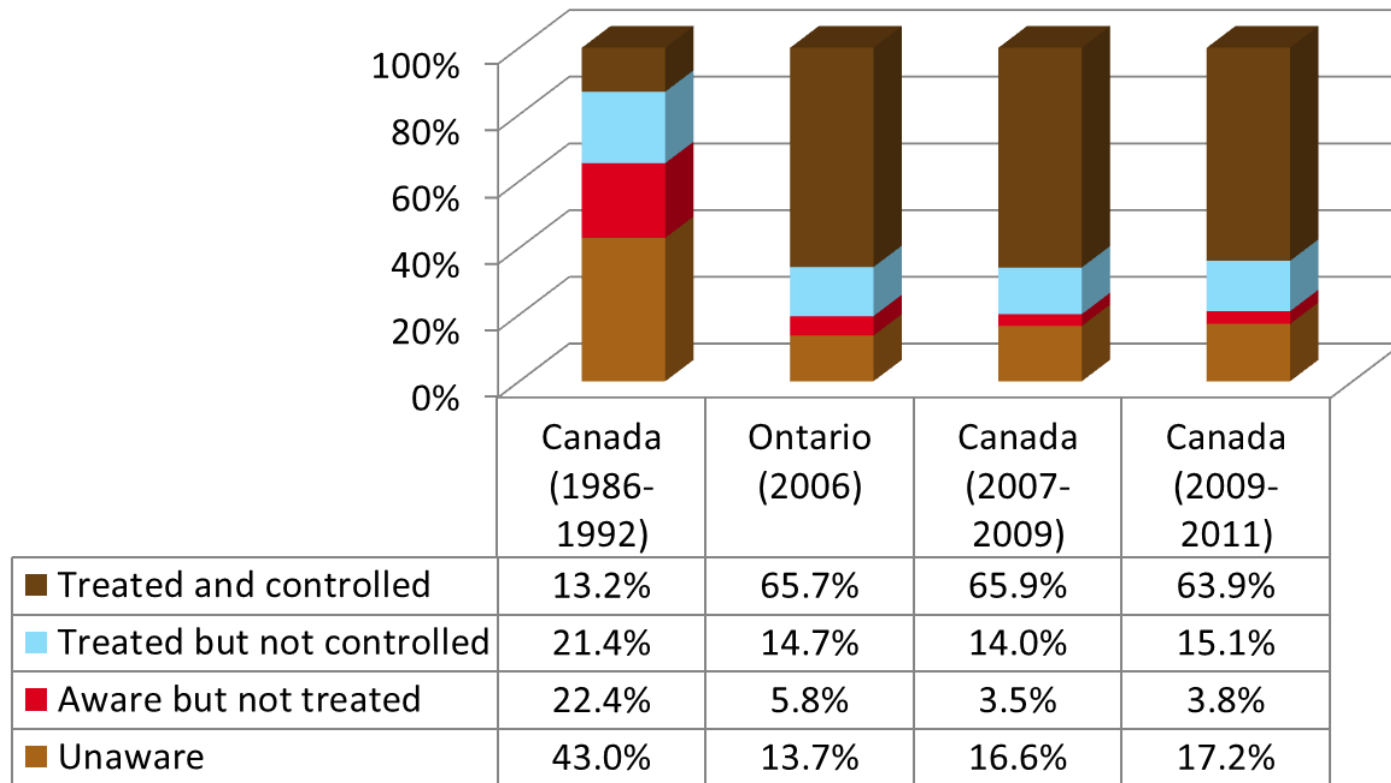# Leading Diagnoses Resulting in Visits to Physician Offices in Canada

Source: IMS HEALTH Canada 2002

When Should Blood Pressure Be Measured?

- Assess blood pressure at all appropriate visits:
    - To screen for hypertension
    - To assess cardiovascular risk
    - To monitor antihypertensive treatment

Hypertension Awareness, Treatment and Control

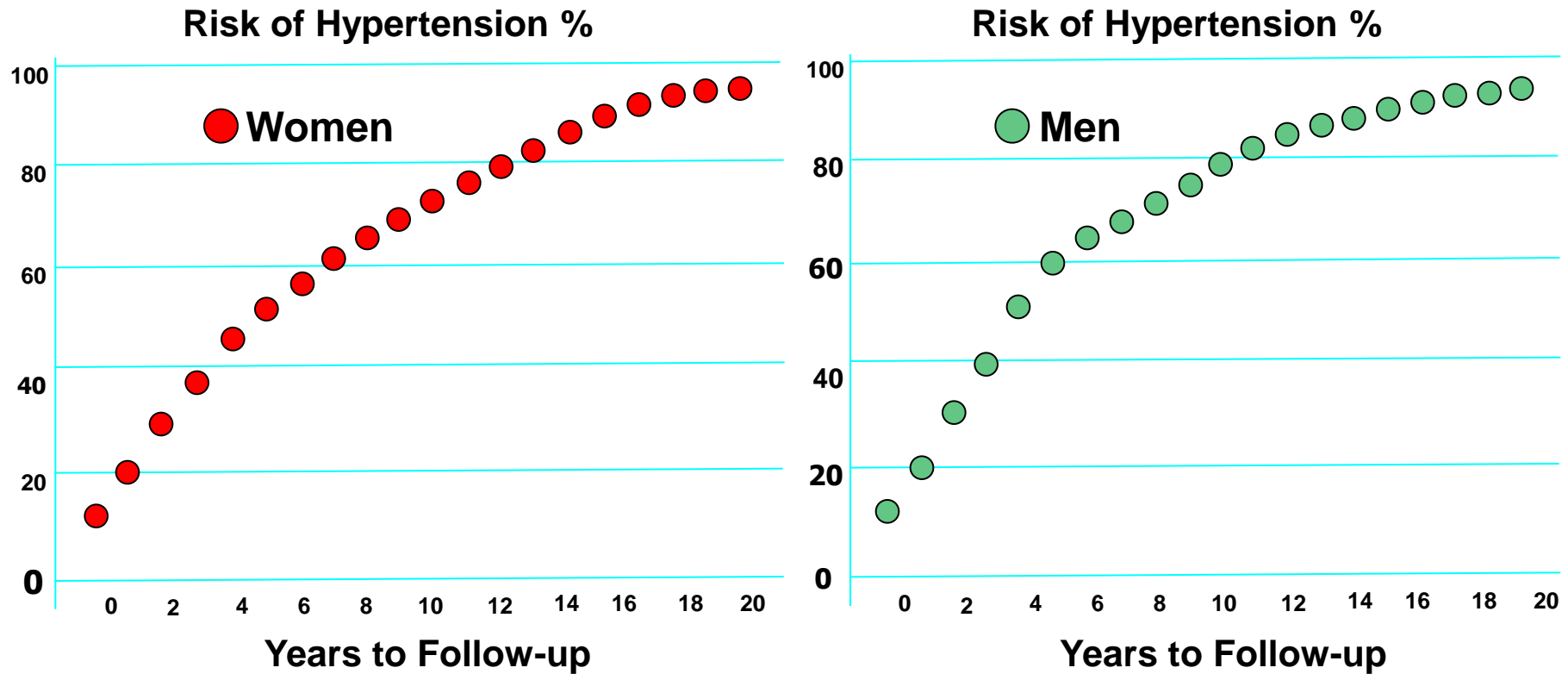|	Canada (1986-1992)	Ontario (2006)	Canada (2007-2009)	Canada (2009-2011)
■ Treated and controlled	13.2%	65.7%	65.9%	63.9%
■ Treated but not controlled	21.4%	14.7%	14.0%	15.1%
■ Aware but not treated	22.4%	5.8%	3.5%	3.8%
■ Unaware	43.0%	13.7%	16.6%	17.2%

