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Connaissances, perception et pratique des professionnels de la santé concernant les méthodes de mesure de la pression artérielle

Knowledge, perception, and practice of health professionals regarding blood pressure measurement methods

par Shweta Todkar

Programme de sciences biomédicales
Faculté de médecine
en extension à l'Université du Québec à Trois-Rivières

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Cette thèse intitulée

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Présentée par

Shweta Todkar

A été évaluée par un jury composé des personnes suivantes :

André Bussière

Présidente-rapporteur

Lyne Cloutier

Directrice de recherche

Raj Padwal

Codirecteur

Jacques Blacher

Membre du jury

Ping Zou

Examinatrice externe

Résumé

L'hypertension est un facteur de risque mondial majeur qui touche environ 23 % de la population canadienne. Si elle n'est pas diagnostiquée et traitée adéquatement, l'hypertension artérielle entraînera des complications affectant le cœur, le cerveau ou les reins. Le diagnostic et le traitement de l'hypertension dépendent en grande partie d'une mesure valide de la pression artérielle (PA). Les lignes directrices d'Hypertension Canada préconisent l'utilisation de méthodes de la mesure de la PA standardisé, à savoir à domicile (MPAD), ambulatoire (MAPA), en clinique (MPAC) et en clinique oscillométrique en série (MPAC-OS) pour la prise en charge de l'hypertension. Ces méthodes de mesure de la PA ont été étudiées de façons indépendantes en ce qui concerne les connaissances, la perception ou la pratique, mais pas systématiquement et seulement partiellement au Canada. Les professionnels de la santé, à savoir les médecins, les infirmières et les pharmaciens, jouent un rôle important dans la mesure de la PA et, par conséquent, une image plus claire de leurs connaissances, de leur perception et de leur pratique est nécessaire. L'objectif de cette étude était ainsi d'évaluer les connaissances, la perception et la pratique des médecins, infirmières et pharmaciens de travail en milieux de soins primaires à travers le Québec concernant les quatre méthodes de mesure de la PA.

Pour identifier la littérature publiée sur ce sujet, une revue de la portée a été réalisée évaluer systématiquement la littérature pour les quatre méthodes de la mesure de la PA en regard des trois concepts pour les professionnels de la santé. Lorsque les résultats rapportés des études individuelles étaient supérieurs à 50%, les études étaient classées comme adéquates pour les connaissances, positives pour la perception et satisfaisantes pour la pratique. Au total, 72 études ont été identifiées. Les résultats ont montré que les perceptions des professionnels de la santé étaient positives, mais que leurs connaissances étaient insuffisantes et leur pratique insatisfaisante, et que les infirmières et les pharmaciens demeurent sous-étudiés. Ceci est le premier article de la thèse, et il a été publié. Une étude descriptive a été menée pour évaluer les connaissances, la perception et la pratique les professionnels de la santé concernant la mesure de la PA tant en clinique qu'en ambulatoire. À l'aide des lignes directrices d'Hypertension Canada et de la littérature pertinente, un questionnaire élaboré par la chercheure a été formulé

et traduit en anglais et en français, puis validé par un panel de quatre experts dans le domaine de l'hypertension.

La population de l'étude concernait tous les médecins, infirmières et pharmaciens exerçant en soins primaires au Québec ont été sélectionnés pour cette étude. Le recrutement des participants a été réalisé en collaboration avec leurs associations professionnelles respectives. Les médecins et pharmaciens ont été recrutés via la lettre d'information mensuelle de leurs associations, tandis qu'une invitation personnalisée a été envoyée par courriel aux infirmières. Un lien vers une plateforme sécurisée suivi de deux rappels a été transmis aux participants. La collecte des données a eu lieu entre novembre 2019 et janvier 2020. Un certificat d'éthique a été obtenu de l'UQTR. Les données ont été analysées à l'aide de statistiques descriptives comprenant la fréquence, le pourcentage, la moyenne et les écart types.

Quant aux résultats, un total de 453 infirmières a participé au sondage. Le score global des connaissances était inférieur à 50%, ce qui a été jugé insuffisant. Cependant, le score global pour la perception était supérieur à 50%, ce qui montre leur accord sur l'utilité des méthodes la mesure de la PA pour la gestion de l'hypertension. La pratique n'était pas satisfaisante pour les méthodes ambulatoires, en particulier dans les domaines de l'éducation dispensée aux patients mais également des conseils dispensés. Une légère évolution dans l'utilisation des dispositifs oscillométriques plutôt que les mesures manuelles a été observée. Cependant, au Canada, l'MPAC-OS, qui est la méthode préférée en clinique, n'est utilisée de façon routinière que par un quart des infirmières. Il s'agit du deuxième article de la thèse. Pour les résultats des médecins et des pharmaciens, un total de 45 médecins et 30 pharmaciens ont participé à l'enquête. Leur score global de perception était supérieur à 50%, tandis que le score global de connaissance était légèrement supérieur à 50%, ce qui est assez adéquat. La pratique était assez satisfaisante pour toutes les méthodes de mesure de la pression artérielle. Cependant, un pourcentage substantiel de médecins (32%) et de pharmaciens (7%) utilisent encore l'auscultation manuelle comme méthode de routine en clinique, tandis que seulement 13% des médecins et 3% des pharmaciens utilisent la méthode MPAC-OS.

À notre connaissance, il s'agit de la première étude au Québec à dresser un portrait complet de la connaissance, de la perception et de la pratique les professionnels de la santé pour

les quatre méthodes la mesure de la PA. Les résultats de l'examen de portée ont mis en évidence qu'une connaissance inadéquate et une pratique insatisfaisante des méthodes de la mesure de la PA restent une préoccupation majeure dans le monde. Le fait est que les infirmières et les pharmaciens ont été peu étudiés, bien qu'une approche d'équipe multidisciplinaire soit fortement encouragée pour la gestion de l'hypertension. Les résultats pour les médecins, les infirmières et les pharmaciens soulignent que les connaissances et la pratique sont sous-optimales et doivent être améliorées. La généralisabilité des résultats est cependant limitée pour les médecins et les pharmaciens en raison de l'échantillon limité. Ces résultats pourraient aider à planifier d'autres stratégies pour mettre en œuvre la certification la mesure de la PA, guider l'application des connaissances, mener d'autres recherches à travers le Canada pour obtenir une vue d'ensemble, identifier les obstacles en la mesure de la PA et aider à combler le fossé entre les lignes directrices et la pratique. Les efforts d'Hypertension Canada et d'autres sociétés d'hypertension pour fournir des ressources éducatives et des outils aux professionnels de la santé sont louables. Il faut donc s'assurer que les ressources disponibles sont mises en œuvre et que la formation continue est encouragée.

Mots clés : connaissances, perception, pratique, infirmière, médecin, pharmacien, monitorage ambulatoire de la pression artérielle, mesure de la pression artérielle à domicile, mesure de la pression artérielle en clinique, mesure de la pression artérielle en clinique - oscillométrique en série, détermination de la pression artérielle.

Abstract

Hypertension is a leading global risk factor affecting approximately 23% of the Canadian population. If not diagnosed and treated accurately, hypertension will lead to complications affecting the heart, brain, or kidneys. The diagnosis and treatment of hypertension depend largely on accurate blood pressure measurement (BPM). Hypertension Canada Guidelines recommend using standardized BPM methods, namely home (HBPM), ambulatory (ABPM), office (OBPM), and automated (AOBP) for hypertension management. These BPM methods have been studied independently concerning either knowledge, perception, or practice, but not systematically and only partially in Canada. Health professionals (HPs), namely the physicians, nurses, and pharmacists, play a significant role in BPM, and therefore a clearer picture of their knowledge, perception, and practice is needed. The objective of this study was to assess the knowledge, perception, and practice of the physicians, nurses, and pharmacists working in the primary care settings across Quebec concerning the four BPM methods.

To identify the published literature on this topic, a scoping review was performed that systematically appraised the literature for the four BPM methods and three concepts for HPs. When results reported from individual studies were above 50%, studies were classified as adequate for knowledge, positive for perception, and satisfactory for practice. A total of 72 studies were identified. The results showed that health professionals' perceptions were positive, but their knowledge was inadequate, the practice was unsatisfactory, and nurses and pharmacists remained understudied. This is the first article of the thesis, and it was published. A descriptive study was conducted to assess knowledge, perception and practice of HPs concerning ambulatory and clinic BPM methods. Using Hypertension Canada Guidelines and relevant literature, an investigator-initiated questionnaire was formulated and translated in English and French and further validated by a panel of four experts in the field of hypertension. All registered physicians, nurses, and pharmacists practicing in primary care across Quebec were selected for this study. Recruitment of participants was executed in collaboration with their respective professional associations. Physicians and pharmacists were recruited through the monthly newsletter of their associations, while a personalized invitation was sent by email to nurses. A link to a secured platform followed by two reminders was provided to participants. Data

collection took place between November 2019-January 2020. An ethical certificate was obtained from UQTR. Data was analyzed using descriptive statistics including frequency, percentage, mean and standard deviation.

As for results, a total of 453 nurses participated in the survey. The overall knowledge score was below 50%, which was considered inadequate. However, the overall perception score was above 50%, showing their agreement on the usefulness of BPM methods for hypertension management. The practice was unsatisfactory for HBPM and ABPM methods, especially in the areas of education and frequency of recommending it to patients, while a slight change from manual auscultation to the oscillometric device is observed. However, in Canada, AOBP, which is the preferred method in-clinic, is used routinely only by a quarter of the nurses. This is the second article of the thesis. For the results of physicians and pharmacists, a total of 45 physicians and 30 pharmacists participated in the survey. Their overall perception score was above 50%, while the overall knowledge score was slightly above 50%, which is fairly adequate. The practice was somewhat satisfactory for all BPM methods. However, a substantial percentage of physicians (32%) and pharmacists (7%) use manual auscultation as a routine in-clinic method, while only 13% of physicians and 30% of pharmacists use the AOBP method.

To our best knowledge, this is the first study in Québec and Canada to depict a complete picture of the knowledge, perception, and practice of HPs for all four BPM methods. The results of the scoping review highlighted that inadequate knowledge and unsatisfactory practice of BPM methods remain a major concern worldwide. The fact is that the nurses and pharmacists were understudied, although a multidisciplinary team approach is strongly promoted for the management of hypertension. The results for physicians, nurses, and pharmacists highlight that the knowledge and practice are suboptimal and need improvement. However, the generalisability of the results is limited for physicians and pharmacists due to the limited sample. These findings could help plan further strategies to implement BPM certification, guide in knowledge translation, conduct further research across Canada to get a larger picture, identify barriers in BPM, and help bridge the gap between guidelines and practice. The efforts of Hypertension Canada and other hypertension societies to provide educational resources and

tools for HPs are commendable. Therefore, it must be ensured that the available resources are implemented, and that continuing education is encouraged.

Keywords: knowledge, perception, practice, nurse, physician, pharmacist, ambulatory blood pressure monitoring, home blood pressure monitoring, automated office blood pressure measurement, blood pressure determination.

Table of content

List of tables

List of figures

List of abbreviations

ABPM	Ambulatory blood pressure measurement
AOBP	Automated blood pressure measurement
ACE	Angiotensin-converting enzyme
ADH	Antidiuretic hormone
ANS	Autonomic nervous system
ANP	Atrial natriuretic peptide
ARBs	Angiotensin receptor blockers
ACEIs	Angiotensin-converting enzyme inhibitors
BP	Blood pressure
BPM	Blood pressure measurement
BIQ	Banque interactive de questions
BEEP	Blood pressure measurement education programme
CCB	Calcium channel blockers
CHD	Coronary heart disease
CHEP	Canadian Hypertension Education Programme
CHF	Congestive cardiac failure
CKD	Chronic kidney disease
CRF	Chronic renal failure
CVA	Cerebrovascular accident
CVD	Cardiovascular disease
CVI	Content validity index
DALYs	Disability-adjusted life years
DASH	Dietary Approach to Stop Hypertension
DBP	Diastolic blood pressure
EHR	Electronic health records
EMR	Electronic medical records
FMOQ	Fédération des Médecins Omnipraticiens du Québec
GMF	Groupe de médecine de Famille

GIRAS	Groupe interdisciplinaire de recherche appliquée en santé
HBPM	Home blood pressure measurement
HP	Health professionals
HICs	High-income countries
I-CVI	Item content validity index
LMICs	Low- and middle-income countries
MUCH	Masked uncontrolled hypertension
NADPH	Nicotinamide adenine dinucleotide phosphate
NPs	Nurse Practitioner
OBPM	Office blood pressure measurement
OIIQ	Ordre des Infirmières et Infirmiers du Québec
OPQ	Ordre des Pharmaciens du Québec
PAD	Peripheral artery disease
RAAS	Renin-angiotensin-aldosterone-system
RCT	Randomized controlled trait
RN	Registered Nurses
SBP	Systolic blood pressure
S-CVI/Ave	Scale level content validity index/average
SQHA	Société Québécoise d'hypertension artérielle
SPSS	Statistical Package for the Social Sciences
SMS	Short messaging services
WCH	White coat hypertension

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Introduction

This doctoral thesis consists of 8 chapters. Chapter 1 covers the research problem and its objectives. Chapter 2 covers the literature review that includes hypertension, the pathophysiology of hypertension, management of hypertension, blood pressure measurement (BPM) evolution, the importance of BPM methods in hypertension management, the diagnostic algorithm in Canada, recommendations concerning BPM methods, sources of errors during BPM, educational interventions on BPM, the role of the nurse in hypertension management, the role of health professionals (HP) in BPM and the conceptual framework adopted for this research. Chapter 3 covers the first article of the research on literature review entitled: *Knowledge, Perception and Practice of Health Professionals Regarding Blood Pressure Measurement Methods: A Scoping Review,* which is published in the *Journal of Hypertension*. Chapter 4 covers the methodology of the research. Chapter 5 covers the second article of the research entitled: *Knowledge, Perception and Practice of Québec Nurses for Ambulatory and Clinic Blood Pressure Measurement Methods: Are We There Yet?* which is published in the *Journal of Hypertension*. Chapter 6 covers the results of physicians and pharmacists entitled: *Knowledge, Perception and Practice of Québec physicians and pharmacists for Ambulatory and Clinic Blood Pressure Measurement Methods.* Chapter 7 covers a general discussion, limits, strengths, and recommendations for education, practice, and research. Finally, chapter 8 concludes this thesis.

Chapter 1. Research problem

Background

Cardiovascular diseases are the leading cause of death worldwide, accounting for more than 17,3 million deaths annually in 2013 and expect to rise by more than 50% by the end of the next decade (Benjamin et al., 2017; Stanaway et al., 2018). Hypertension is the leading global risk factor accounting for 9,4 million deaths annually and 7% of the disability-adjusted life years (DALYs) (Lim et al., 2012). In 2000, 1 out of 6 world's adult population aged 20 years and above had hypertension which increased by 7,7% in 2010 and is predicted to grow by 50% by 2050 (Kearney et al., 2005; Mills et al., 2016). In 2010, a total of 31% of the global adult population (32% among men and 30% among women); had hypertension defined as systolic blood pressure (SBP) ≥140 mmHg and diastolic blood pressure (DBP) ≥90 mmHg (Mills et al., 2016); while in 2015, 24% men and 20% women had hypertension (Zhou et al., 2017). Also, the prevalence of hypertension was higher in the low- and middle-income countries (LMICs) (32%, 1.04 billion people) as compared to high-income countries (HICs) (29%, 349 million people) (Mills et al., 2016; Mills, Stefanescu, & He, 2020). Despite the increase in prevalence, the proportion of hypertension awareness, treatment, and control is considerably lower in LMICs than HICs (Geldsetzer et al., 2019; Mills et al., 2020). Recent global data reported that among the 34% with hypertension, 59% were aware of their diagnosis, 55% were treated, 32% were controlled, while 32% had never had their BP measured before (Beaney et al., 2020).

In Canada, approximately 23% of the adult population [24,3% women and 21,7% men] have been diagnosed with hypertension (Robitaille et al., 2012). The Canadian rates for hypertension awareness, treatment, and control are highest in the world and have significantly increased from 13,2% to 64,6% between 1992 and 2007, and the rate continued to grow to 68,1% in 2013 (McAlister et al., 2011; Padwal, Bienek, McAlister, & Campbell, 2016). This attributed to various health strategies that include a well-funded medical and public health system, efforts of health care organizations and professionals to reduce the burden of hypertension, the presence of annually updated Hypertension Canada guidelines, and a robust implementation framework for these guidelines, the efficacy of knowledge translation about hypertension, its diagnosis, and treatment (Campbell & Chen, 2010; Campbell & Feldman, 2016; Schiffrin et al., 2016). Even with these significant improvements, hypertension remains uncontrolled in >30% of individuals, and about 16% of individuals are unaware of their high BP, thus susceptible to health complications (Padwal et al., 2016). Furthermore, despite the achievements, the hypertension awareness, treatment and control rates in Canada declined substantially between 2007-2017 and, mainly, in women (Leung et al., 2020). In Canada, hypertension attributable costs were nearly $14 billion in 2010 and were estimated to increase to $20.5 billion by 2020 (Weaver et al., 2015).

Hypertension

Hypertension is defined as elevated systolic blood pressure (SBP) of ≥140 mmHg and diastolic blood pressure (DBP) of ≥ 90 mmHg (Kaplan, Victor, & Flynn, 2015). Several factors, including age, genetic, environmental, and lifestyle, contribute to the onset of hypertension (Kaplan et al., 2015; Staessen, Wang, Bianchi, & Birkenhäger, 2003). The prevalence of hypertension increases significantly with age (Buford, 2016). The pathogenesis of hypertension is multifactorial, involving the central nervous system, renal system, and endocrine system (Kaplan et al., 2015; Oparil, Zaman, & Calhoun, 2003). Hypertension is often called the silent killer, and it often remains undetected until the complications arise (Kaplan et al., 2015). If left untreated, hypertension can increase a person's risk of coronary heart disease (CHD), myocardial infarction (MI), congestive cardiac failure (CHF), peripheral artery disease (PAD), cerebrovascular accident (CVA), retinopathy, chronic renal failure (CRF) and dementia (Kaplan et al., 2015). Mostly hypertension shows no symptoms and can be diagnosed through proper BP measurement (BPM) (Oparil et al., 2018).

Blood pressure measurement

The impact of uncontrolled or untreated hypertension among the adult population is a significant contributor to cardiovascular risk and the overall burden of the disease (Zhou, Xi, Zhao, Wang, & Veeranki, 2018). Early diagnosis and treatment are essential to reduce this impact (Veiga et al., 2016). Accurate BPM is crucial for the optimal diagnosis and treatment of hypertension (Cloutier et al., 2015; Pickering et al., 2005). Accurate BPM requires standardized measurement methods, proper patient preparation, calibrated device, and valid interpretation of readings (Cloutier et al., 2015; Kallioinen, Hill, Horswill, Ward, & Watson, 2017; Padwal et al., 2019). Inconsistency in BPM results in misdiagnosis and treatment inaccuracies, further increasing cardiovascular risk (Campbell, Myers, & McKay, 1999; McKay, Raju, & Campbell, 1992; Ray, Nawarskas, & Anderson, 2012).

Such inaccuracies have many sources categorized into patient-related, technique-related, equipment-related, and observer-related (Kallioinen et al., 2017; Muntner et al., 2019; Padwal et al., 2019). For example, the common factors related technique include arm position below heart level, which can lead to an overestimation of BP by 7-10/8-11 mmHg, leg crossing increases BP by 8-10/4-5 mmHg and talking during the procedure increases BP by 17/13 mmHg. These factors can lead to misinterpretation of BP (Campbell, Culleton, & McKay, 2005; Kallioinen et al., 2017; Netea, Lenders, Smits, & Thien, 2003). In addition, constant overestimation and underestimation of BP by 5 mmHg can lead to incorrect diagnosis and inappropriate treatment with antihypertensive medications, further increasing unnecessary treatment costs (Campbell et al., 2005; Handler, 2009; Jones, Appel, Sheps, Roccella, & Lenfant, 2003; Ray et al., 2012; Turner, Baker, & Kam, 2004). Hence, it is essential to consider these factors when measuring BP to ensure the accurate measurement is performed.

Blood pressure measurement methods

In Canada, special efforts have been made to improve hypertension diagnosis and treatment through dedicated guidelines (Rabi et al., 2020). Guidelines regarding BPM have been widely available in Canada through various dissemination activities (Campbell et al., 2012).

These guidelines are essential for HP to accurately measure BP using the standardized BPM methods (Rabi et al., 2020). Standardized BPM methods exist for out-of-office and in-office: out-of-office BPM includes ambulatory (ABPM) and home (HBPM), and in-office BPM includes office (OBPM) and automated (AOBP) methods. HBPM refers to BP measured by the patient with an oscillometric device twice in the morning and twice in the evening for seven days. ABPM refers to out-of-clinic BPM using a fully automated device that automatically calculates and records BP readings (every 20-30 minutes over 24hr) (Blom et al., 2015; Cloutier et al., 2015). These methods have gained increasing importance in the clinical approach for measuring BP and are recommended and supported by Hypertension Canada guidelines (Cloutier et al., 2015; Rabi et al., 2020). OBPM refers to in-clinic BPM by a trained HP using electronic oscillometric upper arm devices. AOBP refers to in-clinic BPM using a fully automated device that automatically records multiple BP readings and averages those readings without an HP (Blom et al., 2015; Cloutier et al., 2015). Traditionally, office BP measurement was performed manually using the auscultatory method with mercury or aneroid sphygmomanometers and a stethoscope (Cloutier et al., 2015). However, due to various factors such as environmental concerns, device errors, and misdiagnosis of hypertension leading to inappropriate treatment, these auscultatory techniques are no longer recommended by the Hypertension Canada guidelines and OBPM with oscillometric devices that are preferred over auscultation (Blom et al., 2015; Cloutier et al., 2015; Gelfer, Dawes, Kaczorowski, Padwal, & Cloutier, 2015; Rabi et al., 2020).

Twenty-four-hour ABPM is considered as the gold standard for diagnosis of hypertension, and HBPM is considered for diagnosis and long-term follow-up in adults with inadequately controlled BP (Cloutier et al., 2015; Padwal et al., 2019; Parati, Ochoa, & Bilo, 2017; Rabi et al., 2020). As for HBPM and ABPM, certain advantages lead to a much better BP assessment (Cloutier et al., 2015; Lamarre-Cliché, Cheong, & Larochelle, 2011; Padwal et al., 2019; Parati et al., 2017).

These include eliminating observer error, eliminating the white coat effect, and detecting masked hypertension. (Cloutier et al., 2015; Lamarre-Cliché et al., 2011; Padwal et al., 2019; Parati et al., 2017). ABPM requires less patient involvement, minimal patient training, and the ability to provide nighttime BPM (Cloutier et al., 2015; Lamarre-Cliché et al., 2011; Padwal et al., 2019). HBPM requires patient training to improve clinical decisions and help patients better control their hypertension (Lamarre-Cliché et al., 2011; Milot et al., 2015; Parati et al., 2017; Uhlig, Patel, Ip, Kitsios, & Balk, 2013). For decades, BP was measured routinely in the clinic using the auscultatory technique (Pickering, 2003; Staessen et al., 2017). However, with growing evidence about the several disadvantages of auscultatory technique, there has been a shift to the use of electronic (OBPM) and automated (AOBP) devices (Campbell, McKay, Chockalingam, & Fodor, 1994; Cloutier et al., 2015; Gelfer et al., 2015; Lamarre-Cliché et al., 2011; Myers, 2014; Padwal et al., 2019; Rinfret et al., 2017; Schiffrin et al., 2016; Staessen et al., 2017). The advantage of OBPM is that it reduces much of the observer related error (e.g., the terminal digit preference), while AOBP requires minimal training and minimal human involvement, which has been shown to eliminate much of the white coat effect linked with OBPM (Campbell et al., 2014; Lamarre-Cliché et al., 2011; Padwal et al., 2019; Parati et al., 2017; Rinfret et al., 2017). In Canada, measurement using an electronic (oscillometric) upper arm device is preferred over auscultation, and AOBP is the preferred in-office BPM method (Rabi et al., 2020).

Blood pressure measurement by health professionals

HP plays an essential role in hypertension management (Campbell et al., 2017; Rabi et al., 2020). Moreover, BPM is a routinely performed procedure by HP, who has received specific training in BPM (Kaczorowski, Dawes, & Gelfer, 2012). Inadequately performed BPM causes misdiagnosis and suboptimal BP control. Hence recommendations must be followed by HP when measuring BP. However, several studies performed over the past have shown that BPM recommendations are rarely followed in clinical practice (Campbell et al., 2005; Campbell et al., 2017; Campbell et al., 1994; Campbell, Myers, et al., 1999; Coogan, Marra, & Lomonaco, 2015; McAlister, Campbell, Zarnke, Levine, & Graham, 2001; McKay et al., 1992; Ray et al., 2012).

HP, namely the physicians, nurses, and pharmacists, are involved in long-term hypertension management and providing education to patients (Campbell et al., 2019; Lamb, Al

Hamarneh, Houle, Leung, & Tsuyuki, 2018; Schiffrin et al., 2016). However, it has been demonstrated that education is rarely provided to their patients (Milot et al., 2015; Wagner et al., 2013). A Canadian study that assessed the perception of primary care physicians and their patients concerning HBPM reported that 78% of patients had an HBPM device (Logan, Dunai, McIsaac, Irvine, & Tisler, 2008). However, only 8% of patients received specific education from their physicians and pharmacists on BPM and interpretation of results, while 45% did not receive any specific education (Logan et al., 2008). Results show that physicians will use HBPM when making diagnostic and therapeutic decisions but only 13% will in fact use HBPM for diagnostic purposes (Logan et al., 2008).

Global data reports that knowledge of HP concerning diagnostic thresholds and technical aspects for BPM methods was inadequate, and their practice for all four BPM methods was also unsatisfactory (Block et al., 2018; Coogan et al., 2015; Dalfó-Pibernat et al., 2018; Dickson & Birkett, 1988; Dickson et al., 2013; Matowe, Abahussain, Awad, & Capps, 2008; Sebo, Pechère-Bertschi, Herrmann, Haller, & Bovier, 2014; Tsakiri, Stergiou, & Boivin, 2013). The only Canadian study that assessed nurses' knowledge concerning OBPM showed inadequate knowledge regarding the technical aspects (Cloutier, 2007). Another recent survey in Canada has shown some improvement in physicians, but the small survey performed only with physicians also showed severe deficiencies in practice that are still present (Kaczorowski et al., 2017). The use of the auscultatory method by more than half of the physicians is a big concern (Kaczorowski et al., 2017). The lack of implementation of guidelines in clinical practice is due to the barriers. Some of the significant barriers include inadequate knowledge, lack of supervised training for health professionals, non-availability of BPM equipment, time constraints for health professionals (Hwang, Aigbe, Ju, Jackson, & Sedlock, 2018; Kaczorowski et al., 2017; Kronish et al., 2017; Logan et al., 2008; Lugtenberg, Burgers, Besters, Han, & Westert, 2011; McAlister et al., 2001; Tislér et al., 2006).

Several studies highlight the need for continuing education, certification in BPM, use of automated devices to improve the knowledge and practice of HP (Campbell et al., 2019; Campbell et al., 2012; Coogan et al., 2015; Padwal et al., 2019). Various educational resources are made available by hypertension Canada (Rabi et al., 2020). Despite their availability, the knowledge and practice of HP are suboptimal. Moreover, most published studies have focused only on physicians, but nurses and pharmacists who are also an integral part of hypertension management are understudied.

Research purpose

Adequate knowledge, perception and practice are essential elements of BPM. The evidence highlights the gap between guidelines and knowledge, perception, and practice of HP. In Canada, the topic of interest is partially studied. To our knowledge, this study is the first in Canada to assess the three concepts, the three health professionals and the four methods of BPM. To improve hypertension management and BP control rates, the proposed study intends to assess knowledge, perception, and practice of physicians, nurses, and pharmacists, working in primary care settings of Quebec concerning all four BPM methods. A descriptive study covering the primary care settings across Quebec is surveyed. This study will benefit all HP working in clinical, educational, and research sectors. Future clinicians, students, and researchers can better understand to excel in their field and provide the community with best possible services. This research will also provide future goals in hypertension, plan and develop new strategies, guide knowledge translation, implement policies and protocols, and formulate guidelines.

Research objectives

1. To assess knowledge, perception, and practice of health professionals regarding ambulatory and clinic BPM methods through a scoping review.
2. To assess knowledge, perception, and practice of Québec nurses, physicians and pharmacists working in primary care settings regarding ambulatory and clinic BPM methods.

Chapter 2. Literature Review

Hypertension

Chronically elevated BP is known as systemic arterial hypertension or hypertension or high blood pressure (Bakris & Sorrentino, 2018; Oparil et al., 2003). Hypertension is a risk factor that affects 40% global adult population and 23% of the Canadian adult population (Leung et al., 2020; Lim et al., 2012; Padwal et al., 2016). If not treated leads to complications affecting numerous organ systems, including the brain, heart, kidney, eyes and peripheral vasculature. Hypertension significantly increases CVD risk, including stroke, ischemic heart disease, heart failure, peripheral vascular disease, renal failure, dementia, and other diseases. Individuals with high-normal BP (130-139/85-89 mmHg) have a three-fold increased risk of hypertension and a two-fold increased risk of CVD (Julius et al., 2006). For every 20 mm Hg increase in SBP to > 115 mm Hg or a 10 mm Hg increase in DBP to > 75 mm Hg, the risk of cardiovascular mortality doubles (Lewington, Clarke, Qizilbash, Peto, & Collins, 2002; Padwal et al., 2016). For example, the Framingham Heart Study showed a direct association between chronic heart disease and stroke morbidity and mortality with hypertension. The study showed that SBP ≥120 mm Hg and DBP <70 mm Hg were associated with a CVD risk equivalent to approximately 20 mm Hg of additional SBP elevation (Franklin & Wong, 2013). Furthermore, the most significant number of SBP-related deaths (>115 mmHg) were caused by ischemic heart disease (55%), hemorrhagic stroke (58%) and ischemic stroke (50%) (Forouzanfar et al., 2017)

BP is expressed as the ratio of SBP, which is the pressure exerted on the arterial walls when the heart contracts, to DBP, which is the pressure exerted on arterial walls when the heart relaxes (Bakris & Sorrentino, 2018; Kaplan et al., 2015; Oparil & Weber, 2005). Systole and diastole are two phases of the cardiac cycle. In the systolic phase, the left and the right ventricles contract and blood is ejected into the aorta and pulmonary artery. In the diastolic phase, blood returns to the heart from the superior and inferior vena cava and flows into the right atrium and ventricle between two systoles. During systole, the arterial BP increases and is about 115 mmHg, while during diastole, the arterial BP decreases and is about 75 mmHg (Hoit, 2014). Therefore, both SBP and DBP are essential components of BP and must be carefully monitored to accurately diagnose hypertension. Hypertension may be primary or secondary (Bakris & Sorrentino, 2018; Kaplan et al., 2015; Oparil et al., 2003). Most patients (90–95%) have primary or essential hypertension, which is multifactorial and involves genetics, environmental, metabolic, and vascular etiology, which is discussed further below. Secondary hypertension is associated with underlying conditions such as primary aldosteronism, pheochromocytoma, or renal artery stenosis.

Blood pressure regulation

BP is determined by cardiac output and peripheral vascular resistance (Bakris & Sorrentino, 2018; Beevers, Lip, & O'Brien, 2001; Hall et al., 2012; Mayet & Hughes, 2003; Oparil & Weber, 2005). The elevation in mean BP occurs when one of these physiological components is increased. Cardiac output is the product of heart rate and stroke volume. Heart rate is the number of heartbeats in a given time. Stroke volume is the volume of blood pumped out of the left ventricle during each ventricular contraction. Thus, stroke volume is an essential determinant of cardiac output. Stroke volume is influenced by preload, afterload, and ventricular muscle contractility. First, the preload, also known as left ventricular end-diastolic volume, is the load on ventricular muscles during the diastole. Increased preload further increases the stroke volume. Second, the afterload is the pressure against which the left ventricle has to push the blood into the systemic circulation during each contraction.

Afterload increases when stroke volume is decreased. Ventricular muscle contractility is the ability of cardiac muscles to contract, which is affected by the change in preload and afterload. All of these factors ultimately affect cardiac output. Peripheral vascular resistance is the resistance of blood flow in the circulatory system. It is determined by the diameter of small arteries and arterioles and controlled by the smooth muscle cells (Bakris & Sorrentino, 2018; Oparil & Weber, 2005; Schiffrin, 2020). Prolonged smooth muscle contraction induces structural changes in the arteriolar vessel walls, resulting in an irreversible increase in BP. Small arteries and arterioles are the main sites for flow resistance and are responsible for 70% of all peripheral vascular resistance (Schiffrin, 2020). Changes in large arteries such as the aorta and its major branches or the microcirculation such as small arteries, arterioles, capillaries, and venules allow peripheral vascular resistance to increase. (Greene, Tonellato, Lui, Lombard, & Cowley, 1989; Schiffrin, 2020). Most patients with essential hypertension have an average cardiac output but elevated peripheral vascular resistance (Kaplan et al., 2015). Given the importance of these two physiological components on BP regulation, any changes are directly related to the cause of hypertension.

Mosaic theory behind primary hypertension

The etiology and pathophysiology of hypertension are multifactorial, multifaceted, and involve many interconnected physiological processes (Touyz, Feldman, Harrison, & Schiffrin, 2020). The mosaic theory, first mentioned in 1982 by Page et al., highlights the molecular and cellular mechanisms involved in hypertension (Page, 1982). This theory indicates that several factors, including genetic, environmental, anatomic, and adaptive, neural, endocrine, humoral, and hemodynamic factors, are responsible for the pathophysiology of hypertension (Page, 1982; Touyz, Feldman, et al., 2020).

The factors as indicated in mosaic theory by Page et al. are briefly presented. First, for genetics involvement, the mosaic theory of hypertension was the first to model the effect of genetics on hypertension and is now well recognized as a dynamic polygenic disease state (Frame & Wainford, 2017; Frohlich, Dustan, & Bumpus, 1991; Page, 1982). According to Page et al., the genetic factor influences the overall pattern of the body, and therefore patients with hypertension differ from one another because of their genetic disposition (Page, 1982). Second, environmental factors such as stress, diet, and pollutants can stimulate the immune cells, renal and vascular system contributing to increased cardiac output and BP (Harrison, 2013; Oparil et al., 2003; Page, 1982). Third anatomic factors include the abnormalities such as coarctation of the aorta, atresia, and aneurysm of the renal artery and are directly linked to hypertension. Fourth, adaptive factors include regulating intracellular sodium and calcium pump by the cell membrane (Page, 1982). Any dysfunction in the sodium-calcium pump directly impacts the peripheral vascular resistance causing hypertension. Fifth neural factors include the complex nervous system mechanism linked to the increased nerve firing that increases the sympathetic outflow. Sixth, endocrine and humoral factors such as angiotensin II, aldosterone, and catecholamines directly or indirectly affect cardiac output and peripheral vascular resistance, thereby increasing BP (Page, 1982). Finally, hemodynamic factors include blood flow and volume, cardiac output and peripheral vascular resistance. Any changes or dysfunction in these factors causes hypertension (Page, 1982).

With advancements in research, additional factors have now been added to the mosaic theory that includes genomics, oxidative stress, inflammation, hyperinsulinemia and insulin resistance, vascular, sex hormones, influences of the sympathetic nervous system, angiotensin II receptor, and as they all appear to be associated with target organ damage (Assersen, Sumners, & Steckelings, 2020; da Silva et al., 2020; DeLalio, Sved, & Stocker, 2020; Feldman, 2020; Lip & Padmanabhan, 2020; Marc, Boitard, Balavoine, Azizi, & Llorens-Cortes, 2020; Oparil et al., 2003; Schiffrin, 2020; Touyz, Feldman, et al., 2020; Touyz, Rios, et al., 2020; Xiao & Harrison, 2020). Few important factors, as an example, are briefly presented. For genomics, recent evidence suggests a variety of genes or, more specifically, allelic variants have been linked to an increased risk of developing hypertension (Lip & Padmanabhan, 2020; Oparil et al., 2018; Oparil et al., 2003). Padmanabhan et al. reviewed and updated Paige's mosaic model of BP control after finding approximately 25 unusual mutations and over 50 single nucleotide polymorphisms that affect BP (Frame & Wainford, 2017; Padmanabhan, Caulfield, & Dominiczak, 2015; Page, 1982). Another critical factor is the oxidative stress that multiple authors have identified as playing an important role in hypertension (Ceriello, 2008; Harrison & Gongora, 2009; Schiffrin, 2020; Touyz, Rios, et al., 2020). Oxidative stress is caused by an imbalance between oxidants and antioxidants, leading to a disruption of oxidation-reduction signalling, control, and molecular damage (Touyz, Rios, et al., 2020). Oxidative stress is characterized by excessive production of reactive oxygen species and altered oxidation-reduction. An enzyme called NADPH oxidases, an essential source of cardiovascular reactive oxygen species is most commonly found in the heart, vessels, kidneys, and immune system (Touyz, Rios, et al., 2020). In hypertension, there is the increased expression and activity of NADPH oxidases, which is one of the primary mechanisms responsible for oxidative stress in cardiovascular diseases. Furthermore, hypertension associated with inflammation, fibrosis, and activation of immune cell processes is caused by oxidative stress (Harrison et al., 2011; Touyz, Rios, et al., 2020; Xiao & Harrison, 2020). Regarding metabolic syndrome, studies have shown a correlation between insulin resistance, hyperinsulinemia, and elevated BP (da Silva et al., 2020; Ferrannini et al., 1987; Julius, Gudbrandsson, Jamerson, Tariq Shahab, & Andersson, 1991). These metabolic syndrome increases sympathetic nervous system activity, impairs kidney function, and increases BP (da Silva et al., 2020). Vascular factors are associated with reactive oxygen species that cause vascular remodelling and vasoconstriction, increasing peripheral vascular resistance and BP and eventually contributing to target organ damage (Harrison, 2013; Schiffrin, 2020).

Main systems involved in hypertension

BP regulation is complex, and multiple systems come into play. The main systems involved are the autonomic nervous system, the renal system, and the vascular system. Any impairment or interference in the mechanisms involved in BP regulation involving these systems can lead to an increase in BP and therefore causing target organ damage (Hall et al., 2012; Oparil et al., 2018).

Autonomic nervous system

The autonomic nervous system controls the cardiac and vascular functions and has a vital role in BP regulation through autonomic vasomotor nerves and circulating catecholamines (Maki-Petaja et al., 2016). The autonomic nervous system plays a significant role in short-term and long-term BP regulation (Charkoudian & Rabbitts, 2009; DeLalio et al., 2020; Joyner, Charkoudian, & Wallin, 2010). The autonomic nervous system consists of the sympathetic and parasympathetic nervous systems (Kaplan et al., 2015). The activation of the sympathetic nervous system stimulates the body for fight or flight response, thereby increasing BP, heart rate, stroke volume and cardiac output. On the contrary, activation of the parasympathetic nervous system stimulates the body for rest and digest response, thereby decreasing BP and heart rate. Compared to normotensive patients, hypertensive patients have increased sympathetic and decreased parasympathetic activity (DeLalio et al., 2020; Grassi, Mark, & Esler, 2015; Maki-Petaja et al., 2016; Mancia & Grassi, 2014).

BP regulation involves baroreceptors, chemoreceptors and adrenergic receptors (Kaplan et al., 2015). However, the baroreceptors play the primary role in BP regulation. Baroreceptors are the sensory afferent nerve endings located in the carotid sinuses and aortic arch. Their function is to detect BP changes and respond by sending the sensory information to the autonomic nervous system to regulate BP (Charkoudian & Rabbitts, 2009; Kaplan et al., 2015). The baroreceptors are activated due to increased BP, cardiac filling pressure or stretching of the blood vessel wall. Inhibitory signals are sent to the autonomic nervous system to increase parasympathetic activity and decrease sympathetic activity, causing bradycardia, myocardial contractility, vasodilation, and decreased stroke volume. During a short-term drop in BP, the baroreceptors transmit the sensory information to the autonomic nervous system to react opposite by increasing BP, stroke volume, heart rate and creating vasoconstriction (Charkoudian & Rabbitts, 2009; Kaplan et al., 2015).