Joffres MR, Hamet P, MacLean DR, L'italien GJ, Fodor G. Distribution of blood pressure and hypertension in Canada and the United States. Am J Hypertens. 2001;14(11):1099-1105.
Leenen FHH, Dumais J, McInnis NH, Turton P, Stratychuk L, Nemeth K, Lum-Kwong MM, Fodor G. Results of the Ontario Survey on the Prevalence and Control of Hypertension. *CMAJ.* 2008;178(11):1441-1449.
Wilkins K, Campbell NRC, Joffres MR, McAlister FA, Nichol M, Quach S, Johansen HL, Tremblay MS. Blood pressure in Canadian adults. *Health Reports*. 2010;21(1):37-46.
Statistics Canada. Blood pressure of Canadian adults, 2009 to 2011. Ottawa, ON: Statistics Canada, 2012. http://www.statcan.gc.ca/pub/82-625-x/2012001/article/11714-eng.pdf.

Lifetime Risk of Hypertension in Normotensive Women and Men Aged 65 Years

Vasan R. *JAMA* 2002;287:1003-10.

Reversible Risk Factors for Developing HTN

- Obesity
- Poor dietary habits
- High sodium intake
- Sedentary lifestyle
- High alcohol consumption

History of Present Illness
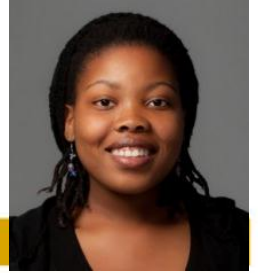
- Mariam has been diagnosed with hypertension for 5 years

- She has no cardiac or vascular complications

- She is taking HCTZ 12.5mg/day and tolerating it well

- Active: Rides bicycle, goes to Pilates 5 days per week

- Diet low in sodium, high in potassium

- Drinks < 10 alcohol equivalents weekly

History of Present Illness
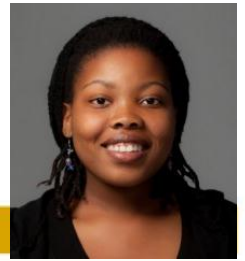
- While shopping for food, dropped into the drug store and measured her BP

- The automated device repeatedly gave measures 145/90 to 155/95

- Her BP at her Family MD's office taken by the Nurse Practitioner has always been < 135/85

- She takes her meds regularly

Past Medical History

- Three normal vaginal deliveries (no complications)
- Hypertension

- No history of Sleep Apnea
- No history of Thyroid Disease
- No history of Regular use of NSAIDs

Family Medical History
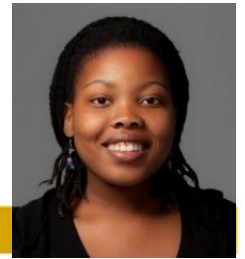
- **Mother**: from Jamaica, now deceased was hypertensive before having stroke at age 64

- **Father**: from Jamaica, deceased at age 78 from MI

- **Sisters**: 2 of 3 sisters are hypertensive

- **Eldest son:** is now hypertensive on therapy

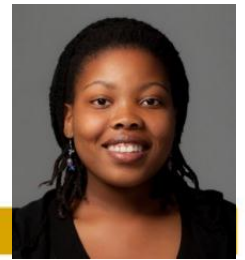# Current Medications

- Hydrochlorothiazide (HCTZ) 12.5 mg po OD
- Vitamin D 1000 IU po daily

Physical Examination

- Height: 172 cm
- Weight: 65 kg
- BMI: 22 kg/m^2
- BP (left arm, seated)
  - 134/86 mmHg
  - using an automated unattended device
  - Mean of 3 measurements

- HR: 72 regular
- Heart sounds normal
- No edema
- Chest exam normal
- Fundi show arterial narrowing
- Pulses normal

Investigations
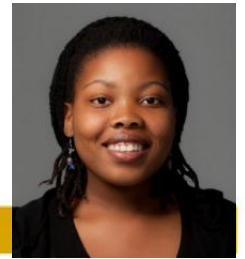
Test	Results	Normal Values
Fasting Glucose	5.5 mmol/L	4.0-8.0 mmol/L
Urea	4.8 mmol/L	3.0-7.0 mmol/L
Creatinine	75 µmol/L eGFR 70ml/min	44-106 umol/L
K	4.3 mmol/L	3.5-5.0 mmol/L
Urine ACR	1.0	< 2.0 mg/mmol

ECG is normal

Investigations
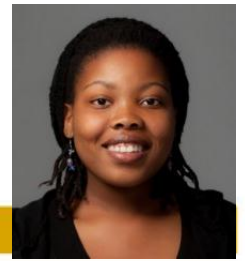
Test	Results	Normal Values
LDL	2.8 mmol/L	<2.50 mmol/L
Total Chol	4.2 mmol/L	<5.20 mmol/L
TG	1.4 mmol/L	<1.70 mmol/L
HDL	1.4 mmol/L	>0.99 mmol/L
TC:HDL	3.0	High risk target: <4.0 Mod risk target: <5.0 Low risk target: <6.0

Discussion Question 1

How do you make the initial diagnosis of Hypertension?

Discussion Question 1:
How do you make the initial diagnosis of HTN?

a) **Where should the initial diagnosis of hypertension be made?**

b) **What measurement methods are recommended to diagnose hypertension?**

c) **What are the current criteria for defining hypertension?**

Note: Discussion questions do not necessarily have only one correct answer

a) Where should the initial diagnosis of hypertension be made?

Acronyms

Office Blood Pressure Measurement	OBPM
Home Blood Pressure Measurement	HBPM
Ambulatory Blood Pressure Measurement	ABPM
Automated Office Blood Pressure Measurement	AOBP

2015 Recommendation Diagnosing HTN

The diagnosis of hypertension should be based on out-of-office measurements:

- Ambulatory Blood Pressure Measurement (ABPM) is the recommended out-of-office measurement method.

- Home Blood Pressure Measurement (HBPM) is recommended if ABPM is not tolerated, not readily available or due to patient preference.

b) What measurement methods are recommended to diagnose hypertension?

Ambulatory Blood Pressure Measurement (ABPM)

Ambulatory Blood Pressure Measurement Report

Physician : ▮▮▮▮
Patient ID ▮▮▮▮
Name : ▮▮▮▮
Sex : Male
Age : 78
DOB : ▮▮▮▮

Study Date_23/09/2015

Day and Night Period

	Time	Interval
Day :	07 ~ 22	20 min
Night :	22 ~ 07	30 min

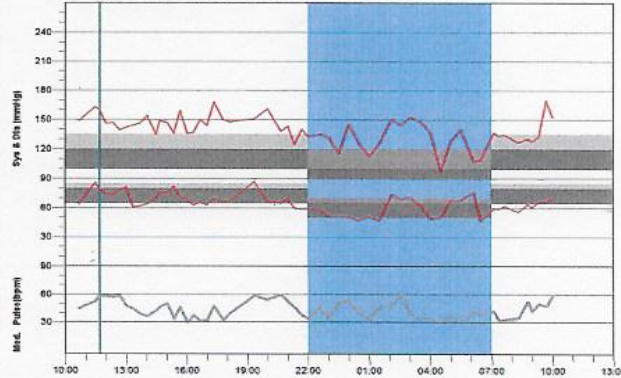**Actual Awake / Asleep**

Awake : 07 ~ 22 h
Asleep : 22 ~ 07 h

BP Threshold

Day : 135/85 mmHg
Night : 120/70 mmHg

Readings

Total Readings : 59
Successful : 55 (93.2%)

BP Load

Day readings ≥ 135/85 93.3%
Night readings ≥ 120/70 66.7%

Average Blood Pressure (SD)

	Sys	Dia	HR	MAP	PP
24-hr	140 (15)	65 (10)	46 (11)	90	75
Awake	145 (11)	69 (8)	48 (11)	94	76
Asleep	130 (16)	58 (10)	42 (10)	82	72

White Coat Window

	Sys	Dia	HR
Readings	3	3	3
1st hr Max	163	86	62

Night-time Dip%

	Sys	Dia
Dip%	10.3	15.9

| Date/ Time	Sys	Dia	HR	Date/ Time	Sys	Dia	HR	Date/ Time	Sys	Dia	HR
23/09/2015				20:41	138	65	64	07:41	135	62	33
10:41	149	64	47	21:00	143	70	56	08:21	127	56	35
11:28	163	86	56	21:20	125	60	48	08:48	131	64	56
11:40	160	80	62	21:43	140	59	39	09:00	128	61	44
12:00	146	75	62	22:01	133	59	34	09:20	133	66	53
12:20	147	74	61	22:38	135	59	49	09:42	170	67	50
12:40	139	79	63	23:03	132	51	34	10:00	153	69	62
13:00	142	81	50	23:31	116	51	54				
13:20	144	61	46	24/09/2015							
13:40	146	62	40	00:01	145	51	56				
14:03	154	64	37	00:30	127	47	42				
14:28	135	70	44	01:03	113	51	34				
14:40	149	76	49	01:31	126	47	50				
15:03	147	76	53	02:08	151	74	50				
15:23	136	82	34	02:34	144	69	64				
15:40	159	72	48	03:00	153	71	40				
16:03	136	69	29	03:33	148	63	34				
16:20	137	63	38	04:01	137	49	35				
16:41	150	66	31	04:31	98	50	29				
17:01	144	63	32	05:01	126	68	39				
17:21	168	70	50	05:30	140	68	28				
17:48	150	67	32	06:08	108	76	43				
18:08	148	67	41	06:30	110	47	41				
19:20	151	87	63	07:08	137	59	43				
20:00	161	67	58	07:23	134	59	32				

Comments: _____

Signature:

Ambulatory Blood Pressure Measurement (ABPM)
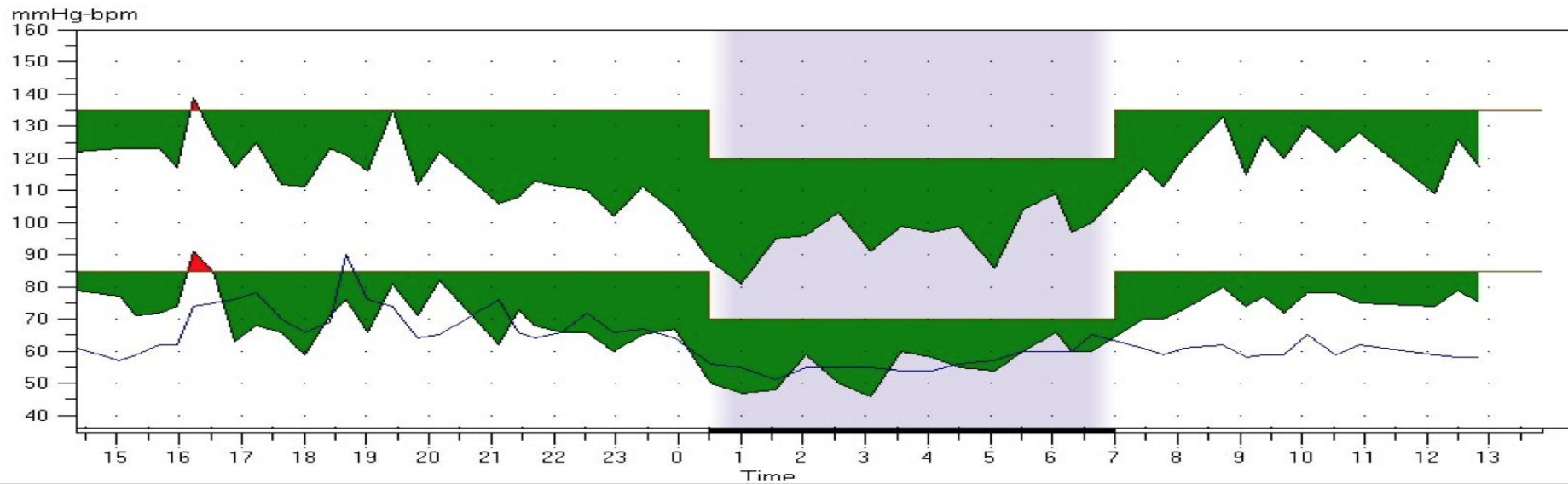
Period	Time	Samples	Mean Sys mmHg (+/- Std.Dev.)	Mean Dia mmHg (+/- Std.Dev.)	Mean HR BPM (+/- Std.Dev.)	BP Load Sys %	BP Load Dia %
Overall	14:22-13:34 (23:12)	52	113 (13.1)	68 (10.2)	63 (7.7)	2	2
Awake Period	07:00-00:30	38	119 (8.7)	72 (7.0)	66 (7.4)	3	3
Asleep Period	00:30-07:00	14	96 (7.5)	55 (6.1)	57 (3.5)	0	0

Asleep Dip: Sys = 19.0% Dia = 23.8%

- Normal study
- 70% capture rate for readings
- Minimum of 21 readings in the daytime
- Minimum 7 at night

Recommended automated blood pressure monitors for home blood pressure measurement

Complete list of devices endorsed by Hypertension Canada
http://www.hypertension.ca/devices-endorsed-by-hypertension-canada-dp1

Resources for Home Monitoring

www.hypertension.ca

- Information to assist you in training patients to measure blood pressure at home

- Information for patients on how to purchase a device for home measurement and how to measure blood pressure at home

- A training DVD on home measurement of blood

- http://www.hypertension.ca/en/hypertension/what-do-i-need-to-know/how-to-measure-my-blood-pressure

Hypertension CANADA

Professional ▾ **Public** ▾ **Congress** ▾ **Membership** ▾ **Research** **Advocacy** **Member Login** **Media** 🔍 search...

2015 CHEP Guidelines

Have your say! Your experience matters.

Professional Education Program

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eINFO Newsletter

Hypertension CANADA eINFO

What's New

Hypertension Canada Statement on the announcement of SPRINT study findings

Read more

High dietary sodium is a key risk contributing to the disease burden in Canada.

Welcome to Hypertension Canada

- Hypertension Canada is a volunteer-based, not-for-profit organization representing over 50 years of expertise in the field of hypertension.

- 7.5 million people in Canada live with hypertension. Hypertension Canada's mission is to advance health through the prevention and control of high blood pressure and its complications.

- Join us in helping Canadians have the healthiest and best managed blood pressure in the world.

Read more   Donate

CHEP Guidelines App

CHEP Guidelines available on Mobile devices. Download the CHEP App now and conveniently have readily available answers to your hypertension diagnosis, management and control questions at the tip of your finger.

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Devices endorsed by Hypertension Canada

Measuring blood pressure in the office

What is high blood pressure?

Diagnosis of high blood pressure

Join Us

c) What are the current criteria for defining hypertension?

Ambulatory Blood Pressure Measurement (ABPM)

ABPM: Criteria for Hypertension

Description	Blood Pressure mmHg
24-hour average	$\geq$130 / 80
Daytime average	$\geq$135 / 85

10-20% dipping from daytime average to nighttime average is considered normal

Home Blood Pressure Measurement (HBPM)

HBPM: Criteria for Hypertension

Description	Blood Pressure mmHg
24-hour average	$\geq$130 / 80
Daytime average	**$\geq$135 / 85**

Discussion Question 2

How should blood pressure be measured in the office?

Discussion Question 2:
How should blood pressure be measured in the office?

a) Using an automated office device?

b) Mercury manometers should be saved carefully?

c) Proper patient positioning is important?

d) Unattended or in the waiting room?

e) What about BP measured in the Pharmacy?

Discussion Question 2:
How should blood pressure be measured in the office?

a) Using an automated office device?

New 2016 Recommendation

Automated office blood pressure (AOBP) measurement is the preferred method of performing in-office BP measurement

Automated Office Blood Pressure Measurement (AOBP)

Office Automated (unattended, AOBP)
Oscillometric (electronic)

BpTRU®

Microlife Watch BP Office®

Omron HEM 907®

Devices Currently Available for AOBP

BpTRU®	• no rest • 6 readings in 6-7 min • 1st reading discarded
Microlife Watch BP Office®	• 1 min rest • 3 readings in 4 min
Omron HEM 907®	• 1 min rest • 3 readings in 4 min

Manual Office BP Measurement Methods

Auscultation Method:
- Standardized Method Takes ≈ 10 minutes

Mercury Sphygmomanometers
(mercury is toxic)

Aneroid Sphygmomanometers
(Calibration checks every 6 months)

Manual OBPM is Inaccurate

- Up to 20 studies in the past 4 decades
  - Errors observed in routine office auscultatory measurement
  - Leads to misclassification of BP
  - Errors by both nurses and physicians:
    - Observer
    - Preparation of the patient
    - Technique
    - Device used

Armstrong RS, et al. Int J Nursing Practice 2002;8:118-26
Gillespie A and Curzio J. Nursing Standard 1998;12:35-7
Gleichmann SI, et al. J Hypertens 1989;7(S3):S99-S102
Dreveniiorn E, et al. J Clinical Nursing 2001;10:189-94
McKay DW, et al. Medical Education 1992;26:208-12

McKay DW, et al. J Hum Hypertens 1990;4:639-45
Kemp F, et al. Professional Nurse 1994;9:521-4
Campbell NC, et al. AJH 2005;18:1522-7
Villegas I, et al. Hypertension 1995;26:1204-6