As for the chemoreceptors, they are primarily involved in maintaining respiration and play a part in BP regulation. They are specialized sensory receptors located in the carotid bodies that detect changes in arterial blood oxygen, carbon dioxide and pH levels. Activation of chemoreceptors in response to decreased oxygen levels (hypoxia) or increased carbon dioxide levels (hypercapnia), or decreased pH levels (acidosis) causes increased stimulation of the sympathetic nervous system. This effect causes tachycardia and vasoconstriction, thereby increasing cardiac output and BP. The effect is seen among hypertensive patients with sleep apnea. Repeated activation of chemoreceptors in sleep apnea contributes to increased BP (Bakris & Sorrentino, 2018; Kaplan et al., 2015; Lanfranchi & Somers, 2011).

The adrenergic receptors mainly mediate the effect of neurotransmitters such as epinephrine and non-epinephrine of the sympathetic nervous system. The adrenergic receptors consist of alpha and beta receptors located on arteries and in the heart. In response to the release of neurotransmitters, stimulation of alpha receptors causes vasoconstriction, vascular remodelling and hypertrophy, which increases BP and stimulation of beta receptors cause increased ventricular contractility, tachycardia and increased cardiac output (Bakris & Sorrentino, 2018; Grassi et al., 2002; Kaplan et al., 2015).

Renal system

The renal system influence BP through the renin-angiotensin-aldosterone-system (RAAS) (Assersen et al., 2020; Beevers et al., 2001; Fountain & Lappin, 2021; Kaplan et al., 2015; Oparil et al., 2018). RAAS and natriuretic peptides play a significant role in BP regulation and hypertension. RAAS helps regulate blood volume and peripheral vascular resistance by increasing sodium reabsorption, water reabsorption and vascular tone. In response to decreased sodium intake, renal hypoperfusion, or systematic nervous system stimulation, the kidney's juxtaglomerular cells cause renin secretion. Renin, an enzyme, then acts on angiotensinogen, a renin substrate produced in the liver that converts into angiotensin I, a physiologically inactive product, which is then converted to angiotensin II by the angiotensin-converting enzyme. The angiotensin-converting enzyme is found preliminarily in the lungs and kidneys.

The release of angiotensin II has a cascade of events occurring that affects the kidneys, adrenal cortex, arterioles, and brain, resulting in increased BP (Assersen et al., 2020; Beevers et al., 2001; Fountain & Lappin, 2021; Kaplan et al., 2015; Oparil et al., 2018). On kidneys, angiotensin II causes vasoconstriction of efferent and afferent renal arterioles and increases sodium reabsorption, thereby increasing the stroke volume. The effect on the adrenal cortex occurs due to the stimulation of zona glomerulosa causes the release of aldosterone. Aldosterone causes an increase in sodium reabsorption and potassium excretion at the distal tubule and collecting duct of the nephron, which in turn causes increased sodium reabsorption. This effect results in increased sodium levels in the body that causes an increase in osmolarity, blood, and extracellular fluid volume, resulting in increased BP (Beevers et al., 2001; Hall et al., 2012; Oparil et al., 2018). On the arterioles, angiotensin II acts as a potent vasoconstrictor, thereby increasing BP. It binds to G protein receptors leading to vasoconstriction, causing increased peripheral vascular resistance and BP. Finally, angiotensin II has three effects on the brain: first, it binds to the hypothalamus causing thirst and increased water consumption. Second, it causes the pituitary gland to release antidiuretic hormone or vasopressin to increase water reabsorption in kidneys. Third, it reduces the baroreceptor reflex sensitivity, thereby decreasing the baroreceptor's response to increased BP, which is incompatible with the RAAS target (Fountain & Lappin, 2021; Hall et al., 2012). The result of all these interactions is an increase in sodium water and peripheral vascular resistance (Fountain & Lappin, 2021; Hall et al., 2012; Kaplan et al., 2015). Studies have shown that angiotensin II is associated with endothelial dysfunction and has fibrotic and inflammatory effects due to increased oxidative stress resulting in renal, cardiac, vascular injury and target organ damage (Assersen et al., 2020; Long, Price, Herrera-Acosta, & Johnson, 2004; Schiffrin, 2020; Touyz et al., 2018; Touyz, Rios, et al., 2020).

Natriuretic peptides

A natriuretic peptide plays a vital role in salt sensitivity and hypertension (Hall et al., 2012; Kerkelä, Ulvila, & Magga, 2015; Oparil et al., 2018; Potter, Yoder, Flora, Antos, & Dickey, 2009). It has two forms: atrial natriuretic peptide and brain natriuretic peptide. They help in maintaining sodium balance and vasodilation, thereby decreasing BP. The atrial natriuretic peptide is a hormone released by the atrium in response to increased blood volume (Beevers et al., 2001). The atrial and ventricular stretch leads to the release of both natriuretic peptides, causing systemic vasodilation and decreased plasma volume. The natriuretic peptides lower BP by increasing the glomerular filtration rate, resulting in increased urine production and increased sodium excretion called natriuresis. It also inhibits renin and aldosterone release. The deficiency of these peptides causes hypertension (Hall et al., 2012; Kerkelä et al., 2015; Oparil et al., 2018; Potter et al., 2009). Obesity is associated with a deficiency of natriuretic peptides (Schlueter et al., 2014).

Vascular system

The structure and function of both small and large arteries play a vital role in hypertension progression (Kaplan et al., 2015; Oparil & Weber, 2005). Small changes in the diameter of blood vessels have an enormous effect on BP. The vascular endothelium is a significant regulator of vascular tone (Oparil & Weber, 2005; Spieker, Flammer, & Lüscher, 2006). Endothelial cells produce vasoactive substances that include nitric oxide, prostacyclin, and endothelin (Hall et al., 2012; Kaplan et al., 2015; Oparil et al., 2018; Oparil & Weber, 2005; Schiffrin, 2020; Spieker et al., 2006; Touyz, Rios, et al., 2020). First, nitric oxide is an essential factor that is thought to regulate the mechanism that controls BP. Nitric oxide is continuously released by the endothelial cells leading to vascular smooth muscle relaxation. Inhibition of nitric oxide production through oxidative stress increases BP and contributes to hypertension. Second, the prostacyclin is another endothelium-derived relaxing factor released in response to shear stress and has a platelet inhibitory effect. Third, the endothelin has a vasoconstrictor effect that increases BP. Therefore, a dysfunctional endothelium causes structural, functional, mechanical, and molecular changes, a hallmark of hypertension and CVD (Schiffrin, 2020). These changes are characterized by large arterial stiffness, vascular remodelling, rarefaction of microcirculation, leading to increased peripheral vascular resistance. As a result of these changes, tissue nutrition, gas exchange, and removal of waste products are compromised, contributing to target organ damage (Schiffrin, 2020).

Risk factors for hypertension

Hypertension is associated with several modifiable and non-modifiable risk factors (Bakris & Sorrentino, 2018). Non-modifiable factors include age, sex and race, and modifiable factors include physical inactivity, obesity, high sodium intake, and excessive alcohol intake (Bakris & Sorrentino, 2018).

Non-modifiable factors

Non-modifiable factors include age, sex, and race. First, advancing age causes structural changes in the arteries leading to arterial stiffness and atherosclerosis, which later increases the pulse pressure. These factors contributed to the development of systolic hypertension and decreased DBP (Bakris & Sorrentino, 2018; Franklin et al., 1997; Izzo, Levy, & Black, 2000; Mikael et al., 2017; Pinto, 2007). For example, the Framingham study showed the association between age-related changes in SBP, DBP and pulse pressure. After 50 years, SBP increased disproportionately compared to DBP, and after 60 years, DBP decreased, causing increased pulse pressure. A gradual increase in SBP and a decrease in DBP confirmed the relationship between ageing and hypertension (Franklin et al., 1997; Franklin & Wong, 2013; Kannel, Gordon, & Schwartz, 1971). The gradual increase in SBP in people under the age of 50 indicated that increased vascular resistance was the dominant factor. With age, DBP decreases, and arterial stiffness progresses, thus causing an increase in SBP and pulse pressure (Franklin et al., 1997; Franklin & Wong, 2013; Kannel et al., 1971).

Second, regarding sex, the overall prevalence of hypertension is higher among men than women, but this difference narrows after women reach menopause. In women, the onset of menopause is associated with a two-fold increased risk of hypertension (Amigoni, Morelli, Parazzini, & Chatenoud, 2000; Barton & Meyer, 2009; Staessen, Bulpitt, Fagard, Lijnen, & Amery, 1989; Zanchetti et al., 2005). Estrogen deficiency is a contributing factor during menopause (Maranon & Reckelhoff, 2013; Nuzzo, Rossi, & Modena, 2010). After women undergo menopause, the sex-related factors may contribute to the development of metabolic syndrome, which leads to increased BP and CVD risk (Barton & Meyer, 2009; Maranon & Reckelhoff, 2013; Nuzzo et al., 2010). Studies have reported that the prevalence of hypertension is higher in older women aged ≥60 years when compared to men of the same age (Benjamin et al., 2019; Kearney et al., 2005; Mills et al., 2016).

Third, regarding race, which is not a simple issue and a large body of literature exist on the difference between race/ethnicity, only a few issues have been identified; for example, the prevalence of hypertension is significantly higher in black adults than in white adults and Asians (Bakris & Sorrentino, 2018; Dorans, Mills, Liu, & He, 2018; Fei et al., 2017; Fuchs, 2011; Lackland, 2014). A recent study showed that the prevalence of hypertension was higher in black adults (44%) than in Asians (38%) and white adults (28%) (Fei et al., 2017). Although racial differences and hypertension are still not completely understood. However, the prevalence is associated with genetic variation and dietary habits such as high sodium (Fuchs, 2011; Mills et al., 2020; Whelton et al., 2016). For example, salt consumption is higher in black adults than in white adults (Fuchs, 2011; Lackland, 2014). As a result, high sodium intake causes renal dysfunction, thereby increasing BP.

Modifiable factors

As far as modifiable factors are considered, the main ones are physical inactivity, obesity, excessive alcohol intake and high sodium intake. First, physical inactivity is the fourth leading risk factor for death worldwide, accounting for 35% of the global prevalence (Benjamin et al., 2019). Physical inactivity is associated with sedentary behaviour, increased body mass index or underlying conditions, such as hyperinsulinemia or diabetes (Diaz & Shimbo, 2013; Hegde & Solomon, 2015). Physiologically the mechanism is linked with neurohormonal and vascular function, reducing the sympathetic nerve activity and causing vascular dysfunction and increased peripheral vascular resistance resulting in increased BP (Diaz & Shimbo, 2013; Hegde & Solomon, 2015; Huai et al., 2013). A meta-analysis reported that physical inactivity causes 6-10% of the global burden from coronary heart diseases (Lee et al., 2012).

Second, obesity is an independent risk factor for hypertension, CVD and CKD (Hall, Carmo, Silva, Wang, & Hall, 2015; Nguyen & Lau, 2012). Studies reported that obesity was the main risk factor for hypertension, contributing to 24% of all cases in both men and women (Leung, Bushnik, Hennessy, McAlister, & Manuel, 2019; Padwal et al., 2016). The mechanism is associated with metabolic abnormalities, overactivation of the sympathetic nervous system and stimulation of RAAS, causing renal dysfunction (da Silva et al., 2020; Hall et al., 2015; Kotsis, Stabouli, Papakatsika, Rizos, & Parati, 2010; Nguyen & Lau, 2012; Rahmouni, Correia, Haynes, & Mark, 2005).

Third, hypertension associated with alcohol consumption is among the top five risk factors for the global disease burden (Campbell, Burgess, et al., 1999; Rehm et al., 2017; Roerecke et al., 2017; Wood et al., 2018). Studies have reported an association of higher alcohol consumption ($\geq$ 210g/week) with hypertension (Fuchs, Chambless, Whelton, Nieto, & Heiss, 2001; Piano, 2017; Roerecke et al., 2017; Wood et al., 2018). An immediate effect of alcohol consumption is vasodilation, and sustained intake results in short-term elevation of BP. However, it is accompanied by long-term vascular changes and affects cardiac output and peripheral vascular resistance due to stimulation of RAAS, vascular and sympathetic nervous system (Beilin & Puddey, 2006; Husain, Ansari, & Ferder, 2014; Roerecke et al., 2017).

Fourth, for high sodium intake, several studies have shown an association between high sodium intake and increased risk for hypertension (Grillo, Salvi, Coruzzi, Salvi, & Parati, 2019; Mente et al., 2016; Strazzullo, D'Elia, Kandala, & Cappuccio, 2009). Chronic high salt consumption causes water retention, renal and vascular dysfunction, increased blood volume, peripheral vascular resistance and cardiac output (Feng, Dell'Italia, & Sanders, 2017; Oparil et al., 2018). A compensatory mechanism occurs and compensates for these hemodynamic changes and maintains normal BP by reducing peripheral vascular resistance and increasing nitric oxide production. However, in individuals with salt sensitivity, the effect of nitric oxide is impaired or absent, thereby increasing BP (Feng et al., 2017; Oparil et al., 2018).

Treatment for hypertension

Treatment for hypertension management includes both pharmacological and non-pharmacological. The choice of treatment for adults with hypertension as recommended by Hypertension Canada is presented in Table I.

Table I Non-pharmacological and pharmacological treatment as recommended by Hypertension Canada guidelines

Non-pharmacological	Pharmacological
Health behaviour management	Single pill therapy
Dietary Approach to Stop Hypertension (DASH diet)	Thiazide/thiazide-like diuretics
Sodium intake	Beta-blockers
Alcohol consumption	ACE inhibitors
Physical activity	ARBs
Stress management	Long-acting CCBs
	Single pill combination therapy

(Rabi et al., 2020) *Notes.* DASH, dietary approach to stop hypertension; CCBs, calcium channel blockers; ARBs, angiotensin receptor blockers; ACEs, angiotensin-converting enzyme inhibitors

Non- pharmacological

Maintaining healthy behaviour is essential and is recommended as a first-line intervention in hypertension management (Rabi et al., 2020). The non-pharmacological intervention recommended by Hypertension Canada guidelines includes DASH diet enriched with a protein source and reducing sodium intake (5g of salt per day), reduction in alcohol consumption (2 drinks per day), moderate exercise daily (30-60 minutes), and stress management (Rabi et al., 2020). A summary of these recommendations is presented in Table II. These interventions have been shown to reduce BP and prevent hypertension (Rabi et al., 2020).

The DASH trial found that eating a diet high in fruits, vegetables, and low dairy products and a diet low in saturated fat and cholesterol decreased SBP by 11.4 and DBP by 5.5 mm Hg in hypertensive individuals (Appel et al., 1997). Additionally, reducing dietary salt intake and increasing hypertension awareness are concrete steps to reduce the hypertension burden (Campbell et al., 2015). A meta-analysis found that a slight reduction in salt intake for four weeks or more induces a substantial reduction in SBP in both hypertensive and normotensive individuals and that considerable reductions in salt intake would result in a more significant reduction in SBP (He, Li, & MacGregor, 2013). Studies have shown that the combination of low sodium intake and the DASH diet was associated with substantially more significant reductions in SBP (Juraschek, Miller, Weaver, & Appel, 2017; Sacks et al., 2001).

For alcohol intake, limiting to 2-3 drinks per day showed a significant reduction in SBP by 5mmHg and DBP by 4mmHg (Roerecke et al., 2017). For physical activity, moderate intensity exercises and resistance training are effective. A meta-analysis of 54 RCT showed that aerobic exercise was associated with a significant reduction in SBP and DBP (-3.84 mmHg and -2.58 mmHg), respectively (Whelton, Chin, Xin, & He, 2002). Studies have reported that resistance training effectively decreases BP and shows a significant reduction in SBP by 4mmHg (Cornelissen, Fagard, Coeckelberghs, & Vanhees, 2011; Ghadieh & Saab, 2015). Recent findings from a pooled analysis showed that health behavioural interventions such as diet, physical activity and alcohol reduction in persons without CVD risk factors were associated with modest reductions in BP (Patnode, Evans, Senger, Redmond, & Lin, 2017).

Table II Summary of recommendation for non-pharmacological management by Hypertension Canada

	Recommendations
Dietary Approach to Stop Hypertension (DASH diet)	Fruits, vegetables, low-fat dairy products, whole-grain foods rich in dietary fibre and protein source. Limit consumption of sodium intake towards 2000mg per day (5g of salt per day). For individuals with hyperkalemia, increase dietary potassium intake.
Alcohol consumption	Less than 2 drinks per day.
Physical activity	Perform 30 to 60 minutes of moderate-intensity dynamic exercise (cycling, swimming, jogging, walking) 4 to 7 days per week in addition to routine activities.
Weight reduction	Height, weight, waist circumference and BMI should be calculated for all adults. A BMI between 18.5-24.9 and a waist circumference <102 cm for men and <88 cm for women is recommended. Overweight individuals should be advised to lose weight.
Stress management	Individualized cognitive behavioural interventions and relaxation techniques should be considered.

(Rabi et al., 2020) *Notes*. BMI, body mass index

Pharmacological

For patients with uncontrolled hypertension with compelling indications for specific agents, the pharmacological treatment includes a single therapy pill with thiazides, calcium channel blockers (CCBs), beta-blockers, angiotensin receptor blockers (ARBs) and angiotensin-converting enzyme inhibitors (ACEs) (Rabi et al., 2020). Initial therapy is either with single-pill therapy or single-pill combination therapy. Single pill combination therapy includes ACE inhibitors with CCBs, ARBs with CCBs, or ACEs or ARBs used with a diuretic. Beta-blockers are not recommended as first-line therapy for uncomplicated hypertension in patients 60years and older (Rabi et al., 2020). The action of drugs is mentioned as follows: CCBs prevent the contraction of smooth muscle cells in the arteries, thereby causing vasodilation, leading to a decrease in peripheral vascular resistance. ARBs and ACEs have vascular effects, and both act on the RAAS axis and decrease aldosterone secretion. Beta-blockers act by blocking β-1 adrenergic receptors in the heart, leading to slower heart rate and lowered BP (Rabi et al., 2020). A significant improvement was reported in Canada in prescribing antihypertensive drugs after the initiation of the Canadian Hypertension Education Programme (CHEP), now called Hypertension Canada guidelines (Campbell, Tu, Brant, Duong-Hua, & McAlister, 2006). A meta-analysis of 147 randomized trials of BP-lowering drugs on a larger population showed that all antihypertensive drugs classes significantly reduce CHD events by a quarter and stroke by about a third (Law, Morris, & Wald, 2009). Single pill therapy and single-pill combination therapy are effective for hypertension management (Feldman, 2017; Imbeault & Vallée, 2018; Wald, Law, Morris, Bestwick, & Wald, 2009).

Blood pressure measurement

Evolution of blood pressure measurement

The measurement of BP began in 1733, with Reverend Stephen Hales reported the first invasive measurement on a horse by inserting a long glass tube upright into an artery and observing the column of the tube with an increase in BP (Booth, 1977; O'Brien & Fitzgerald, 1994; Rader & Victor, 2017; Roguin, 2006b). Further, in 1817 the stethoscope was invented by a French physician Dr. Rene Laennec (Roguin, 2006a). In 1827, the first mercury manometer was built for BPM by Dr. Jean Poiseuille (Booth, 1977; O'Brien & Fitzgerald, 1994; Rader & Victor, 2017; Roguin, 2006b). All this contributed to the invention of the first sphygmomanometer and the first non-invasive BPM in 1881 by Austrian physician Dr. von Basch. When the cuff was inflated, the radial artery was palpated, and when the radial artery pulsations stopped, SBP was measured by the pressure in a mercury sphygmomanometer (O'Brien & Fitzgerald, 1994; Verrij, Montfrans, & Bos, 2008). In 1896, Riva-Rocci further improved the device and introduced the upper arm cuff to measure SBP, which was a standard device for many decades (O'Brien & Fitzgerald, 1994; Roguin, 2006b; Verrij et al., 2008). Adding to the auscultatory technique, in 1905, Dr. Nicolai Korotkoff introduced the Korotkoff sounds that can be easily heard with a stethoscope. Dr. Korotkoff described the appearance and disappearance of sounds over the brachial artery, distally of the Riva-Rocci cuff allowing the measurement of both SBP and DBP. For more than a century, BPM using the auscultatory method has been one of the most commonly performed clinical measurements (O'Brien & Fitzgerald, 1994; Verrij et al., 2008). However, further advancements have been made in the device ranging from mercury to aneroid and electronic to automated (Padwal et al., 2019; Staessen et al., 2017). In addition, much improvement has been made to BPM by establishing standardized measurement protocols by many hypertension societies, widely available to all health professionals (Campbell et al., 2014; Cloutier et al., 2015; Schiffrin et al., 2016).

Blood pressure measurement methods

BPM can be performed in-office and out-of-office. In-office BPM is carried out in usual care settings such as hospitals or clinical setting like a physician or NP office and include OBPM and AOBP. Out-of-office BPM, also called an ambulatory measurement, is carried out in outpatient settings or outside usual care and includes the home and ambulatory methods.

In-office blood pressure measurement methods

In-office BPM methods, OBPM and AOBP, are routinely used in the office for BP assessment, hypertension management and follow-up.

Office BP measurement method (OBPM)

The OBPM refers to in-office BPM performed using an electronic upper arm device with a provider in the room (Blom et al., 2015; Cloutier et al., 2015; Rabi et al., 2020). OBPM is performed using an oscillometric (also called electronic) device or an auscultatory method. The auscultatory method with an aneroid device or mercury sphygmomanometer and a stethoscope is no longer recommended and is only considered an alternative if an oscillometric device is unavailable (Rabi et al., 2020).

Auscultatory OBPM was considered the standard BP method for diagnosing and managing hypertension (Drawz, Abdalla, & Rahman, 2012; Kollias, Stambolliu, Kyriakoulis, Gravvani, & Stergiou, 2019; Stergiou, Kollias, Parati, & O'Brien, 2018). However, to be valid, this method needs a high degree of standardization, which is rarely seen in the real world and is being gradually phased out due to its various limitations (Drawz et al., 2012; Stergiou, Kyriakoulis, & Kollias, 2018). For example, the limitations include environmental concerns related to mercury use, clinicians' hearing deficits, technical errors, rapid deflation, terminal digit bias (Blom et al., 2015; Cloutier et al., 2015; Stergiou, Kyriakoulis, et al., 2018). Additionally, important concerns were raised regarding the use of uncalibrated or inaccurate devices and measurement bias due to poor adherence to guidelines by HP and require appropriate training for auscultatory OBPM (Myers, Asmar, & Staessen, 2018; Myers et al., 2010; Padwal et al., 2019; Schiffrin et al., 2016; Stergiou, Kyriakoulis, et al., 2018). Several studies have shown that this method is often poorly performed and is responsible for much of the error (Campbell et al., 2005; Campbell, Myers, et al., 1999; McKay, Campbell, Parab, Chockalingam, & Fodor, 1990; Ray et al., 2012). Consequently, the auscultatory method has increasingly been replaced by oscillometric or automated devices (Cloutier et al., 2015; Myers et al., 2018; Stergiou, Palatini, et al., 2018). In place of auscultatory OBPM, oscillometric OBPM is recommended for measuring BP in the office due to its several advantages that include reduction of technical errors such as observer bias or terminal digit bias, minimal observer involvement and training, minimal maintenance, minimize auscultation-induced errors, and does not rely on Korotkoff sound, (Bonafini & Fava, 2015; Cloutier et al., 2015; Drawz et al., 2012; Kollias et al., 2019; Myers, 2014; Myers et al., 2010; Stergiou, Kyriakoulis, et al., 2018; Stergiou, Palatini, et al., 2018). However, OBPM, either by auscultatory or oscillometric, is associated with the white coat effect due to the presence of HP near the patient.

Furthermore, OBPM has some limitations because it fails to detect masked hypertension, has poor reproducibility, is less practical to evaluate the effect of drug therapy and is performed inaccurately (Cloutier et al., 2015; Kollias et al., 2019; Stergiou, Kollias, et al., 2018; Stergiou, Palatini, et al., 2018). Therefore, OBPM alone is not the best option for hypertension diagnosis (Stergiou, Kollias, et al., 2018; Stergiou, Palatini, et al., 2018). A recent study finding confirmed the low validity of OBPM for diagnosing and monitoring hypertensive patients (Gonzalez, Fernández, Pillado, Calviño, & Díaz, 2017). However, if performed accurately in a standardized manner, OBPM correlated well with ambulatory measurements and can predict target organ changes (Cloutier et al., 2015; Drawz et al., 2012; Lamarre-Cliché et al., 2011; Rinfret et al., 2017). Recent study findings showed that OBPM provides similar BP readings as AOBP provided that BPM must be performed in a standardized manner (Kollias et al., 2019). Additionally, comparison of research quality BPM performed in a standardized manner with the routine manual BPM, studies have shown that manual BPM in the office on an average was 10 mm Hg greater than corresponding research quality measurements and exceeds the AOBP and ABPM measurements (Cloutier et al., 2015; Lamarre-Cliché et al., 2011; Rinfret et al., 2017).

Although OBPM is often used for initial BP assessment, the diagnosis is confirmed by performing out-of-office BPM (Cloutier et al., 2015; Rabi et al., 2020). It is important to note that since 2015, the diagnosis of hypertension in Canada is not based on OBPM, and out-of-office methods are preferred as they better predict CVD outcomes (Campbell et al., 2014; Cloutier et al., 2015; Rabi et al., 2020). The prognostic and predictive accuracy for CVD risk with OBPM is lower than HBPM and ABPM method (Banegas et al., 2018; Bliziotis, Destounis, & Stergiou, 2012; Bobrie, Chatellier, Genes, & et al., 2004; Niiranen, Mäki, Puukka, Karanko, & Jula, 2014; Parati, Ochoa, Salvi, Lombardi, & Bilo, 2013; Zhu, Zheng, Liu, Mai, & Huang, 2020).

The diagnostic threshold for OBPM is ≥140/90 mmHg (Rabi et al., 2020). The measurement of BP begins with the adequate preparation of the patient and environment (Cloutier et al., 2015; Pickering et al., 2005; Rabi et al., 2020). For the patient preparation, the patient should not have consumed caffeine or tobacco 30 mins before the measurement, should be in a sitting position with 5 minutes of rest, back supported, legs uncrossed, feet flat on the floor, arm bare and supported at heart level, use of appropriate cuff size according to individuals arm circumference, the lower edge of cuff 3 cm above the crease, and no talking or moving before or during the measurement. In addition, the environment should be quiet, and the room temperature should be comfortable (Cloutier et al., 2015; Rabi et al., 2020). The protocol for OBPM is presented in Table III and Annexe 1.

Automated BP measurement method (AOBP)

AOBP is an oscillometric device similar to OBPM. The AOBP refers to in-office BPM using a fully automated device that automatically records multiple BP readings at an interval of 30 seconds to 1 min apart, over 4-7 minutes and averages those readings while the patient is alone in a quiet room without an HP (Blom et al., 2015; Cloutier et al., 2015; Myers, Kaczorowski, Dawes, & Godwin, 2014).

AOBP devices are pre-programmed to take serial measurements and are used in many clinical settings in Canada. Commonly used devices include BpTRU (BpTRU Medical Devices, Coquitlam, Canada), Omron HEM 907 (Omron Corporation, Kyoto, Japan), and the MicroLife WatchBP Office (Microlife, Widnau, Switzerland) (Cloutier et al., 2015; Myers, 2014). AOBP provides more standardized measurements and overcomes some of the limitations of OBPM, and more specifically, reduces the white coat effect (Schiffrin et al., 2016). The advantages of the AOBP includes patient is left alone in the room, minimal training for HP, non-involvement of HP, cost-effective and less time-consuming in terms of retraining of HP and is associated with a lower prevalence of masked hypertension (Campbell et al., 2014; Cloutier et al., 2015; Myers et al., 2012; Myers et al., 2014; Myers, Valdivieso, & Kiss, 2009; Padwal et al., 2019). Studies have shown that AOBP is more reproducible than the auscultatory OBPM and correlates closely with daytime ABPM (Beckett & Godwin, 2005; Cloutier et al., 2015; Godwin et al., 2011; Graves, Nash, Burger, Bailey, & Sheps, 2003; Lamarre-Cliché et al., 2011; Myers & Godwin, 2012; Myers et al., 2010; Myers et al., 2014). A recent meta-analysis data suggests that AOBP is a more standardized and accurate BP assessment method than OBPM and correlated well to ABPM readings (Bo et al., 2021; Jegatheswaran, Ruzicka, Hiremath, & Edwards, 2017; Pappaccogli et al., 2019; Roerecke, Kaczorowski, & Myers, 2019).

The diagnostic threshold for AOBP is ≥135/85 mmHg (Rabi et al., 2020). The protocol for AOBP is presented in Table III and Annexe 1. The patient must be alone and sitting quietly with legs uncrossed, back supported, and arm supported at heart level. A 5-minute rest period is not required for AOBP measurement (Myers & Colella, 2019; Stults, Doane, Penrod, & Conroy, 2019).

Given the limitation of OBPM, one reason to perform out-of-office BPM is to rule out the white-coat effect and masked hypertension. This detection will further help to avoid unnecessary diagnosis and treatment. Therefore, it is important to highlight the significance of these two concepts before moving to out-of-office BPM methods.

White coat hypertension

White coat hypertension (WCH) is defined as increased office readings and normal out-of-office readings in individuals not receiving antihypertensive treatment (Cloutier et al., 2015; Franklin, Thijs, Hansen, O'Brien, & Staessen, 2013; Kario, Thijs, & Staessen, 2019). The diagnosis is confirmed when there is an elevated OBPM above the diagnostic thresholds (≥140/90mmHg) with normal out-of-office (< 135/85 mmHg for daytime ABPM or HBPM and/or < 130/80 for 24-hour ABPM) (Cloutier et al., 2015).

The white coat hypertension is assumed as a neuro-endocrine reflex conditioned by anticipation of BPM taken and fear of what this measurement might indicate regarding future illness (Bloomfield & Park, 2017). The prevalence of WCH occurs in 15%-30% of the individuals with increased office readings (Franklin et al., 2013; Gorostidi, Vinyoles, Banegas, & de la Sierra, 2015; Hänninen, Niiranen, Puukka, Johansson, & Jula, 2012; O'Brien et al., 2013; Stergiou et al., 2014).

WCH has an increased risk of CVD events in untreated individuals compared to normotensive individuals (Cohen et al., 2019; Franklin et al., 2013; Hansen et al., 2007; Mancia et al., 2013; Stergiou et al., 2014). Recent meta-analyses data suggest that WCH is associated with 38% CVD risk and 20% total mortality in the untreated cohort compared to normotensive individuals (Huang et al., 2017). WCH individuals have a high risk for CVD mortality, probably due to the phenomenon of increased pulse pressure caused by arterial stiffness (Sung et al., 2013). WCH must be precisely identified as this could lead to a false diagnosis of normotensives and hypertensives when in fact, their BP is under control when the measurement is taken out of the office (Cloutier et al., 2015; Franklin et al., 2013). False diagnosis will further cause long-term antihypertensive treatment initiation, resulting in unnecessary cost and potential adverse side effects. Therefore, it is critical to closely follow up on patients with WCH and insist on lifestyle improvement. If left untreated, some patients with WCH will develop hypertension over time (Cloutier et al., 2015; Hansen et al., 2007; Mancia et al., 2013; Mancia et al., 2009). If WCH is identified, HPs should use out-of-office BPM to diagnose and manage hypertension (Cloutier et al., 2015).

Masked hypertension

Masked hypertension is defined as increased out-of-office readings with normal office readings in untreated individuals, and for treated individuals, the term used is masked uncontrolled hypertension (MUCH) (Gorostidi et al., 2015; Kario, Thijs, et al., 2019; O'Brien et al., 2013; Parati et al., 2018). Masked hypertension is confirmed when there is an elevated out-of-office BP above the diagnostic thresholds (≥ 135/85 mmHg for daytime ABPM or HBPM and/or ≥130/80 for 24-hour ABPM) with normal OBPM (<140/90mmHg) (Franklin, O'Brien, Thijs, Asayama, & Staessen, 2015; Gorostidi et al., 2015; Kario, Thijs, et al., 2019; O'Brien et al., 2013; Pickering, Eguchi, & Kario, 2007; Stergiou et al., 2014).

The prevalence of masked hypertension is estimated to occur in 10%-30% of individuals (Gorostidi et al., 2015; Hänninen et al., 2012; Kario, Thijs, et al., 2019; O'Brien et al., 2013; Peacock, Diaz, Viera, Schwartz, & Shimbo, 2014; Stergiou et al., 2014; Trudel, Brisson, Larocque, & Milot, 2009) and the prevalence of MUCH occurs in 30% of the patients because of poorly controlled nocturnal BP (Agarwal, Pappas, & Sinha, 2016; Banegas et al., 2014; Franklin, O'Brien, & Staessen, 2017; Fujiwara, Yano, Hoshide, Kanegae, & Kario, 2018; Parati et al., 2018). The high prevalence is due to advancing age and is associated with baroreceptor sensitivity and increased BP variability (Franklin et al., 2017; Pickering et al., 2007).

Masked hypertension has a risk for target organ damage, CVD events and mortality (Bromfield et al., 2016; Franklin et al., 2015; Hänninen et al., 2012; Hänninen et al., 2013; Hansen et al., 2007; Kario, Thijs, et al., 2019; Peacock et al., 2014; Stergiou et al., 2014). Studies have also shown that patients with masked hypertension are at increased risk of developing sustained hypertension (Hänninen et al., 2013; Hansen et al., 2007; Mancia et al., 2009).

Masked hypertension goes unnoticed in routine clinical assessment, although the patient is hypertensive. Therefore, OBPM alone is not sufficient to ascertain its detection, and 24-hour ABPM must be considered (Bromfield et al., 2016; Franklin et al., 2015; Hansen et al., 2007; Kario, Thijs, et al., 2019; Pickering et al., 2007; Whelton, 2019). Assessment of 24-hour BP, including both daytime and nighttime values, is important to facilitate masked hypertension diagnosis (Franklin et al., 2015; Hansen et al., 2007). A study reported that ABPM and HBPM effectively detected masked hypertension in a quarter of the patients (Stergiou et al., 2014).

Out-of-office blood pressure measurement methods

Out-of-office BPM methods, such as HBPM and ABPM, have gained increasing importance in clinical practice due to technological advancements and increased awareness of OBPM limitations (Parati, Omboni, & Bilo, 2009). Both these methods provide more stable and reproducible information on BP values which is more useful for prognosis. According to Hypertension Canada guidelines, out-of-office BPM is necessary for the diagnosis of hypertension, and up until 2020, they were not promoted to be used for treatment and follow-up (Rabi et al., 2020).

Home BP measurement method (HBPM)

The HBPM method refers to series of BP measurements taken by patients at home (Blom et al., 2015; Cloutier et al., 2015; Rabi et al., 2020). The measurements are taken with an oscillometric device twice in the morning and twice in the evening for seven days. In Canada, it is recommended to use the HBPM device approved by Hypertension Canada. The recommended threshold for HBPM in the general population for diagnosis of hypertension is ≤135/85 mmHg (see Figure 1) (Rabi et al., 2020).

When performed in a standardized manner, HBPM has been shown to better predict CVD risk compared to OBPM and has better prognostic accuracy than OBPM (Bliziotis et al., 2012; Bobrie et al., 2004; Bonafini & Fava, 2015; Cloutier et al., 2015; Fuchs, Mello, & Fuchs, 2013; Niiranen, Hänninen, Johansson, Reunanen, & Jula, 2010; Shimbo, Abdalla, Falzon, Townsend, & Muntner, 2016; Stergiou, Kario, et al., 2018). In addition, results of a metanalysis showed HBPM is a significant predictor of CVD events and mortality compared with OBPM and has a significant prognostic value above OBPM (Ward, Takahashi, Stevens, & Heneghan, 2012).

Furthermore, HBPM can improve treatment adherence and contribute to better BP control (Bonafini & Fava, 2015; Cappuccio, Kerry, Forbes, & Donald, 2004; Kario, Thijs, et al., 2019; McManus, Wood, et al., 2014; Staessen et al., 2004; Tucker et al., 2017; Uhlig et al., 2013; Verberk et al., 2007). The result of two RCT studies showed that adjustment of antihypertensive therapy based on HBPM instead of OBPM leads to less drug prescription and lower medical costs (Staessen et al., 2004; Verberk et al., 2007). Because of its diagnostic accuracy and prognostic ability, HBPM plays an important role in the long-term management of treated hypertension (Stergiou, Kario, et al., 2018).

HBPM offers several advantages over OBPM, for example, the elimination of white coat hypertension and observer bias; since the measurements are carried out in a familiar setting, more measurements can be obtained in a limited time, allows patient engagement and activation, HBPM data correlates better with daytime values of ABPM, evaluate the efficacy of drug therapy, assess day to day BP variability, provides multiple measurements for several days or longer time (Bloomfield & Park, 2017; Bonafini & Fava, 2015; Cloutier et al., 2015; Franklin et al., 2013; Parati et al., 2013; Stergiou, Kario, et al., 2018; Wood, Boulanger, & Padwal, 2017). However, HBPM has some limitations consisting of the time and education required to ensure measurements are performed in a standardized manner, patient anxiety and misreporting of BP readings, use of a non-validated device (Bonafini & Fava, 2015; Milot et al., 2015; Stergiou, Kario, et al., 2018; Verberk, Kroon, Kessels, & de Leeuw, 2005; Wood et al., 2017).

In addition, studies have reported that patients could not follow the HBPM protocol correctly and that no specific education was provided by their HP (Bancej et al., 2010; Flacco et al., 2015; Logan et al., 2008; Milot et al., 2015). These studies indicated that less than half (≤50%) of the patients were compliant with guidelines, and ≥50% of patients received no specific education on HBPM from their HP.

Like other BPM methods, HBPM requires a standardized technique to measure BP (Cloutier et al., 2015). However, if not performed correctly, HBPM can increase the risk of reporting bias by patients (Myers & Stergiou, 2014). Therefore, HPs must ensure that patients receive proper education regarding HBPM to improve their performance (Cloutier et al., 2015; Rabi et al., 2020). The protocol for HBMP is presented in Table III and Annexe 1 and briefly highlighted further. According to Hypertension Canada guidelines, HBPM must be performed using a validated upper arm electronic device with the correct cuff size; two readings in the morning and evening are take approximately 1 min apart for seven days (Rabi et al., 2020). The first-day readings are discarded, and the remaining readings are averaged. The patient must be sitting quietly with back supported, legs uncrossed, arm at the heart level, and resting for 5 minutes before the measurement (Rabi et al., 2020).

Additionally, preparation required before measurements must be explained to the patients that include measurements should be carried out at least two hours after the last meal, before taking medications, no caffeine or smoking in an hour and 30 minutes of rest before any physical activity. Once the education about HBM protocol is provided to patients, it is essential that HPs advise their patients about device purchase, interpretation of HBPM readings and verify patient's technique and device accuracy (Bonafini & Fava, 2015; Pickering et al., 2008). This will minimize the reporting bias and measurement errors. In Canada, HBPM booklets and logbooks are made available for patients by Hypertension Canada (Rabi et al., 2020).

Ambulatory BP measurement method (ABPM)

ABPM refers to out-of-clinic BPM using a fully automated device that automatically records and calculates BP readings every 20-30 minutes over a 24hour period (Blom et al., 2015; Cloutier et al., 2015). Over past decades many studies have looked at the BPM method that best correlates with clinical outcome (Gelfer et al., 2015; Grossman, 2013; O'Brien et al., 2013; Turner, Viera, & Shimbo, 2015). ABPM has emerged as the preferred method due to its ability to take many measurements in patients' normal environment and measure BP during sleep. ABPM measured during 24-hour is considered the gold standard for diagnosing hypertension and is recommended by hypertension societies (Boffa, Constanti, Floyd, & Wierzbicki, 2019; Rabi et al., 2020; Whelton et al., 2018; Williams et al., 2018).

ABPM estimates mean BP more accurately than clinic BP because of its ability to take multiple readings during daytime and nighttime (Hodgkinson et al., 2011; Kario, Shin, et al., 2019). ABPM also provides data on BP variability and the circadian rhythm of BP in a given individual (Jegatheswaran et al., 2017). In addition to diagnosis, there are many clinical indications for ABPM, among which the prominent are detecting white coat hypertension, masked hypertension or MUCH, nocturnal hypertension, early morning BP surge pattern, BP variability and monitoring BP periodically in patients during pharmacological treatment (Dadlani, Madan, & Sawhney, 2019; Kario, Shin, et al., 2019; O'Brien & Dolan, 2016; Rabi et al., 2020; Whelton et al., 2018; Williams et al., 2018).

There are several advantages of ABPM, including its ability to take a more significant number of BPM readings, absence of white coat hypertension, lack of observer bias, the requirement of minimal subject training, ability to daytime as well as night time BP readings, provides BP readings in a real-life setting, (at home, work, during rest, sleep, stressful events and physical activities) (Cloutier et al., 2015; Kario, Shin, et al., 2019; Pappaccogli et al., 2019; Williams et al., 2018). The limitations of ABPM include limited availability, expensive for both patients and provider, no reimbursement for provider and patient in some jurisdictions, not always well tolerated by patients, proper training to health professionals (Kario, Shin, et al., 2019; Pappaccogli et al., 2019; Williams et al., 2018).

ABPM would help reduce the possibility of misdiagnosis and overtreatment and ensure that the right people are treated with BP-lowering drugs and reduce the number of patients treated for hypertension (O'Brien & Dolan, 2016; Piper et al., 2015). For example, a large prospective study showed that compared with OBPM, 24-hour ABPM led to a 7% reduction in the proportion of older patients recommended for hypertension treatment and a substantial increase in the proportion of those with hypertension control (Banegas et al., 2015). In context to the cost-effectiveness of ABPM, the Ontario health technology assessment center investigated the cost-effectiveness of using ABPM to confirm a diagnosis when OBPM is increased found that patients diagnosed using ABPM were more likely to have better BP control and discontinue drug therapy. The analysis concluded that considering the cost of over $2.3 billion (CAD) spent on hypertension in Canada in 2003, the use of ABPM would have allowed saving Ontario's health care system $ 19 million over 5 years (Ontario, 2012).

ABPM has the highest prognostic value for CVD risk due to its access to nighttime BP values, circadian BP status, 24-hour BP variability along with morning BP surge (Banegas et al., 2018; Gonzalez et al., 2017; Kario, Thijs, et al., 2019; Piper et al., 2015; Turner et al., 2015; Verdecchia, Angeli, & Cavallini, 2007; Zhu et al., 2020). Studies have reported that ABPM is a stronger predictor of CVD outcomes, target organ damage and mortality than OBPM and has the highest prognostic accuracy (Banegas et al., 2018; Bliziotis et al., 2012; Hansen et al., 2007; Niiranen et al., 2014; Parati et al., 2013; Piper et al., 2015; Turner et al., 2015). A meta-analysis showed that in hypertensive patients at high CVD risk, a nighttime SBP >130mmHg increased CVD risk by 52% compared to SBP < 115 mmHg and indicated that nighttime SBP was the only significant predictor of CVD outcomes compared to OBPM (de la Sierra, Banegas, Segura, Gorostidi, & Ruilope, 2012). Another recent meta-analysis data reported that a 20mmHg increase in nighttime SBP was significantly associated with 21-36% CVD risk, whereas daytime SBP was significantly associated with a 22% increase in stroke risk (Kario et al., 2020). There is increasing evidence supporting that nighttime BP is a significant predictor of CVD outcomes (Cloutier et al., 2015; Dadlani et al., 2019; de la Sierra et al., 2012; Hansen et al., 2011; Kario, 2018; Roush et al., 2014; Salles et al., 2016).

Usually, during sleep, BP is low, and a dip of 10%-20% is considered normal. Thus, nocturnal hypertension and non-dipping pattern are strongly associated with increased CVD mortality and morbidity. Approximately 70% of individuals show BP at night, and 30% have non-dipping patterns (Dadlani et al., 2019; de la Sierra et al., 2014; Kario, 2018; Turner et al., 2015). Therefore 24-hour ABPM is more crucial because it reports nighttime BP (Cloutier et al., 2015).

The diagnostic threshold for daytime mean is ≥135/85 mm Hg, or 24-hour mean is ≥130/80 mm Hg (Cloutier et al., 2015; Rabi et al., 2020). Health professionals must adequately provide education to patients regarding ABPM. The protocol is presented in Table III and Annexe 1 and briefly highlighted further. A validated upper arm device consisting of an oscillometric device worn on a belt and connected to an appropriately sized cuff must be used. The cuff should be applied to the non-dominant arm unless the SBP of > 10 mm Hg between two arms, in which case the arm with the highest value obtained should be used. The device is set to record 24-hour BP with measurement frequency set at 20-30 minutes intervals during the day and 30-60 minutes intervals during the night. However, the night interval frequency is revised in the 2020 guidelines, and the new recommended frequency is set at 20-30 minutes throughout day and night. ABPM should be performed regularly, and patients must use the activity logbook to note the daytime and nighttime activities, symptoms, and medications administered. This data is valuable for research purposes. ABPM test is considered successful if at least 70% of readings are valid and at least 20 daytime and 7 nighttime readings are valid. For ABPM, the diagnostic thresholds are lower than OBPM since values are obtained over 24 hours, including the nighttime or sleep. The diagnostic threshold for the daytime mean is ≥135/85 mm Hg, or the 24-hour mean is ≥130/80 mm Hg (Rabi et al., 2020).

Table III Summary of recommended protocol for measuring BP by Hypertension Canada

BPM methods	Protocol
OBPM Oscillometric	The patient must be in a sitting position with 5 minutes of rest, back supported, legs uncrossed, feet flat on the floor, arm bare and supported, use of appropriate cuff size according to individuals arm circumference, bladder width should be close to 40% of the arm circumference and length should cover 80-100% of the arm circumference, cuff placement at heart level, lower edge of cuff 3 cm above the crease, and no talking or moving before or during the measurement. Three measurements must be performed, and an average of the last two must be taken.
AOBP	The patient must be sitting alone in a quiet room, no talking, legs uncrossed, back supported, and arm supported at heart level. Use appropriate cuff size. The device automatically takes subsequent readings and averages those readings. The average is displayed on the device that must be recorded.
HBPM	Measurements must be performed at home by patients using a validated upper arm electronic device with the correct cuff size. The patient must be sitting, quiet with back supported, legs uncrossed, arm at the heart level, and resting for 5 min before the measurement. Two readings in the morning and evening are taken approximately 1 min apart for seven days. The first-day readings are discarded, and the remaining readings are averaged.
ABPM	An appropriate-sized cuff should be applied to the non-dominant arm unless the SBP difference between arms is >10 mm Hg, in which case the arm with the highest value obtained should be used. The device should be set to record for at least 24 hours, with the measurement frequency set at 20-30-minute intervals during the day and every 30-60 minutes at night. (The frequency are revised for 2020 guidelines and included 20-30-minute interval throughout ay and night). Daytime and night-time measurements should be defined using the patient's diary. Alternatively, pre-defined thresholds can be used (e.g., 8 AM to 10 PM for awake and 10 PM and 8 AM for night-time). A patient-reported diary to define daytime (awake), night-time (sleep), activities, symptoms and medication administration is useful for study interpretation.

Data is taken from Hypertension Canada guidelines (Rabi et al., 2020) with permission (see Annexe 3)

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Recommendations for accurate measurement of blood pressure

Accurate measurement of BP is a crucial aspect of hypertension management (Kaczorowski et al., 2012; Padwal et al., 2019). Our study follows the Hypertension Canada Guidelines and recommendations for BPM; therefore, those recommendations for accurate BPM measurement for all four BPM methods are presented in Annexe 2.

Diagnostic algorithm in Canada

Various hypertension societies have established recommendations for hypertension diagnosis and management (Boffa et al., 2019; Umemura et al., 2019; Unger et al., 2020; Whelton, 2019; Whelton et al., 2018; Williams et al., 2018). However, concerning our study and thesis, we are presenting the hypertension diagnostic algorithm in Canada. The diagnostic algorithm is presented in Figure 1. In Canada, diabetes was included in the diagnostic algorithm to provide a comprehensive overview of the diagnosis of hypertension. If at visit 1, mean OBPM or AOBP SBP/DBP is ≥ 180/110 mm Hg, hypertension is diagnosed. If the mean OBPM is ≥ 140/90 mm Hg or the mean AOBP is ≥135/85 mm Hg or the mean OBPM is ≥130/80 mm Hg (diabetes), then the out-of-office measurement is performed before visit 2. ABPM is the recommended out-of-office measurement method, and HBMP is recommended if ABPM is not tolerated, not readily available, or patient preference. The patient can be diagnosed with hypertension if the mean awake ABPM is ≥135/85 mm Hg or the mean 24-hour is ≥130/80 mm Hg and if the mean HBPM is ≥135/85 mm Hg (Rabi et al., 2020). Autorisation is obtained to reuse Figure 1 (see Annexe 3).

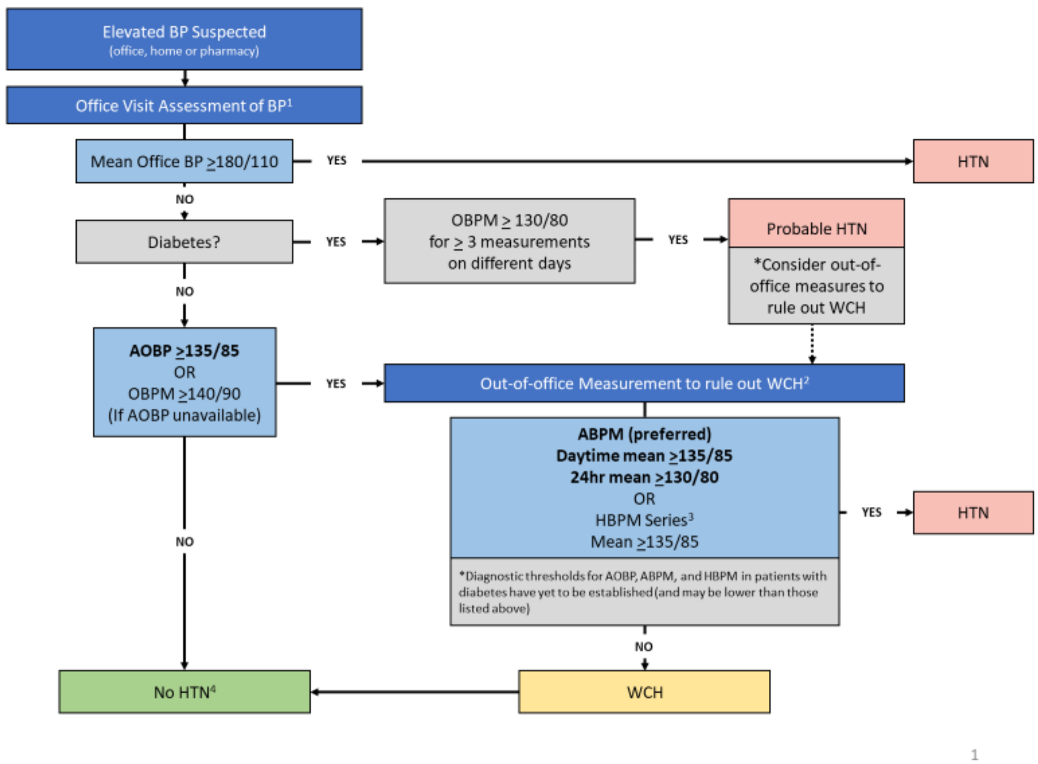

Figure 1 Hypertension diagnostic algorithm for adults in Canada: reused with permission

Sources of error during blood pressure measurement

Multiple causes of inaccuracy exist and can be categorized into patient-related, procedure-related, equipment-related, and observer-related (Kallioinen et al., 2017; Padwal et al., 2019). The sources of errors are summarized in Table IV. A recent systematic analysis study included 328 studies investigating the source of inaccuracy during BPM by categorizing to patient, device, procedure, or observer related. Results showed that these sources significantly affect SBP and DBP, contributing to underestimation or an overestimation of BP (Kallioinen et al., 2017).

Table IV Summary of sources of error during blood pressure measurement

Source	Range of mean error in SBP/DBP mm Hg	
	SBP	DBP
Patient-related		
Acute meal ingestion	-6	-5 to -2
Acute caffeine use	+3 to +14	+2 to +13
Acute nictoine use	+3 to +25	+3 to +18
Exposure to cold	+5 to +32	+4 to +23
Bladder distension	+4 to +33	+3 to +19
White-coat effect	Up to +26	Up to +21
Procedure-related		
Insufficient rest	+4 to +12	+2 to +4
Legs crossed at knees	+3 to +15	+1 to +11
Body position		
Standing	-3 to +5	+7
Supine	-11 to +10	-13 to +6
Unsupported back	No significant effects reported	+7
Unsupported arm	+5	+3 to +5
Arm lower than heart level	+4 to +23	+3 to +12
Incorrect cuff size		
Smaller cuff	+2 to +11	+2 to +7
Larger cuff	-4 to -1	-5 to -1
Talking during measurement	+4 to +19	+5 to +14
Equipment related		
Automated device variability	-4 to +17	-8 to + 10
Observer related		
Terminal digit preference for zero (during auscultatory measurement)	Up to 79% over-representation of terminal zero	
Observer hearing deficit	-2	+1 to +4
Reliance on single measurement	+3 to +10	- 2 to +1

Data taken from (Kallioinen et al., 2017; Padwal et al., 2019);
+,overestimation,-,underestimation
Notes. SBP, systolic blood pressure; DBP, diastolic blood pressure.

Role of nurses in hypertension management

It is essential to highlight the role of nurse in hypertension management as they are the frontline professionals delivering primary care to the general population and involved in various aspects of hypertension management. Nurses are key health professionals who work closely and collaboratively with patients and act as liaisons between patients and the interprofessional team (McLean, Kingsbury, Costello, Cloutier, & Matheson, 2007). Nurses are often involved in all stages of hypertension management, such as patient education, coordinating and delivering direct care, assessment, treatment, and follow-up. In addition, nurses contribute to improving health and disease prevention through their enhanced knowledge and skills (McLean et al., 2007).

Traditionally, the nurses' role was limited to routine monitoring of vital signs and BPM, collecting samples, managing appointments and education, and counselling (McLean et al., 2007). Over the years, the role of nurses expanded with evidence-based protocols to guide nurses and training programmes (Himmelfarb, Commodore-Mensah, & Hill, 2016). As nurses' skills evolved through graduate training, their roles in hypertension management evolved (Himmelfarb et al., 2016). Nurses gained skills to assess patients' health status, adjust medications, address hypertension care and control barriers, and assess and manage hypertension (Himmelfarb et al., 2016). Globally, nurses have advanced their knowledge, skills, and decision-making competencies by specializing in programmes such as nurse practitioners (McLean et al., 2007). Nurse practitioners (NPs) have legislative authority and the competencies to diagnose and treat chronic diseases autonomously, order and interpret diagnostic tests, prescribe medication, perform specific procedures within the legislated scope of nursing practice, and practice independently or in teams (Himmelfarb et al., 2016; McLean et al., 2007).

The roles of nurses are evolving, and possibilities for involvement are limitless in hypertension management (Clark, Smith, Taylor, & Campbell, 2010; McLean et al., 2007). Today the role of nurses in hypertension management involves all aspects of care, including detection, referral and follow-up, diagnostics and medication management, patient education, counselling and skill-building, coordination of care, clinic or office management, population health management, performance measurement and quality improvement (Himmelfarb et al., 2016). In Canada, nurses are involved in assessment, diagnosis, and treatment (McLean et al., 2007). Assessment and diagnosis include assessing patients' condition, health history and physical examination, participating in hypertension screening, office, home and ambulatory BPM, participating in support and education concerning HBPM, ordering and interpreting laboratory tests (NPs) (McLean et al., 2007). Nurses role in treatment includes use a holistic approach for care by engaging patient and family in hypertension management, involve the patient in the decision making process, prescribe medication (NPs), monitor efficacy of pharmacological treatment and adherence to treatment, help educate and evaluate lifestyle changes (McLean et al., 2007). Beyond the traditional roles, nurses have been involved in clinic and community-based research and have assumed leadership roles to improve hypertension care and control (Himmelfarb et al., 2016). In Canada, nurses have expanded their roles in high-quality research, advocacy and are involved in all steps of knowledge translation, guideline development and guideline dissemination (McLean et al., 2007).

One of the key features of effective hypertension care is interprofessional team practice (Himmelfarb et al., 2016; Santschi et al., 2014). Depending on the country's regulations and traditions, the team members can vary. For example, in Canada, this team can include patients, nurses, physicians, pharmacists, nutritionists, kinesiologists, and social workers. Interprofessional team practice enriches the experience of delivering care, expanding knowledge, and supporting patient-centred care (McLean et al., 2007). In addition, team-based care allows the primary provider to delegate routine matters to the team, thereby permitting more time to manage complex and critical patients (Himmelfarb et al., 2016; Santschi et al., 2014). It also aims to achieve effective hypertension control and reduce the consequences of uncontrolled hypertension (Proia et al., 2014). Several randomized controlled trials (RCTs) and meta-analyses involving team-based hypertension care delivered by nurses, NPs, pharmacists when compared with usual care have demonstrated a more significant reduction in SBP and DBP and greater achievement of BP targets (Carter, Bosworth, & Green, 2012; Clark et al., 2010; Proia et al., 2014; Santschi et al., 2014; Shaw et al., 2014). In Canada, nurses are often encouraged to participate in interprofessional team practice with patient-centred care (McLean et al., 2007). Nurse-led clinics, interprofessional team practice, and research involvement have contributed to the increasing number of patients receiving high-quality hypertension care and control (Himmelfarb et al., 2016).

Role of health professionals in blood pressure measurement

Health professionals (HP), namely physicians, nurses and pharmacists, are involved in blood pressure measurement and hypertension management (Carter et al., 2012; Himmelfarb et al., 2016; Kaczorowski et al., 2012; Marra, Johnston, Santschi, & Tsuyuki, 2017). All three HPs are skilled professionals and have the required education. Physicians are the specialist in BPM and hypertension management due to the broader education they receive. Their role in BPM is mainly to measure BP, diagnose hypertension based on the BP readings, prescribe and decide pharmacological treatment to patients, follow-up of patients on treatment and patient education concerning the device to use for HBPM. Overall, physicians are involved in decision-making. Nurses are primarily involved in BPM (Curzio & Beevers, 1997; Himmelfarb et al., 2016; Jackson, Ayala, Tong, & Wall, 2019; McLean et al., 2007). They measure BP regularly, provide education and instructions to patients on HBPM, perform screening and follow-up. The patients' education involves the techniques to measure BP, such as body position, arm position, cuff size and cuff placement, taking readings and logging those readings, reporting the readings to nurses or doctors, and the number of days the measurements should be performed pre-requisites before measuring BP. Nurses also provide education regarding pharmacological treatment.

Pharmacists are highly accessible primary providers and ideally placed to address the care gaps in hypertension management (Tsuyuki, Beahm, Okada, & Al Hamarneh, 2018). Pharmacists work closely with physicians and nurses, and their role in BPM and hypertension management focuses on patient education and counselling (including instructing patients about HBPM and device purchase, educating patients regarding device use and maintenance); recommendation to physicians about antihypertensive therapy (including drug-related problems, recommendations for changing pharmacotherapy and development of care plan); direct medication management with patients (including prescribing drug therapy, monitoring with adjustment or change in medication) (Marra et al., 2017; Matowe et al., 2008; Santschi et al., 2014). However, pharmacists also measure BP at the pharmacies and educate patients about BPM (Matowe et al., 2008).

Educational interventions performed in blood pressure measurement

Education in BPM for HPs and patients is a critical component in hypertension management (Campbell et al., 2019; Milot et al., 2015; Padwal et al., 2019). Hypertension Canada uses many strategies to reach HPs who care for patients with hypertension (Rabi et al., 2020). Efforts include knowledge translation, exchange forums, targeted educational material for primary care providers and patients, slide kits and summary documents (Rabi et al., 2020). However, OBPM training is included in initial training across Canada, but other methods are not necessarily covered in the programs. A multitude of evidence has addressed significant gaps in knowledge and practice concerning BPM among physicians and nurses (Campbell et al., 2005; Cloutier, 2007; Dickson & Birkett, 1988; Dickson et al., 2013; McKay et al., 1992). These studies have highlighted the need for knowledge translation and educational interventions.

Educational interventions can positively modify the behaviour of HPs that will lead to improvement in adherence to guidelines (Ribeiro et al., 2015). Patient education will improve patients' ability to measure BP at home accurately, and treatment adherence will contribute to better BP control (Magadza, Radloff, & Srinivas, 2009; Ribeiro et al., 2015). One of the roles of HPs is to provide education and training to patients concerning HBPM. A Canadian study that investigated the outcome of three educative programmes, including individual, group and self-learning, on 60 participants indicated that participants attending an individual or group training programme for HBPM retained their theoretical and practical knowledge better than before those engaged in self-learning (Leblanc, Cloutier, & Veiga, 2011). This was attributed to interaction with the nurse.

Several studies have shown that structured educational programmes for HPs and patient-oriented education can improve intermediate outcomes in hypertension management and achieve better BP control (Chang, Fritschi, & Kim, 2012; Hacihasanoğlu & Gözüm, 2011; Perl et al., 2011). A pilot project demonstrated that a structured programme such as a blood pressure measurement education programme (BEEP) improved knowledge and practice among nurses and is feasible and acceptable to nurses (Dickson & Hajjar, 2007). The study also highlighted the need for continuous reinforcement and evaluation of knowledge and practice to avoid the decline of these areas over time. Wider adoption of such a program can improve the accuracy of BPM and potentially reduce high health care costs at the national level (Dickson & Hajjar, 2007). Recent studies that assessed knowledge of physicians and nurses before and after an educational programme reported significant improvement in their knowledge (Block et al., 2018; Dalfó-Pibernat et al., 2018; Daniel, Veiga, Machado, Mafra, & Cloutier, 2019; Rabbia et al., 2013).

With recent advancement in educational programmes, web-based education has gained popularity as a modality for delivering up to date, standardized, accessible training in line with organizational goals (Block et al., 2018; Compas, Hopkins, & Townsley, 2008; Cook, 2006; Ruiz, Mintzer, & Leipzig, 2006). Such educational programmes can promote the long-term viability of education that needs constant reinforcement of knowledge. This could effectively improve the quality of education and evaluation of knowledge and practice (Ruiz et al., 2006).

Conceptual framework

Health professionals play an important role in BPM and hypertension management. It is therefore essential to determine their clinical competencies about knowledge, perception and practice. A wide range of factors can influence the clinical competencies of HP that includes their knowledge, skills, attitudes, individual motivation, interest, values (Roe, 2002). Therefore, to determine the clinical competency of HP, we have adopted the framework on the "Competence architecture model" by Robert Roe (Roe, 2002). The model is presented in Figure 2. According to Roe, competencies are built from sub competences, knowledge, attitudes and skills. This whole structure is built upon the individual abilities, personality traits and other characteristics such as biographical, interests, values (Bartram & Roe, 2005; Roe, 2002). The definitions are presented in Table V.

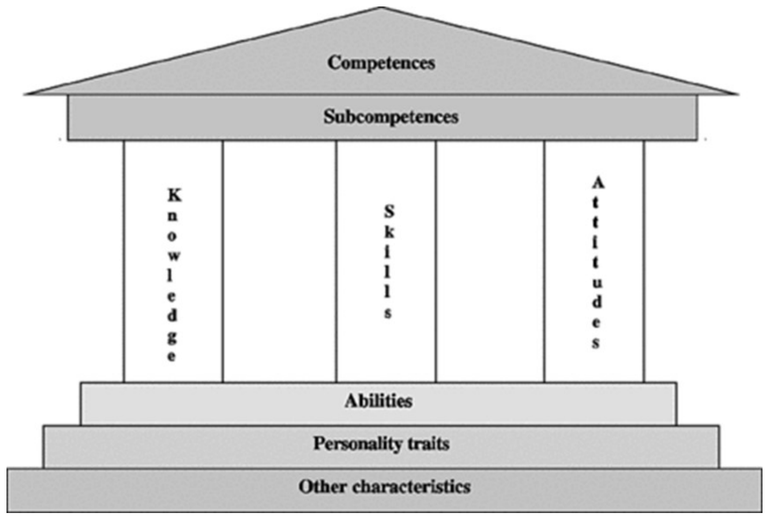

Figure 2 Competence architecture model (Roe, 2002) (used with permission)[1]

According to Roe, competence is the intellectual ability to perform a task, duty or role (Bartram & Roe, 2005; Roe, 2002). Competence has two features, first, a specific type of work to be performed in a particular work setting, and second, it integrates with several types of knowledge, skill, and attitudes that are assessed separately (Roe, 2002). Examples of competence are making a budget plan (accountant), drafting a contract (lawyer), carrying out a tooth extraction (dentist), providing behaviour therapy (clinical psychologist), developing and applying a personnel selection procedure (work and organizational psychologist). Competences are typically acquired in the process of learning-by-doing in the actual work situation, during an internship or in a simulation-based learning situation (Roe, 2002). The definitions are presented in Table V.

[1] Used with permission from European Psychologist, Vol. 7, No. 3, September 2002, pp. 192–202

www.hogrefe.com https://doi.org/10.1027//1016-9040.7.3.192

The competence architecture model was intended as a guide for designing a competence-based curriculum for European work and organizational psychology (Bartram & Roe, 2005; Roe, 2002). This model was originally used to assess psychologists' competence during training and before starting their practice. However, this model is designed to apply to any area of practice and occupation. For example, the model can be applied to identify competence at health, work, education, public health care, behavioural health workforce and school system (Bartram & Roe, 2005; Roe, 2002). So far, this model is applied in the engineering field to understand if engineers require technical and non-technical competence (Parts, Teichmann, & Ruutmann, 2013).

Roe suggests applying this model in student selection, academic curriculum design, basic professional training, continued professional training, accreditation, and quality assurance (Bartram & Roe, 2005; Roe, 2002). An example is presented further. As this model was applied explicitly in psychology, Roe defines competences as the higher-level task or duties the psychologist must fulfill, such as conducting an individual assessment. Sub competencies are the lower-level task related to fulfilling such essential occupational functions as administering tests, conducting interviews, applying group techniques, and searching for literature. The knowledge pertains to the various theories and empirical data produced within the different fields of psychology. The attitudes relate to accuracy, integrity, self-criticism, commitment, responsibility, respect and tolerance for others, ethical awareness, service orientation.

The skills apply to oral and written communication, observing and listening, problem analysis, applying statistical methods, using computer software. In addition, the abilities, personality traits, and other characteristics such as styles, values, interests, physical traits, and biographical characteristics are required to successfully complete the academic and professional learning processes to become a psychologist (Bartram & Roe, 2005; Roe, 2002). The model describes that to perform a given task, one should acquire the necessary knowledge and skills, display the appropriate attitudes, and ultimately carry out the task to the standard expected by their profession.

Application of the competence architecture model in our study

The objective of our study was to assess the knowledge, perception and practice of HPs, namely physicians, nurses and pharmacists, concerning the different BPM methods. Given the objectives of our study, the three concepts of the model, namely knowledge, attitudes, and skills, are replaced with our study concepts, namely knowledge, perception and practice. The definitions are presented in Table V.

We prefer to follow the competence architecture model for several reasons. First, this theoretical model is based on well-defined work, organizational psychology theories, and concepts that complement one another and are compatible with existing learning and activity theories. Second, it may be applied to different occupations. Third, it provides the opportunity to define competencies as a learned ability to do a specific task (for example, blood pressure measurement). HPs' competencies may be viewed as a set of behaviours that enables them to complete the required task effectively. Fourth, it allows for a better understanding of the interrelation between knowledge, skills, attitudes, and competence influenced by individual abilities, personality traits, and other characteristics. Our study offers a better understanding of HPs knowledge, perception, and practice concerning the different BPM methods.

Table V Definition of concepts according to competence architecture model and its application in our study

Competence architecture model	**Concepts**	Application in our study
A learned ability to adequately perform a task, duty, or role.	**Competence**	Blood pressure measurement
Competences that often learned in scholastic situations.	**Sub competence**	Theoretical and practical education concerning BPM that is acquired at school, internships or through specific BPM training.
Ability to reproduce or recognize specific facts and result from what the individual has accomplished using his or her mental capacities.	**Knowledge**	Knowledge is defined as theoretical comprehension of BPM methods.
Person readiness or willingness to act in accordance with his personal values.	**Attitude**	Attitude is replaced with Perception. Perception is defined as the beliefs of HPs towards the usefulness of BPM methods.
Abilities to perform specific tasks in a prescribed manner	**Skills**	Skills are replaced with Practice. Practice is defined as the implementation of recommended BPM methods for hypertension management in clinical practice
Abilities are his capacity to acquire the necessary knowledge and skills.	**Abilities**	Not applicable

Chapter 3. Article 1: Knowledge, perception, and practice of health professionals regarding blood pressure measurement methods: a scoping review

Authors contribution

Shweta Todkar	First author Developed the scoping review protocol Developed search strategy Conducted the scoping review Data extraction Data analysis Data interpretation Writing and submitting the article
Raj Padwal	Second author Expert reviewer Reviewed the article
André Michaud	Third Author Reviewed the article
Lyne Cloutier	Fourth author Expert reviewer Study supervision Developed the scoping review protocol Involved in all steps of the review article

This chapter presents the published article 1 of the thesis. First, a brief introduction to scoping review is presented, followed by the original article. The methodology is thoroughly and systematically described in the article. The manuscript was submitted to the Journal of Hypertension on April 7, 2020, published in March 2021. Next, the preliminary results of the scoping review were presented as a poster presentation at various conferences. The reference list for poster presentations and posters is attached in special documents Annexe 22-23. Finally, an editorial was published on our scoping review that highlighted BPM as an essential clinical skill worldwide (Cappuccio, 2021).

Introduction to scoping review

This paragraph presents a brief introduction to scoping review in terms of context and its objective.

Context and objective

Hypertension is the most critical risk factor contributing to the global burden of the disease (Beaney et al., 2020). Around 40% of the global adult population is still unaware or uncontrolled, thus susceptible to further complications affecting the brain, heart, kidneys (Beaney et al., 2020; Zhou et al., 2019). Hypertension guidelines for HP have been developed and disseminated in many countries worldwide (Kotchen, 2014; Whelton, 2019). These guidelines recommend using standardized BPM methods, namely home, ambulatory, office, and automated for accurate BPM. If performed inaccurately, it results in misdiagnosis and overtreatment, thus increasing the unnecessary burden of disease (Handler, 2009; Piper et al., 2015). BPM is the most commonly performed procedure in clinical practice by HP and requires adequate knowledge, perception, and practice. Unfortunately, in clinical practice, BPM is often suboptimally performed (Clark, Horvath, Taylor, & Campbell, 2014; Handler, 2009; Padwal et al., 2019; Pickering et al., 2005; Ringrose & Padwal, 2017).

Moreover, knowledge, perception and practice of HPs concerning the four BPM methods have been studied individually but not systematically. Therefore, we found it appropriate to conduct a scoping review to gather evidence to see the current BPM state. This evidence would help develop our research on BPM that will be conducted in Canada. Therefore, the objective was to perform a scoping review to identify knowledge, perception, and practice of physicians, nurses, and pharmacists regarding the home, ambulatory, office, and automated BPM methods. The full methodology is presented in the article.

Article 1: Knowledge, Perception and Practice of Health Professionals Regarding Blood Pressure Measurement Methods: A Scoping Review

Short title: Blood pressure measurement methods

Shweta Todkar [a], Raj Padwal [b], André Michaud [c], Lyne Cloutier [a]

[a] Department of Nursing, Université du Québec à Trois-Rivières, Trois-Rivières, Québec, Canada.

[b] Department of Medicine, University of Alberta, Alberta, Canada.

[c] School of Nursing, Université de Sherbrooke, Longueuil, Québec, Canada.

Correspondence to : Shweta Todkar, RN, MSN candidate PhD, Programme of Biomedical Sciences, Université du Québec à Trois-Rivières, 3351 Boulevard des Forges, Trois-Rivières, QC, Canada G9A 5H7; Tel: +1 819 668 8002; Fax : 819 376-5048

E-mail: Shweta.Kiran.Todkar@uqtr.ca

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Résumé en français

Objectif : La performance concordante aux lignes directrices de la mesure précise de la pression artérielle (PA), que la modalité soit à domicile (MPAD), ambulatoire (MAPA), en oscillométrique en série (MPAC-OS) et clinique (MPAC), dépend de la technique appropriée. Les connaissances, la perception et la pratique des professionnels de la santé pour la mesure PA sont cruciales et ont été en partie étudiées, mais un examen approfondi n'a jamais été rapporté. Une revue de la portée des études mondiales a été menée pour synthétiser les données publiées sur ce sujet.

Méthodes : Un cadre méthodologique Arksey et O`Malley a été utilisé. Les mots clés ont été identifiés et l'extraction a été achevée jusqu'en avril 2019 à l'aide de CINAHL et MEDLINE. Les études ont été classées comme positives pour les connaissances, la perception et la pratique si la majorité (> 50 %) des réponses rapportées étaient favorables, et négatives dans le cas contraire. Si des résultats spécifiques n'étaient pas rapportés, les conclusions de l'auteur ont été utilisées pour classer.

Résultats : Soixante-douze études ont été identifiées : 25 MPAD, 14 MAPA, 2 MPAC-OS, 40 MPAC. Pour la connaissance, le pourcentage d'études négatives était plus élevé pour MPAD (40 %) et MPAC (68 %) et plus faible pour MAPA (14 %) en ce qui concerne les techniques de la mesure PA. Pour la perception, le nombre d'études négatives était plus faible pour MPAD (20 %) et MAPA (7 %) concernant l'utilité des méthodes de la mesure PA dans la gestion de l'hypertension. Pour la pratique, le nombre d'études négatives était plus élevé pour MPAD (48 %), MAPA (71 %), MPAC (73 %) et MPAC-OS (50 %) concernant la mise en œuvre des directives sur l'hypertension.

Conclusion : Les résultats de cette revue de cadrage démontrent une perception adéquate du la mesure PA, mais des connaissances et des pratiques sous-optimales. L'éducation est encore nécessaire pour améliorer les connaissances et la pratique. Les efforts futurs devraient se concentrer sur l'amélioration de ce que nous savons et ce que nous faisons lors de la mesure de la PA.

Abstract

Objective: Guideline-concordant performance of accurate blood pressure measurement (BPM), whether the modality is home (HBPM), ambulatory (ABPM), automated (AOBP) or office (OBPM), is dependent on proper technique. Knowledge, perception and practice of health professionals for BPM is crucial and has been partly studied, but a thorough review has never been reported. A scoping review of global studies was conducted to synthesize published data on this topic.

Methods: An Arksey and O`Malley methodological framework was used. Keywords were identified, and extraction was completed to April 2019 using CINAHL and MEDLINE. Studies were classified as positive for knowledge, perception and practice if the majority (>50%) of reported responses were favourable and negative otherwise. If specific results were not reported, the author's conclusions were used to classified.

Results: Seventy-two studies were identified: 25 HBPM, 14 ABPM, 2 AOBP, 40 OBPM. For knowledge, the percentage of negative studies was higher for HBPM (40%) and OBPM (68%) and lower for ABPM (14%) regarding BPM techniques. For perception, the number of negative studies was lower for HBPM (20%) and ABPM (7%) regarding the usefulness of BPM methods in hypertension management. For practice, the number of negative studies was higher for HBPM (48%), ABPM (71%), OBPM (73%) and AOBP (50%) regarding implementation of hypertension guidelines.

Conclusion: The results of this scoping review demonstrate the adequate perception of BPM but suboptimal knowledge and practice. Education is still needed to improve knowledge and practice. Future efforts should focus on improving what we know and what we do when measuring BP.

Keywords: knowledge, perception, attitude, practice, physician, nurse, pharmacist, ambulatory blood pressure monitoring, home blood pressure monitoring, automated office blood pressure measurement, blood pressure determination.

Introduction

Hypertension is a leading global risk factor accounting for 10.4 million deaths and 218 million disability-adjusted life-years (DALYs) (Stanaway et al., 2018). Hypertension affects 40% of the global adult population aged ≥ 25 years (Lim et al., 2012). In 2000, 1 out of 6 world's adult population aged 20 years and above had hypertension which increased by 7,7% in 2010 and is predicted to grow to 50% by 2050 (Kearney et al., 2005; Mills et al., 2016). Globally, in 2015, it is estimated that 3.5 billion individuals had systolic blood pressure (SBP) of at least 110 to 115 mmHg (Forouzanfar et al., 2017). A global campaign by the International Society of Hypertension (ISH) identified that over a third of a million adults had untreated hypertension, and 40.5% of hypertensive adults were unaware of having hypertension (Beaney et al., 2020). In Canada, approximately 23% of the adult population [24,3% women and 21,7% men] have been diagnosed with hypertension (Robitaille et al., 2012). Although Canada has the highest blood pressure (BP) control rates, one-third of the population (32.5%) remains either unaware or not controlled, thus susceptible to complications (coronary heart disease, chronic kidney disease, stroke) (Padwal, Bienek, McAlister, & Campbell, 2016).

Accurate BP measurement (BPM) is of great importance in hypertension management since improper BPM can result in misdiagnosis, treatment inaccuracies and increased cardiovascular risk (Campbell, Culleton, & McKay, 2005; Kallioinen, Hill, Horswill, Ward, & Watson, 2017). The guidelines by the American Heart Association (AHA), Hypertension Canada, European Society of Hypertension (ESH), National Institute for Health and Care Excellence (NICE) have meticulously appraised the evidence supporting the use of BPM methods in hypertension management (Boffa, Constanti, Floyd, & Wierzbicki, 2019; Muntner et al., 2019; Nerenberg et al., 2018; Williams et al., 2018). These guidelines recommend using standardized BPM methods, namely home (HBPM) and ambulatory (ABPM) to confirm the diagnosis of hypertension; and automated (AOBP) and office (OBPM) for screening and treatment of hypertension. Validated devices should be used in all cases.

When measuring BP in the office, the auscultatory technique can cause inaccuracy and errors in BPM and, therefore, the use of electronic oscillometric and/or automated devices is preferred (Campbell et al., 2014; Cloutier et al., 2015). The evidence-based guidelines are established to assist health professionals (HP) in decision-making for the management of hypertension based on clinical judgement for individual patients (Muntner et al., 2019; Nerenberg et al., 2018; Williams et al., 2018). However, these guidelines need to be put into practice and implemented. Few attempts have been made at compiling all the evidence, and studies have been published demonstrating that BPM is less than optimal (Lamarre-Cliché, Cheong, & Larochelle, 2011; Padwal et al., 2019; Rinfret et al., 2017; Staessen et al., 2017).

HP play an important role in BPM and hypertension management. Thus, a clearer picture of the knowledge, perception and practice of HP is needed. BPM methods have been studied individually concerning either knowledge, perception, and practice but not systematically and not in Canada. To our best knowledge, so far, no systematic and scoping reviews have been performed specifically on this topic of BPM (Cloutier, 2007). Therefore, this is not just one more review but the first scoping review to provide a comprehensive scenario about BPM globally. Scoping reviews are useful to identify gaps in evidence, mapping evidence to inform the practice in the topic of interest and clarify concepts (Arksey & O'Malley, 2005; Peters et al., 2015) (The Joanna Briggs Institute, 2015). We performed a scoping review to present a global analysis of knowledge, perception, and practice of HP concerning BPM methods and further identify if gaps exist in the implementation of international hypertension guidelines by HP.

Methods

Scoping review process

A scoping review was performed using the methodological framework suggested by Arksey and O`Malley (2005) (Arksey & O'Malley, 2005) and further refined by Joanna Briggs Institute (Peters et al., 2015). The stages of this framework include identifying the research question, identifying different key terms for the search strategy, identifying relevant studies using those key terms, selecting studies, charting the data, and collating, summarizing, and reporting the results (Arksey & O'Malley, 2005; Peters et al., 2015).

Identifying research question

This scoping review addresses the underlying research question: *What is the extent of literature related to knowledge, perception, and practice of HP regarding BPM methods?*

Identifying key terms: Definition of concepts

To identify and include the relevant studies, the three concepts, namely knowledge, perception, practice, and four BPM methods, were defined accordingly (see Table VI). The definitions for the three concepts are derived from the framework on the "Competence architecture model by Robert Roe (2002) (Roe, 2002). This framework aims to determine the clinical competency pertaining to knowledge, perception and practice of HP. BPM methods were defined using the Hypertension guidelines published by International Hypertension Societies, namely AHA, ESH, Hypertension Canada, NICE, British Hypertension Society (BHS).

Table VI Definition of BPM methods

BPM methods	Definition
HBPM	BP is measured by the patient with an oscillometric device at home.
ABPM	Out of clinic BPM over 24hr using a fully automated device.
AOBP	In-clinic BPM using an oscillometric device that automatically records multiple BP readings and averages those readings.
OBPM	In-clinic BPM by a trained HP using the oscillometric or auscultatory device.