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Manual OBPM is Inaccurate

Accuracy of Manual BP can be adversely affected by:

- Conversation during BP readings
- Recording of only a single BP reading
- No antecedent period of rest before BPM
- Rapid deflation of the cuff
- Digit preference with rounding off readings to 0 or 5
- Patient's anxiety
- Mercury sphygmomanometer being phased out

Discussion Question 2:
How should blood pressure be measured in the office?

b) **Mercury manometers should be saved carefully?**

Mercury Control of Substances Hazardous to Health (COSHH) Regulations

- Mercury sphygmomanometers have been the 'gold standard' for measuring blood pressure for the last few decades

- Most are moving away from mercury equipment but they are still in use in many offices or are tucked away in cupboards gathering dust

- Mercury is toxic and mercury-containing products are being banned or phased out

- European Commission banned the of sale of mercury sphygmomanometer in 2009

- Spill Kits and Proper Disposal

http://esuppliesmedical.co.uk/blog/mercury-coshh-regulations/

Discussion Question 2:
How should blood pressure be measured in the office?

c) **Proper patient positioning is important?**

Positioning the patient

Common to all methods of office BP measurement, the patients should be:

- ❑ Seated
- ❑ Back supported
- ❑ Legs uncrossed
- ❑ Feet flat on floor
- ❑ Arm supported
- ❑ Midpoint of cuff at heart level

Adapted from Cloutier, Perspective infirmière, p.48, 2011

How should blood pressure be measured in the office?

d) **Unattended or in the waiting room?**

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Hypertension
CANADA

Comparison of AOBP, ABPM and Waiting Room

Comparison of Automated Office Blood Pressure Measurement (AOBP), Ambulatory Blood Pressure Measurement (ABPM) and Waiting Room:

- Readings recorded in an ABPM unit or in an office waiting room are similar to AOBP recorded in a physician's examination room

Therefore AOBP is NOT Affected by the Setting in which Blood Pressure is Recorded

Myers MG, et al. Blood Press Monit 2009;14:108-11
Greiver M, et al. Blood Press Monit 2012;17:137-8
Armstrong D, et al. Blood Press Monit 2015;20:204-8

Discussion Question 2:
How should blood pressure be measured in the office?

e) What about BP measured in the Pharmacy?

Comparison of AOBP, ABPM and Pharmacy

Comparison of Automated Office Blood Pressure Measurement (AOBP), Ambulatory Blood Pressure Measurement (ABPM) and Pharmacy Blood Pressure Measurements:

- Pharmacy BP's were comparable with AOBP results from the physician's office.
- Does it requires patient training?

Therefore AOBP is NOT Affected by the Setting in which Blood Pressure is Recorded

Chambers LW, et al. CMAJ Open 2013;1:E37-42

Discussion Question 3

Is Mariam Hypertensive?
If so, what kind of hypertension does she have?

Discussion Question 3: Is Mariam Hypertensive? If so, what kind of hypertension does she have?
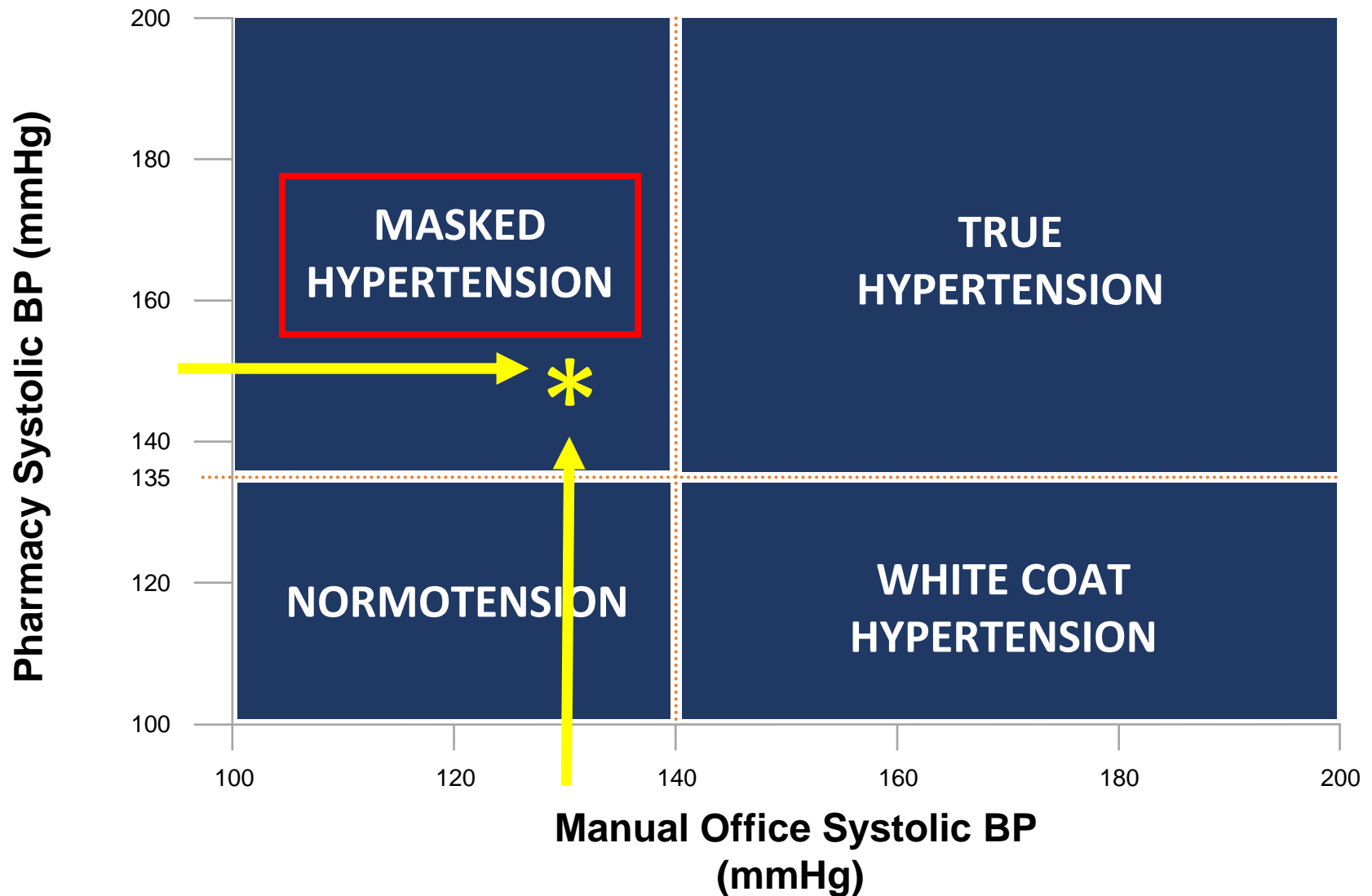
REMINDER of the Case:

- While shopping for food, measured her BP at the drug store

- Automated device repeatedly gave measures → 145/90 to 155/95

- Family MD's office BP's have always been < 135/85

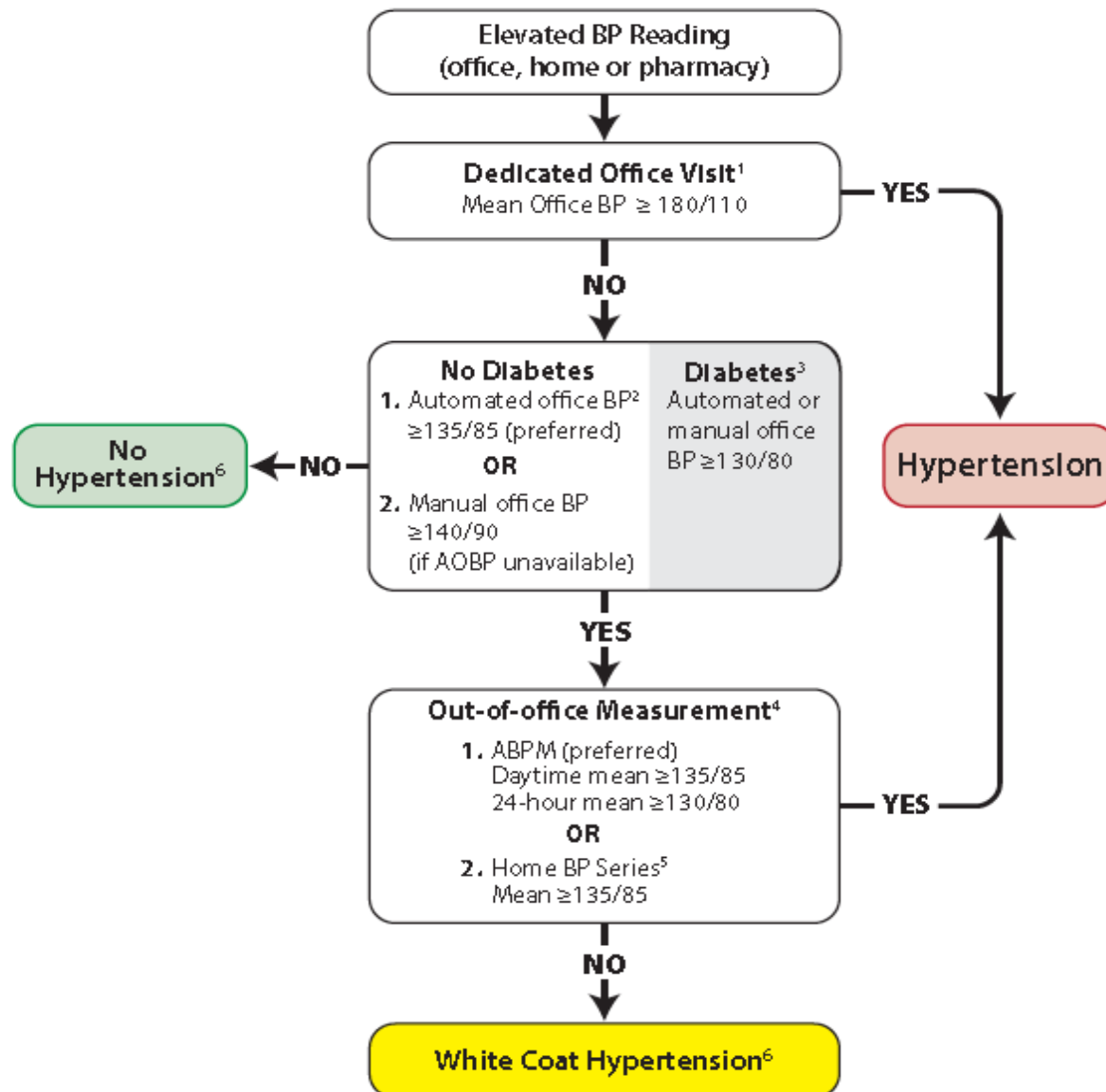- She takes HCTZ 12.5mg po daily, regularly

Discussion Question 3: Is Mariam Hypertensive? If so, what kind of hypertension does she have?

a) Not hypertensive, controlled BP?

b) White Coat Hypertension?

c) Masked Hypertension?

d) Masked Uncontrolled Hypertension?

White Coat and Masked Hypertension

Adapted from CHEP. www.hypertension.ca. Derived from Pickering *et al. Hypertension* 2002: 40: 795-796.

Hypertension Diagnostic Algorithm

Elevated BP Reading
(office, home or pharmacy)

↓

Dedicated Office Visit[1]
Mean Office BP ≥ 180/110 —— **YES** ——→ **Hypertension**

NO ↓

No Diabetes	**Diabetes[3]**
1. Automated office BP[2] ≥135/85 (preferred)	Automated or manual office BP ≥130/80
OR	
2. Manual office BP ≥140/90 (if AOBP unavailable)	

←— **NO** —— **No Hypertension[6]**

YES ↓

Out-of-office Measurement[4]

1. ABPM (preferred)
   Daytime mean ≥135/85
   24-hour mean ≥130/80
OR
2. Home BP Series[5]
   Mean ≥135/85

—— **YES** ——→ (Hypertension)

NO ↓

White Coat Hypertension[6]

Notes:

1. If manual BP is used, take at least three readings, discard the first and calculate the mean of the remaining measurements. If AOBP is used, use the mean calculated and displayed by the device. A history and physical exam should be performed and diagnostic tests ordered.

2. Automated office BP is performed with the patient unattended in a room or private area.

3. Diagnostic thresholds for automated office BP, ABPM, and home BP in patients with diabetes have yet to be established (and may be lower than 130/80 mmHg).