Selection of studies

Studies were included if they focused mainly on knowledge, perception, and practice on BPM methods (home, ambulatory, office, automated) and HP (physicians, nurses and pharmacists), respectively. In addition, studies in English and French language were considered for inclusion.

Search methods

A comprehensive literature search of human studies was performed using CINAHL and MEDLINE databases. Key words were identified from relevant publications and MeSH terms. A preliminary search strategy was formulated, assembling all the identified keywords. After several rounds of preliminary search, we identified our final search strategy. The search strategy was used separately for each database. Additionally, studies were identified through web searches and by reviewing the reference lists of all articles. Each database was searched from inception to April 2019 and further updated in November 2019.

Charting the data: Data extraction and analysis

The following details were extracted from the studies: author, year of publication, BPM guidelines, study population, the objective of the study, classification of studies based on the three themes, methodology, results, statistical analysis. For knowledge, data were extracted regarding diagnostic thresholds and techniques to measure BP as recommended by national and Canadian guidelines. For perception, data were extracted regarding the perception of HP about the usefulness of BPM methods. For practice, data were extracted regarding the practice of HP about using BPM methods in clinical practice as recommended by guidelines. BPM guidelines suggest using BPM methods for hypertension management, including hypertension screening, diagnosis, treatment, and follow-up.

Furthermore, for each concept, a classification was defined according to the results presented in each study. The criteria for the classification of studies are reported in Table VII. For example, knowledge was classified as inadequate and adequate; perception was classified as negative and positive, and practice was classified as unsatisfactory and satisfactory.

For analysis, the criteria for analysis are presented in Table VII. Results from each study were categorized as positive or negative. If the reported responses were >50%, the results were classified as positive, and if the reported responses were ≤50%, then the results were classified as negative. If the studies did not report specific results, the decision regarding classification was based on the author's conclusions. For example, studies showing inadequate knowledge, negative perception, unsatisfactory practice, with reported responses of ≤50%, were classified as negative. Whereas studies showing adequate knowledge, positive perception, satisfactory practice, with reported responses of >50%, were classified as positive.

Table VII Criteria for classification of studies and definition of concepts

Concepts Definitions	Classification of concepts and results	
	Negative ≤ 50%	**Positive > 50%**
Knowledge Theoretical understanding of BPM methods concerning BPM techniques and diagnostic thresholds	Inadequate knowledge	Adequate knowledge
Perception Beliefs of HP towards the usefulness of BPM methods for hypertension management	Negative perception	Positive perception
Practice Implementation of BPM methods in clinical practice for hypertension management as recommended by guidelines	Unsatisfactory practice	Satisfactory practice

Results

Study selection

The PRISMA flow diagram (see Figure 3) represents the scoping review process for identification, screening, eligibility, and inclusion of studies, along with the reasons for excluding studies. Overall, 1456 articles across Medline (927) and CINAHL (529) databases were retrieved. After the removal of duplicates, 1316 articles remained. After the title scan, a comprehensive abstract scanning of 220 articles resulted in identifying 92 potentially relevant articles for full-text review. Additional 30 articles were identified through reference scanning. Thus, a total of 122 full-text articles were assessed for eligibility. After a full-text review, 72 potentially relevant studies were identified for the final data extraction and analysis.

Out of the 72 studies identified, 25 (35%) studies focused on HBPM, 14 (19%) studies on ABPM, 2 (3%) studies on AOBP and 40 (56%) studies focused on OBPM. Since a few studies have assessed two concepts simultaneously in a single study, the total number of studies for each BPM method exceeds the overall total. Similarly, a few studies included both physicians and nurses in a single study. To achieve the objective of the scoping review, we are presenting results distinctly for physicians and nurses irrespective of their inclusion in the same studies (see supplemental content). Results for each BPM method are presented regarding the knowledge, perception, and practice of physicians, nurses, and pharmacists.

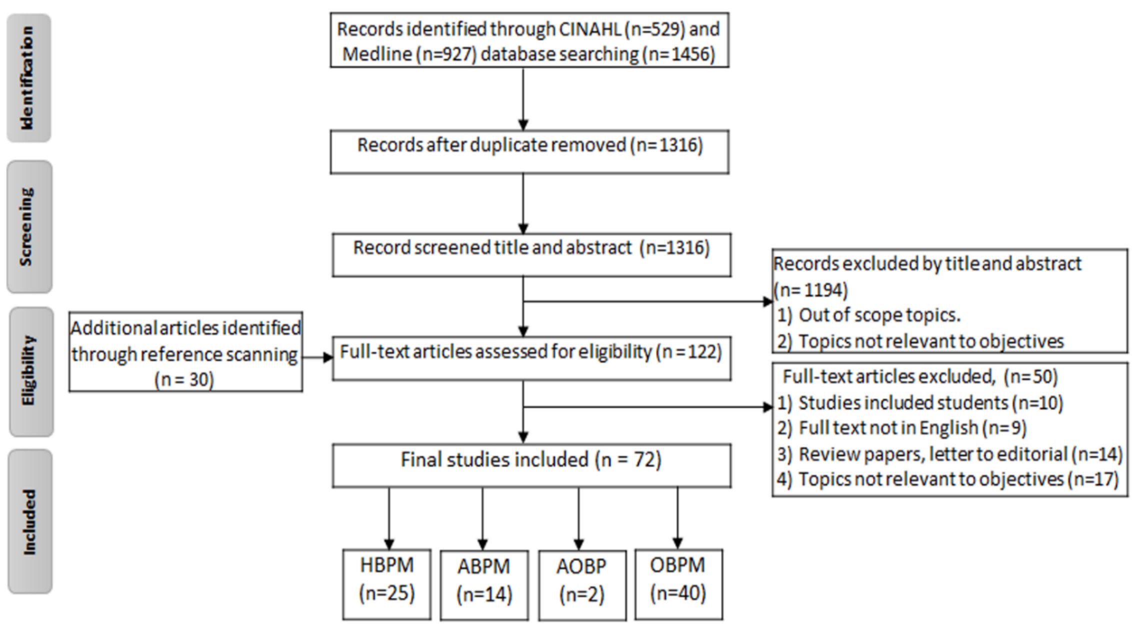


Figure 3 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram for the scoping review process

Study characteristics

Most studies enrolled physicians, whereas few studies enrolled nurses and pharmacists. These studies were performed in USA, Canada, Europe, UK, Asia, Australia, Africa. The majority of studies implemented guidelines, namely, AHA, ESH, NICE, BHS, Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC7), Canadian Hypertension Education Program (CHEP), Japanese Society of Hypertension (JSH). In addition, most of the HBPM, ABPM and AOBP studies used an online questionnaire, whereas the majority of OBPM studies used a self-administered (paper) questionnaire.

Studies included were published between the years 2003 to 2019 for HBPM, from 1993 to 2018 for ABPM, from 2013 to 2018 for AOBP, from 1988 to 2018 for OBPM. The role of out-of-office BPM has been defined by international hypertension societies in recent years, and studies on the subject started later on since out-of-office was adopted later. In our analysis, we had taken into consideration guidelines used by authors at the time the studies were conducted. A descriptive summary of data extracted from these studies is available in Annexe A Supplemental Content Table 1-4.

Study results

Home blood pressure measurement method (HBPM)

Out of 25 studies, 10 studies focused on knowledge, 15 studies focused on perception and 22 studies focused on practice (see Figure 4). Studies 19 (76%) included physicians, 1 (4%) included nurses, 2 (8%) included pharmacists and 3 (12%) included both physicians and nurses.

Knowledge

All 10 studies were classified as negative since they demonstrated inadequate knowledge about BPM techniques based on diagnostic thresholds for HBPM, frequency and timings of HBPM measurements, mean calculation and HBPM guidelines (see Figure 4) (Boivin et al., 2011; Fletcher et al., 2016; Ishikuro et al., 2016; Kim, Kim, Kim, Jung, & Ryu, 2012; Matowe, Abahussain, Awad, & Capps, 2008; Obara et al., 2010; Obara et al., 2012; Setia, Subramaniam, Teo, & Tay, 2017; Setia, Subramaniam, Tay, & Teo, 2017; Tsakiri, Stergiou, & Boivin, 2013).

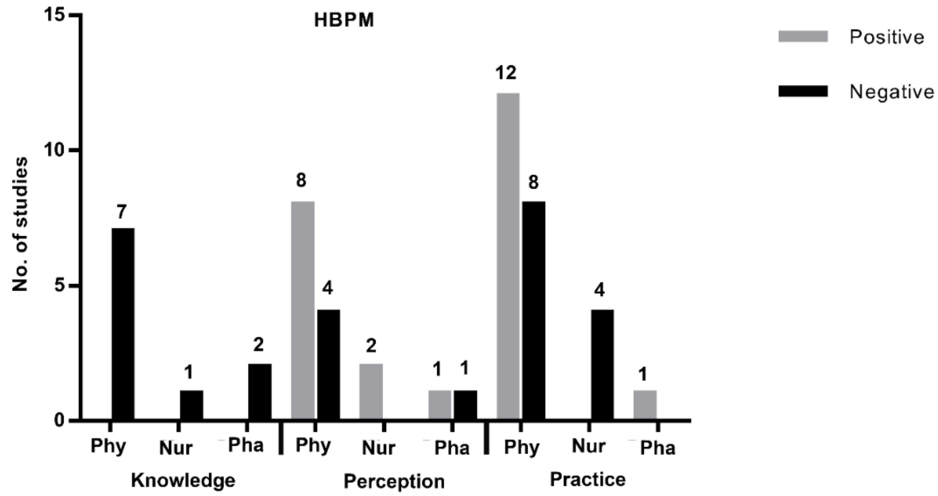
Perception

Majority of studies showed positive perceptions, yet few studies with physicians 4 (27%) and nurses 1 (7%) were classified as negative since HP did not believe that HBPM is useful for hypertension management (see Figure 4) (Boivin et al., 2011; Logan, Dunai, McIsaac, Irvine, & Tisler, 2008; Martín-Rioboó et al., 2018; Matowe et al., 2008; Tsakiri et al., 2013).

Practice

Some studies with physicians 8 (36%) and nurses, 4 (18%) were classified as negative since they showed major deficiency amongst HP in using the HBPM method for hypertension management (see Figure 4). Results of these studies showed that HBPM was less frequently recommended, and instructions were not provide to patients (e.g., regarding self BP measurement, interpretation of readings obtained, cuff size and device information) (Boivin et al., 2011; Ishikuro et al., 2016; Jackson, Ayala, Tong, & Wall, 2019; Jones et al., 2013; Kaczorowski et al., 2017; Mejzner, Clark, Smith, & Campbell, 2017; Obara et al., 2010; Tirabassi, Fang, & Ayala, 2013; Woolsey, Brown, Ralls, Friedrichs, & Stults, 2017).

Overall, negative results for knowledge, perception and practice were observed in the continents of North America, Europe, and Asia.



Notes. Phy, Physician; Nur, Nurse; Pha, Pharmacist

Figure 4 Knowledge, perception, and practice of health professionals regarding home blood pressure measurement method

Ambulatory blood pressure measurement method (ABPM)

Out of 14 studies, 1 study focused on knowledge, 7 studies focused on perception and 11 studies focused on practice (see Figure 5). Vast majority of studies, 12 (86%) included physicians, and 2 (14%) included both physicians and nurses. There are no studies with pharmacists.

<u>Knowledge</u>

The one study that assessed physicians' and nurses' knowledge was classified as negative since both physician and nurse demonstrated a lack of knowledge based on diagnostic thresholds for ABPM and accurate interpretation of ABPM results (see Figure 5) (Dalfó-Pibernat et al., 2018).

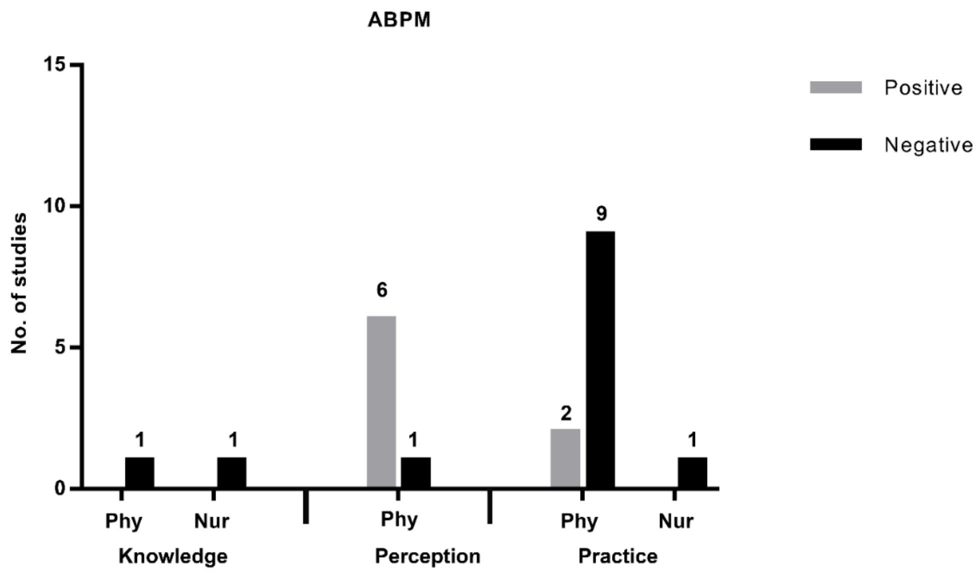
Perception

Majority of studies were classified as positive, yet only 1 study showed negative perception amongst physicians towards the usefulness of the ABPM method in hypertension management (see Figure 5) (Martín-Rioboó et al., 2018).

Practice

Majority of studies with physicians 9 (82%) and nurses 1 (9%) were classified as negative since they showed unsatisfactory practice (see Figure 5). Results of these studies showed that the ABPM method was less frequently used and provided to patients for diagnostic purposes due to limited access (Carter & Kaylor, 2016; Dehaeck, Thurston, Gibson, Stephanson, & Ross, 2010; Kaczorowski et al., 2017; Kobayashi, Sato, Hatori, & Miyakawa, 2017; Martín-Rioboó et al., 2018; McGowan, Gough, Maxwell, & Padfield, 2007; Mejzner et al., 2017; Setia, Subramaniam, Teo, et al., 2017; Woolsey et al., 2017).

Overall, negative results for knowledge, perception and practice were observed in the continents of North America, Europe, and Asia.



Notes. Phy, Physician; Nur, Nurse; Pha, Pharmacist

Figure 5 Knowledge, perception, and practice of health professionals regarding ambulatory blood pressure measurement method

Office blood pressure measurement method (OBPM)

Out of 40 studies, 27 studies focused on knowledge, 1 study focused on perception and 26 studies focused on practice (see Figure 6). Studies 13 (33%) included physicians, 16 (40%) included nurses, 11 (28%) included both physician and nurse. So far, there are no studies with pharmacists.

<u>Knowledge</u>

Majority studies with physicians 11 (41%) and nurses 15 (54%) were classified as negative since they demonstrated inadequate knowledge about BPM techniques based on diagnostic thresholds, arm position, cuff placement, posture, mean calculation etc. (see Figure 6) (Ahmed, 1997; Cloutier, 2007; Coogan, Marra, & Lomonaco, 2015; Dickson & Hajjar, 2007; Feher, Harris-St John, & Lant, 1992; Gillespie & Curzio, 1998; Gleichmann, Gleichmann, Mannebach, Mellwig, & Philippi, 1989; Machado et al., 2014; Markandu, Whitcher, Arnold, & Carney, 2000; McKay, Raju, & Campbell, 1992; McVicker, 2001; Mion, Pierin, Lessa, & Nobre, 2002; Nolan & Nolan, 1993; Obara et al., 2010; Ojo, Sogunle, Malomo, & Adesoji, 2018; Ray, Nawarskas, & Anderson, 2012; Villegas, Arias, Botero, & Escobar, 1995; Vloet, Smits, Frederiks, Hoefnagels, & Jansen, 2002; Wingfield, Pierce, & Feher, 1996).

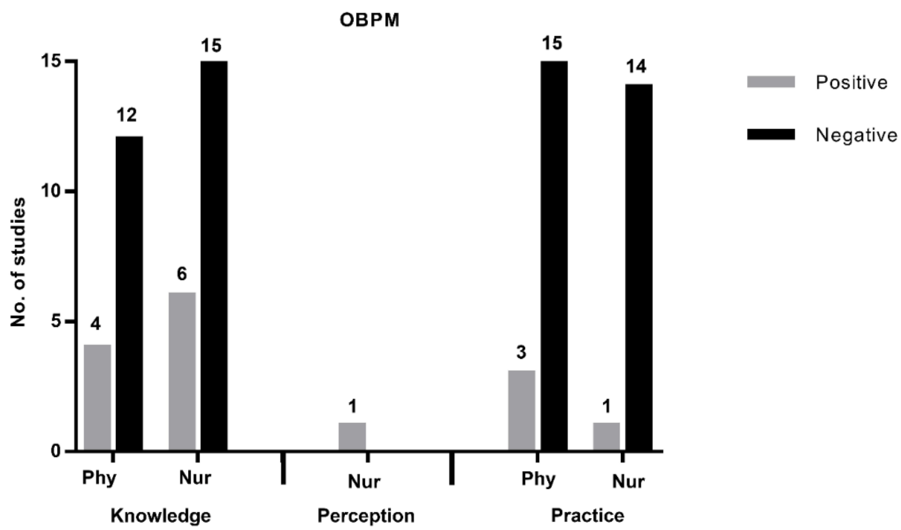
Perception

The only study that assessed nurses perception was classified as positive since they showed positive perception among nurses about the usefulness of OBPM (see Figure 6) (Block et al., 2018).

Practice

Majority of studies with physicians, 15 (58%) and nurses, 14 (54%) were classified as negative as a result of unsatisfactory practice (see Figure 6). In the majority of these studies, BPM was done by using the auscultatory method, which is not according to guidelines (Bhalla, Singh, D'Cruz, Lehl, & Sachdev, 2005; Carney et al., 1999; Dickson & Birkett, 1988; Dickson et al., 2013; Dickson & Hajjar, 2007; Drevenhorn, Hakansson, & Petersson, 2001; Gillespie & Curzio, 1998; Kaczorowski et al., 2017; Kay, 1998; Kobayashi et al., 2010; McKay, Campbell, Parab, Chockalingam, & Fodor, 1990; McVicker, 2001; Mion et al., 2002; Mohan et al., 2014; Ojo et al., 2018; Rabbia et al., 2013; Sandoya-Olivera, Ferreira-Umpiérrez, & Machado-González, 2017; Veiga et al., 2003; Villegas et al., 1995; Vloet et al., 2002; Wingfield et al., 1996).

Overall, negative results for knowledge and practice were observed in the continents of North America, South America, Africa, Europe, Asia and Australia.



Notes. Phy, Physician; Nur, Nurse; Pha, Pharmacist.

Figure 6 Knowledge, perception, and practice of health professionals regarding in-office blood pressure measurement method

Automated blood pressure measurement method (AOBP)

<u>Practice</u>

Out of 2 studies, 1 study was classified as negative since results showed that the majority of physicians (54.2%) were measuring BP using the auscultatory method (Kaczorowski et al., 2017). While 1 study showed the majority of physicians (56.6%) use and preferred the AOBP method (Martín-Rioboó et al., 2018). So far, no study is identified for knowledge and perception.

Overall, negative results for knowledge and practice were observed in the continent of North America.

Discussion

This scoping review was undertaken to summarize the literature and present a global picture pertaining to knowledge, perception, and practice of HP with regard to BPM methods. To our best knowledge, this is the first scoping review that has analyzed the literature relating to all the four BPM methods, all three concepts and all health professionals, namely physicians, nurses, and pharmacists, in a single study. In order to improve BP management, there are guidelines published by hypertension societies across the world, including Hypertension Canada, which recommend using standardized BPM methods for accurate BP measurement and hypertension management. However, the results of our review suggest that a gap remains between recommendations and their implementation by HP with regard to knowledge, perception, and practice. This gap is a limiting factor to achieve better hypertension control.

Home blood pressure measurement method (HBPM)

With respect to knowledge, since all studies were classified as negative, the results of our scoping review highlight a persistent lack of knowledge amongst HP regarding diagnostic thresholds for HBPM and awareness about HBPM guidelines. Studies assessing barriers for HBPM method also identified lack of knowledge about BP targets and protocols for HBPM and lack of awareness about HBPM guidelines as an important barrier limiting the implementation of the HBPM method by HP (Dugelay, Kivits, Desse, & Boivin, 2019; Kronish et al., 2017) A report by *Tay et al.* highlighted knowledge gaps about HBPM protocols and techniques in Asia (Tay & Teo, 2020).

However, concerning perception about the usefulness of HBPM, 73% of studies showed positive results, which is encouraging. To be noted, although HP were positive about the usefulness of the HBPM method, some HP were not confident to fully endorse it in their practice. The limitations for the uptake of HBPM include lack of education for patients and uncertainty about the interpretation of results, device cost and patient anxiety (Boivin et al., 2011; Logan et al., 2008; Martín-Rioboó et al., 2018).

Regarding practice, almost half of the studies (55%) showed deficiencies in implementing the HBPM method. The study by *Kaczorowski et al.* showed that in Canada, only

22.4% of family physicians used HBPM for the diagnostic purpose (Kaczorowski et al., 2017). The major barriers to the use of HBPM in clinical practice highlighted in these studies were lack of reimbursement for physicians, lack of access to HBPM, lack of staff time to provide HBPM education to patients, inadequate measurement conditions (Jackson et al., 2019; Kaczorowski et al., 2017; Martín-Rioboó et al., 2018; Woolsey et al., 2017).

Ambulatory blood pressure measurement method (ABPM)

When it comes to ABPM, studies focused mainly on perception and practice. The one study that assessed knowledge showed that before their training session, 26.7% of physicians and nurses had adequate knowledge, and this score significantly increased to 85.3% following the education program, which highlights the importance of education (Dalfó-Pibernat et al., 2018). Interestingly, most HP have positive perception about ABPM, although the majority of studies (91%) exposed deficiencies in the practice. The main barriers highlighted in these studies include the reimbursement fees, lack of insurance coverage, lack of access, lack of education to patients to interpret readings (Kaczorowski et al., 2017; Martín-Rioboó et al.,2018; Mejzner et al., 2017; Setia, Subramaniam, Teo, et al., 2017; Woolsey et al., 2017). A study by *Deborah et al.* indicated that ABPM is underused in clinical practice due to environmental barriers (e.g., access, cost, and education to patients), and thus, payment transformation*,* incentivized outcome along with team-based care might increase the use of ABPM (Taira et al., 2017). Globally there is no published study on pharmacists assessing knowledge, perception, and practice, which, for Canada, is remarkable since the pharmacists are often involved in ABPM. Also, there are very few studies on nurses.

Office blood pressure measurement method (OBPM)

The majority of the studies on OBPM, 79% demonstrated a lack of knowledge amongst physicians and nurses regarding BPM techniques pertaining to position, cuff placement and cuff size, rest period, mean calculation, and diagnostic thresholds. A review by *Cloutier et al*. concerning HP knowledge of OBPM identified deficiencies in knowledge (Cloutier, 2007). Regarding perception, so far, there is only 1 study about nurse perception.

Regarding practice, the majority of studies, 88%, showed deficiencies in implementing the OBPM method for hypertension management. The limiting factor was continuing use of auscultatory technique to measure BP in healthcare setup. Results of a recent Canadian study indicated that 54.2% of HP use manual OBPM with a mercury or aneroid device as the routine method to screen patients for above threshold BP, while 42.9% are using AOBP measurement, although the auscultatory is not recommended in the Canadian guidelines and that AOBP should be the preferred method for diagnosis in Canada (Kaczorowski et al., 2017). In 2013, a global survey by ISH from 90 national and regional societies and 77 countries about the current practice in the management of hypertension showed that the prevailing method to measure BP was mercury sphygmomanometer (68%), aneroid sphygmomanometer (65%), semi-automated (65%) (Chalmers, Arima, Harrap, Touyz, & Park, 2013). The barriers for unsatisfactory practice include lack of time for HP to follow guidelines and lack of availability of electronic devices to measure BP (Dickson et al., 2013; Hwang, Aigbe, Ju, Jackson, & Sedlock, 2018). Globally, no published studies were identified that assessed physician and pharmacist perception and pharmacist knowledge and practice.

Automated blood pressure measurement method (AOBP)

Globally, no published studies were identified concerning knowledge, perception of HP and practice of either nurses or pharmacists. Regarding practice, so far, only 2 studies were identified concerning physician practice. A study by *Kaczorowski et al.* showed that 42.9% of physicians used an AOBP method to screen patients for high BP while the majority are still using the auscultatory method (Kaczorowski et al., 2017). Although the auscultatory method is not recommended, yet it is still being used in clinical practice. Thus, emphasizing the need for transition from auscultatory to automated method (Veiga et al., 2016).

Overall, our scoping review results highlight that not a lot of data are reported about AOBP and ABPM methods and also, not many studies have included nurses and pharmacists.

Limitations

First, we included English and French language only and would have missed studies published in other languages. Second, we included studies published in peer-reviewed journals only, excluding grey literature. Third, we had a defined criterion for the classification of studies and based on this classification, data was extracted from published studies and results were reported accordingly. Some studies that addressed the three concepts were not similar to our definitions, and therefore results of those studies were presented based on our definitions. Fourth, we did not attempt to explore the inconsistencies between high-income countries (HICs) and low middle-income countries (LMICs), but comparatively, we attempted to show a global picture.

Conclusion

Inadequate BPM measurement remains a big concern. Our scoping review results showed that although HP have positive perception towards the usefulness of BPM methods for hypertension management, the inadequate knowledge and unsatisfactory practice towards implementing those BPM methods in actual clinical practice is somewhat disappointing. Hypertension guidelines published worldwide recommend using standardized BPM methods, especially ABPM and HBPM for diagnosis and AOBP and OBPM for screening and ongoing management of hypertension. The results of this scoping review clearly demonstrate that there is still room for improvement. Not much data is available in Canada. Thus, further studies should focus on understanding the knowledge, perception, and practice of HP regarding BPM methods, especially for nurses and pharmacists.

There are still unmet needs that contribute to the burden of hypertension, especially in LMICs but even in the HICs where we can see that discrepancies still remains. It is therefore essential to develop effective strategies such as knowledge translation, continuing education, regular training, and professional certification programme along with interprofessional collaboration. This is crucial since these strategies can increase appropriate implementation of guidelines into practice, thus, improving BP control rates. In addition, to achieve global BP control rates, in both HICs and LMICs, a transformative health service policy, transformative clinical approach as recommended by World Hypertension League and may measuring month developed by the International Hypertension Society (ISH) to raise awareness about hypertension screening are very effective global strategies favourable for LMICs where shortcomings in the management of hypertension still exist (Beaney et al., 2020; Campbell et al., 2019). More systematic studies are needed to address this issue. We anticipate that our results will be of interest to national hypertension societies, HP and researchers in the area of hypertension. This should guide future education programs in basic training as well as continuous professional education sessions for all HP around the world.

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None to declare.

Conflict of interest

Dr. Raj Padwal is Co-Founder and CEO of mmHg Inc., a University of Alberta based start-up creating software and hardware innovations in the field of blood pressure measurement. Dr. Lyne Cloutier has received honoraria and travel support from Servier Canada. For the remaining authors, none were declared.

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Annexe A- Supplemental digital content for scoping review

Table 1 Home Blood Pressure Measurement

	Year	Author	Country	Guideline	Health professional			Knowledge		Perception		Practice	
					Phy	Nur	Pha	–	+	–	+	–	+
1.	2003	Cheng	USA	JNC 7	X						X		
2.	2006	Tisler	Hungary	ESH	X						X		X
3.	2008	Logan	Canada	CHEP	X					X			
4.	2008	Matowe	Kuwait	BHS			X	X		X			
5.	2010	Kobayashi	Japan	JSH	X							X	
6.	2010	Obara	Japan	JSH	X			X					X
7.	2010	Dehaeck	Canada	SOGC	X								X
8.	2011	Boivin	France	ESH	X			X		X		X	
9.	2011	Steinmann	USA	JNC 7	X						X		X
10.	2012	Obara	Japan	JSH			X	X			X		X
11.	2012	Tsakiri	Greece	ESH	X			X		X			X
12.	2012	Kim	S. Korea	KSH	X			X					X
13.	2013	Jones	UK	NICE	X	X					X	X	
14.	2013	McManus	UK	NICE	X						X		X
15.	2013	Tirabassi	USA	JNC 7	X	X						X	
16.	2014	Sugano	Japan	JSH	X						X		X
17.	2016	Fletcher	UK	NICE	X			X			X		X
18.	2016	Ishikuro	Japan	JSH		X		X			X	X	
19.	2017	Kaczorowski	Canada	CHEP	X							X	
20.	2017	Setia	Singapore	ESH	X			X					X
21.	2017	Setia	Singapore	ESH	X			X					X
22.	2017	Mejzner	UK	NICE	X						X	X	
23.	2017	Woolsey	USA	AHA	X							X	
24.	2018	Martin	Spain	ESH	X					X			X

25.	**2019**	**Jackson**	**USA**	**AHA**	**X**	**X**						**X**	
TOTAL		**25**			**22**	**4**	**2**	**10**	**0**	**5**	**10**	**9**	**13**
					19/22	**1/4**	**2/2**						
					Both= 3			**10**		**15**		**22**	

Py, Physician; Nu, Nurse; Pa, Pharmacist;(-) = negative; (+) = positive; JNC7, Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure; AHA, American Heart Association; ESH, European Society of Hypertension; NICE, National Institute for Health and Care Excellence; BHS, British Hypertension Society; CHEP, Canadian Hypertension Education Program; SOGC, Society of Obstetricians and Gynaecologists of Canada; JSH, Japanese Society of Hypertension; KSH, Korean society of hypertension.

Table 2 Ambulatory Blood Pressure Measurement

	Year	Author	Country	Guideline	Health professional			Knowledge		Perception		Practice	
					Phy	Nur	Pha	–	+	–	+	–	+
1.	1993	Grin	USA	NHBPEP	X						X		X
2.	1993	White	USA	NHBPEP	X						X		X
3.	2007	McGowan	UK	BHS	X	X						X	
4.	2010	Dehaeck	Canada	SOGC	X							X	
5.	2015	Carrera	Netherlands	ESH	X						X		
6.	2016	Carter	USA	JNC 7	X							X	
7.	2017	Kaczorowski	Canada	CHEP	X							X	
8.	2017	Setia	Singapore	ESH	X						X	X	
9.	2017	Setia	Singapore	ESH	X						X		
10.	2017	Mejzner	UK	NICE	X						X	X	
11.	2017	Kobayashi	Japan	JSH	X							X	
12.	2017	Woolsey	USA	AHA	X							X	
13.	2018	Pibernat	Spain	ESH	X	X		X					
14.	2018	Martin-Rioboo	Spain	ESH	X					X		X	
TOTAL	14				14	2	0	1		1	6	9	2
					12/14								
					Both =2			1		7		11	

Py, Physician; Nu, Nurse; Pa, Pharmacist;(-) = negative; (+) = positive; NHBPEP, National High Blood Pressure Education Program.

Table 3 Office Blood Pressure Measurement

	Year	Author	Country	Guideline	Health professional			Knowledge		Perception		Practice	
					Phy	Nur	Pha	–	+	–	+	–	+
1.	1988	Dickson (a)	Canada	CHS	X							X	
2.	1989	Gleichmann	Germany	BMA	X	X		X					
3.	1990	McKay (a)	Canada	AHA	X							X	
4.	1992	McKay (b)	Canada	AHA	X			X				X	
5.	1992	Feher	UK	BMA	X			X					
6.	1993	Nolan	UK	BHS		X		X					
7.	1995	Villegas	USA	AHS	X	X		X				X	
8.	1996	Wingfield	UK	ISH	X	X		X				X	
9.	1997	Ahmed	S. Arabia	NM	X	X		X					
10.	1998	Gillespie	UK	BHS		X		X				X	
11.	1998	Kay	USA	AHA		X						X	
12.	1999	Carney (a)	Australia	BHS		X			X			X	
13.	1995	Carney (b)	Australia	BHS	X	X			X				
14.	2000	Drevenhorn	Sweden	NSG, ISH		X						X	
15.	2000	Markandu	UK	BHS	X	X		X					
16.	2001	McVicker	UK	BHS	X	X		X				X	
17.	2002	Armstrong	Australia	NHFA		X			X				
18.	2002	Vloet	Netherlands	AHA		X		X				X	
19.	2002	Mion	Brazil	JNC 6, BCH 3	X			x				x	
20.	2003	Veiga	Brazil	AHA	X	X						X	
21.	2005	Bhalla	India	BHS	X							X	
22.	2007	Dickson	USA	AHA, JNC7		X		X				X	
23.	2007	Cloutier	Canada	CHEP		X		X					
24.	2010	Chatterjee	USA	JNC 7	X								X
25.	2010	Kobayashi	Japan	JSH	X			X				X	
26.	2011	Hsiao-Lien	Taiwan	THG, JNC7		X		X					
27.	2012	Gracia	Singapore	JBI-PACES		X							X
28.	2012	Nelson	USA	NHBPEP, JNC7		X			X				
29.	2013	Dickson (b)	Canada	CHEP	X							X	

	Year	Author	Country	Guideline	Health professional			Knowledge		Perception		Practice	
					Phy	Nur	Pha	–	+	–	+	–	+
30.	2013	Rabbia	Switzerland	ISH		X						X	
31.	2014	Machado	Brazil	BGH		X		X					
32.	2014	Mohan	India	JNC 7	X	X			X			X	
33.	2015	Obara	Japan	JSH	X				X				X
34.	2015	Coogan	USA	AHA		X		X					
35.	2017	Kaczorowski	Canada	CHEP	X							X	
36.	2017	Woolsey	USA	USPSTF	X								X
37.	2017	Ale	Nigeria	IFHA	X				X				
38.	2017	Sandoya	Uruguay	AHA	X	X						X	
39.	2018	Ojo	Nigeria	AHA, ESH	X	X		X				X	
40.	2018	Block	USA	AHA		X			X		X		
TOTAL	40				24	26	0	19	8	0	1	22	4
					13/24	15/26	0						
					Both = 11			27		1		26	

Py, Physician; Nu, Nurse; Pa, Pharmacist;(-) = negative; (+) = positive. CHS, Canadian hypertension society; BMA, British Medical Association; ISH, International society of hypertension; NSG, National Swedish Guidelines; NHFA, National Heart Foundation of Australia; BCH, Brazilian Consensus on Hypertension; THG, Taiwan hypertension guidelines; JBI_PACES, Joanna Briggs Institute Practical Application of Clinical Evidence System; SBH, Brazilian guidelines of hypertension; USPSTF, US Preventive Services Task Force; IFHA; International Forum for Hypertension control and prevention in Africa.

Table 4 Automated Office Blood Pressure Measurement

	Year	Author	Country	Guideline	Health professional			Knowledge		Perception		Practice	
					Phy	Nur	Pha	−	+	−	+	−	+
1.	2017	Kaczorowski	Canada	CHEP	X							X	
2.	2018	Martin-Rioboo	Spain	ESH	X								X
TOTAL	2				2							1	1

Py, Physician; Nu, Nurse; Pa, Pharmacist;(-) = negative; (+) = positive.

Annexe B- Search strategy

Search strategy for Medline and CINAHL

(S1 OR S2)

S1- MH Exact Subject Heading

“Blood Pressure Determination” OR “Blood Pressure Monitoring, Ambulatory” OR “Blood Pressure Determination methods” OR “Blood Pressure Monitoring, Ambulatory methods” OR “Hypertension Diagnosis” OR “Masked Hypertension”

OR

S2- Select field optional

Blood Pressure* OR “ambulatory blood pressure measurement” OR ABPM OR “home blood pressure measurement” OR HBPM OR “self-blood pressure measurement” OR SBPM OR “office blood pressure measurement” OR OBPM OR “automated blood pressure measurement” OR AOBP

AND

S3- MH Exact Subject Heading

“Health Personnel” OR “Personnel, Health Facility” OR “Physician, Primary Care” OR “Physicians, Family” OR “General Practitioners” OR “Medical Staff, Hospital” OR “Nurse Practitioners”

OR

S4- Select field optional

Physician* OR Nurs* OR Pharmacist* OR "Medical Staff"

AND

S5- MH Exact Subject Heading

"Professional Knowledge" OR "Attitude of Health Personnel" OR "Practice Patterns" OR “Health Knowledge, Attitudes, Practice”

OR

S6- Select field optional

Knowledge* OR Attitude* OR Practice*

S7 = (S1 OR S2)

S8 = (S3 OR S4)

S9 = (S5 OR S6)

S10 = (S1 OR S2) AND (S3 OR S4) AND (S5 OR S6)

Chapter 4. Methodology

In this chapter, a comprehensive methodology of the leading research project is presented.

Context

Canada is a global leader to achieve the highest BP control rates, yet >30% of the population remain uncontrolled, and nearly 16% remain unaware of their high BP (Padwal et al., 2016). A significant improvement in BP control rates were directly associated with CHEP's implementation, now called Hypertension Canada Guidelines (Campbell & Chen, 2010; Padwal et al., 2016; Schiffrin et al., 2016). Hypertension guidelines are a key component of transmitting new and updated evidence-based clinical practice recommendations to HPs (physicians, nurses and pharmacists) for hypertension management (Rabi et al., 2020; Schiffrin et al., 2016). Therefore, it is important to identify if the updated guidelines are appropriately implemented in clinical practice by HP and that they have adequate BPM knowledge and perception. A recent scoping review demonstrated that studies performed globally indicated that BPM knowledge and practices are suboptimal among physicians, nurses and pharmacists (Todkar, Padwal, Michaud, & Cloutier, 2020). However, a systematic study including all the three HPs and three concepts concerning the BPM methods was not performed in Canada. Therefore, we found it appropriate to conduct a descriptive survey to get a clearer picture of Canadian HP concerning knowledge, perception, and practice and the four BPM methods.

Objectives

The research objective was to assess knowledge, perception, and practice of physicians, nurses and pharmacists concerning home and ambulatory (HBPM and ABPM) and office and automated (OBPM and AOBP) BPM methods.

Methods

Research design

A descriptive survey design was selected to assess the knowledge, perception and practice of the HP regarding the four BPM methods (Gray, Grove, & Sutherland, 2017). Such a design allows the researcher to describe the phenomenon of interest and gather related information of interest.

Population and setting

The target population consisted of physicians, nurses and pharmacists working in the primary care setting across Quebec, Canada. Primary care settings provide primary care for chronic diseases, such as hypertension. In addition, hypertensive individuals frequently see their primary care provider for hypertension management. As a result, primary care settings were chosen because this is where the initial screening, diagnosis, treatment, and follow-up for hypertension takes place. Primary care settings included Groupe de médecine de Famille (GMF), outpatient clinic, soins de première ligne (primary care clinics) and community pharmacies.

The information concerning the number of HP for each category was obtained from the Fédération des Médecins Omnipraticiens du Québec (FMOQ), the Ordre des Infirmières et Infirmiers du Québec (OIIQ) and the Ordre des Pharmaciens du Québec (OPQ) for the year 2017-2018.For physicians, out of 23236 physicians members of the College des Médecins du Québec, 10917 practice family medicine (Collège des médecins du Québec, 2017-2018). For pharmacists, out of 9465 pharmacists that detain a membership from l'Ordre des pharmaciens du Québec, 4869 practice in community pharmacies (Ordre des pharmaciens du Québec, 2017-2018). The statistical information was obtained from the association's annual report published each year which was available on their website. For nurses out of 75529 nurses with a permit, 7886 practice in primary care settings (Ordre des infirmières et infirmiers du Québec, 2017-2018).

For nurses, a request was made to OIIQ to provide us with the recent statistics about the number of nurses working in the primary care setting. After signing a confidentiality form, the actual number of nurses working in primary care settings was provided by OIIQ. According to the data received, 10731 nurses registered with OIIQ are working in a primary care setting. This includes emergency care (soins d'urgence), outpatient care clinics (soins ambulatoires - clinique externe), primary care or routine services (soins de première ligne - services courants), public health (santé publique) and nurse practitioner (IPSPL and IPSSA). Out of these 10731 members, 4020 (37.5%) members gave consent to OIIQ to send their contact details to a third party for research or survey purposes.

Inclusion criteria

Physicians, nurses, and pharmacists working in primary care settings across Québec, Canada, were included.

a) Physicians- Registered Physicians who have obtained a valid license to practice by Fédération des Médecins Omnipraticiens Du Québec (FMOQ).

b) Nurses- Registered Nurses (RN); who have obtained a valid license to practice by Ordre des Infirmières Et Infirmiers Du Québec (OIIQ).

c) Pharmacists- Registered Pharmacists who have obtained a valid license to practice by Ordre Des Pharmaciens Du Québec (OPQ).

Sample size calculation

Given the research design and recruitment method, a sample size calculation is not applicable. However, to determine the approximate sample size and expected response rate, we calculated the sample size using Dillman’s formula (Dillman, Smyth, & Christian, 2014). The sample size is calculated based on the confidence interval, the margin of error, and response. The confidence interval chosen is 95, with a margin of error of 5%. The response rates for email surveys are generally very low, from 16% to 20% (Corner & Lemonde, 2019; Weaver, Beebe, & Rockwood, 2019).

Therefore, a more significant proportion of the population needs to be surveyed to achieve the required sample size based on the expected response rate. Since the response rate of 20% is expected, the final population size surveyed should be greater than the required sample size. To have a representative sample, the actual number of participants required for the study is physicians (N=372), nurses (N=371) and pharmacists (N=357).

Ethical certification

A request was made to the UQTR Ethics and Research Committee to obtain the ethical certificate. As a result, all documents explaining the research protocol and methodology were prepared, including the informed consent forms both in English and French (see Annexe 4-5). An electronic consent form was used. Access to the questionnaire was only granted after clicking on the AGREE button of the consent form. The study was approved by the UQTR Ethics and Research Committee (CER-19-259-07.22) (see Annexe 6).

Risk and benefits

No risk was associated with participation in the research. However, the only drawback was the time to complete the questionnaire, which was estimated at 20-minutes. To minimize it, the questionnaire was validated by experts and was kept short. In addition, the questionnaire was pretested on a small group of nurses from UQTR.

For benefits, no individual benefit was offered to participants; however, participation in this research allowed them to win an incentive. In collaboration with the hypertension societies, namely the Société Québécoise d'hypertension artérielle (SQHA) and Hypertension Canada, physicians, nurses, and pharmacists participating in the study had a chance to win an incentive consisting of a free registration to a 15,5-hour accredited online training course offered by the SQHA or a free registration at the Hypertension Canada Congress (see Annexe 7-8). At the end of the questionnaire, a secure link was provided to participate in the draw voluntarily, and the physicians, nurses and pharmacists who completed the whole questionnaire were able to access the link. Hypertension societies then contacted the draw winners to provide information on the free online training course and free registration for the congress. Thus, the benefit would help participants in the advancement of knowledge in BPM.

Recruitment

Professional associations including Fédération des Médecins Omnipraticiens du Québec (FMOQ), Ordre des Infirmières et Infirmiers du Québec (OIIQ) and Ordre des Pharmaciens du Québec (OPQ) were requested to collaborate in contacting the participants. The final acceptance to collaborate in the research was notified by OIIQ, FMOQ and OPQ through email. The letters are attached in Annexe 9-11.

For FMOQ and OPQ, recruitment was made possible through the association's monthly newsletters (see Annexe 12-13). A short text to introduce our research and the link to participate in the survey was sent to FMOQ and OPQ and was published in their monthly newsletter (see Annexe 12 and 13). For OIIQ, a list of potential participants with their email addresses was provided. This list can be provided for research purposes or surveys since nurses give their consent to the OIIQ to provide their information to the researchers. For this purpose, a confidentiality agreement was signed between OIIQ and us. For nurses, a personalized email invitation signed by a known researcher in Quebec (Pr Lyne Cloutier) along with the link to a secured platform was sent (see Annexe 14). Using this strategy, we believed to get a better response rate and minimize dropouts as participants could complete the surveys (Fan & Yan, 2010; Saleh & Bista, 2017). In addition, the link led the participants to an informed consent page that provided detailed information about the research.

Physicians, nurses, and pharmacists who agreed to participate could access the questionnaire either in French or English. The recruitment started on 7th November 2019 and ended on 10th January 2020. For nurses, two reminder emails each at two weeks intervals were sent (see Annexe 15). For physicians, two reminders each at two weeks intervals were included in the FMOQ newsletter (see Annexe 16). However, for pharmacists, permission was only granted for one reminder that was included again in the OPQ newsletter (see Annexe 17). The recruitment dates are presented in Table VIII.

Table VIII Recruitment plan of health professionals

	Nurses	Physicians	Pharmacists
Start	7 November 19	8 November 19	20 November 19
1st reminder	21 November 19	22 November 19	4 December 19
2nd reminder	5 December 19	6 December 19	-
End	10 January 2020	10 January 2020	18 December 2019

Research tool

The research tool used was a questionnaire. A questionnaire is a vital tool to collect and obtain statistically helpful information related to the topic of interest (Dillman et al., 2014; Gray et al., 2017). Questionnaires are designed to survey a large population quickly and in a short duration. In addition, the questionnaire allows maintaining the anonymity of the participants (Dillman et al., 2014; Gray et al., 2017). Given the design of our research, the questionnaire survey was deemed adequate since it gives the researcher the feasibility to gather extensive population data quickly and cost-effectively.

An investigator-initiated blood pressure measurement questionnaire was developed. For the following reasons, we did not use existing questionnaires: first, the three concepts defined in our study was different from those defined in other studies; second, well-established or standard questionnaires were not available on this topic; third, those questionnaires were not consistent with our research objectives and fourth limited questionnaires were available addressing the four BPM methods, three concepts and three health professionals and the fact that nurses and pharmacists were under-studied. The questionnaire was validated and pretested. The mode of accessibility was online. The electronic questionnaire was prepared using the software Banque interactive de questions (BIQ) developed specifically by UQTR to prepare surveys. The final questionnaire is included in Annexe 18-21.

Development and validation of the questionnaire

The questionnaire was constructed for collecting data concerning the three concepts and four BPM methods. Based on the conceptual model adapted for this research, first, the three concepts were defined. Knowledge is defined as the theoretical comprehension of BPM methods regarding diagnostic thresholds and technical aspects. Perception is defined as the beliefs regarding the usefulness of BPM methods. Practice is defined as the implementation of recommended BPM methods in clinical practice for hypertension management.

The development of the questionnaire had a five-step process: first, item formulation; second, item validation; third, question formulation; fourth, question validation and fifth, pretesting the questionnaire. Validity is an important factor during instrument development. The validity of an instrument is defined as the ability of an instrument to measure the properties under construct (Gray et al., 2017; Waltz, Strickland, & Lenz, 2018). There are three forms of validity: content, construct, and criterion-related validity (Gray et al., 2017; Waltz et al., 2018). However, content validity plays a primary role in developing a new instrument and provides evidence about the validity of an instrument by assessing the degree to which the selected items are relevant to the content being measured (Gray et al., 2017; Lynn, 1986; Waltz et al., 2018). In simple terms, content validity assesses if the instrument fully represents what it aims to measure. The more the items represent the concept being measured, the greater is the content validity (Lynn, 1986). Therefore, for this research, content validation of the questionnaire was performed. The five-step process is explained below.

Step 1: Item formulation

Items were formulated for the three concepts and four BPM methods using the relevant scoping review literature and Hypertension Canada Guidelines. Relevant items were first selected from the literature and later formulated according to the BPM recommendations provided by Hypertension Canada Guidelines. A set of 98 items for the three concepts and four BPM methods, and eight items for demographic characteristics were formulated (see Table IX). The topics covered for the items include knowledge concerning the diagnostic thresholds and technical aspects of four BPM methods (35 items). Some examples include the protocol for BPM, indication for BPM using different methods, factors causing errors. Items for perceptions concerned the usefulness of BPM methods (28 items). Some examples include the usefulness of BPM for screening, diagnosis, therapeutic and follow-up purposes, patient acceptance of device, ability of HPs to perform BPM correctly, the preferred method for performing BPM. Finally, items for practice were concerning the frequency of using the BPM method (35 items). Some examples include using BPM methods for screening, diagnosis, therapeutic and follow-up purposes, frequency of recommending ambulatory methods to patients, the proportion of patients using ambulatory methods, frequency of providing patient education, the device used in office, device validation, barriers for BPM. Items for demographic characteristics (8 items) concerning age, sex, profession, years of graduation, professional qualification, years in practice (2 items), training in BPM, membership of hypertension societies.

Table IX Distribution of items formulated for blood pressure measurement methods and three concepts

BPM methods	Knowledge	Perception	Practice	Demographic
	Number of items			
HBPM	8	10	10	
ABPM	8	6	10	
OBPM	5	5	7	
AOBP	14	7	8	
Total		**98**		**8**

Step 2: Item validation

For item validation, a standard four-point item rating scale was used for rating each item for relevancy (Waltz et al., 2018). The ratings consisted of 1 - not relevant, 2 - somewhat relevant, 3 - quite relevant, 4 - very relevant (Gray et al., 2017; Lynn, 1986; Waltz et al., 2018). A panel of four methodology and content experts were identified and requested to participate in the validation process. Doctors and nurses with expertise in hypertension were chosen as experts. They are specialists on the Hypertension Canada Guideline committee and are extensively involved in formulating guidelines for BPM. The protocol for the validation process was explained to experts through email. Upon their acceptance, the items were sent for validation by email. Well-defined instructions were provided to experts for the evaluation. Experts were requested to rate each item for relevancy using the four-point rating scale. They were also requested to write their comments about the necessity of adding new items or removing the existing item.

Following validation with the experts, the next step was to select the relevant items for question formulation. To do this, an item-level content validity index (I-CVI) was calculated based on the four-point rating scale provided to experts to rate the items as mentioned in the above paragraph (Gray et al., 2017; Lynn, 1986; Waltz et al., 2018). The I-CVI was determined as the number of experts judging the item as relevant divided by the total number of experts. According to Waltz & Strickland 2018, an I-CVI of 1.00 is considered a perfect agreement and is acceptable. If all the experts give a rating of 3 or 4 on a 4-point scale is considered perfect agreement. Therefore, items with a score of 1.00 were considered relevant, whereas items with a score of 0.75 and above were modified and improved for question formulation (Waltz et al., 2018). Items with a score below 0.75 were discarded. Figure 7 shows the item validation process.

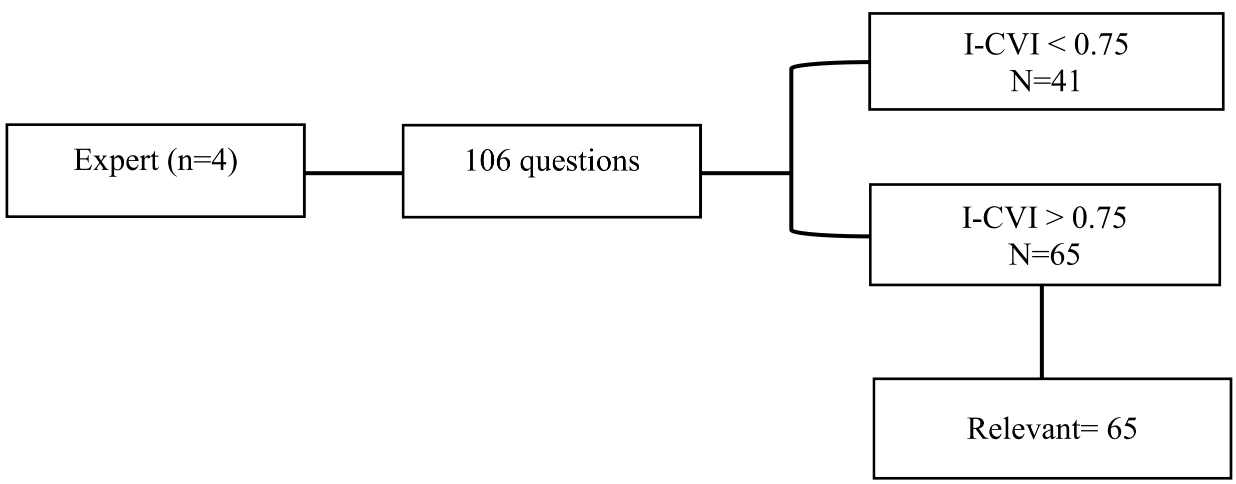

Figure 7 Item validation process

In order to consider the tool (questionnaire) as valid, a scale level content validity index/average (S-CVI/Ave) was calculated. The S-CVI/Ave ensures the content validity of the overall section. For example, it gives an average of I-CVI for each section of knowledge, perception, and practice for four BPM methods. The S-CVI/Ave was computed by averaging the I-CVIs (i.e., the sum of all I-CVIs) divided by the number of items.

It is recommended that a minimum S-CVI/Ave should be 0.8 for reflecting the content validity (Gray et al., 2017; Lynn, 1986). In our validation, the S-CVI was 0.8 and above and was considered valid. Results are presented in Table X.

Table X Distribution of content validity scores for each blood pressure measurement method and three concepts for the health professionals

BPM methods	Knowledge		Perception		Practice	
	Number of items	S-CVI/Ave	Number of items	S-CVI/Ave	Number of items	S-CVI/Ave
HBPM	8	0.81	10	0.92	10	0.85
ABPM	8	0.85	6	0.91	10	0.80
AOBP	5	0.95	5	0.80	7	0.80
OBPM	14	0.91	7	0.80	8	0.84

Notes. S-CVI/Ave, scale level content validity index/average

Step 3: Question formulation

After validation of items, the next step was question formulation. From the 106 items initially formulated, 65 items were selected for question formulation. At this point, the questions were formulated separately for physicians and nurses-pharmacists from the selected items. First, we formulated the questions for physicians and then for nurses-pharmacists. The questions for knowledge and perception were similar for the three HP; however, for practice, physicians had additional questions concerning the frequency of using BPM methods for screening, diagnosis, therapeutic and follow-up purposes which are reserved acts for physicians in Québec. Thus, the final questionnaire consisted of 63 questions for physicians and 55 questions for nurses-pharmacists (see Table XI). The questions were formulated first in English and French.

Table XI Distribution of questions for each blood pressure measurement method, three concepts and the health professionals

Sections	Physicians			**Total no. of questions**	Nurses, Pharmacists			**Total no. of questions**
	Kn	Pe	Pr		Kn	Pe	Pr	
1-HBPM	4	4	6	**14**	4	4	4	**12**
2-ABPM	4	4	6	**14**	4	4	4	**12**
3-AOBP	4	4	5	**13**	4	4	3	**11**
4-OBPM	5	4	6	**15**	5	4	4	**13**
5-General				**7**				**7**
Final questionnaire				**63**				**55**

Notes. Kn, Knowledge; Pe, Perception; Pr, Practice; no., number.

The questions were grouped into five sections. Four sections were about BPM methods, and the fifth section contained questions about demographic characteristics. Each section of BPM methods had questions concerning knowledge, perception and practice. Closed-ended questions were formulated for knowledge and practice. Four to five choices were provided for each question. For the perception question, a five-point Likert scale was used. Likert scale ratings consisted of "1 - strongly disagree, 2-disagree, 3-neutral, 4- agree and 5 - strongly agree". For a question on the barrier for BPM, principal barriers were identified from relevant literature and are mentioned in the scoping review article (Todkar et al., 2020). Choices were provided for selecting the barriers, and an additional choice (other, specify) was provided to specify their response if necessary. Such a choice was design to allow us to identify other barriers that could be bought to attention.

The topics covered for the questions included knowledge concerning the diagnostic thresholds and technical aspects of four BPM methods (17 items). Some examples include a protocol for HBPM and ABPM, protocol for BPM position, rest period, average calculation.

Questions for perceptions included the usefulness of BPM methods (16 items). Some examples include the usefulness of BPM methods for treating hypertension, easy access to patients, office setup to measure BP.

Questions for practice included the frequency of using the BPM method (23 items for physicians, 15 items for nurses and pharmacists). Some examples include using BPM methods for screening, diagnosis, therapeutic and follow-up purpose, frequency of recommending ambulatory methods to patients, the proportion of patients using ambulatory methods, frequency of providing patient education, device use in office BPM barriers etc. Questions for demographic characteristics included age, sex, professional qualification, years in practice (2 items), training in BPM, membership of hypertension societies. The questionnaire was copy-edited for language and grammar errors. Upon completion of this step, the questions and answers were validated for clarity and simplicity.

Step 4: Question validation

Following question formulation, the final step was question validation. The questions and answers were sent to experts for final validation. For validation, an online evaluation using the BIQ software was performed. Well-defined instructions were provided to experts for the evaluation. Experts were requested to evaluate each question and answer for clarity and simplicity. Three choices were given for the evaluation of the clarity and simplicity of each question and answer. For clarity, the choices included were *not clear, need some revision and clear*. Form simplicity choices included were *not simple, need revision and simple*.

Experts validated each question and answer. All the experts showed perfect agreement regarding the clarity and simplicity of each question and answer. Minor grammatical revisions were made as suggested by experts. The validated questionnaire was translated to French. Pr Lyne Cloutier helped with the French translation.

A panel of three experts consisting of a doctor and nurses with expertise in hypertension and BPM and fluent in the French language validated the questionnaire in French for clarity and simplicity. Again, minor grammatical revisions were made. The final BPM questionnaire was prepared using BIQ software. The questionnaire was ready for pretesting.

Step 5: Pretesting the questionnaire

After development and validation were completed, the questionnaire was pretested for reliability and stability. A pretest was conducted on student nurses certified to practice as a nurse and pursuing bachelor's degree at UQTR. The reason for selecting them was that they have experience in nursing and are certified to practice as nurses in Quebec. One group pretest and posttest design was used, and the interval between tests was one week. An electronic questionnaire using BIQ software was used. The questionnaire was available in French. The link to access the questionnaire was sent to the group. This link took the participants to the informed consent page. Upon acceptance, participants could access the questionnaire.

Eleven nurses participated in the pre-test. However, only three completed both the pretest and posttest. The average time required to complete the questionnaire was 20 minutes and was equivalent to our estimated time. Paired t-test was used for the analysis. The results showed no significant difference in the scores for the pretest (M=2.76±0.17) and posttest (M= 2.60±0.08). Thus, the results of the pretest showed the reliability of the questionnaire.

Data analysis

Descriptive statistics were used, and data were analyzed using SPSS version 27 (IBM SPSS Statistics 27, Canada). Descriptive statistics included frequency, percentage, mean, and standard deviation (SD). Knolwedge, perception and practice was analyzed using frequency and percentage. In addition, knowledge and perception scores were analyzed using the mean and standard deviation.

The following chapters are the results of the research. Chapter 5 is the results of nurses, which is article 2 of this thesis and chapter 6 is the results of physicians and pharmacists, which is not published.

Chapter 5. Article 2 Knowledge, Perception and Practice of Québec Nurses for Ambulatory and Clinic Blood Pressure Measurement Methods: Are We There Yet?

Authors contribution

Shweta Todkar	First author Developing research protocol Research and data collection Data analysis Data interpretation Writing and submitting the article
Raj Padwal	Second author Expert reviewer Reviewed the article
Lyne Cloutier	Third author Expert reviewer Study supervision Involved in all steps of the article

This chapter presents the published article 2 of the thesis. The manuscript was submitted to the Journal of Hypertension on April 5, 2021 and was accepted on June 21, 2021. In addition, the preliminary results of the article were presented virtually as a poster presentation at the ESH-ISH congress and Hypertension Canada Congress 2021. The reference list and poster are attached in the special document Annexe 24-25.

Article 2: Knowledge, Perception and Practice of Québec Nurses for Ambulatory and Clinic Blood Pressure Measurement Methods: Are We There Yet?

Short title: Blood pressure measurement and nurses

Shweta Todkar [a], Raj Padwal [b], Lyne Cloutier [a]

[a] Department of Nursing, Université du Québec à Trois-Rivières, Trois-Rivières, Québec, Canada.

[b] Department of Medicine, University of Alberta, Alberta, Canada.

Correspondence to : Shweta Todkar, RN, MSN PhD (c), Programme of Biomedical Sciences, Université du Québec à Trois-Rivières, 3351 Boulevard des Forges, Trois-Rivières, QC, Canada G9A 5H7; Tel: +1 819 668 8002; Fax : 819 376-5048

E-mail: Shweta.Kiran.Todkar@uqtr.ca

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Résumé en français

Objectif : Les lignes directrices pour les méthodes de la mesure de la pression artérielle (PA), à savoir à domicile (MPAD), ambulatoire (MAPA), en clinique (MPAC) et en clinique oscillométrique en série (MPAC-OS) sont publiées par Hypertension Canada et sont basées sur une technique de mesure précise. Les infirmières exécuter le BPM, mais leurs connaissances, leur perception et leur pratique avec toutes les méthodes sont sous-étudiées. Cette étude est la première à établir un portrait des infirmières québécoises travaillant en première ligne concernant les quatre méthodes de la mesure de la PA.

Méthodes : Toutes les infirmières autorisées exerçant en soins primaires au Québec ont été ciblées dans notre sondage. Les données ont été recueillies à l'aide d'un questionnaire validé et prétesté initié par l'investigateur en anglais et en français. Une invitation personnalisée par courriel et deux rappels, incluant un lien vers une plateforme sécurisée, ont été envoyés en décembre 2019. Une attestation d'éthique a été délivrée par l'UQTR.

Résultats : Au total, 453 infirmières ont participé à l'étude. L'âge médian était de 40 ± 11 ans et 92% étaient des femmes. Le score global sur la connaissance concernant les quatre méthodes de la mesure de la PA était légèrement inférieur à 50% (46% ± 23). La perception était majoritairement positive, avec un score global supérieur à 50% (73% ± 8). En pratique, MPAD était recommandée par 47% des infirmières et la MAPA par 18%. Alors que MPAC-OS est la méthode préférée au Canada, seulement 25% des infirmières l'utilisent, compris les 57% qui utilisent un appareil oscillométrique et 11% qui utilisent l'auscultation manuelle.

Conclusion : Les infirmières travaillant en soins primaires jouent un rôle central dans la mesure de la PA. Nos résultats montrent que les connaissances et la pratique globales sont sous-optimales. Il convient donc d'allouer des ressources pour assurer la prise en compte de la formation initiale et de la formation continue.

Abstract

Objective: Guidelines regarding blood pressure measurement (BPM) methods, namely home (HBPM), ambulatory (ABPM), office (OBPM) and automated (AOBP), are published by Hypertension Canada and rely on accurate measurement techniques. Nurses commonly perform BPM, but their knowledge, perception and practice considering all methods is understudied. This study is the first to establish the picture of Quebec nurses working in primary care settings concerning the four BPM methods.

Methods: All nurses licensed to practice in primary care in Quebec were targeted in our survey. Data were collected using a validated and pretested investigator-initiated questionnaire in English and French. A personalized email invitation and two reminders, including a link to a secured platform was sent in December 2019. A certificate of ethics was issued by UQTR.

Results: A total of 453 nurses participated in the study. Median age was 40 ± 11 years, and 92% were female. The overall score on BPM methods knowledge was slightly below 50% (46% ± 23). The perception was mostly positive, with an overall score above 50% (73% ± 8). In practice, HBPM was recommended by 47% of nurses, and ABPM by 18%. While AOBP is the preferred method in Canada, only 25% of the nurses use it, including the 57% that use an oscillometric device and 11% that use manual auscultation.

Conclusion: Nurses working in primary care play a central role in BPM. Our results highlight that overall knowledge and practice are suboptimal. Resources should therefore be allocated to ensure that initial training and continuing education are addressed.

Keywords: knowledge, perception, attitude, practice, nurse, ambulatory blood pressure monitoring, home blood pressure monitoring, automated office blood pressure measurement, blood pressure determination.

Introduction

Hypertension is the leading global risk factor for death and disability, contributing to over 10 million deaths annually (Lim et al., 2012; Stanaway et al., 2018). Previous global estimates suggest that nearly 1.4 billion adults had hypertension in 2010 (Mills et al., 2016). In Canada, hypertension affects nearly 23% of the adult population (Padwal, Bienek, McAlister, & Campbell, 2016; Robitaille et al., 2012). Although Canada has been a world leader in achieving the highest blood pressure (BP) control rates, still one-third of the affected population (32.5%) remains either unaware or not controlled, thus susceptible to complications (coronary heart disease, stroke, chronic kidney disease, dementia) (Campbell et al., 2020; McAlister et al., 2011; Padwal et al., 2016).

The management of hypertension should be informed by appropriate blood pressure measurement (BPM) and the use of a recommended method of measurement (home, ambulatory, office) (Rabi et al., 2020). Guidelines published by international societies recommend using standardized BPM methods, namely home (HBPM) and ambulatory (ABPM) to confirm the diagnosis of hypertension; and automated (AOBP) and office (OBPM) for screening and treatment of hypertension (NGC, 2019; Rabi et al., 2020; Whelton et al., 2018; Williams et al., 2018). HBPM and ABPM methods are superior to office measurements in terms of their ability to predict cardiovascular events, diagnostic accuracy in detecting white coat and masked hypertension and prognostic value (Bobrie, Chatellier, Genes, & et al., 2004; Clement et al., 2003; Lamarre-Cliché, Cheong, & Larochelle, 2011; Padwal et al., 2019; Stergiou et al., 2018). Twenty-four-hour ABPM is considered as the gold standard for hypertension diagnosis and HBPM for diagnosis and long-term management of treated hypertension (NGC, 2019; Rabi et al., 2020; Whelton et al., 2018; Williams et al., 2018). Both methods require proper patient education and technique (Rabi et al., 2020).

For decades, OBPM based on the auscultatory technique has remained the cornerstone for routine diagnosis and hypertension management (Parati, Ochoa, & Bilo, 2017). The auscultatory technique has serious limitations due to problems with the patient preparation, device, observer, and standardized measurement protocol (Cloutier et al., 2015; Kallioinen, Hill, Horswill, Ward, & Watson, 2017). The growing awareness of these limitations has led to developments in BPM (Parati et al., 2017). Thus, the approach to measuring BP has evolved with the acceptance of electronic (OBPM) and automated (AOBP) devices as an alternative to auscultation along with HBPM and ABPM (Rabi et al., 2020). Electronic devices have been shown to reduce the limitations associated with auscultation (Cloutier et al., 2015). These devices are designed to take single measurements (OBPM) or an automated series of measurements and average of the results (AOBP) (Cloutier et al., 2015).

In addition, Hypertension Canada and similar organizations in other countries have invested significant efforts and resources in knowledge translation, providing educational resources for health professionals (Campbell & Chen, 2010; Hua et al., 2012; Rabi et al., 2020). Despite these efforts, inaccurate BPM remains problematic worldwide (Chalmers, Arima, Harrap, Touyz, & Park, 2013; Olsen et al., 2016; Padwal et al., 2019). Improvements in BPM accuracy require a standardized protocol and well-trained health professionals, and evidence suggests that BPMs taken by trained nurses were highly beneficial in hypertension management (Campbell, Conradson, Kang, Brant, & Anderson, 2005; Padwal et al., 2019; Rinfret et al., 2017). Given that most studies of hypertension management focus on physicians rather than on nurses, it is important to identify the current state of hypertension management in primary care, given that nurses are performing most routine BPMs in these settings.

With significant advances in BPM, it is imperative to get a clearer picture that accurately reflects on the implementation of Hypertension Canada guidelines. Our study aimed to assess the knowledge, perception, and practice of primary care setting nurses in Quebec regarding the ambulatory and clinical BPM methods. To our knowledge, this is the first complete picture of Quebec nurses' usage of all four BPM methods. Awareness about the current status in BPM is the mandatory first step to implement BPM guidelines successfully.

Methods

Study design and population

A descriptive study using an electronic questionnaire was performed. All registered nurses practicing in primary care across Quebec were targeted for this study. The Ordre des Infirmières et Infirmiers du Québec (OIIQ) collaborated for this study by providing a list of all email addresses of targeted nurses who had previously agreed to be contacted for research purposes. A total of 4,020 primary care nurses were contacted, which represents (37.5%) of all primary care nurses in Quebec.

Data collection and ethics

Data collection took place between November 7th, 2019 and January 30th, 2020. A personalized invitation signed by a known researcher in Quebec was sent by email along with the link to a secured platform, followed by two reminders. The link led the participants to an informed consent page that provided detailed information about the study. Nurses who agreed to participate could access the questionnaire either in French or English. The study was approved by the UQTR Ethics and Research Committee (CER-19-259-07.22).

Incentivization

In collaboration with the hypertension societies, namely the Société Québécoise d'hypertension artérielle (SQHA) and Hypertension Canada, nurses participating in the study had a chance to win an incentive consisting of a free registration to a 15.5 hour accredited online training course offered by the SQHA or a free registration at the Hypertension Canada Congress 2021. At the end of the questionnaire, a secure link was provided to participate in the draw voluntarily, and the nurses who completed the full questionnaire were able to access the link. Hypertension societies then contacted the draw winners to provide information on the online training.

Definition of concepts

Knowledge was assessed in order to determine theoretical comprehension of BPM methods regarding diagnostic thresholds and technical aspects. Perception was assessed in order to understand beliefs regarding the usefulness of BPM methods. Practice was assessed to observe if recommended BPM methods for hypertension management are being implemented in clinical practice.

Questionnaire

For data collection, an investigator-initiated questionnaire developed and designed in accordance with Hypertension Canada Guidelines was used. The questionnaire was validated using a two-step process consisting of item validation for relevancy and question validation for clarity and simplicity. A panel of four methodology and content experts in the field of hypertension participated in validating the questionnaire in English and French. For item validation, a standard four-point scale from "1- not relevant to 4- very relevant" was used (Lynn, 1986; Waltz, Strickland, & Lenz, 2017). Based on this scale, a content validity index (CVI) was calculated to select relevant items evaluated by experts. Items with a score of 0.75 and above were selected for question formulation (Lynn, 1986; Waltz et al., 2017). For questions validation, an online evaluation was performed using secured software. Experts evaluated each question and answer and commented for simplicity and clarity. The questionnaire was then pretested for its reliability and stability with nurses. The questionnaire consisted of 48 questions: 17-knowledge, 16-perception and 8-practice pertaining to all four BPM methods and 7 demographic questions. The topics covered in this questionnaire were knowledge concerning diagnostic thresholds and technical aspects; perception concerning usefulness of BPM methods; practice concerning device and BPM method used, frequency of recommending HBPM and ABPM to patients, frequency of providing education to patients, and barriers for BPM. Demographic questions concerning age and sex, full-time practice years as nurse, full-time practice years as primary care nurse, specific training on BPM received, member of hypertension society. A 5-point Likert's scale from "1 - strongly disagree to 5 - strongly agree" was used for responses to perception questions. The average time required to complete the questionnaire was 20 minutes. Descriptive statistics was used for analysis using SPSS version 27 (IBM SPSS Statistics 27, Canada). Supplementary material detailing the results, with questions and answers, is available, while the detailed questionnaire is available upon request.

Results

Sample characteristics

Of the 4020 email invitations sent to primary care nurses, 573 opened the questionnaire link, and 453 completed the full questionnaire, corresponding to a response rate of 11%. Although the majority of respondents completed the questionnaire, not all respondents answered all questions. Therefore, the number of respondents to each question is presented. The characteristics of nurses are presented in Table XII. The median age was 40.5 ± 11.5 years (ranging between 30-49 years), and 92% were women. The majority (93%) were nurses, while 7% were nurse practitioners. Most nurses were quite experienced as 63% were practicing for more than 11 full-time years, and a majority (65%) were in primary care practice for at least a decade. Less than half (48%) identified never having received any specific training on BPM, and only 7% of nurses were either members of Hypertension Canada or SQHA or both.

Table XII Distribution of demographic characteristics and general questions

Variables	n(%)
Nurse	447(100)
Age (years) (n=447)	
< 30	83(19)
30-39	148(33)
40-49	114(25)
50-59	72(16)
≥ 60	30(7)
Sex (n=446)	
Male	35(8)
Female	409(92)
Decline to answer	2
Full-time practice as nurse (years) (n=429)	
≤3	48(11)
4-10	113(26)
≥11	268(63)
Full-time practice in primary care practice (years) (n=447)	
≤3	147(33)
4-10	145(32)
≥11	155(35)
Received specific training on BPM (n=447)	
Yes, theoretical only (articles, conferences)	117(26)
Yes, practical only	32(7)
Yes, theoretical and practical	84(19)
Never received training	214(48)
Member of hypertension society (n=448)	
Hypertension Canada	15(3)
SQHA	14(3)
I am a member of both societies	5(1)
Neither of them	414(92)

Notes. BPM, Blood pressure measurement; SQHA,Société québécoise d'hypertension artérielle

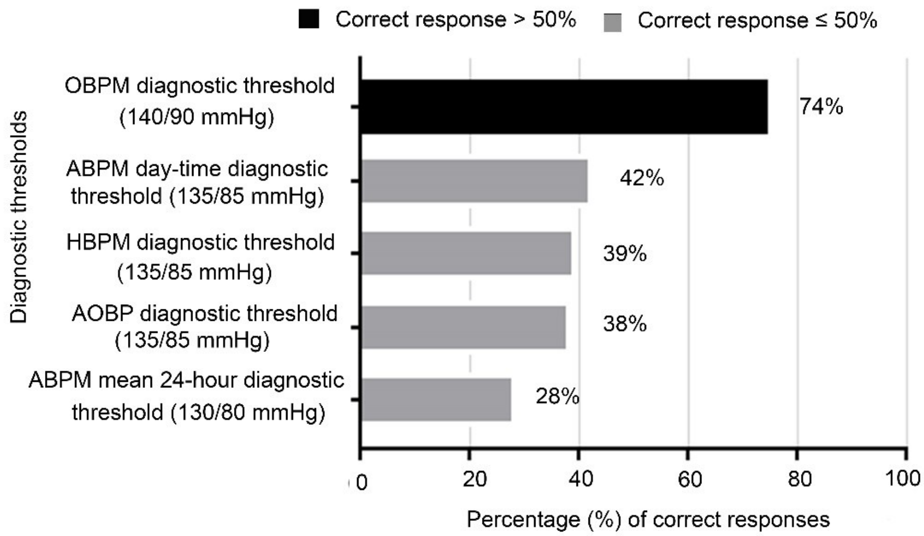
Knowledge of nurses concerning BPM methods

Having sufficient knowledge regarding hypertension thresholds is a crucial aspect of BPM. By author consensus, knowledge was deemed adequate when scores for diagnostic thresholds and technical aspects were above 50%. Nurses showed a high degree of knowledge for OBPM thresholds (74%), while for all other methods (ABPM, HBPM and AOBP), correct responses were below 50% (see Figure 8). In addition, nurses showed adequate knowledge levels about the use of back support during OBPM (78%), the measurement protocol for HBPM (66%), intervals used for night-time measurement using ABPM (63%), BPM position (58%), and AOBP measurement protocol for average calculation (57%) (see Figure 9). The overall mean knowledge score obtained by nurses for all methods was 7.90/17 ± 3.89 (46% ± 23), which did not exceed the 50% threshold Table XIII. The detailed results are available in Annexe A Supplemental Table S1. In conclusion, nurses had adequate knowledge of OBPM but performed less well in specific areas of other BPM methods.

Table XIII Mean knowledge score of nurses for all BPM methods

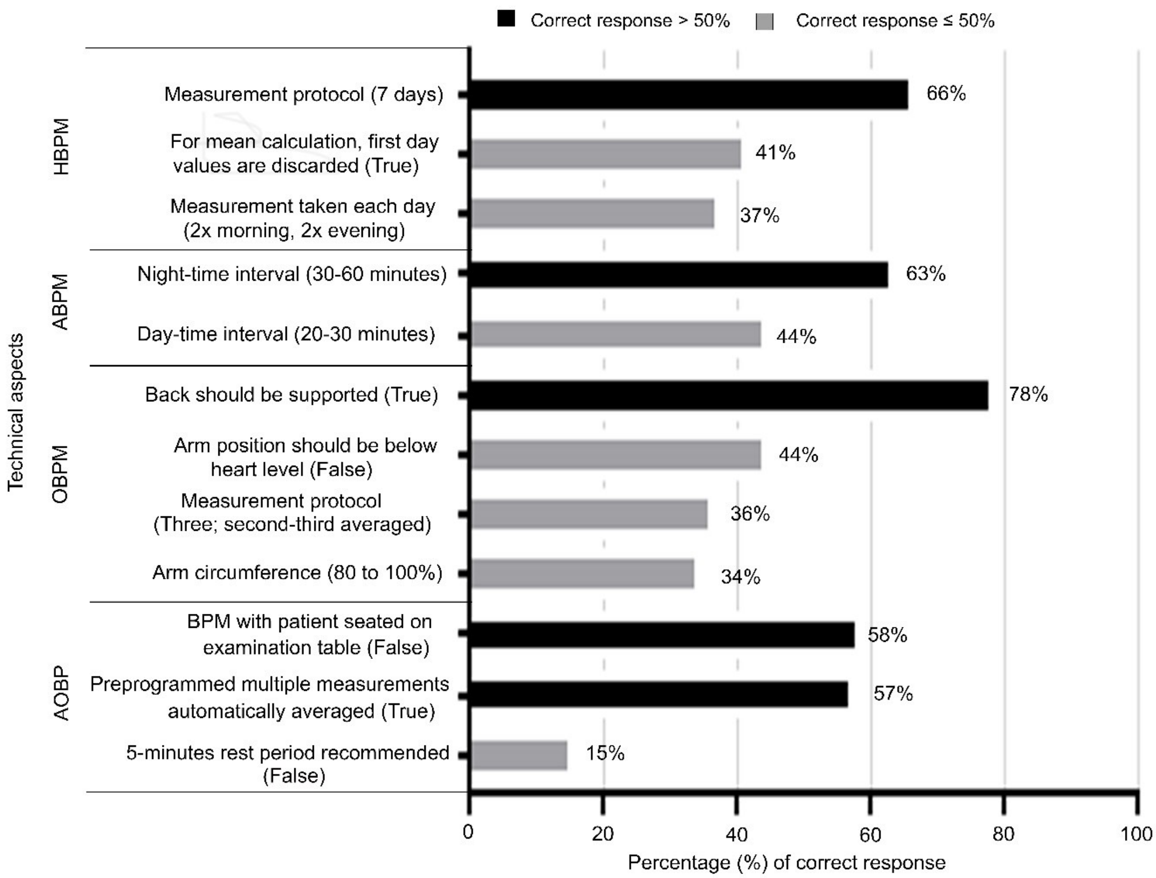
BPM methods (n)	Maximum score	Score N M ± SD	Score % M ± SD
HBPM (453)	4	1.8 ± 1.4	46 ± 36
ABPM (451)	4	1.7 ± 1.2	44 ± 31
AOBP (452)	4	1.6 ± 1.1	42 ± 30
OBPM (452)	5	2.6 ± 1.2	53 ± 24
Overall (453)	**17**	**7.9 ± 3.8**	**46 ± 23**

Notes. BPM, Blood pressure measurement; M, Mean; SD, Standard deviation



Notes. (correct answers); BPM, Blood pressure measurement

Figure 8 Percentage of correct responses of nurses knowledge concerning diagnostic thresholds for all BPM methods



Notes. (correct answers); BPM, Blood pressure measurement

Figure 9 Percentage of correct responses of nurses knowledge regarding technical aspects of the distinct BPM methods

Perception of nurses concerning BPM methods

The overall score obtained by nurses for all methods was 58/80 ± 6.2 (73% ± 8) Table XII. On a scale of 1 to 5, nurses showed strong agreement for the usefulness of HBPM (16.6/20 ± 3.2) and ABPM (14.2/20 ± 2.8) (see Table XIV). However, more neutral responses were seen for AOBP (Annexe A Supplemental Table S2). OBPM remains the most frequently used method for BPM, and nurses showed agreement when asked if their office is properly equipped to measure BP in a standardized manner and if they agreed that standardized OBPM is not time-consuming for their practice. This is especially important as these two items are often identified as important BPM barriers (Block et al., 2018; Dickson et al., 2013; Lugtenberg, Burgers, Besters, Han, & Westert, 2011). The detailed results are available in Annexe A Supplemental Table S2.

Table XIV Mean perception score of nurses for all four BPM methods

BPM methods (n)	Maximum score	Score M ± SD	Score %
HBPM (453)	20	16.6 ± 3.0	83 ± 15
ABPM (452)	20	14.2 ± 2.8	71 ± 14
AOBP (449)	20	13.4 ± 2.7	67 ± 14
OBPM (450)	20	14.0 ± 2.9	70 ± 14
Overall (453)	**80**	**58.3 ± 6.2**	**73 ± 8**

Notes. BPM, Blood pressure measurement; M, Mean; SD, Standard deviation.