4. Serial manual office measurements over 3-5 visits can be used if ABPM or home measurement not available.

5. Home BP Series: Two readings taken each morning and evening for 7 days (28 total). Discard first day readings and average the last 6 days.

6. Annual BP measurement is recommended to detect progression to hypertension.

Manual BP = Non-automated measurement performed using an electronic upper arm device with the provider in the room.

ABPM: Ambulatory Blood Pressure Measurement

AOBP: Automated Office Blood Pressure

Discussion Question 3: Is Mariam Hypertensive? If so, what kind of hypertension does she have?

c) Masked Hypertension?

- Normal BP in Office, but Elevated BP out of office
- Not on any medications for Blood Pressure

Discussion Question 3: Is Mariam Hypertensive? If so, what kind of hypertension does she have?

- While shopping for food, dropped into the drug store and measured her BP

- The automated device repeatedly gave measures of: 145/90 to 155/95

- Her BP at her Family MD's office taken by the Nurse Practitioner has always been < 135/85

- **She takes her meds regularly**

Discussion Question 3: Is Mariam Hypertensive? If so, what kind of hypertension does she have?

d) Masked Uncontrolled Hypertension?

- **Treated with Anti-Hypertensive Medications**
  - Short Acting Agents
  - May not be compliant
- **Good Blood Pressure Reading in the office, but Elevated Outside of Office**

Prevalence of Masked and Masked Uncontrolled Hypertension

about

10%

in the general population
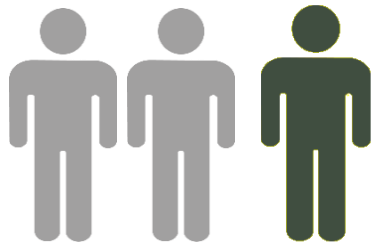
about

30%

in treated hypertensive patients*
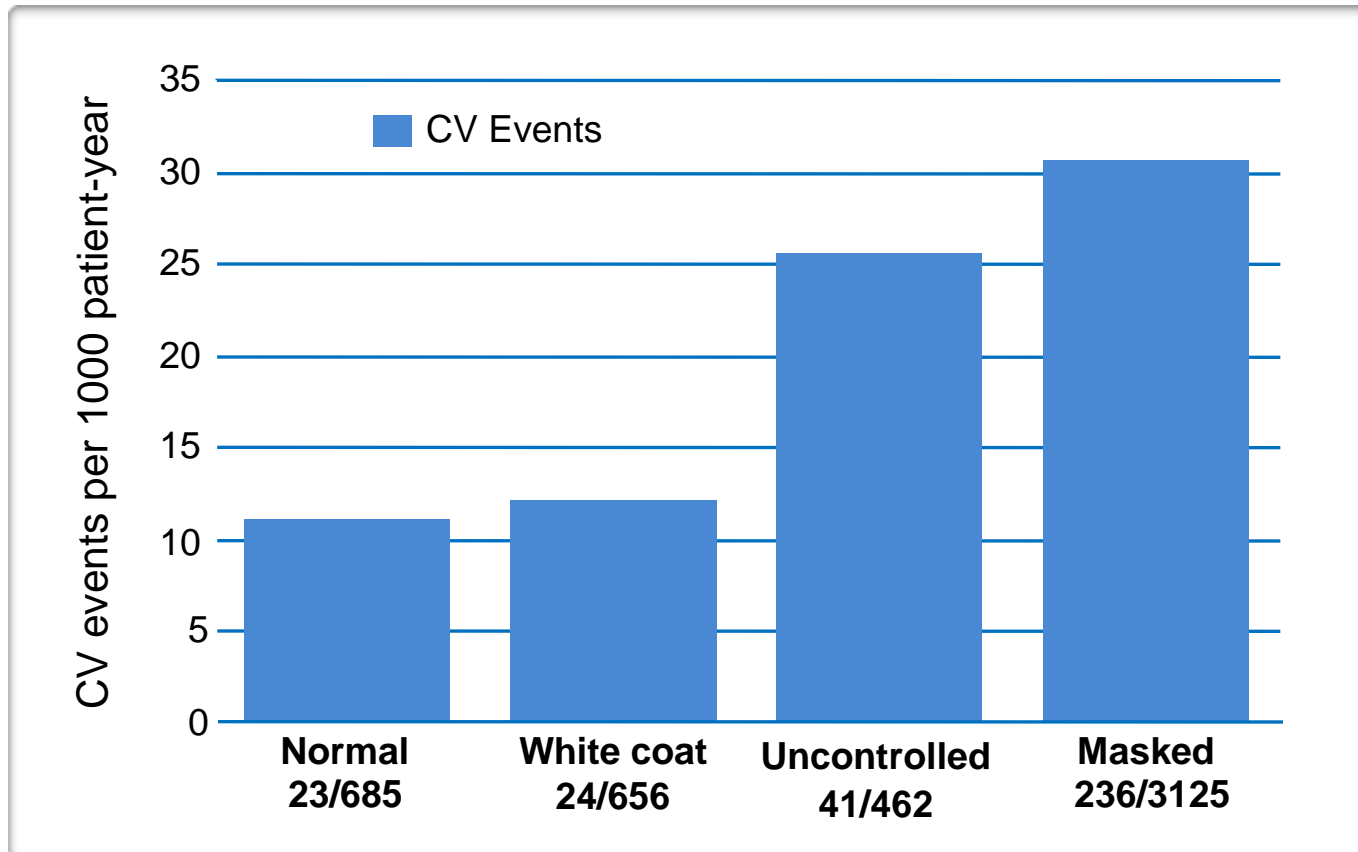
higher

in patients with

diabetes

and

chronic kidney

disease patients

One out of three treated hypertensive patients has masked hypertension

*Andalib A et al. Int Med J 2012; 42:260-6

Prognosis of *White Coat & Masked* Hypertension

Okhubo et al. *J. Am. Coll. Cardiol.* 2005;46;508-515

Discussion Question 4

How to manage Mariam's hypertension?