Practice of nurses for BPM methods

Less than half the nurses (47%) indicated HBPM was frequently recommended to their patients, whereas only 18% recommended ABPM (see Figure 10 3a). One-third of the nurses (35%) indicated that education for HBPM was frequently provided to their patients. However, 35% of nurses also indicated that education for ABPM was rarely provided to their patients (see

Figure 10 3b). More than half of the nurses (57%) indicated using an electronic oscillometric device as a routine method to measure BP in the clinic, followed by AOBP (25%), aneroid and manual mercury sphygmomanometer (11%), while the rest (7%) did not know the device they used (see Figure 11 4a). While OBPM was a frequently used method by 70% of nurses and AOBP by 32% of nurses, 52% of nurses also indicated never using AOBP (see Figure 11 4b). Finally, nurses were invited to identify the four main barriers they perceived towards all four BPM methods. Most frequent were the cost of HBPM for patients (72%), lack of time to follow guidelines when measuring BP in-office (33%), non-availability of AOBP devices (51%), and lack of access to ABPM (60%). The detailed results are presented in Annexe A Supplemental Table S3.

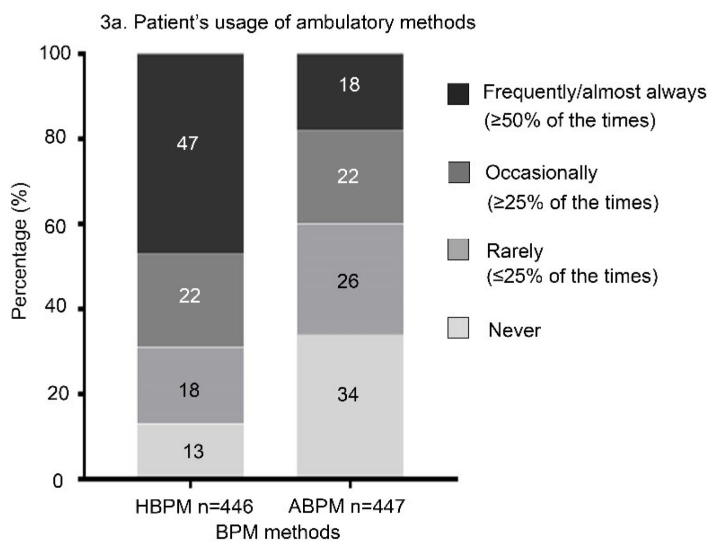


Figure 10 Distribution of nurses responses regarding practice about HBPM and ABPM

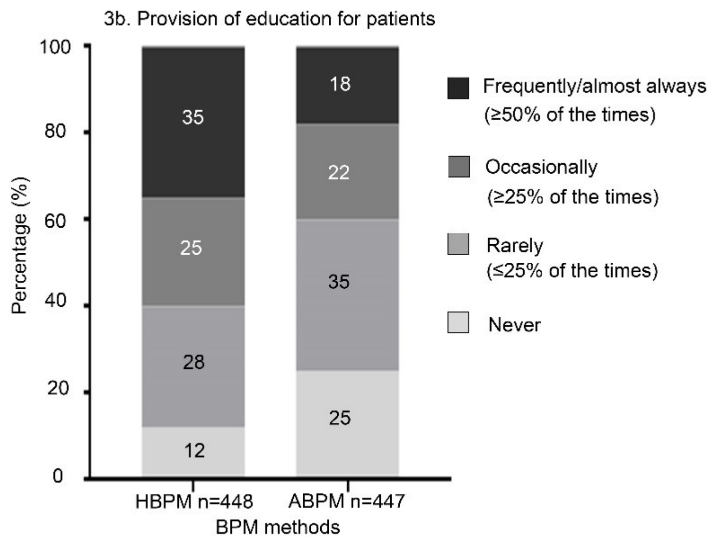


Figure 11 Distribution of nurses responses regarding practice about HBPM and ABPM

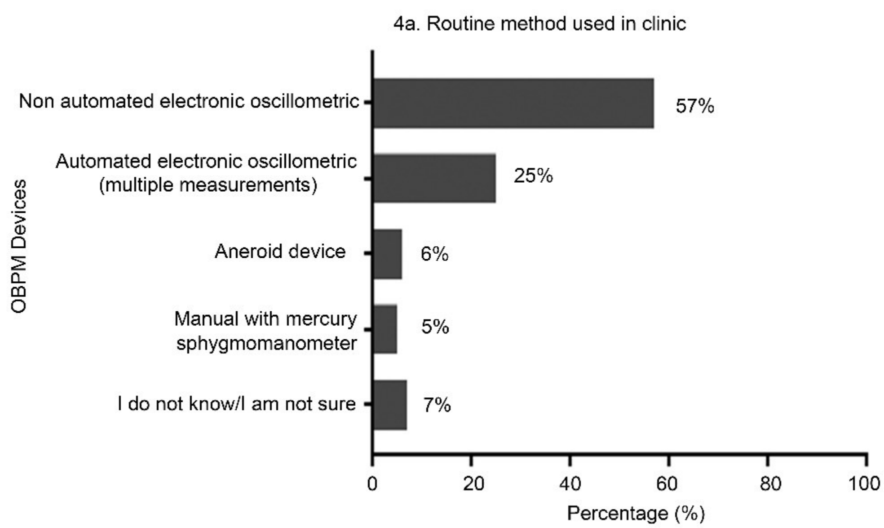


Figure 12 Distribution of nurses responses regarding practice for office measurements

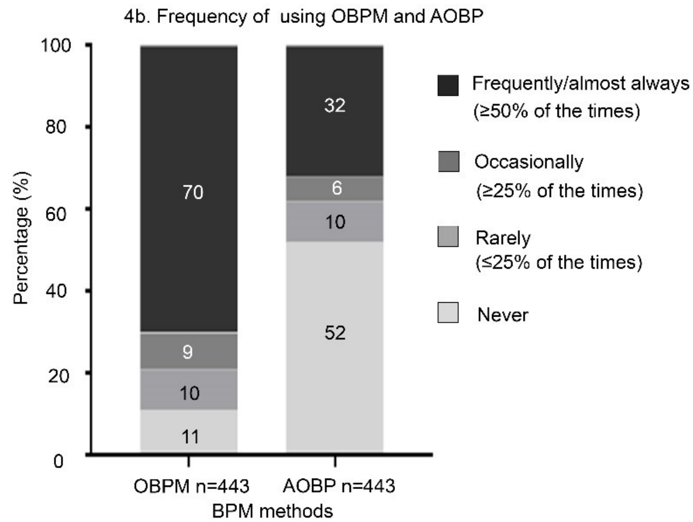


Figure 13 Distribution of nurses responses regarding practice for office measurements

Discussion

To the best of our knowledge, this is the first study in Quebec, Canada, to survey the knowledge, perception, and practice of nurses in primary care settings concerning all four BPM methods. Considering recent advances in BPM methods and that most hypertensive patients are diagnosed and managed in primary care settings, assessing nursing practice in this setting is essential (Godwin et al., 2015; Himmelfarb, Commodore-Mensah, & Hill, 2016; Kaczorowski et al., 2017). The present study demonstrates that although nurses showed positive perceptions towards BPM methods, improvements in knowledge and practice are needed.

The results of our study highlight that nurses' knowledge of diagnostic thresholds was adequate for OBPM and inadequate for HBPM, ABPM and AOBP. In addition, we noticed that most nurses overestimated the thresholds for HBPM, ABPM and AOBP and chose thresholds similar to that of OBPM. Such results mean that in practice, nurses could disregard the patients who are truly hypertensives, reducing appropriate diagnosis and treatment. Studies in other countries, including some performed with doctors, nurses, and pharmacists, have shown similar results (Fletcher et al., 2016; Ishikuro et al., 2016; Obara et al., 2010; Obara et al., 2012; Setia, Subramaniam, Teo, & Tay, 2017; Tsakiri, Stergiou, & Boivin, 2013).

When measuring BP, technical aspects can significantly impact obtained values. In our study, some fundamental technical aspects, such as obtaining the correct number of days of measurement and calculating mean values, seemed lacking in HBPM protocols. In practice, where nurses are primarily involved in educating their patients about HBPM, our results were alarming, with more than half (54%) nurses not knowing the number of measurements needed each day for HBPM. As the nurses need to take an active part in educating the patient, this is certainly a concern. Since there is limited data about nurses' knowledge for HBPM, we could not draw any comparisons to other studies concerning technical aspects. Thus, it is interesting to emphasize the fact that to date, on a global scale and especially in Canada, no other published studies have documented nurses' knowledge concerning ABPM and AOBP methods.

Concerning in-office BPM, although comprehensive education has been provided over the years and frequent discussion in the literature (Carney et al., 1999; Cloutier et al., 2015; Dickson et al., 2013; Kobayashi et al., 2010; McKay, Raju, & Campbell, 1992; McVicker, 2001; Padwal et al., 2019; Veiga et al., 2003; Villegas, Arias, Botero, & Escobar, 1995; Wingfield, Pierce, & Feher, 1996), we see that certain areas still need improvement even in the most fundamental aspects of BPM (for example, arm position, arm circumference, mean value calculation and 5-min rest period with AOBP). A Canadian study by *Cloutier et al.* evaluated nurses' knowledge and demonstrated significant knowledge gaps in BPM technical aspects. The overall theoretical knowledge score obtained by nurses was below 50% (Cloutier, 2007). The broader literature derived from a recent Canadian scoping review that analyzed a global picture of health professionals competencies pertaining to BPM methods also showed significant knowledge gaps regarding the OBPM method (Todkar, Padwal, Michaud, & Cloutier, 2020).

HBPM is evolving as a result of new technological developments and patient engagement (Wood, Boulanger, & Padwal, 2017). It is, therefore, encouraging to note that our study showed a strong agreement amongst nurses regarding the usefulness of HBPM and OBPM methods. These results are similar to the published literature on the global perception of health professionals for HBPM (Cheng, Studdiford, Diamond, & Chambers, 2003; Fletcher et al., 2016; Ishikuro et al., 2016; Jones et al., 2013; Logan, Dunai, McIsaac, Irvine, & Tisler, 2008; Martín-Rioboó et al., 2018; McManus et al., 2014; Mejzner, Clark, Smith, & Campbell, 2017; Obara et al., 2012; Tislér et al., 2006).

Hypertension Canada guidelines, as do others, emphasize the importance of routine use of out-of-office methods, both ambulatory and home, for diagnosis of hypertension (Cloutier et al., 2015; NGC, 2019; Rabi et al., 2020; Williams et al., 2018). However, it is surprising to note that in our study, the frequency of recommending HBPM and ABPM often was below 50%. Results of a recent Canadian survey of family physicians (n=769) showed that only 22.4% and 14.4% of physicians use HBMP and ABPM, respectively, for diagnostic purposes, while 77.8% indicated ABPM was readily available for their patients (Kaczorowski et al., 2017). These discrepancies in results could be further explained by the barriers reported in our study for the ambulatory methods, namely the cost for patients (72%), patient unwillingness to perform HBPM (50%), lack of access to ABPM (60%). Patient education about HBPM is crucial in the management of hypertension (Cloutier et al., 2015; Rabi et al., 2020). However, in our study, this area where nurses are involved the most continues to remain unsatisfactory, with only one-third (35%) of nurses frequently providing education to their patients. Similar findings reported by two Canadian studies show that less than 10% of patients received specific education for HBPM and that patients did not correctly follow the recommended technique for HBPM (Logan et al., 2008; Milot et al., 2015).

For in-office BPM, standardized BP measurement using validated protocols and devices are recommended by Hypertension Canada guidelines (Rabi et al., 2020). There is ample evidence in Canada and globally that the manual method (auscultatory and aneroid) is still most commonly used to routinely measure BPM (Cloutier, 2007; Dickson et al., 2013; Kaczorowski et al., 2017; Martín-Rioboó et al., 2018; Sandoya-Olivera, Ferreira-Umpiérrez, & Machado-González, 2017; Sebo, Pechere-Bertschi, Herrmann, Haller, & Bovier, 2014). A study by *Kaczorowski et al.* showed the preferred methods of family physicians to measure BP were manual method (auscultatory and aneroid) (54.2%), and AOBP (42.9%); and that the most frequently used method for diagnostic purposes was AOBP (31.1%) (Kaczorowski et al., 2017). In our study, AOBP was less favoured by nurses, likely explained by the barriers to AOBP identified, namely non-availability of AOBP devices at their office/workplace (51%) and not having room to leave patients unattended for BPM (33%). It is surprising to note that 48% of nurses reported they never received any formal training in BPM, given that this is a core competency in most programs.

Strength and limitations

The major strength of this study was that a validated and pretested questionnaire was used, thus minimizing the risk of response bias. This study is unique in that, to our knowledge, it is the first study assessing nurses for all BPM methods in Canada. The primary limitation of our study was the low response rate, albeit similar to other published studies performed recently (Kaczorowski et al., 2017). Additionally, the fact that not all registered nurses in primary care participated in the study. Therefore, it is possible that our participants are most likely those, who agreed to participate in the study, agreed to be contacted for research purposes and those who are interested, motivated, and experienced in hypertension management. In fact, few questions (e.g., technical aspects for HBPM and ABPM) require good knowledge and may have caused some nurses to refuse to answer the entire questionnaire, thus contributing to a low response rate. Also, the fact that choices had to be made to keep the study available for three months, despite sending two reminders, contributed to a low response rate.

Conclusion

In conclusion, Hypertension Canada guidelines continue to encourage the importance of proper BP measurement and the use of standardized measurement methods both in and out of office for optimal hypertension management (Rabi et al., 2020). However, the results of our study show that there is scope for improvement, especially in the areas of knowledge and practice. Despite the investment by Hypertension Canada in many resources (including online) for knowledge transfer (Campbell & Chen, 2010; Rabi et al., 2020), the gaps remain between what is recommended and what is known and performed in actual clinical practice and should be addressed for nurses. Even the educational resources developed by Hypertension Canada, such as professional educational programmes, workshops, training courses, are available online for all health professionals, yet nurses' knowledge continues to remain inadequate. Further efforts are needed, focusing on implementing available resources, improving availability of new technologies, identifying and considering the barriers at the organizational and health care professionals level and overcoming them by increasing resources. Knowledge transfer and quality assessment of practice should also be a target at clinics and providers. Academic and medical institutions could standardize training by knowledge reinforcement and timely assessment. Useful strategies may include using BPM algorithm posters and handouts and short summaries, educational slide kits, optimizing patient-centred care using team-based approaches and using new technologies to encourage proper BPM and enable patient education (Campbell et al., 2019; Padwal et al., 2019; Rabi et al., 2020).

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Disclosure for funding

None to declare.

Conflict of interest

Dr. Raj Padwal is Co-Founder and CEO of mmHg Inc., a University of Alberta based start-up creating software and hardware innovations in the field of blood pressure measurement. For the remaining authors, none were declared.

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Annexe A- Supplemental content

Supplemental Table S1. Response of nurses for knowledge about home, ambulatory, office, and automated blood pressure measurement methods

Knowledge questions for all BPM methods (n)	**Answer** n(%)	**Answer** n(%)	**Answer** n(%)	**Answer** n(%)
HBPM				
Q.1 What is the recommended diagnostic threshold for hypertension with HBPM? (n=451)	140/90 mmHg	***135/85 mmHg**	130/80 mmHg	120/80 mmHg
	215(48)	**178(39)**	34(8)	24(5)
Q.2 How many consecutive days of measurements should be taken with HBPM? (n=447)	3 days	5 days	***7 days**	I do not know
	51(12)	50(11)	**296(66)**	50(11)
Q.3 How many measurements should be taken each day with HBPM? (n=452)	Several measurements at different time during the day over a few days	***Twice in the morning and twice in the evening**	Three times in the morning and three times in the evening	I do not know
	244(54)	**170(37)**	8(2)	30(7)
Q.4 When calculating the mean value for HBPM, the values from the first day should be discarded (n=452)	***True**	False	It makes no difference	I do not know
	184(41)	138(30)	44(10)	86(19)
ABPM				
Q.1 What is the recommended diagnostic threshold for hypertension with mean 24-hour ABPM? (n=449)	140/90 mmHg	135/85 mmHg	***130/80 mmHg**	120/80 mmHg
	176(40)	136(30)	**127(28)**	10(2)
Q.2 What is the recommended diagnostic threshold for	140/90 mmHg	***135/85 mmHg**	130/80 mmHg	120/80 mmHg
	207(47)	**185(42)**	41(9)	11(2)

hypertension with day-time ABPM? (n=444)					
Q.3 What interval should be used for day-time measurement with ABPM? (n=449)	***20–30 minutes**	30–60 minutes	It has little impact	I do not know	
	196(44)	137(30)	17(4)	99(22)	
Q.4 What interval should be used for day-time measurement with ABPM? (n=449)	20–30 minutes	***30–60 minutes**	It has little impact	I do not know	
	19(4)	**282(63)**	33(7)	115(26)	
OBPM					
Q.1 What is the recommended diagnostic threshold for hypertension with OBPM for the general population? (n=451)	***140/90 mmHg**	135/85 mmHg	130/80 mmHg	120/80 mmHg	
	335(74)	75(17)	29(6)	12(3)	
Q.2 What percentage of the arm circumference should the length of the cuff bladder cover? (n=450)	40 to 59%	60 to 79%	***80 to 100%**	I do not know	
	64(14)	134(30)	**154(34)**	98(22)	
Q.3 When measuring BP, the back should be supported in order to get valid results (n=449)	***True**	False	It makes no difference	I do not know	
	349(78)	24(5)	44(9)	32(7)	
Q.4 When measuring BP, the arm should be positioned below heart level (n=450)	True	***False**	It makes no difference	I do not know	
	224(50)	**200(44)**	7(2)	19(4)	
Q.5 When measuring blood pressure in office during the initial visit, how many measurements should be performed (n=452)	One measurement is sufficient	Two measurements and the average should be used	***Three measurements, the first discarded and the second and third averaged**	Three BP measurements and all three results should be averaged	I do not know
	77(17)	79(18)	**164(36)**	53(12)	79(18)
AOBP					
Q.1 What is the recommended diagnostic threshold for	140/90 mmHg	***135/85 mmHg**	130/80 mmHg	120/80 mmHg	
	225(51)	**170(38)**	36(8)	12(3)	

hypertension with AOBP? (n=443)				
Q.2 When AOBP is used, preprogrammed multiple measurements are automatically averaged (n=451)	***True**	False	It makes no difference	I do not know
	258(57)	40(9)	1(0)	152(34)
Q.3 A 5 min rest period is recommended before measuring BP with AOBP (n=450)	True	***False**	It makes no difference	I do not know
	268(60)	**67(15)**	9(2)	106(23)
Q.4 BP should be measured with the patient seated on an examination table (n=450)	True	***False**	It makes no difference	I do not know
	74(17)	**263(58)**	24(5)	89(20)

**Correct responses are in bold*

Notes. HBPM, home blood pressure measurement; ABPM, ambulatory blood pressure measurement; OBPM, office blood pressure measurement; AOBP, automated blood pressure measurement; BP, blood pressure; BPM, blood pressure measurement.

Supplemental Table S2. Response of nurses for perception about home, ambulatory, office, and automated blood pressure measurement methods

	Strongly Disagree n (%)	Disagree n (%)	Neither Agree nor Disagree n (%)	Agree n (%)	Strongly Agree n (%)
HBPM					
Q.1 I believe that HBPM is useful for patients when treating hypertension (n=452)	17 (4)	10 (2)	9 (2)	167 (37)	249 (55)
Q.2 I believe that patients can measure their BP correctly at home (n=448)	10 (2)	17 (4)	49 (11)	248 (55)	124 (28)
Q.3 I believe that HBPM can be used for making therapeutic decisions (n=451)	11 (2)	19 (4)	34 (8)	222 (49)	165 (37)
Q.4 I believe that HBPM should be considered as part of standard hypertensive care (n=451)	10 (2)	12 (3)	35 (8)	217 (48)	177 (39)
ABPM					
Q.1 I believe that ABPM is useful for patients in treating hypertension (n=451)	9 (2)	35 (8)	48 (11)	207 (46)	152 (33)
Q.2 I believe that ABPM is well tolerated by patients (n=450)	9 (2)	55 (12)	118 (26)	221 (49)	47 (11)
Q.3 I believe that my patients have easy access to ABPM (n=447)	39 (9)	116 (26)	127 (28)	123 (27)	42 (10)
Q.4 I believe that ABPM is necessary to confirm values obtained in the office (n=449)	13 (3)	41 (9)	92 (21)	203 (45)	100 (22)
OBPM					
Q.1 I believe that I measure BP according to the recommended guidelines (n=449)	5 (1)	36 (8)	72 (16)	271 (60)	65 (15)
Q.2 I believe my colleagues (doctor, nurse and pharmacist) measure BP according to the recommended guidelines (n=446)	10 (2)	81 (18)	120 (27)	208 (47)	27 (6)
Q.3 I believe that using a standardized OBPM is not time consuming for my practice. (n=449)	18 (4)	59 (13)	86 (19)	186 (42)	100 (22)
Q.4 I believe my office is properly set up for me to measure BP in a standardized manner (n=450)	46 (10)	98 (22)	86 (19)	149 (33)	71 (16)

AOBP					
Q.1 I believe that AOBP measurement is superior to OBPM (non-AOBP) (n=447)	15 (3)	46 (10)	172 (39)	135 (30)	79 (18)
Q.2 I believe that AOBP measurement is equivalent to both awake ABPM and HBPM (n=448)	10 (2)	91 (20)	199 (44)	123 (28)	25 (6)
Q.3 I believe that AOBP should be used to make therapeutic decisions (n=446)	2 (0)	29 (6)	150 (34)	200 (45)	65 (15)
Q.32 I believe that I have sufficient knowledge to perform and use AOBP correctly (n=447)	69 (16)	64 (14)	99 (22)	129 (29)	86 (19)

Notes. HBPM, home blood pressure measurement; ABPM, ambulatory blood pressure measurement; OBPM, office blood pressure measurement; AOBP, automated blood pressure measurement; BP, blood pressure; BPM, blood pressure measurement.

Supplemental Table S3. Barriers for all BPM methods

BPM methods	Top four Barriers identified	n (%)
HBPM	Cost for patients	326 (72)
	Patient unwillingness to perform HBPM	226 (50)
	Patient anxiety	216 (48)
	Low patient reliability to report HBPM readings	195 (43)
ABPM	Patients lack access to ABPM	269 (60)
	Non-availability of ABPM at workplace	264 (58)
	Patients incapacity to complete the test due to discomfort	188 (42)
	Patient preference	132 (29)
OBPM	Insufficient time to follow guidelines when measuring BP	150 (33)
	Non-availability of educational material in my primary setting	135 (30)
	Insufficient time to calculate an average	135 (30)
	Insufficient resources and equipment to measure BP	126 (28)
AOBP	Non-availability of AOBP device at my office/workplace	230 (51)
	Not having room to leave patient unattended for BP measurement	147 (33)
	Insufficient time to follow guidelines when measuring BP with AOBP	141 (31)
	Cost of the device for physicians	131 (29)

Notes. HBPM, home blood pressure measurement; ABPM, ambulatory blood pressure measurement; OBPM, office blood pressure measurement; AOBP, automated blood pressure measurement; BP, blood pressure; BPM, blood pressure measurement.

Chapter 6. Knowledge, Perception and Practice of Québec Physicians and Pharmacists for Ambulatory and Clinic Blood Pressure Measurement Methods

This chapter presents the results for physicians and pharmacists. These results will be published as an article in the near future. The preliminary results of physicians were presented virtually as a poster presentation at the SQHA congress, and results including preliminary results for all three HP were presented at Hypertension Canada Congress. The reference list and poster are attached in Annexe 24-25

Résumé en français

Objectifs : Des lignes directrices pour les méthodes de mesure de la pression artérielle (PA), à savoir à domicile (MPAD), ambulatoire (MAPA), en clinique (MPAC) et oscillométrique en série (MPAC-OS) sont publiées par Hypertension Canada. Les médecins et les pharmaciens sont principalement impliqués dans les mesures de la PA, mais leurs connaissances, leur perception et leur pratique concernant toutes les méthodes sont en partie étudiées, et les études montrent des lacunes critiques avec les directives. Il s'agit de la première étude au Québec à dresser un tel portrait des médecins et pharmaciens travaillant en première ligne concernant les différentes méthodes de la PA.

Méthodes : Les médecins et pharmaciens autorisés à exercer en première ligne au Québec ont été ciblés. Les données ont été recueillies à l'aide d'un questionnaire validé et pré-test initié par l'investigateur en anglais et en français. En décembre 2019, les médecins et pharmaciens ont été recrutés via la newsletter mensuelle de leurs associations avec un lien vers une plateforme sécurisée. L'UQTR a délivré un certificat d'éthique.

Résultats : Au total, 45 médecins et 30 pharmaciens ont participé à l'étude. L'âge médian était de 50 ± 13 ans pour les médecins et de 42 ± 12 ans pour les pharmaciens. Le score global de connaissance des méthodes de la PA pour les médecins était de 52% ± 16 et pour les pharmaciens était de 60% ± 16, tandis que le score de perception pour les médecins était de 71% ± 9 et pour les pharmaciens était de 72% ± 5. En pratique, les médecins utilisent fréquemment les MPAD à des fins de diagnostic (73%), de traitement (91%) et de suivi (86%), tandis que MPAD était recommandée par 53% des pharmaciens. Dans l'ensemble, la MAPA a été utilisée moins fréquemment (<50% du temps) par les médecins et les pharmaciens. En clinique, la méthode auscultatoire est encore utilisée par un pourcentage important de médecins (32%) et de pharmaciens (7%), tandis que 13% des médecins et 30% des pharmaciens utilisent la méthode MPAC-OS.

Conclusion : Les connaissances et la pratique globales étaient quelque peu optimales pour les médecins et les pharmaciens. La formation et la formation continue doivent être encouragées et renouvelées avec les méthodes pédagogiques les plus récentes.

Abstract

Objectives: Guidelines regarding blood pressure measurement (BPM) methods, namely home (HBPM), ambulatory (ABPM), office (OBPM), and automated (AOBP), are published by Hypertension Canada. Physicians and pharmacists are commonly involved in BPM, but their knowledge, perception, and practice concerning all methods are partly studied, and studies show critical gaps with the guidelines. This study is the first to establish the portrait of Quebec physicians and pharmacists working in primary care settings concerning the four BPM methods.

Methods: Physicians and pharmacists licensed in primary care were targeted. Data were collected using a validated and pretested investigator-initiated questionnaire in English and French. In December 2019, physicians and pharmacists were recruited through their associations' monthly newsletter with a link to a secured platform. UQTR issued a certificate of ethics.

Results: A total of 45 physicians and 30 pharmacists participated in the study. The median age was 50 ± 13 years for physicians and 42 ± 12 for pharmacists. The overall knowledge score on BPM methods for physicians was 52% ± 16 and for pharmacists was 60% ± 16. The overall perception score for physicians was 71% ± 9 and for pharmacists was 72% ± 5. In practice, physicians use HBPM frequently for diagnostic purposes (73%), treatment (91%), and follow-up (86%), while HBPM was recommended by 53% of pharmacists. Overall, ABPM was used less frequently (<50% of the time) by physicians and pharmacists. In the clinic, the auscultatory method is still used by a significant percentage of physicians (32%) and pharmacists (7%), while 13% physicians and 30% pharmacists use the AOBP method.

Conclusion: Overall, knowledge and practice were somewhat optimal for physicians and pharmacists. Training and continuing education should be encouraged and should be renewed with the newest education methods.

Results

Sample characteristics

A total of 45 physicians and 30 pharmacists completed the full questionnaire, corresponding to a response rate below 5%. The characteristics of physicians and pharmacists are presented in Table XV**.** The median age was 50 ± 13 years for physicians and 42 ± 12 for pharmacists. Most physicians (77%) and pharmacists (60%) that answered were women. Most physicians (71%) and pharmacists (57%) were practicing for more than 11 full-time years in primary care practices. Less than a quarter (16%) physicians and 17% pharmacists indicated never having received any specific training on BPM. Five percent (5%) of physicians and 17% pharmacists were either members of Hypertension Canada or SQHA.

Table XV Distribution of demographic characteristics and general questions

Variables	Physicians (n=45)	Pharmacists (n=30)
	n(%)	
Age (years)		
< 30	2(5)	5(17)
30-39	10(23)	9(30)
40-49	6(14)	7(23)
50-59	11(26)	8(27)
≥ 60	14(33)	1(3)
Sex		
Male	10(23)	11(37)
Female	33(77)	18(60)
Full-time practice in primary care practice (years)		
≤3	3(7)	6(20)
4-10	9(21)	7(23)
≥11	30(71)	17(57)
Received specific training on BPM		
Yes, theoretical only (articles, conferences)	19(44)	18(60)
Yes, practical only	2(5)	1(3)
Yes, theoretical and practical	15(35)	6(20)
Never received training	7(16)	5(17)
Member of hypertension society		
Hypertension Canada	2(5)	3(10)
SQHA	-	2(7)
Neither of them	41(95)	25(83)

Notes. BPM, Blood pressure measurement; SQHA, Société québécoise d'hypertension artérielle

Knowledge of physicians and pharmacists concerning BPM methods

Knowledge was assessed concerning diagnostic thresholds and technical aspects for all BPM methods (see Table XVI and Table XVII). By author consensus, knowledge was deemed adequate when scores for diagnostic thresholds and technical aspects were above 50%. Physicians showed adequate knowledge for OBPM, HBPM, ABPM (daytime) and AOBP thresholds with correct responses above 50%, while for ABPM (24-hour), correct responses were below 50% (see Table XVI). Pharmacists showed adequate knowledge for OBPM, HBPM and ABPM (daytime) with correct responses above 50%, while for AOBP and ABPM (24-hour), correct responses were below 50% (see Table XVI). For technical aspects, both physicians and pharmacists showed adequate knowledge with correct responses above 50% for 9 out of 12 aspects (see Table XVII). The overall mean knowledge score obtained by physicians for all methods was 8.8/17 ± 2.7 (52% ± 16) and by pharmacists for all methods was 10.1/17 ± 2.7 (60% ± 16), which exceeded the 50% threshold (see Table XVIII).

Table XVI Percentage of correct responses of physicians and pharmacists concerning diagnostic thresholds for all BPM methods

Diagnostic thresholds	Physicians (n=45)		Pharmacists (n=30)	
	Correct response		Correct response	
	> 50%	**≤ 50%**	**> 50%**	**≤ 50%**
OBPM diagnostic threshold *(140/90 mmHg)*	68%		87%	
HBPM diagnostic threshold *(135/85 mmHg)*	62%		67%	
ABPM day-time diagnostic threshold *(135/85 mmHg)*	56%		67%	
AOBP diagnostic threshold *(135/85 mmHg)*	53%			37%
ABPM mean 24-hour diagnostic threshold *(130/80 mmHg)*		40%		47%

Notes. BPM, Blood pressure measurement; (correct answers)

Table XVII Percentage of correct responses of physicians and pharmacists concerning technical aspects for all BPM methods

Technical aspects	Physicians (n=45)		Pharmacists (n=30)	
	Correct response		Correct response	
	> 50%	**≤ 50%**	**> 50%**	**≤ 50%**
HBPM				
1. Measurement protocol *(7days)*	59%		87%	
2. For mean calculation, first day values are discarded *(True)*	50%			47%
3. Measurement taken each day *(2x morning, 2x evening)*		44%	57%	
ABPM				
4. Night-time interval *(30-60 minutes)*	71%		87%	
5. Day-time interval *(20-30 minutes)*	51%		73%	
OBPM				
6. Back should be supported *(True)*	75%		73%	
7. Arm position should be below heart level *(False)*	59%		63%	
8. Protocol for average calculation *(Three; second-third averaged)*	59%		57%	
9. Arm circumference *(80 to 100%)*		18%		27%
AOBP				
10. Preprogrammed multiple measurements automatically averaged *(True)*	66%		63%	
11. BPM with patient seated on examination table *(False)*	66%		57%	
12. 5-minutes rest period recommended *(False)*		7%		20%

Notes. BPM, Blood pressure measurement; (correct answers)

Table XVIII Mean knowledge score of physicians and pharmacists for all BPM methods

BPM methods	Maximum score	Physicians (n=45)		Pharmacists (n=30)	
		Score N M ± SD	Score % M ± SD	Score N M ± SD	Score % M ± SD
HBPM	4	2.1 ± 1.4	53 ± 35	2.5 ± 1.2	64 ± 31
ABPM	4	2.1 ± 1.1	53 ± 28	2.7 ± 1.1	68 ± 29
AOBP	4	1.8 ± 1.1	47 ± 28	1.7 ± 0.8	44 ± 22
OBPM	5	2.8 ± 0.9	56 ± 19	3.0 ± 1.0	61 ± 21
Overall	**17**	**8.8 ± 2.7**	**52 ± 16**	**10.1 ± 2.7**	**60 ± 16**

Notes. BPM, Blood pressure measurement; M, Mean; SD, Standard deviation; N, numerical;%, percentage

Perception of physicians and pharmacists concerning BPM methods

The perception was assessed concerning the beliefs of physicians and pharmacists about the usefulness of BPM methods. On a scale of 1 to 5, physicians and pharmacists showed strong agreement for the usefulness of all BPM methods (see Table XIX). The overall perception score for all methods obtained by physicians was 57/80 ± 7.2 (72% ± 9) and by pharmacists was 57/80 ± 4.3 (72% ± 5) (see Table XIX).

Table XIX Mean perception score of physicians and pharmacists for all BPM methods

BPM methods	Maximum score	Physicians (n=45)		Pharmacists (n=30)	
		Score N M ± SD	Score % M ± SD	Score N M ± SD	Score % M ± SD
HBPM	20	17.3 ± 3.0	87 ± 15	16.7 ± 1.8	84 ± 9
ABPM	20	13.4 ± 3.1	67 ± 16	14.6 ± 2.3	73 ± 12
AOBP	20	14.6 ± 2.3	73 ± 12	13.8 ± 2.2	69 ± 11
OBPM	20	12.3 ± 4.0	62 ± 20	12.4 ± 1.8	62 ± 9
Overall	**80**	**57.7 ± 7.2**	**72 ± 9**	**57.6 ± 4.3**	**72 ± 5**

Notes. BPM, Blood pressure measurement; M, Mean; SD, Standard deviation; N, numerical; %, percentage

Practice of physicians and pharmacists concerning BPM methods

Ambulatory methods

In practice, physicians indicated using HBPM frequently for diagnosis (73%), treatment (91%) and follow-up (86%) purposes (see Figure 12). ABPM is considered as a gold standard method; however, physicians indicated using ABMP (<50% of the time) for diagnosis (23%), treatment (24%) and follow-up (11%) (see Figure 12). More than half (53%) of the pharmacists indicated HBPM was frequently recommended to their patients, whereas 47% indicated ABPM was rarely recommended to their patients (see Figure 13). Concerning the provision of education to patients, 62% of the physicians indicated that education for HBPM was frequently provided to their patients (see Figure 14). However, nearly one-third (38%) of the physicians indicated that education for ABPM was rarely provided to their patients (see Figure 14). Interestingly, less than a quarter (20%) of pharmacists indicated education for HBPM and ABPM was frequently provided (see Figure 15).

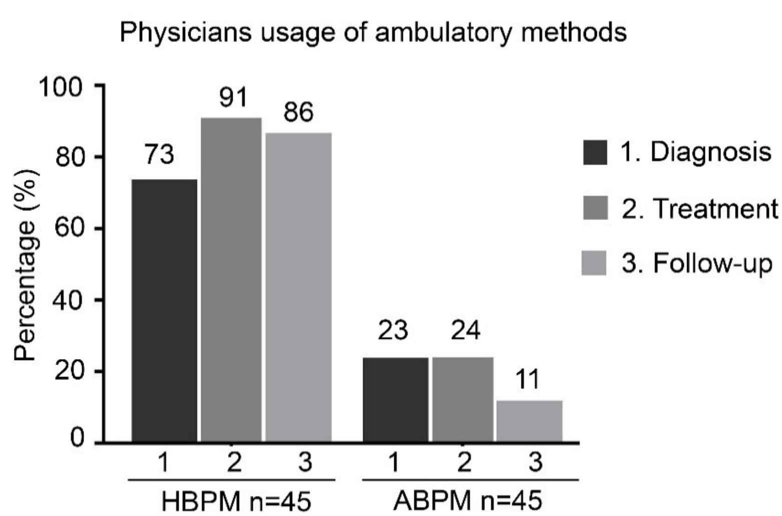

Figure 14 Distribution of physicians responses regarding practice about HBPM and ABPM

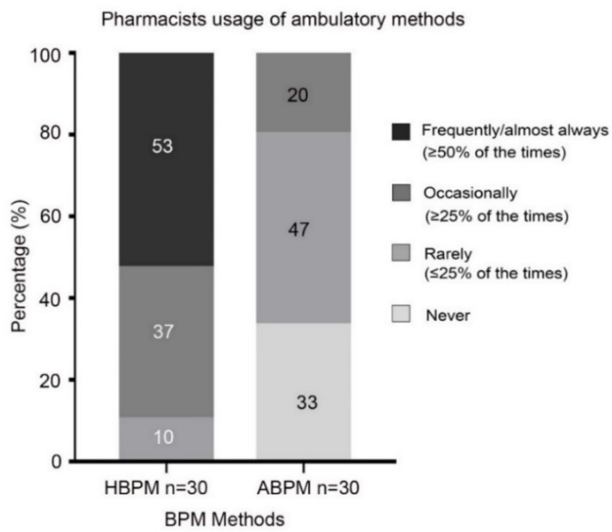

Figure 15 Distribution of pharmacists responses regarding practice about HBPM and ABPM

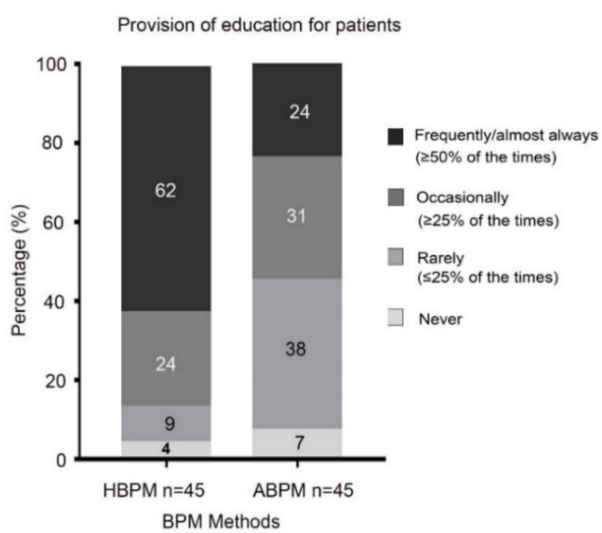

Figure 16 Distribution of physicians responses regarding the provision of education concerning HBPM and ABPM

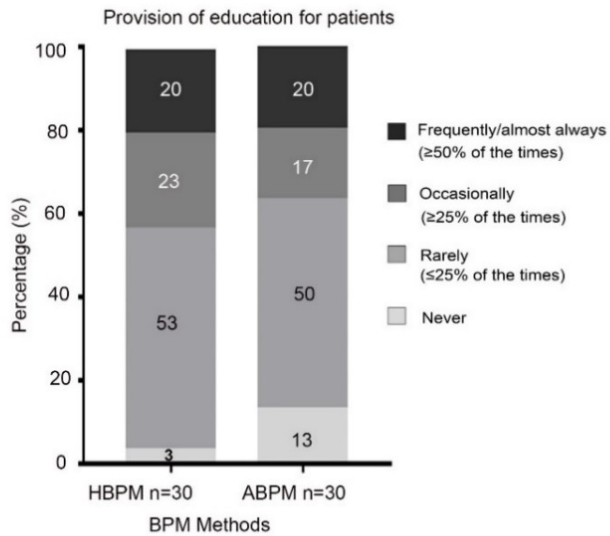

Figure 17 Distribution of pharmacists responses regarding the provision of education concerning HBPM and ABPM

Clinic methods

For clinic BPM methods, physicians indicated using OBPM frequently for screening (78%), diagnosis (59%) and treatment (56%) (see Figure 16). AOBP was also used quite frequently for screening (60%), diagnosis (59%) and treatment (57%) (see Figure 16). The auscultatory method was still used by a significant percentage of physicians (32%) and pharmacists (7%), while 13% of physicians and 30% pharmacists use the AOBP method and 57% physicians and 57% pharmacists use the electronic oscillometric device (see Figure 17). Finally, physicians and pharmacists identified the main barriers they perceived for all four BPM methods (see Table XX). Most frequent were the cost of HBPM for patients (65% physicians, 83% pharmacists), patients lack access to ABPM (82% physicians, 60% pharmacists), insufficient time to follow guidelines when measuring BP (47% physicians, 44% pharmacists), not having room to leave patient unattended for BP measurement (36% physicians, 23% pharmacists) (see Table XX).

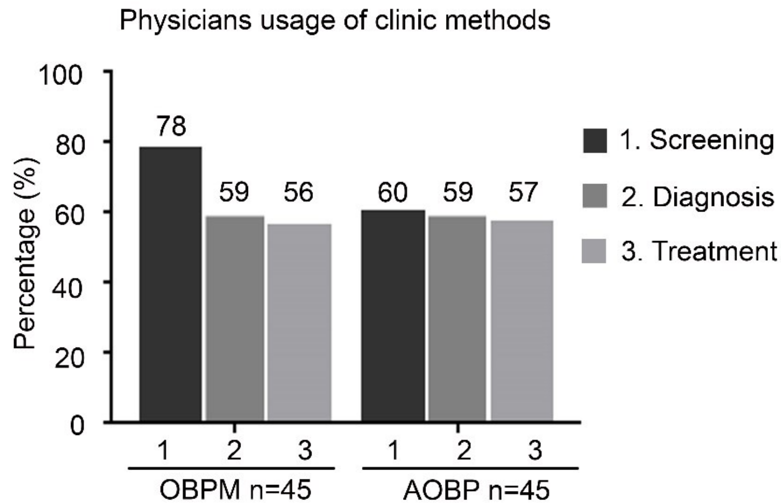

Figure 18 Distribution of physicians responses regarding practice about OBPM and AOBP

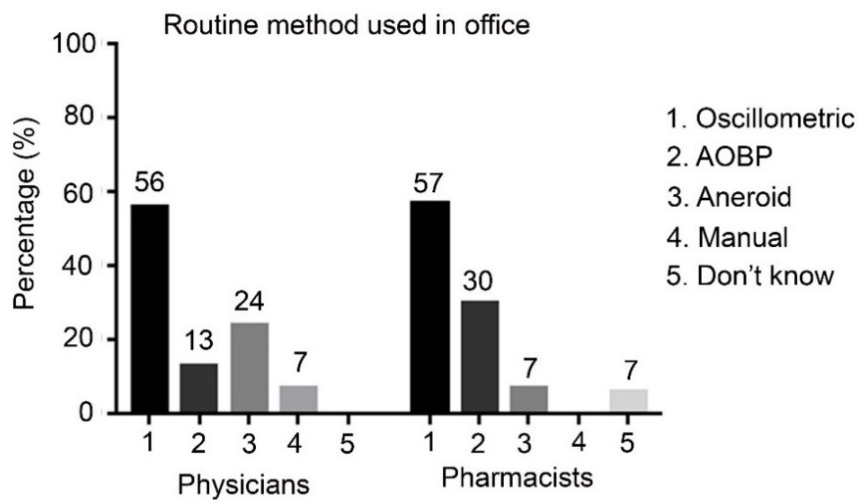

Figure 19 Distribution of physicians and pharmacists responses regarding practice about OBPM

Table XX Barriers for all BPM methods

BPM methods	Top four Barriers identified	Physicians (%)	Pharmacists (%)
HBPM	Cost for patients	65%	83%
	Patient unwillingness to perform HBPM	63%	53%
	Patient anxiety	40%	-
	Low patient reliability to report HBPM readings	37%	-
	Low reimbursement fees for health professionals	-	57%
	Insufficient time to teach patient about HBPM	-	53%
ABPM	Patients lack access to ABPM	82%	60%
	Cost of the test for patients	56%	67%
	Non-availability of ABPM at workplace	49%	37%
	Patient preference	51%	-
OBPM	Insufficient time to follow guidelines when measuring BP	47%	44%
	Insufficient time to calculate an average	36%	11%
	Insufficient resources and equipment to measure BP	24%	15%
	Non-availability of educational material in my primary setting	24%	-
	Non-availability of electronic oscillometric device (non-automated)	-	22%
AOBP	Insufficient time to follow guidelines when measuring BP with AOBP	53%	57%
	Cost of the device for physicians	51%	27%
	Not having room to leave patient unattended for BP measurement	36%	23%
	Non-availability of AOBP device at my office/workplace	-	63%

Chapter 7. Discussion

This thesis primarily focused on the research project concerning the knowledge, perception, and practice of HP about the different BPM methods. More precisely, the articles of this thesis, through a scoping review and as a systematic study, presented the global portrait and provincial portrait of HP concerning the three concepts and four BPM methods. Although a complete discussion is made in each article, this chapter offers a general discussion. This chapter also outlines the strengths and limitations of the research and offers future perspectives for practice, education and research.

Scoping review

The scoping review was the foundation of our research and made it possible to assess the literature globally and gather evidence concerning knowledge, perception and practice of physicians, nurses, and pharmacists regarding the four BPM methods. Since this is a scoping review consisting of global data, we briefly present the discussion here and highlight the results. The scoping review highlights that on a global scale, knowledge of the three HP is inadequate, and practices are unsatisfactory, while perceptions are mostly positive. These results were observed in the continents of North America, South America, Africa, Europe, Asia, and Australia. The results further highlight the gap between the recommended guidelines for BPM methods and the knowledge, perception, and practice of HP. Though nurses and pharmacists are an integral part of primary care management, our scoping review highlighted that they were partly studied. Therefore, when conducting our research survey, we included all three HP.

Knowledge, perception, and practice of Quebec nurses concerning ambulatory and clinic BPM methods

This study is the first in Canada to draw a portrait of Quebec nurses' knowledge, perception, and practice concerning ambulatory and clinic BPM methods. The results of this study demonstrated that knowledge and practice were suboptimal, while perception was optimal. The potential impact of such results means that a large population could be misdiagnosed and put on unnecessary treatment. Also, it may lead to truly hypertensive patients being overlooked. Additionally, if nurses do not have adequate knowledge, patient education is also incorrectly provided, resulting in imprecise diagnosis and treatment of hypertensive patients.

Nurses should have adequate knowledge about diagnostic thresholds and technical aspects of BPM methods (Rabi et al., 2020). Disregarding these areas can impact the values obtained, which leads to an incorrect diagnosis of hypertension (Campbell et al., 2005; Kallioinen et al., 2017). Our study showed that the overall knowledge of nurses for all BPM methods was below 50%. In addition, the aspects such as diagnostic thresholds for HBPM, ABPM and AOBP need to be improved, as noted from our results that nurses overestimated those thresholds. So far, only one study has documented nurses' knowledge concerning HBPM, which indicated that only 3% of nurses knew the correct thresholds (Ishikuro et al., 2016). Interestingly, in our study, 39% of nurses knew the correct HBPM thresholds. Globally no published study has documented nurses' knowledge concerning ABPM and AOBP methods. Unfortunately, we cannot draw comparisons with Canadian studies because no study documented nurses knowledge of HBPM, ABPM and AOBP methods. Given that nurses are primarily involved in BPM and provide education to patients about ambulatory methods, it is discouraging to note that nurses remain under-studied.

Furthermore, concerning technical aspects of BPM, results of our study showed that nurses had inadequate knowledge about HBPM protocol for average calculation, measurement protocol with HBPM, the protocol for the time interval with ABPM, recommended rest period with AOBP and the most fundamental aspects with OBPM such as arm position, arm circumference and average calculation. Nurses play an active role in BPM and, more specifically, provide education to patients regarding HBPM and ABPM, and therefore, our results are alarming. However, our results are consistent with the global literature that highlights the most fundamental aspects are often overlooked (Ahmed, 1997; Chen, Liu, Liu, & Tsai, 2011; Cloutier, 2007; Coogan et al., 2015; Dalfó-Pibernat et al., 2018; Dickson & Hajjar, 2007; Gillespie & Curzio, 1998; Gleichmann, Gleichmann, Mannebach, Mellwig, & Philippi, 1989; Ishikuro et al., 2016; Machado et al., 2014; Markandu, Whitcher, Arnold, & Carney, 2000; McVicker, 2001; Nolan & Nolan, 1993; Ojo, Sogunle, Malomo, & Adesoji, 2018; Villegas, Arias, Botero, & Escobar, 1995; Vloet, Smits, Frederiks, Hoefnagels, & Jansen, 2002; Wingfield, Pierce, & Feher, 1996). Results of our scoping review have meticulously appraised the literature and highlighted these results (Todkar et al., 2020). BPM training is a core competency of many curriculum programmes, and HP acquires it during their academic career. Therefore, it is not reassuring to note that 48% of the nurses in our study did not have formal theoretical or practical training in BPM, while only 26% received theoretical training (articles, conferences), 7% received practical training, and 19% received both. Similar results were seen in one study that reported 84% of physicians and nurses received no formal training in BPM (McVicker, 2001).

Despite significant resources invested in Canada over the last few years in developing and implementing the Hypertension Canada Guidelines, knowledge transfer strategies, the knowledge did not improve. This could be because BPM is still considered a basic and simple procedure, and HP may have overlooked it. As a result, they might have focused on other more complex procedures.

Concerning perceptions, our results are encouraging to note that nurses have a strong agreement regarding the usefulness of ambulatory and clinic BPM methods in hypertension management. Our results are consistent with literature for HBPM and OBPM methods that showed nurses had positive perceptions concerning these methods (Block et al., 2018; Ishikuro et al., 2016; Jones et al., 2013). However, globally no published study has documented nurses' perceptions concerning ABPM and AOBP methods. In addition, only two studies on HBPM and one study on OBPM have documented nurses' perceptions (Block et al., 2018; Ishikuro et al., 2016; Jones et al., 2013). Therefore, to our best knowledge, our study is the first to document nurses' perceptions concerning ambulatory and clinic BPM methods.

Concerning practice, our study showed several divergences regarding the ambulatory and clinic BPM methods. Although nurses strongly agreed about the usefulness of ambulatory methods, our results showed that the frequency of recommending HBPM and ABPM to their patients was below 50%. One reason could be because physicians often recommend HBPM and ABPM to their patients, and not all nurses are authorized to make the decision. The divergences can be further explained due to the top barriers listed in our study that includes HBPM cost for patients, patients unwillingness to perform HBPM, patients anxiety, patients' lack of access to ABPM or non-availability of ABPM at the workplace. Similar barriers have also been identified in other studies with physicians (Boivin et al., 2011; Jackson et al., 2019; Jones et al., 2013; Kaczorowski et al., 2017; Martín-Rioboó et al., 2018; Setia, Subramaniam, Teo, & Tay, 2017; Steinmann, Chitima-Matsiga, & Bagree, 2011; Tirabassi, Fang, & Ayala, 2013; Tislér et al., 2006; Tsakiri et al., 2013; Woolsey, Brown, Ralls, Friedrichs, & Stults, 2017). Our results are similar to other studies that showed the frequency of recommending HBPM to patients was below 50% (Ishikuro et al., 2016; Tirabassi et al., 2013). A study by Tirabassi et al. mentioned that compared to physicians, nurses were significantly likely to recommend HBPM to their patients; however, the percentage was below 50% (32% physicians vs 40% nurses) (Tirabassi et al., 2013). We could not make comparisons for ABPM due to the lack of published literature globally and in Canada.

Regarding patient education, which is a crucial area of BPM, and one that is directly in the scope of nursing practice~~,~~ our results showed that the frequency of providing patient education for HBPM and ABPM methods was below 50%. Similar findings were observed in other studies where patient education is often a neglected area (Ishikuro et al., 2016; Jackson et al., 2019; Jones et al., 2013; McGowan, Gough, Maxwell, & Padfield, 2007). Finally, we note that no study published in Canada has documented nurses' practice concerning ambulatory methods. Our scoping review highlighted that globally not many studies were performed on nurses concerning ambulatory methods (Todkar et al., 2020).

Concerning clinic methods, our results showed a slight shift towards the use of the oscillometric device (57%) as a routine BPM method, while still, a significant proportion of nurses (11%) use the manual method and only a quarter (25%) use AOBP method. Recent literature shows similar results where nurses and physicians still use the manual method for routine BPM (Kaczorowski et al., 2017; Ojo et al., 2018; Sandoya-Olivera, Ferreira-Umpiérrez, & Machado-González, 2017). Additionally, the results of our scoping review highlighted that prior to the technological advancement of BPM, studies in the past have shown that the manual method (auscultatory and aneroid) was routinely used BPM method (Todkar et al., 2020). A recent Canadian survey of physicians reported that 54% of physicians used the manual method, and only 43% used the AOBP method routinely to measure BP (Kaczorowski et al., 2017). Hypertension Canada guidelines recommend the AOBP method; however, it is not fully implemented in clinical practice. This could be explained further by the top barriers identified in our study, including non-availability of AOBP device at the office (51%), not having room to leave patients unattended for BPM (33%), insufficient time to follow guidelines when measuring BP with AOBP (31%), cost of the device for physicians (29%). So far, no published study in Canada and globally has documented nurses' practice concerning the AOBP method.

Knowledge, perception and practice of Quebec physicians and pharmacists concerning ambulatory and clinic BPM methods

This study demonstrated that physicians and pharmacists have positive perceptions and somewhat adequate knowledge and practice. However, some areas of knowledge and practice need to be improved. Physicians and pharmacists are primary care providers and play a vital role in BPM. Therefore, it is deemed essential to have knowledge concerning diagnostic thresholds and technical aspects of BPM methods (Rabi et al., 2020; Williams et al., 2018). Our study showed that the overall knowledge of physicians and pharmacists for all BPM methods was slightly above 50% (physicians 52% vs pharmacists 60%). Concerning knowledge about diagnostic thresholds, physicians showed adequate knowledge level above 50% for HBPM, OBPM, day-time ABPM and AOBP; however, physicians overestimated the thresholds for 24-hour ABPM. In practice, this would mean that patients will be misdiagnosed as hypertensive.

Pharmacists had adequate knowledge level above 50% for HBPM, OBPM, day-time ABPM; however, pharmacists overestimated the thresholds for AOBP and 24-hour ABPM and chose thresholds similar to that of OBPM. These aspects need improvement as they are very crucial for the diagnosis of hypertension. It is important to highlight that no study published in Canada has documented knowledge of physicians and pharmacists. Due to limited data in Canada, we cannot make a comparison for the diagnostic threshold aspect. This comparison is crucial because we are using Hypertension Canada Guidelines as a reference framework for our study.

The global literature has shown that physicians have inadequate knowledge regarding the diagnostic threshold with HBPM, ABPM and OBPM (Fletcher et al., 2016; Kobayashi et al., 2010; Mion, Pierin, Lessa, & Nobre, 2002; Obara et al., 2010; Tsakiri et al., 2013). Results of our scoping review highlighted these findings (Todkar et al., 2020). Results of our study show slight variance from the literature showing adequate knowledge level of Quebec physicians. However, we cannot generalize the results of our study due to the limitations attributed to the small sample size. We also point out that so far, only one study has documented physicians' knowledge about ABPM that showed knowledge gaps (Dalfó-Pibernat et al., 2018). Furthermore, no published study in Canada and globally documented physicians' knowledge about the AOBP method. For pharmacists, the results of two HBPM studies indicated that less than a third (29%) of pharmacists had adequate knowledge about diagnostic thresholds (Matowe et al., 2008; Obara et al., 2012). So far, no published study in Canada and globally documented pharmacists' knowledge for ABPM, OBPM and AOBP methods. Moreover, on a global scale, pharmacists remain under-studied, especially for ambulatory methods, although they are part of a multidisciplinary team-based approach for hypertension management (Marra et al., 2017; Matowe et al., 2008; Santschi et al., 2014; Tsuyuki et al., 2018). To our best knowledge, our study is the first in Canada to document the knowledge of physicians and pharmacists for ambulatory and clinic methods.

Concerning the knowledge on technical aspects, our study showed that physicians and pharmacists had overall adequate knowledge. However, some technical aspects still need to be improved. Physicians showed inadequate knowledge (below 50%) for the protocol for measurement with HBPM, the protocol for arm circumference with OBPM and recommended rest period with AOBP. Pharmacists showed inadequate knowledge (below 50%) for the protocol for average calculation with HBPM, the protocol for arm circumference with OBPM and recommended rest period with AOBP. Such results would mean that non-hypertensive patients are misdiagnosed, and hypertensive patients are disregarded. Here, we note that both physicians and pharmacists lacked knowledge about the rest period with AOBP and protocol for arm circumference with OBPM. Regarding the rest period with AOBP, Hypertension Canada Guidelines recommend that AOBP be performed with no particular rest period (Myers & Colella, 2019; Rabi et al., 2020; Stults et al., 2019). Adding a 5-minute rest period could result in readings that are lower than the corresponding awake ABPM (Myers & Colella, 2019; Myers & Kaczorowski, 2017). Despite the recommendations, only 7% of physicians and 20% of pharmacists gave the correct response in our study. We cannot compare with other studies because no published study in Canada and globally documented knowledge of physicians and pharmacists about AOBP method. Regarding arm circumference with OBPM, Hypertension Canada guidelines recommend that the bladder length should cover 80-100% of the arm circumference (Rabi et al., 2020). In our study, only 18% of physicians and 27% of pharmacists gave the correct response. Our results are consistent with other studies that found similar results (Ahmed, 1997; Gillespie & Curzio, 1998; Markandu et al., 2000). A study by Markandu et al. reported that only 32% of physicians correctly knew the bladder length (Markandu et al., 2000). So far, no study has documented pharmacists' knowledge for AOBP and OBPM methods.

Furthermore, 35% of physicians and 20% of pharmacists in our study mentioned having received theoretical and practical training in BPM, and 44% of physicians and 60% of pharmacists received only theoretical training (articles, conferences) on BPM. Similar results were seen in one study that reported 84% of physicians and nurses received no formal training in BPM (McVicker, 2001).

Concerning perceptions, our results are encouraging to note that physicians and pharmacists strongly agree on the usefulness of ambulatory and clinic BPM methods. Our results are consistent with literature for HBPM and ABPM methods that showed physicians had positive perceptions concerning these methods (Carrera & Lambooij, 2015; Cheng, Studdiford, Diamond, & Chambers, 2003; Fletcher et al., 2016; Grin, McCabe, & White, 1993; Jones et al., 2013; McManus, Wood, et al., 2014; Mejzner, Clark, Smith, & Campbell, 2017; Obara et al., 2012; Setia, Subramaniam, Teo, et al., 2017; Setia, Subramaniam, Tay, & Teo, 2017; Steinmann et al., 2011; Sugano et al., 2014; Tislér et al., 2006; White, Grin, & McCabe, 1993). A Canadian survey indicated that 52% of physicians considered HBPM as part of standard hypertensive care and 63% often recommended it to their patients (Logan et al., 2008). This study also reported that physicians had concerns with HBPM regarding patients becoming preoccupied with HBPM (70%) and accuracy of device (65%). In our study, physicians listed the top barriers for HBPM implementation that included cost for patients (65%), patient unwillingness to perform HBPM (63%), patient anxiety (40%), low patient reliability to report HBPM readings (37%) (see Table XVIII). A study by Obara et al. showed that pharmacists had a positive perception of HBPM and that 90% of pharmacists considered HBPM more useful than the clinic method (Obara et al., 2012). So far, no published study in Canada documented physicians' and pharmacists' perceptions of ABPM, OBPM and AOBP methods. Globally, no published study documented pharmacists' perception for ABPM, OBPM and AOBP methods. Thus, our study is the first in Canada to document perceptions of physicians and pharmacists regarding ambulatory and clinic BPM methods.

Concerning practice for ambulatory methods, our results showed satisfactory practice with 73% of physicians using HBPM for diagnosis purposes, 91% for treatment and 86% for follow-up. Interestingly, variance in practice was seen in a recent Canadian survey of family physicians (n=769) that reported HBPM was frequently used by only 22% of physicians for diagnosis purposes and 69% of physicians for ongoing management of hypertension (Kaczorowski et al., 2017). However, studies from other countries reported satisfactory physicians' practice with HBPM, which is similar to the results of our study (Fletcher et al., 2016; Kim, Kim, Kim, Jung, & Ryu, 2012; Martín-Rioboó et al., 2018; McManus, Wood, et al., 2014; Obara et al., 2010; Setia, Subramaniam, Teo, et al., 2017; Setia, Subramaniam, Tay, et al., 2017; Steinmann et al., 2011; Sugano et al., 2014; Tislér et al., 2006).

For ABPM, our results were unsatisfactory and showed that the frequency of using and recommending ABPM to patients was below 50%. Although ABPM is considered the gold standard method for diagnosis and is recommended by Hypertension Canada Guidelines, our results are disappointing. However, similar findings were seen in the Canadian survey of family physicians (n=769), which reported, despite the easy access to ABPM, only 14% of physicians were using it for diagnosis purposes (Kaczorowski et al., 2017). Studies in other countries have also reported that the frequency of using and recommending ABPM to patients by physicians was below 50% (Carrera & Lambooij, 2015; Kobayashi et al., 2010; Martín-Rioboó et al., 2018; McGowan et al., 2007; Mejzner et al., 2017; Setia, Subramaniam, Teo, et al., 2017; Woolsey et al., 2017). The relatively low use of ABPM could be further be explained by the barriers listed by physicians in our study that include patients lack of access to ABPM (82%), cost of the test for patients (56%), patient preference (51%) and non-availability of ABPM at workplace (49%) (see Table XVIII). Interestingly, in the study by Kaczorowski et al., 78% of physicians indicated that ABPM was readily available for their patients (Kaczorowski et al., 2017). Surprisingly, this was the top listed barrier in our study, as mentioned earlier. A study by Martín-Rioboó et al. reported that only 30% of physicians recommend ABPM for diagnosis purposes, and 70% reported a lack of access to ABPM as an important reason for not using ABPM in their practice (Martín-Rioboó et al., 2018).

Regarding pharmacists, the results of our study reported that 53% of pharmacists frequently recommended HBPM to their patients, while for ABPM, the frequency was below 50%. The possible explanation is the barriers reported in our study by pharmacists that included the cost of HBPM for patients, patient unwillingness to perform HBPM, low reimbursement fees for HP, patients lack of access to ABPM, cost of the test for patients, non-availability of ABPM at workplace (see Table XVIII). Unfortunately, due to limited data for pharmacists, we could only retrieve results from one study that reported 72% of community pharmacists and

49% of hospital pharmacists recommended HBPM to their patients (Obara et al., 2012). Unfortunately, we cannot make comparisons for pharmacists concerning the ABPM method since no published study in Canada and globally documented pharmacists' practice.

Hypertension Canada guidelines strongly recommend providing education to patients concerning ambulatory methods (Rabi et al., 2020). However, the results of our study indicated that the frequency of providing patient education by physicians for HBPM was more than 50%, while for ABPM, it was below 50%. In addition, pharmacists indicated that the frequency of providing patient education for HBPM and ABPM methods was below 50%. One possible reason could be the different roles of HP, such that nurses often perform patient education. Another reason could be the barrier identified in our study that includes insufficient time to teach patients about HBPM, as indicated by 53% of pharmacists. Results from two Canadian surveys reported that less than 10% of patients received specific education concerning HBPM (Logan et al., 2008; Milot et al., 2015). In addition, studies in other countries have reported that physicians and pharmacists rarely provide patient education for HBMP and ABPM (Boivin et al., 2011; Jackson et al., 2019; Jones et al., 2013; Martín-Rioboó et al., 2018; Matowe et al., 2008; Obara et al., 2010; Setia, Subramaniam, Teo, et al., 2017; Woolsey et al., 2017).

Concerning practice for clinic methods, we found a slight variation compared to another Canadian survey (Kaczorowski et al., 2017). It is important to note that we cannot generalize the results due to the low response rate. Results of our study showed that 78% of physicians were using OBPM, and 60% were using AOBP for screening purposes, 59% were using OBPM, and 59% were using AOBP for diagnosis purposes, 56% were using OBPM, and 57% were using AOBP for treatment purposes. Surprisingly, the results of the Canadian survey reported that for screening, 54% of physicians were still using manual methods (mercury or aneroid) while 43% were using AOBP (Kaczorowski et al., 2017). Additionally, for diagnosis purposes, 31% of physicians frequently used AOBP, and 21% used manual OBPM, and for ongoing management, 59% used AOBP, and 64% used the manual OBPM method (Kaczorowski et al., 2017).

Globally, this particular aspect of OBPM practice has not been studied. Additionally, our study showed that although an oscillometric device was used by more than 50% of physicians and pharmacists, AOBP remains a less used method (below 50%), and the manual method was still used for routine BPM. The relatively low use of AOBP in our study is explained by the barriers listed by physicians and pharmacists that include insufficient time to follow guidelines (physicians 53% vs 57% pharmacists), cost of the device for physicians (51% vs 27%), not having room to leave the patient alone (36% vs 23%). Despite the guidelines by hypertension societies, studies in Canada and globally have shown that the manual method is still being used as a routine BPM method and that AOBP remains a less used method (Bhalla, Singh, D'Cruz, Lehl, & Sachdev, 2005; Chalmers, Arima, Harrap, Touyz, & Park, 2013; Dickson et al., 2013; Kaczorowski et al., 2017; Kobayashi et al., 2010; McKay et al., 1990; Mion et al., 2002; Mohan et al., 2014; Ojo et al., 2018; Sandoya-Olivera et al., 2017; Sebo et al., 2014; Veiga et al., 2003; Wingfield et al., 1996; Woolsey et al., 2017). Moreover, most literature identified is over the past 20 years when the auscultatory method was being used, and BPM advancement is recent. Also, the fact that AOBP is still not completely incorporated by many Hypertension societies.

Finally, as mentioned previously in the theoretical framework, the competence of HP is built on knowledge, perception, and practice. Therefore, these three areas are crucial to performing the required task accurately and meeting the professional standards. However, our results showed that there are gaps in the knowledge and practice of HP. Therefore, to be clinically competent in BPM, improvements are needed, especially in those two areas.

Strength and limitations

Some of the strengths and limitations are presented in the articles. Here general strengths and limitations are presented. Our research consisted of the scoping review and the study concerning nurses, physicians, and pharmacists. To our knowledge, our research was the first to conduct the scoping review specifically on knowledge, perception, and practice of physicians, nurses, and pharmacists concerning the four BPM methods together in a single study. In addition, the survey was the first to portrait the knowledge, perception and practice of nurses, physicians and pharmacists in Quebec concerning the ambulatory and clinic BPM methods together in a single study.

Thus, one of the strengths of our research is the methodology. First, for the scoping review, we systematically appraised the heterogeneous literature and presented the results. Following our scoping review, an editorial comment was published emphasizing BPM as an essential clinical skill worldwide (Cappuccio, 2021). Second, for our study concerning nurses, physicians, and pharmacists, we used a well-validated and pretested investigator-initiated questionnaire. The questionnaire validation method has been well explained in our article concerning nurses. It is also explained precisely in the methodology chapter of this thesis.

We emphasize that the development and validation of the questionnaire followed a rigorous process, thus ensuring good internal validity of the study. In addition, it is well-established that instrument validation is a crucial step in determining the internal validity of any study (Boateng, Neilands, Frongillo, Melgar-Quiñonez, & Young, 2018; Gray et al., 2017; Kimberlin & Winterstein, 2008; Waltz et al., 2018). However, we note that the questionnaire validation method has been rarely discussed in the previously listed literature. Our BPM questionnaire is available in English and French which could be used by other researchers across Canada. Since the questionnaire for our study was developed using Hypertension Canada Guidelines as a reference framework, it seems appropriate to be considered in Canada. It could also be used as a pretest-posttest during BPM education for HP. In addition, regarding the recruitment method, we noted that for nurses, a personalized email invitation signed by a known researcher in Quebec seemed effective in obtaining a better response rate compared to that of physicians and pharmacists. One possible explanation for this is that nurses are more willing to disclose their contact information to participate in research, and when contacted, more nurses participate in research. Also, they have the opportunity during their academic studies to become aware of the research.

Limitations were well discussed in the articles of scoping review and in the study of nurses. Here we briefly highlight the general limitations of our study concerning the three HP. A significant limitation of our study concerning nurses, physicians, and pharmacists was a low response rate. One of the reasons could be the recruitment method. In the study concerning nurses, personalized email invitations seemed slightly more effective than associations' monthly newsletters in achieving a better response rate. However, the response rates for online surveys are generally very low, ranging from 16% to 20% (Corner & Lemonde, 2019; Dillman et al., 2014; Waltz et al., 2018; Weaver et al., 2019). The low response rates are consistent with other global and Canadian surveys (Cook, Dickinson, & Eccles, 2009; Kaczorowski et al., 2017; Logan et al., 2008; Martín-Rioboó et al., 2018; Nulty, 2008; Ojo et al., 2018; Weaver et al., 2019; Wiebe, Kaczorowski, & MacKay, 2012). There is a concern that response rates have recently declined due to the increasing demand for HP to participate in research activities (Cook et al., 2009; McAvoy & Kaner, 1996; Moore, Post, & Smith, 1999). The declining trend in response rates has led some physicians to adopt an office policy of not participating in surveys of any kind (Wiebe et al., 2012). In addition, low response rates can lead to bias, as non-respondents may be systematically different from the respondents (Cook et al., 2009). Although in our study concerning nurses, physicians, and pharmacists, respondents appear to be similar to non-respondents, the response rate and the number of characteristics available for this comparison are very low. Therefore, it is possible that participants in our study, especially physicians and pharmacists, are likely those interested, motivated, and experienced in BPM. This could have resulted in voluntary bias.

Additionally, the fact that not all registered nurses, physicians and pharmacists participated in our study. We tried to minimize the risk of a low response rate by sending two reminders, keeping the survey anonymous and providing incentives to participants. These methods effectively minimize low response rates (Cook et al., 2009; Dillman et al., 2014; Nulty, 2008). However, there is also the possibility of social desirability bias, which leads respondents to choose options that are perceived to be more appropriate but do not necessarily reflect actual practice.

Regarding external validity, it should be noted that generalization of results is a significant limitation for the following reasons. First, we cannot validate that our sample is random. Second, we do not know all characteristics of the respondents. Third, our study objective was to conduct a descriptive survey, and therefore we only performed descriptive analysis. We did not do the correlation analysis for demographic characteristics such as age, and therefore we do not know if younger or older HPs perform better. Fourth, we only surveyed primary care settings across Quebec. Therefore, we do not know the generalisability of our findings to other specialties or practices. As a result, the observations captured herein can only be generalized to settings with a similar context. However, a similar process is likely to exist in other parts of Canada, and the results of this study could be used as a basis for a more extensive survey that could attempt to confirm them in a broader setting. Fifth, we have no data based on regions of Quebec in which nurses, physicians, and pharmacists are practicing since our questionnaire did not include this question. It would have been interesting to study it and do the correlation analysis. Also, our questionnaire did not have questions about the educational level and categories of HP, so we cannot draw any comparisons. It would be interesting to add these questions in future research and analyze the impact of education level on knowledge and practice of HP and compare with different categories of HP such as NPs, clinical nurses, residents, specialists, hospital pharmacists.

Recommendations for education, practice, and research

Education

Consistent with our research findings, we note that improvements are still needed in knowledge. BPM is a core competence that HP learns in their graduate school. However, studies have shown that even newly graduated students lack the necessary knowledge of BPM (Alimp lu, Mamakli, Gürq1nar, & Aktekin, 2011; Bland & Ousey, 2012; Bogan, Kritzer, & Deane, 1993; Bottenberg, Bryant, Haack, & North, 2013; Crosley & Rose, 2013; Gazibara et al., 2015;

González-López et al., 2009; Rakotz et al., 2017; Torrance & Serginson, 1996). Therefore, it is essential to review the strategies and content of BPM education at the graduate level. The core curriculum of schools and postgraduate training programs should include standardized education and performance evaluation in BPM (Padwal et al., 2019). Although teaching will be more simplified due to technological advances in BPM, yet knowledge concerning fundamental aspects of BPM is still required. The graduate-level education programme should focus on the most fundamental aspects of BPM, such as cuff placement, arm circumference, position, rest period, and average calculation. The curriculum should include the guidelines, and students should be made aware of BPM guidelines. Those who teach about BPM must be specifically trained in BPM (Consortium, 2017).

A semi-annual or annual competency evaluation should be performed in programmes of longer duration (for example, in medicine) (Consortium, 2017; Padwal et al., 2019). In addition, practical and theoretical knowledge should be evaluated using written, oral exams, observational checklists, pre-post tests (Luetsch & Burrows, 2016). Studies have shown that implementing an educational training programme on BPM effectively improves HPs theoretical and practical knowledge (Block et al., 2018; Daniel et al., 2019; Rabbia et al., 2013). In addition, studies have highlighted some effective teaching strategies for students, including group discussions, individual instruction, interactive learning, web-based learning, games, simulation, and role-playing (Bellan, Alves, Neves, & Lamas, 2017; Côrtes et al., 2018; Courtier, Webb, Phelps, & Naeger, 2016; Daniel et al., 2019; Davidson & Candy, 2016; Horntvedt, Nordsteien, Fermann, & Severinsson, 2018). These strategies could promote the active participation of students, use their cognitive and affective psychomotor skills, and develop their theoretical and practical knowledge and critical thinking abilities (Daniel et al., 2019).

For example, Lyne Cloutier, a well-known researcher and professor of nursing in Quebec, has developed a virtual training programme for BPM consisting of teaching material and resources such as a visual poster presenting BPM protocol, a video on BPM, and a test to evaluate knowledge. This material could be used in the teaching curriculum. It would also assist HP or students to acquire theoretical and practical knowledge, test their knowledge and perform

BPM correctly. In this COVID-19 pandemic, such a virtual course on BPM would be an effective strategy for education.

Even after graduate-level education, knowledge gaps persist and therefore, continuing professional education, preferably with certification, is needed to refresh knowledge. Regular certification in BPM should be considered to improve knowledge and practice (Padwal et al., 2019). Certification programmes should be simple, brief, multilingual, inexpensive, easily repeatable and widely accessible (Padwal et al., 2019). Continued professionals education activities consisting of workshops, conferences, seminars, lectures, and educational sessions have demonstrated efficacy in changing professional practice, physicians' behaviour, and health outcome (Davis et al., 1999). Professional societies should advocate such certification programmes to help advance knowledge (Padwal et al., 2019).

An example is Hypertension Canada and SQHA that offer continuing education and knowledge exchange forums on BPM. It is easily accessible and widely available for all HP. Another example is the World Hypertension League, an online certification course on BPM for HP (Campbell et al., 2020). In addition, BPM educational resources and virtual courses are made available on their website.

In addition, annual conferences are organized by these hypertension societies that provide extensive information concerning BPM and hypertension management. For example, our research collaborated with Hypertension Canada and SQHA to offer an incentive consisting of a free registration to a 15.5 hour accredited online training course offered by the SQHA and a free registration at the Hypertension Canada Congress 2021. This benefited our study participants for knowledge advancement and provided an opportunity to be a member of these societies. Membership provides easy access to educational materials, eINFO newsletter, knowledge forums, annual meeting highlights, guidelines, and position statements. It also allows participation in working groups for guidelines formulation and expands their network.

Knowledge translation plays an essential role in closing gaps between knowledge to practice (Straus, Tetroe, & Graham, 2009). Hypertension Canada guidelines are considered part of knowledge translation (Campbell & Chen, 2010; Feldman, Campbell, & Wyard, 2008). They are a vital component of providing HP with new, updated and evidence-based clinical practice recommendations. HPs can benefit from guidelines to improve their knowledge, perception, and practice and change practice behaviours (Schiffrin et al., 2016). The implementation and dissemination of guidelines prioritize Hypertension in Canada (Rabi et al., 2020). Many strategies are used to reach HP involved in hypertension management. These include knowledge translation forums, targeted educational material for primary care providers and patients, slide kits and summary documents available online in English and French (Rabi et al., 2020). In addition, funding from health agencies could support accredited education programmes (Padwal et al., 2019; Schiffrin et al., 2016). Much has already been done for education, and if these strategies are implemented well, we would perhaps fill the knowledge and practice gaps.

Practice

Consistent with our research findings, we note that improvements are still needed in the area of practice. Standardization and rigorous methods for BPM are essential to ensure the accuracy of BPM (Campbell et al., 2019; Padwal et al., 2019; Rabi et al., 2020). Hypertension Canada guidelines aspire to standardize these practices and annually publish evidence-based guidelines to improve treatment and control of hypertension by HP (Campbell & Chen, 2010; Rabi et al., 2020).

With significant advances in BPM, we are moving faster towards digital innovations consisting of automation and telemonitoring. The manual method should be retained, and semi-automated (oscillometric) or fully automated (AOBP) BP devices should be incorporated into practice as recommended by guidelines (Campbell et al., 2014; Parati et al., 2017; Rabi et al., 2020; Schiffrin et al., 2016). Automated devices will allow HP to have shorter training and focus on other essential aspects of BPM, including patient education (Campbell et al., 2014). Additionally, HBPM and ABPM should be encouraged and incorporated by HP. To incorporate ambulatory methods, particularly ABPM, the financial and organizational barriers must be removed first. Government, health agencies, scientific communities, and BP device manufacturers could ensure widespread availability of affordable BPM devices, facilitate workplace infrastructure, and provide reimbursement to physicians (Campbell et al., 2014; Kaczorowski et al., 2017; Padwal et al., 2019; Schiffrin et al., 2016; Veiga et al., 2016).

HBPM is also evolving. In particular, when combined with modern telecommunications tools, HBPM could become an ideal tool for personalized hypertension management (Omboni & Ferrari, 2015; Parati et al., 2017; Wood et al., 2017). HBPM with telemonitoring will help send recorded home BP values to an HP and get feedback assistance from their HP (Campbell et al., 2019; Omboni & Ferrari, 2015; Wood et al., 2017). This will further help optimize treatment, improve patient compliance, and reduce therapeutic inertia (Campbell et al., 2019; Omboni & Ferrari, 2015; Omboni, Panzeri, & Campolo, 2020). Several home BP telemonitoring systems have been demonstrated to be feasible, solve home BP reporting problems, improve patient compliance and physician-patient interaction, and promote BP control (McManus et al., 2010; Omboni, Gazzola, Carabelli, & Parati, 2013; Omboni et al., 2020; Parati et al., 2017). Home BP telemonitoring is performed by teletransmitting HBPM in real-time to a secure health portal, then summarizing the readings for provider use (Wood et al., 2017). Measurements can be teletransmitted to electronic health records (EHR) and electronic medical records (EMR), which ensure proper documentation, facilitate billing and allow the provider to review BPM before visits (Wood et al., 2017). It also allows follow-up visits to be conducted virtually rather than in person (Wood et al., 2017). This has become a key and potential solution during the current era of the COVID-19 pandemic (Alexander et al., 2020; Feldman, Padwal, & Tobe, 2021; Padwal & Wood, 2021). Home BP telemonitoring could encourage patients to self-monitor BP in patients' natural environment and enable self-management (Albrecht et al., 2018; McManus, Mant, et al., 2014). Nearly 50% of Canadians self-monitor BP at home (Bancej et al., 2010). Eventually, with COVID-19, the percentage could increase with more patients self-monitoring their BP (Feldman et al., 2021; Padwal & Wood, 2021). Although technological advancements have made home telemonitoring highly feasible, some financial and infrastructure barriers are challenging (Wood et al., 2017). However, if these barriers are overcome, then home BP telemonitoring has a promising future that will allow HP to provide patient care quickly and easily, thereby improving hypertension control (Wood et al., 2017).

New possibilities have opened up with diffusion of communications technology, including digital health and mobile health (mHealth), which can disseminate health information to patients, provide patient education, send reminders for BPM and medication intake, and automatic data reporting (Campbell et al., 2019; Omboni & Ferrari, 2015; Omboni et al., 2020; Parati et al., 2017; Schiffrin et al., 2016). The available communication technology includes smartphones and tablets with hypertension management-related applications and access to wireless communications such as short messaging services (SMS) and the internet. (Albini et al., 2016; Bhavnani, Narula, & Sengupta, 2016; Omboni & Ferrari, 2015; Omboni et al., 2020; Padwal & Wood, 2021; Parati et al., 2017; Schiffrin et al., 2016). These technological advances would reduce HP's time and workload and make it a robust decision-making tool in daily hypertension management (Campbell et al., 2019; Omboni & Ferrari, 2015; Parati et al., 2017). In addition, better patient engagement would be achieved (Albini et al., 2016; Campbell et al., 2019). Furthermore, the universal adoption of the EMR system could improve patient care if EMRs are linked to patients' medical records and other health information, include guideline-based prompts and reminders embedded in them for HP and patients, and provide sufficient quality data to HP for evaluation (Omboni et al., 2020; Schiffrin et al., 2016).