Discussion Question 4:
How to manage Mariam's hypertension?

a) Recognize that uncontrolled hypertension in treated women over age 60 is common

b) Consider longer lasting therapy
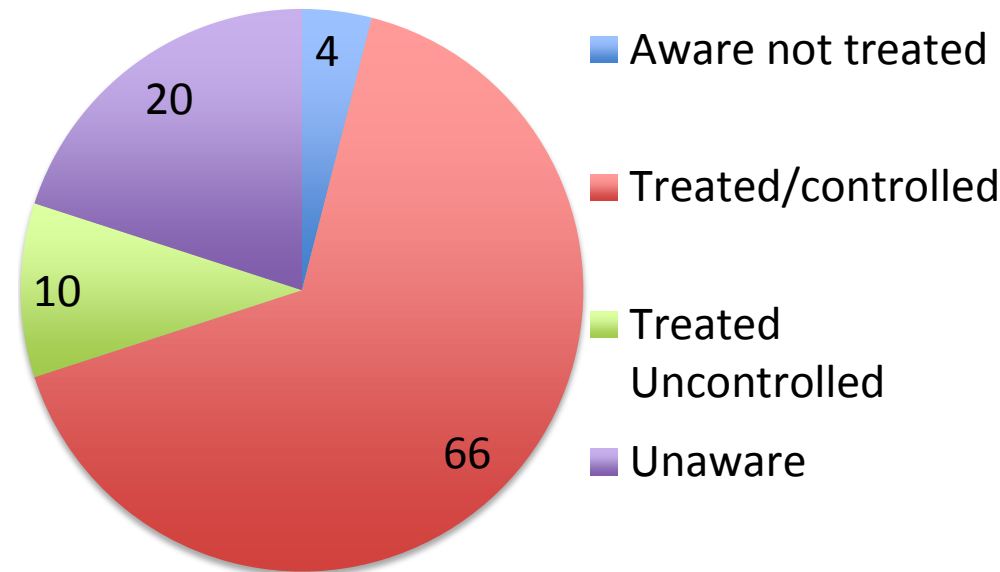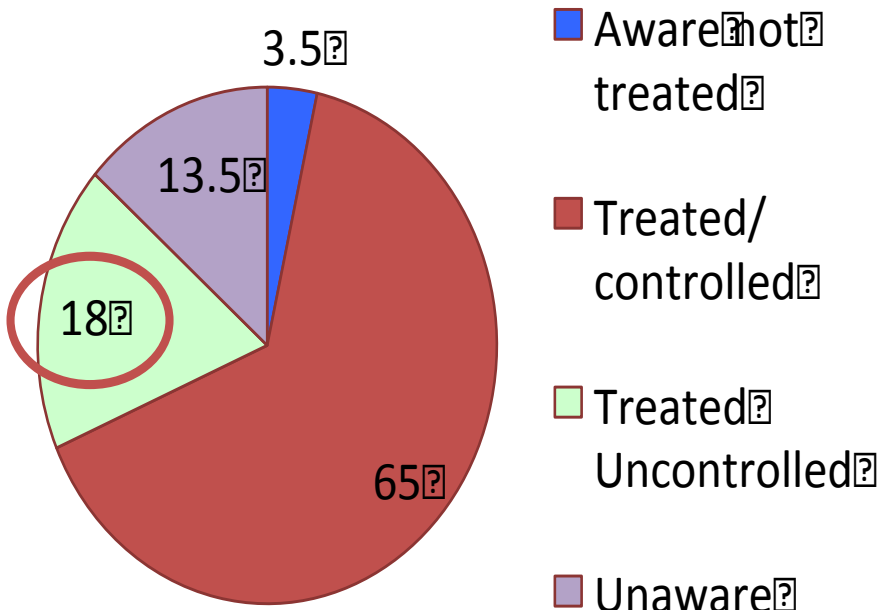
c) Consider adherence

Discussion Question 4:
How to manage Mariam's hypertension?

a) **Recognize that uncontrolled hypertension in treated women over age 60 is common**

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Awareness Treatment and Control in Men and Women from the Canadian Health Measures Survey

% Female

3.5
13.5
18
65

- ■ Aware not treated
- ■ Treated/ controlled
- □ Treated Uncontrolled
- ■ Unaware

% male

4
20
10
66

- ■ Aware not treated
- ■ Treated/controlled
- ■ Treated Uncontrolled
- ■ Unaware

Uncontrolled hypertension is particularly common in treated woman over 60 years old

CHEP

Wilkins K. Cdn Health Reports 2010

Hypertension CANADA

Discussion Question 4:
How to manage Mariam's hypertension?

b) **Consider longer lasting therapy**

Discussion Question 4:
How to manage Mariam's hypertension?

b) Consider longer lasting therapy

- **Indapamide**
- **Chlorthalidone**
- **ACEi**
- **ARB**
- **CCB**

Impact of Health Behaviours on Blood Pressure

Intervention	Systolic BP (mmHg)	Diastolic BP (mmHg)
Diet and weight control	-6.0	-4.8
Reduced salt/sodium intake	- 5.4	- 2.8
Reduced alcohol intake (heavy drinkers)	-3.4	-3.4
DASH diet	-11.4	-5.5
Physical activity	-3.1	-1.8
Relaxation therapies	-3.7	-3.5
Multiple interventions	-5.5	-4.5

CHEP

Hypertension CANADA

2014

Discussion Question 4:
How to manage Mariam's hypertension?

C) Consider adherence

Adherence in Hypertensive Patients

Can be improved by:

- Assess adherence to pharmacological and health behaviour therapies at every visit

- Teach patients to take their pills on a regular schedule (associated with a routine daily activity → brushing teeth)

- Simplify medications by using long acting once daily dosing

- Utilize single pill combinations

- Utilize unit-of-use packaging (ie. blister packs)

Case Progression

- Patient returns to your office.
- She is now on chlorthalidone 25 mg po daily
- Her BP at home is now < 130/80

Key Learnings

1. New Canadian Hypertension Guidelines for diagnosis of hypertension are with Home and Ambulatory Blood Pressure Monitor (ABPM)

2. Automated Office Blood Pressure (AOBP) measurements for follow-up BP

3. Defined White Coat, Masked, and Masked UnControlled Hypertension (MUCH)

Key Learnings

4. ABPM has better predictive ability than OBPM and is the recommended out-of-office measurement method.

5. HBPM has better predictive ability than OBPM and is recommended if ABPM is not tolerated, not readily available or due to patient preference.

6. Identifies white coat hypertension (as well as diagnosing masked hypertension)