Other recognized and effective ways of improving professional practice and health outcomes are audits and feedback (Ivers et al., 2012; Sim, Handler, Jacobsen, & Kanter, 2014). In the audit and feedback process, the individuals' performance is measured and then compared to professional standards. The results of this performance are given as feedback. This process encourages individuals to meet professional standards (Ivers et al., 2012; Schiffrin et al., 2016; Sim et al., 2014). Additionally, a multidisciplinary team-based approach including physicians, nurses, pharmacists, and the patient should be incorporated as it has shown to be an effective strategy in BPM and hypertension control (Mills et al., 2018; Sim et al., 2014). Moreover, patient-centred care can be optimized using a multidisciplinary team-based approach in BPM (Campbell et al., 2019).

Research

BPM is a crucial part of hypertension management. However, it is disappointing to see that not many studies have conducted research to identify the knowledge, perception and practice of the three HP. Future research should focus on assessing the knowledge, perception and practice of physicians, nurses, and pharmacists across primary care settings across Canada because education obtained in Quebec is different from the rest of Canada. Additionally, this study could be performed in hospital settings across Quebec and Canada using our questionnaire. Our questionnaire could be updated, and questions like educational level could be included for future research. Furthermore, the research could be conducted among different categories of nurses, physicians, and pharmacists such as NPs, nursing aids, clinical nurses, residents, junior doctors, hospital pharmacists, and compare those results. Due to the low response rate of physicians and pharmacists, we suggest that this study be conducted using personalized invitation emails as a recruitment method. Research is also needed to identify the best methods of delivering training and continuing education. It would be interesting to know the effectiveness of training and continuing education in improving knowledge, perception and practice concerning BPM. Again, our BPM questionnaire could be updated and used for this purpose.

Chapter 8. Conclusion

BPM is the most fundamental and commonly performed procedure that often is overlooked by HPs. We cannot compromise the fact that accurate BPM is a crucial component in the diagnosis and management of hypertension. Therefore, HP must demonstrate that they have adequate knowledge, perception, and practice for BPM. The objective of our research project was first to scope the available literature and gather evidence in order to have a global portrait of knowledge, perception and practice of physicians, nurses and pharmacists concerning BPM methods and second to assess the knowledge, perception and practice of physicians, nurses and pharmacists in Quebec concerning ambulatory and clinic BPM methods. To our knowledge, both the scoping review and our study were the first in Canada to draw such a portrait. The results of our scoping review demonstrated that there are still unmet needs globally that contribute to the burden of hypertension. The results of our study for the three HPs in Quebec demonstrated that there is still room for improvement, particularly in areas of knowledge and practice concerning the ambulatory and clinic BPM methods. There is limited literature in Canada addressing the three concepts, the three HPs and the BPM methods. Importantly, nurses and pharmacists remain understudied despite being an integral part of the health care system. Therefore, our study highlights the need to include nurses and pharmacists in future research. Based on our findings, we have discussed the effective strategies for knowledge and practice in the recommendations for education, practice, and research.

Hypertension Canada guidelines have invested significant efforts in disseminating the guidelines to HPs. Many resources are available for knowledge transfer and standardization of practices. In the era of expanding technologies, we must move forward and integrate the available resources for BPM supported by the evolution of professional development and evidence-based research. We need to enhance interprofessional collaboration and optimize patient-centred care. A multidisciplinary team consisting of physicians, specialists, nurses, pharmacists, methodologists, and researchers should be part of the guidelines team to design the protocol and discuss practical strategies to improve the accuracy of BPM. These measures will help in the management and control of hypertension. At the same time, it is not only the HPs but also the government, funding agencies, and manufacturers who play an active role in hypertension control. They should consider the barriers at the organizational and HPs level and overcome them by increasing resources. With the Covid-19 pandemic, digital health will be the new approach in chronic disease management. Our research has contributed to knowledge transfer. We anticipate that the results of this thesis will be of greater importance to Hypertension Canada guidelines and other hypertension societies. We believe that our research will benefit all the HPs working in the clinical, education and research sectors. In addition, future clinicians, students, researchers can gain a better insight to excel in their field and provide the best possible services to the community.

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Annexe 1. Protocol for blood pressure measurement methods recommended by Hypertension Canada Guidelines

Recommended Technique for Office Blood Pressure Measurement (OBPM)

1. Measurements should be taken with a sphygmomanometer known to be accurate. A validated electronic device should be used. If not available, a recently calibrated aneroid device can be used. Aneroid devices or mercury columns need to be clearly visible at eye level.
2. Choose a cuff with an appropriate bladder size matched to the size of the arm. For measurements taken by auscultation, bladder width should be close to 40% of arm circumference and bladder length should cover 80 – 100% of arm circumference. When using an automated device, select the cuff size as recommended by its manufacturer.
3. Place the cuff so that the lower edge is 3 cm above the elbow crease and the bladder is centered over the brachial artery. The patient should be resting comfortably for 5 minutes in the seated position with back support. The arm should be bare and supported with the BP cuff at heart level, as a lower position will result in an erroneously higher SBP and DBP. There should be no talking, and patients' legs should not be crossed. The first reading should be discarded and the latter two averaged. BP should also be assessed after 2 minutes standing (with arm supported) and at times when patients report symptoms suggestive of postural hypotension. Supine BP measurements may also be helpful in the assessment of elderly and diabetic patients. When using automated office oscillometric devices such as the BpTRU (VSM MedTech Ltd, Vancouver, Canada), the patient should be seated in a quiet room (no specified period of rest). With the device set to take measures at 1- or 2-minute intervals, the first measurement is taken by a health professional to verify cuff position and validity of the measurement. The patient is left alone after the first measurement while the device automatically takes subsequent readings. The BpTRU automatically discards the first measure and averages the next 5 measures.

For auscultation, at least three measurements should be taken in the same arm with the patient in the same position. The first reading should be discarded and the latter two averaged.

Steps 4-7 are specific to auscultation.

4. Increase the pressure rapidly to 30 mmHg above the level at which the radial pulse is extinguished (to exclude the possibility of a systolic auscultatory gap).

5. Place the bell or diaphragm of the stethoscope gently and steadily over the brachial artery.

6. Open the control valve so that the rate of deflation of the cuff is approximately 2 mmHg per heartbeat. A cuff deflation rate of 2 mmHg per beat is necessary for accurate systolic and diastolic estimation.

7. Read the systolic level -the first appearance of a clear tapping sound (phase I Korotkoff) and the diastolic level- the point at which the sounds disappear (phase V Korotkoff). If Korotkoff sounds persist as the level approaches 0 mmHg, then the point of muffling of the sound is used (phase IV) to indicate the diastolic pressure. Leaving the cuff partially inflated for too long will fill the venous system and make the sounds difficult to hear. To avoid venous congestion, it is recommended that at least one minute should elapse between readings.

8. Record the BP to the closest 2 mmHg on the manometer (or 1 mmHg on electronic devices) as well as the arm used and whether the patient was supine, sitting or standing. Avoid digit preference by not rounding up or down. Record the heart rate. The seated BP is used to determine and monitor treatment decisions. The standing BP is used to examine for postural hypotension, if present, which may modify the treatment.

9. In the case of arrhythmia, additional readings with auscultation may be required to estimate the average systolic and diastolic pressure. Isolated extra beats should be ignored. Note the rhythm and pulse rate.

10. BP should be taken in both arms on at least one visit and if one arm has a consistently higher pressure, that arm should be subsequently used for BP measurement and interpretation.

Recommended Technique for Automated Office Blood Pressure (AOBP)

1. Measurements should be taken with a validated sphygmomanometer known to be accurate.

2. Choose a cuff with an appropriate bladder size matched to the size of the arm. Select the cuff size as recommended by its manufacturer.

3. Place the cuff so that the lower edge is 3 cm above the elbow crease and the bladder is centered over the brachial artery. There is no rest period needed before measurement. The arm should be

bare and supported with the BP cuff at heart level, as a lower position will result in an erroneously higher SBP and DBP. There should be no talking, and patients' legs should not be crossed.

4. When using automated office oscillometric devices, the patient should be seated in a quiet room (no specified period of rest). With the device set to take measures at 1- or 2-minute intervals. The first measurement is taken by a health professional to verify cuff position and validity of the measurement. The patient is left alone after the first measurement while the device automatically takes subsequent readings.

5. Record the average BP as displayed on the electronic device as well as the arm used and whether the patient was supine, sitting or standing. Record the heart rate.

Recommended Technique for Home Blood Pressure Measurement (HBPM)

1. Measurements should be taken with a validated electronic device.
2. Choose a cuff with an appropriate bladder size matched to the size of the arm. Bladder width should be close to 40% of arm circumference and bladder length should cover 80 – 100% of arm circumference. Select the cuff size as recommended by its manufacturer.
3. Cuff should be applied to the non-dominant arm unless the SBP difference between arms is >10 mmHg, in which case the arm with the highest value obtained should be used.
4. The patient should be resting comfortably for 5 minutes in the seated position with back support.
5. The arm should be bare and supported with the BP cuff at heart level.
6. Measurement should be performed before breakfast and 2 hours after dinner, before taking medication.
7. No caffeine or tobacco in the hour and no exercise 30 minutes preceding the measurement.
8. Duplicate measurement should be done in the morning and in the evening for seven days (i.e., 28 measurements in total).
9. Average the results excluding the first day's readings.

Recommended Technique for Ambulatory Blood Pressure Monitoring (ABPM)

1. The appropriately sized cuff should be applied to the non-dominant arm unless the SBP difference between arms is >10 mm Hg, in which case the arm with the highest value obtained should be used.

2. The device should be set to record for a duration of at least 24 hours, with the measurement frequency set at 20–30-minute intervals (revised guideline).

3. A patient-reported diary to define daytime (awake), night-time (sleep), activities, symptoms and medication administration is useful for study interpretation.

4. Daytime and night-time should preferentially be defined using the patient's diary. Alternatively, pre-defined thresholds can be used (e.g. 8 AM to 10 PM for awake and 10 PM and 8 AM for night-time).

5. The ambulatory BP monitoring report should include all of the individual BP readings (both numerically and graphically), the percentage of successful readings, the averages for each time frame (daytime, night-time, 24 hours) and the "dipping" percentage (the percentage the average BP changed from daytime to night-time).

6. Criteria for a successful ambulatory BP monitoring study are:

i. At least 70% of the readings are successful AND

ii. At least 20 daytime readings and 7 night-time readings are successful.

Abbreviations: BP, blood pressure; DBP, diastolic BP; SBP, systolic BP. Unless otherwise mentioned, steps apply to measurement by auscultation and oscillometry using an upper arm cuff.

Annexe 2. Recommendations for blood pressure measurement methods by Hypertension Canada Guidelines

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Guidelines

Hypertension Canada's 2020 Comprehensive Guidelines for the Prevention, Diagnosis, Risk Assessment, and Treatment of Hypertension in Adults and Children

Doreen M. Rabi, MD, MSc,[a] Kerry A. McBrien, MD, MPH,[b]
Ruth Sapir-Pichhadze, MD, MSc, PhD,[c] Meranda Nakhla, MD, MSc,[d]
Sofia B. Ahmed, MD, MMSc,[e] Sandra M. Dumanski, MD,[e] Sonia Butalia, BSc, MD, MSc,[f]
Alexander A. Leung, MD, MPH,[a] Kevin C. Harris, MD, MHSc,[g] Lyne Cloutier, RN, PhD,[h]
Kelly B. Zarnke, MD, MSc,[i] Marcel Ruzicka, MD, PhD,[j] Swapnil Hiremath, MD, MPH,[k]
Ross D. Feldman, MD,[l] Sheldon W. Tobe, MD, MScCH,[m]
Tavis S. Campbell, PhD, RPsych,[n] Simon L. Bacon, PhD,[o] Kara A. Nerenberg, MD, MSc,[p]
George K. Dresser, MD, PhD,[q] Anne Fournier, MD,[r] Ellen Burgess, MD,[s]
Patrice Lindsay, RN, PhD,[t] Simon W. Rabkin, MD,[u] Ally P.H. Prebtani, MD,[v]
Steven Grover, MD, MPA,[w] George Honos, MD,[x] Jeffrey E. Alfonsi, MD,[q]
JoAnne Arcand, PhD, RD,[y] François Audibert, MD, MSc,[z] Geneviève Benoit, MD,[aa]
Jesse Bittman, MD,[bb] Peter Bolli, MD,[cc] Anne-Marie Côté, MD, MHSc,[dd]
Janis Dionne, MD,[ee] Andrew Don-Wauchope, MD,[ff] Cedric Edwards, MD,[j]
Tabassum Firoz, MD, MSc,[gg] Jonathan Y. Gabor, MSc, MD,[hh]
Richard E. Gilbert, MBBS, PhD,[ii] Jean C. Grégoire, MD,[jj] Steven E. Gryn, MD,[q]
Milan Gupta, MD,[kk] Fady Hannah-Shmouni, MD,[ll] Robert A. Hegele, MD,[q]
Robert J. Herman, MD,[mm] Michael D. Hill, MD, MSc,[nn] Jonathan G. Howlett, MD,[oo]
Gregory L. Hundemer, MD, MPH,[j] Charlotte Jones, PhD, MD,[pp]
Janusz Kaczorowski, PhD,[qq] Nadia A. Khan, MD, MSc,[bb] Laura M. Kuyper, MD,[bb]
Maxime Lamarre-Cliche, MD,[rr] Kim L. Lavoie, PhD,[ss] Lawrence A. Leiter, MD,[tt]
Richard Lewanczuk, MD, PhD,[uu] Alexander G. Logan, MD,[vv] Laura A. Magee, MD, MSc,[ww]
Birinder K. Mangat, MD, MPH,[bb] Philip A. McFarlane, MD, PhD,[xx]
Donna McLean, RN, NP, PhD,[yy] Andre Michaud, RN, PhD,[zz] Alain Milot, MD, MSc,[aaa]

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Corresponding author: Dr Doreen M. Rabi, Division of Endocrinology and Metabolism, Department of Medicine, 3330 Hospital Drive NW, University of Calgary, Calgary, Alberta T2N 4N1, Canada. Tel.: +1-403-220-3319; fax: +1-403-210-8113.
E-mail: doreen.rabi@albertahealthservices.ca

See page 621 for disclosure information.

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adults with: (1) high in-office BP to rule out white coat hypertension; and (2) suspected hypertension (including adults with diabetes) to rule out masked hypertension.

- Adults with confirmed diagnosis of hypertension should have a baseline assessment of: (1) cardiovascular risk factors (including screening for diabetes, hyperlipidemia, and renal disease); (2) target organ damage; and (3) routine lab testing.
- The possibility of pregnancy should be considered in all women of reproductive age with a new diagnosis of hypertension, and during follow-up visits.

I. Accurate measurement of BP

Revised/new recommendations for 2020

- The recommended measurement frequency for ABPM is at 20- to 30-minute intervals throughout the day and night (Supplemental Table S1).

Most studies with data linking ABPM to clinical outcomes used a 24-hour BP measurement frequency of 30 minutes or less.[3-8] In addition, the minimum recommended number of good-quality readings is 20 daytime and 7 night-time readings. Depending on the duration of sleep, 7 good-quality readings might not be achievable if intervals are less frequent than 30 minutes. Moreover, the greater the number of readings, the more precise the average BP.[9] ABPM should be performed according to a standard protocol (Supplemental Table S1).

- HBPM should be considered in adults with inadequately controlled BP.

Home systolic BP (SBP)/diastolic BP (DBP) values 135/85 mm Hg or higher are considered high.[10-13] This is supported by prognostic studies that showed an increased risk of cardiovascular events above or near this threshold.[10-18]

HBPM should be performed according to a standard protocol (Supplemental Table S1). Despite varied measurement protocols, HBPM has been shown to predict health outcomes better than office BP measurements (OBPMs).[14,17,19-22] Although single home readings were shown to be predictive of stroke in a large population,[15] multiple BP readings are required for accurate risk prediction within individuals.[16] BP readings taken on the first day in a series of measurements[23,24] are higher than those on subsequent days, and with respect to duplicate readings, first readings are consistently higher than second readings in the morning as well as in the evening.[24,25]

In the Efficacy of Self-Monitoring of Blood-Pressure, With or Without Telemonitoring, for Titration of Antihypertensive Medication (TASMINH4) study 1182 hypertensive patients were enrolled across 142 primary care clinics in the United Kingdom and randomized to hypertension medication titration on the basis of self-monitoring (HBPM), self-monitoring with telemonitoring, or usual care (clinic-measured BP).[26] BP targets varied according to patient characteristics but were uniformly 5/5 mm Hg lower for HBPM. At 12 months, the average clinic SBP was lower in both HBPM groups by 3.5-7.5 mm Hg, compared with the usual care group. The number of medications used was higher by on average 0.11-0.13 for the HBPM groups. There was no difference in safety outcomes. A shorter (6-month) trial showed similar results,[27] whereas studies that used a common target for HBPM and OBPM did not show benefit of HBPM.[28,29] On the basis of the improvement in BP control using HBPM over 12 months, it is recommended that HBPM be considered in those with inadequately controlled hypertension.

In studies of patients with chronic kidney disease,[30,31] HBPM independently predicted the development of end-stage renal failure. The use of HBPM can increase patient adherence.[32-34] Using population-based home BP measurements from the Ohasama study (N = 128 subjects),[35] it was reported that patients with white coat hypertension followed for 8 years were more likely to develop home hypertension than normotensive patients without white coat hypertension (47% vs 22%, respectively; odds ratio, 2.86; 95% confidence interval [CI], 1.90-4.31). Furthermore, there seems to be a considerable diagnostic agreement between home and ambulatory BP in most of the subjects with and without hypertension.[36]

Patients with a diagnosis of hypertension but with stable normotensive BP averages, “long-term observation” might be achieved with 1 week of HBPM every 3 months.[37] Patients who have difficulty remembering to take medication might benefit from daily home BP measurement[33] and patients with diabetes can benefit from frequent HBPM.[38]

Recommendations

1. Health care professionals who have been specifically trained to measure BP accurately should assess BP in all adult patients at all appropriate visits to determine cardiovascular risk and monitor antihypertensive treatment (Grade D).
2. Use of standardized measurement techniques and independently validated equipment for all methods (automated OBPM [AOBP], OBPM, ABPM, and HBPM) is recommended (Grade D; see Supplemental Table S1 for recommended techniques). Unless specified otherwise, measurement using electronic (oscillometric) upper arm devices is preferred over auscultation (Grade C). Devices that are appropriate for the individual and have met the ISO-81060 protocol (Association for the Advancement of Medical Instrumentation: Non-invasive sphygmomanometers - Part 2: Clinical investigation of automated measurement type. ANSI/AAMI/ISO 81060-2/ANSI-AAMI, 2nd ed. Arlington, VA: AAMI 2013; see https://www.iso.org/standard/57977.html) should be used. For HBPM, patients should be encouraged to use devices with data recording capabilities or automatic data transmission to increase the reliability of reported HBPM (Grade D).
3. In patients with large arm circumferences when standard upper arm cuffs cannot be used, validated wrist devices (used with arm and wrist supported at heart level) may be used for BP estimation (Grade D).

4. Four approaches can be used to assess BP:
   i. AOBP is the preferred method of performing OBPM (Grade D). The BP value calculated and displayed by the device should be used. When using AOBP (see the *Recommended Technique for Automated Office Blood Pressure* section in Supplemental Table S1), displayed mean SBP ≥ 135 mm Hg or DBP ≥ 85 mm Hg is high (Grade D).
   ii. When using OBPM, the first reading should be discarded and the latter readings averaged (see the *Recommended Technique for Office Blood Pressure Measurement* section in Supplemental Table S1). Mean SBP between 130 and 139 mm Hg or mean DBP between 85 and 89 mm Hg is high-normal, and mean SBP ≥ 140 mm Hg or DBP ≥ 90 mm Hg is high (Grade C).
   iii. Using ABPM, mean awake SBP ≥ 135 mm Hg or DBP ≥ 85 mm Hg or mean 24-hour SBP ≥ 130 mm Hg or DBP ≥ 80 mm Hg are high (Grade C).
   iv. Using HBPM, mean SBP ≥ 135 mm Hg or DBP ≥ 85 mm Hg are high and associated with an increased overall mortality risk (Grade C). HBPM values should be on the basis of a series comprised of the mean of duplicate measures, for morning and evening, for a 7-day period. First day home BP values should not be considered (Grade D).

Key Messages

- Out-of-office BP measurements are essential to rule out white coat hypertension in subjects with and without diabetes and to diagnose masked hypertension, when suspected. A revised algorithm is presented (Figure 2).

II. Diagnosis of hypertension and follow-up

Hypertension Canada continues to emphasize the use of out-of-office measurements to rule out white coat hypertension in subjects with increased BP in the office (Fig. 2). Its prevalence is estimated to be between 9% and 30%.[39,40] It is more common in women, older subjects, nonsmokers, subjects with mildly elevated office BP, pregnant women, and subjects without target organ damage. Subjects with white coat hypertension have been shown to have an overall cardiovascular risk that approximates that of normotensive subjects.[40-43] Thus, at present, there is no evidence to support pharmacologic treatment of subjects with white coat hypertension. Because treated and untreated subjects have long-term cardiovascular risk similar to that of treated and untreated normotensive individuals, respectively,[40,44,45] it is clinically relevant to identify individuals with white coat hypertension to avoid overtreatment. In individuals with diabetes, diagnosis of hypertension is probable when OBPM is ≥ 130/80 for 3 or more measurements on different days; out-of-office measurements could be considered to rule out white coat hypertension, when suspected. Although the diagnostic thresholds for ABPM and HBPM (as well as for AOBP) have not yet been established in subjects with diabetes, they are probably lower than those mentioned for diagnosis of hypertension in the general population.[46]

In cases of normal BP in the office, the possibility of masked hypertension (high out-of-office BP) should be suspected in the following cases: older age, men, current smoking, heavy alcohol drinking, obesity, diabetes mellitus, or other traditional cardiovascular risk factors, as well as in cases of electrocardiographic left ventricular hypertrophy, and high-normal systolic and diastolic office BP.[47,48] Masked hypertension is common in untreated adults, with a possible prevalence of approximately 20%, which is even higher in individuals with controlled office BP (more than 1 of 3 treated individuals).[48] When suspected, masked hypertension should be ruled out by performing out-of-office measurements. In subjects with diabetes, absence of nocturnal dipping in BP (identified using ABPM) is common and correlates with higher cardiovascular mortality.[49-51] Specifically, although mean attended AOBP and daytime ABPM have been shown to be similar in subjects with diabetes, baseline 24-hour SBP (hazard ratio, 1.53; 95% CI, 1.28-2.03) and nighttime SBP (hazard ratio, 1.50; 95% CI, 1.26-1.89) were independent predictors of short-term cardiovascular outcomes.[52] Furthermore, in diabetes the adjusted odds ratio for progression to macroalbuminuria has been shown to be more than eight-fold higher in the masked hypertension group (diagnosed with HBPM) than in the controlled BP group.[53]

Guidelines for diagnosis of hypertension

1. At initial presentation, patients who exhibit features of a hypertensive urgency or emergency (Supplemental Table S2) should be diagnosed as hypertensive and require immediate management (Grade D). In all other patients, at least 2 more readings should be taken during the same visit.
2. If the visit 1 OBPM is high-normal (thresholds outlined in section *I. Accurate measurement of BP*, *Recommendation 4. ii*) the patient's BP should be assessed at yearly intervals (Grade C).
3. If the visit 1 mean AOBP or OBPM is high (thresholds outlined in section *I. Accurate measurement of BP*, *Recommendation 4. i and ii*), a history and physical examination should be performed, and, if clinically indicated, diagnostic tests to search for target organ damage (Table 2) and associated cardiovascular risk factors (Table 3) should be arranged within 2 visits. Exogenous factors that can induce or aggravate hypertension should be assessed and removed if possible (Supplemental Table S3). Visit 2 should be scheduled within 1 month (Grade D).
4. If the visit 1 mean AOBP or OBPM SBP is ≥ 180 mm Hg or DBP is ≥ 110 mm Hg then hypertension is diagnosed (Grade D).
5. If the visit 1 mean AOBP SBP is 135-179 mm Hg or DBP is 85-109 mm Hg or the mean OBPM SBP is 140-179 mm Hg or DBP is 90-109 mm Hg, out-of-office BP measurements should be performed before visit 2 (Grade C).

   i. ABPM is the recommended out-of-office measurement method (Grade D). Patients can be diagnosed with hypertension according to the following thresholds:

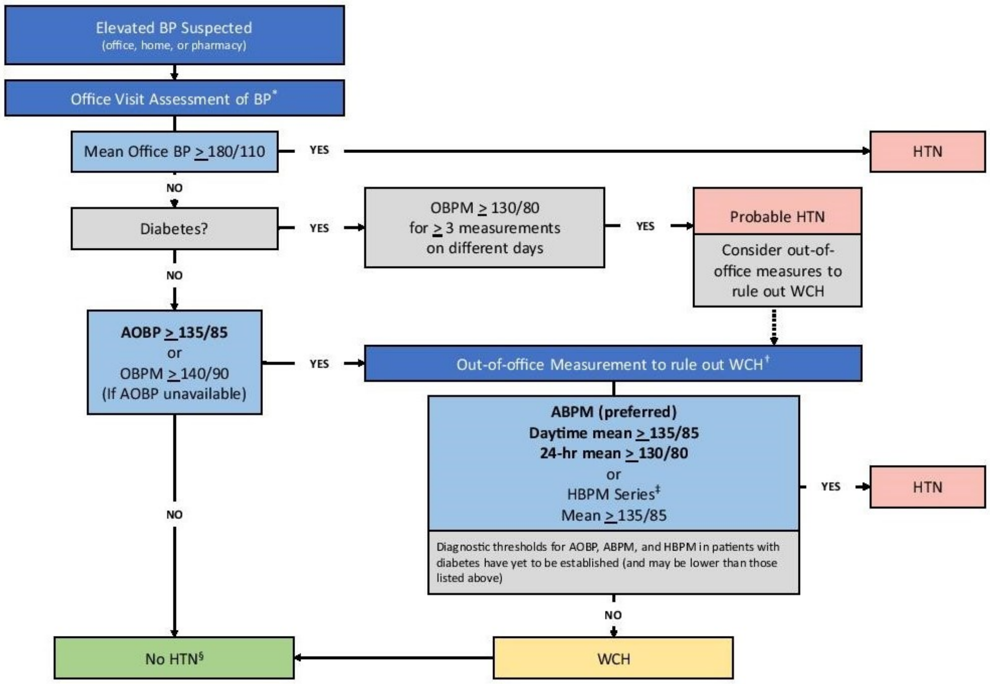

Figure 2. Hypertension diagnostic algorithm for adults. All measurement values in the algorithm are reported as mm Hg. The diagnostic algorithm has been revised for the 2020 Guidelines. In 2017 and 2018, diabetes was included in the diagnostic algorithm to provide a comprehensive overview of the diagnosis of hypertension. However, this introduces several complexities: the OBPM diagnostic threshold is different in patients with diabetes; evidence for defining AOBP and out-of-office (ABPM and HBPM) diagnostic thresholds is lacking; and the potential prognostic value of out-of-office measurements in patients with diabetes, including the identification of white coat hypertension or masked hypertension, exists but definitions are not established. The Hypertension Canada Guidelines Committee considered several options, including no change, revising the algorithm, or creating a separate algorithm for diabetes. The committee elected to revise the 2018 algorithm to include the recommendation that a series of 3-5 office measurements can be used to establish a diagnosis of hypertension in diabetes. Although this was in place for the "no diabetes" side of the algorithm, it was not explicit on the diabetes side, and the algorithm might have given the impression that hypertension could be diagnosed in patients with diabetes on the basis of 1 office visit. This has now been addressed. The algorithm for patients with diabetes might change as future studies are made available. At present, the algorithm specifies 1 threshold above which office BP is considered high in patients with diabetes, primarily on the basis of the **H**ypertension **O**ptimal **T**reatment (HOT) study, in which OBPM was used.[54] Although it is plausible that an AOBP threshold could be lower, there is currently no published evidence to guide a specific AOBP threshold. Similarly, there are no studies to date that have established ABPM or HBPM thresholds in patients with diabetes. Other guideline bodies have elected to estimate corresponding values for HBPM and ABPM on the basis of the established thresholds for the general population,[110,111] however, the evidence is not clear and these are not validated for diabetes.[46] With respect to identifying white coat hypertension in patients with diabetes, there are currently no evidence-based definitions. Elevated ABPM, including 24-hour BP and night-time BP, is associated with cardiovascular disease events and mortality in patients with diabetes.[49-52] However, a comprehensive review of the published evidence is required to establish thresholds upon which diagnostic and treatment decisions can be based. ABPM, ambulatory blood pressure measurement; AOBP, automated office blood pressure (performed with the patient unattended in a private room); BP, blood pressure; HBPM, home blood pressure measurement; HTN, hypertension; OBPM, office blood pressure measurement (measurements are performed in the office using an electronic upper arm device with a provider in the room); WCH, white coat hypertension. * If AOBP is used, use the mean calculated and displayed by the device. If OBPM is used, take at least three readings, discard the first and calculate the mean of the remaining measurements. A history and physical exam should be performed and diagnostic tests ordered. † Serial office measurements over 3-5 visits can be used if ABPM or HBPM are not available. ‡ 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. § In patient with suspected masked hypertension, ABPM or HBPM could be considered to rule out masked hypertension.

a. if the mean awake SBP is ≥ 135 mm Hg or DBP is ≥ 85 mm Hg, or
b. if the mean 24-hour SBP is ≥ 130 mm Hg or DBP is ≥ 80 mm Hg (Grade C).

ii. HBPM (as outlined in section *I. Accurate measurement of BP, Recommendation 4. iv*) is recommended if ABPM is not tolerated, not readily available, or patient preference (Grade D). Patients can be diagnosed with hypertension if the mean SBP is ≥ 135 mm Hg or DBP is ≥ 85 mm Hg (Grade C).

iii. If the out-of-office ABPM or HBPM average is not elevated, white coat hypertension should be diagnosed and

Table 2. Examples of target organ damage

Cerebrovascular disease
Stroke
Ischemic stroke and transient ischemic attack
Intracerebral hemorrhage
Aneurysmal subarachnoid hemorrhage
Dementia
Vascular dementia
Mixed vascular dementia and dementia of the Alzheimer's type
Hypertensive retinopathy
Left ventricular dysfunction
Left ventricular hypertrophy
Heart failure
Coronary artery disease
Myocardial infarction
Angina pectoris
Acute coronary syndromes
Renal disease
Chronic kidney disease (GFR < 60 mL/min/1.73 m^2)
Albuminuria
Peripheral artery disease
Intermittent claudication

GFR, glomerular filtration rate.

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pharmacologic treatment should not be instituted (Grade C). If the mean HBPM is < 135/85 mm Hg, before diagnosing white coat hypertension, it is advisable to either: (1) perform ABPM to confirm that the mean awake BP is < 135/85 mm Hg and the mean 24-hour BP is < 130/80 mm Hg (preferred); or (2) repeat a HBPM series to confirm the home BP is < 135/85 mm Hg (Grade D).

6. If the out-of-office measurement, although preferred, is not performed after visit 1, then patients can be diagnosed as hypertensive using serial OBPM visits if any of the following conditions are met:
   i. At visit 2, the mean OBPM (averaged across all visits) is ≥ 140 mm Hg SBP and/or ≥ 90 mm Hg DBP in patients with macrovascular target organ damage, diabetes mellitus, or chronic kidney disease (glomerular filtration rate [GFR] < 60 mL/min/1.73 m^2; Grade D);
   ii. At visit 3, the mean OBPM (averaged across all visits) is ≥ 160 mm Hg SBP or ≥ 100 mm Hg DBP; and

Table 3. Examples of key cardiovascular risk factors for atherosclerosis

History of clinically overt atherosclerotic disease indicates a very high risk for a recurrent atherosclerotic event (eg, peripheral arterial disease, previous stroke or transient ischemic attack)
Nonmodifiable
Age ≥ 55 years
Male sex
Family history of premature cardiovascular disease (age < 55 in men and < 65 in women)
Modifiable
Sedentary lifestyle
Poor dietary habits
Abdominal obesity
Dysglycemia
Smoking
Dyslipidemia
Stress
Nonadherence

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   iii. At visit 4 or 5, the mean OBPM (averaged across all visits) is ≥ 140 mm Hg SBP or ≥ 90 mm Hg DBP.

7. Investigations for secondary causes of hypertension should be initiated in patients with clinical and/or laboratory features indicative of hypertension (outlined in sections *III. Routine and optional laboratory tests for the investigation of patients with hypertension*, *XVI. Assessment for renovascular hypertension*, *XVII. Treatment of hypertension in association with renovascular disease*, *XVIII. Assessment for endocrine hypertension*, and *XIX. Treatment of secondary hypertension due to endocrine causes*; Grade D).

Guidelines for follow-up of hypertension

1. If at the last diagnostic visit the patient is not diagnosed as hypertensive and has no evidence of macrovascular target organ damage, the patient's BP should be assessed at yearly intervals (Grade D).
2. Hypertensive patients actively modifying their health behaviours should be followed-up at 3- to 6-month intervals. Shorter intervals (every 1 or 2 months) are needed for patients with higher BP (Grade D).
3. Patients receiving antihypertensive drug treatment should be seen monthly or every 2 months, depending on the level of BP, until readings on 2 consecutive visits are below their target (Grade D). Shorter intervals between visits will be needed for symptomatic patients and those with severe hypertension, intolerance to antihypertensive drugs, or target organ damage (Grade D). When the target BP has been reached, patients should be seen at 3- to 6-month intervals (Grade D).
4. Standard OBPM should be used for follow-up. Measurement using electronic (oscillometric) upper arm devices is preferred over auscultation (Grade C).
5. ABPM or HBPM is recommended for follow-up of patients with demonstrated white coat effect (Grade D).

ABPM

A suggested protocol for ABPM is presented in Supplemental Table S1.

Recommendations

1. In addition to a general recommendation for hypertensive patients (in section *II. Diagnosis of hypertension and follow-up*, *5*), ABPM should be considered when an office-induced increase in BP is suspected in treated patients with:
   i. BP that is not below target despite receiving appropriate chronic antihypertensive therapy (Grade C);
   ii. symptoms suggestive of hypotension (Grade C); or
   iii. fluctuating office BP readings (Grade D).
2. The magnitude of changes in nocturnal BP should be taken into account in any decision to prescribe or withhold drug therapy on the basis of ABPM (Grade C) because a decrease in nocturnal BP of < 10% is associated with increased risk of cardiovascular events.

HBPM

A suggested protocol for HBPM is presented in Supplemental Table S1.

<u>Recommendations</u>

1. The use of HBPM on a regular basis should be considered for patients with hypertension, particularly those with:
   i. Inadequately controlled hypertension (Grade B; **revised recommendation**);
   ii. Diabetes mellitus (Grade D);
   iii. Chronic kidney disease (Grade C);
   iv. Suspected nonadherence (Grade D);
   v. Demonstrated white coat effect (Grade C); or
   vi. BP controlled in the office but not at home (masked hypertension; Grade C).
2. Health care professionals should ensure that patients who measure their BP at home have adequate training, and if necessary, repeat training in measuring their BP. Patients should be observed to determine that they measure BP correctly and should be given adequate information about interpreting these readings (Grade D).

Routine Testing

III. Routine and optional laboratory tests for the investigation of patients with hypertension

<u>New recommendations for 2020</u>

- Consider the potential for pregnancy in women with hypertension.

Women of child-bearing potential should be asked at regular intervals about possible pregnancy. If unsure, a repeat pregnancy test may be done depending upon current or potential antihypertensive treatments. The determination of pregnancy is important in the treatment of women of reproductive age because some medications have relative contraindications in pregnancy (see part *3. Hypertension and Pregnancy* for further details). Similarly, health behaviour changes for hypertension are generally modified during pregnancy.

<u>Recommendations</u>

1. Routine tests that should be performed for the investigation of all patients with hypertension include the following:
   i. Urinalysis (Grade D);
   ii. Blood chemistry (potassium, sodium, and creatinine; Grade D);
   iii. Fasting blood glucose and/or glycated hemoglobin (Grade D);
   iv. Serum total cholesterol, low-density lipoprotein, high-density lipoprotein (HDL), and non-HDL cholesterol, and triglycerides (Grade D); lipids may be drawn fasting or nonfasting (Grade C); and
   v. Standard 12-lead electrocardiography (Grade C).
2. Assess urinary albumin excretion in patients with diabetes (Grade D).
3. All treated hypertensive patients should be monitored according to the current Diabetes Canada guidelines for the new appearance of diabetes (Grade B).
4. During the maintenance phase of hypertension management, tests (including those for electrolytes, creatinine, fasting lipids, and pregnancy) should be repeated with a frequency reflecting the clinical situation (Grade D; **revised recommendation**).
5. A pregnancy test should be considered before initiation of health behaviour management changes or drug therapy (Grade D; **new recommendation**).
6. Routine echocardiographic evaluation of all hypertensive patients is not recommended (Grade D).
7. An echocardiogram for assessment of left ventricular hypertrophy is useful in selected cases to help define the future risk of cardiovascular events (Grade C).
8. Echocardiographic assessment of left ventricular mass, as well as of systolic and diastolic left ventricular function is recommended for hypertensive patients suspected to have left ventricular dysfunction or coronary artery disease (CAD; Grade D).
9. Patients with hypertension and evidence of heart failure should have an objective assessment of left ventricular ejection fraction, either using echocardiogram or nuclear imaging (Grade D).

Cardiovascular Risk Assessment

IV. Assessment of overall cardiovascular risk in hypertensive patients

<u>Recommendations</u>

1. Global cardiovascular risk should be assessed. Multifactorial risk assessment models can be used to:
   i. Predict more accurately an individual's global cardiovascular risk (Grade A);
   ii. Help engage individuals in conversations about health behaviour change to lower BP (Grade D); and,
   iii. Use antihypertensive therapy more efficiently (Grade D).

   In the absence of Canadian data to determine the accuracy of risk calculations, avoid using absolute levels of risk to support treatment decisions (Grade C).
2. Consider informing patients of their global risk to improve the effectiveness of risk factor modification (Grade B). Consider also using analogies that describe comparative risk, such as "cardiovascular age," "vascular age," or "heart age" to inform patients of their risk status (Grade B).

Cardiovascular Health Promotion

Key Messages

- Health behaviour change plays an important role in hypertension prevention and BP-lowering in people diagnosed with hypertension
- Health behaviour change is strongly recommended as a first-line intervention to lower BP in people with hypertension
- Optimization of lipid levels with the use of statins in higher-risk patients is recommended
- The use of acetylsalicylic acid (ASA) for primary prevention of cardiovascular disease is no longer recommended in people with hypertension

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Aug 12, 2021

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Annexe 4. Methodology - Consent form (English)

INFORMATION AND CONSENT FORM

Title of project	Québec health professionals and blood pressure measurement methods: a descriptive study assessing knowledge, perception and practice in primary care setting.
Researcher	Shweta Kiran Todkar candidate au doctorat en sciences biomédicales, (1654) Département des sciences infirmières, Université du Québec à Trois-Rivières.
Supervisor	Lyne Cloutier, inf. PhD Professeure titulaire Département des sciences infirmières, Université du Québec à Trois-Rivières.
Co-supervisor	Dr. Raj Padwal, MD MSc. Professor. Department of medicine, University of Alberta.
Source of funding :	Société québécoise d'hypertension artérielle (SQHA) and Canadian Queen Elizabeth II Diamond Jubilee Scholarship (QES)
Declaration of conflict of interest:	No conflict of interest

Preamble

Your participation in this research that aims at understanding your knowledge, perception and practice regarding blood pressure measurement methods would be greatly appreciated. However, before agreeing to participate in this project and sign this information and consent form, please take the time to read this form. It will help you understand the implications of your possible participation in the research so you can make an informed decision about it.

This form may contain words that you do not understand. We invite you to contact the researcher in charge of the project or with a member of his research team to ask any questions that you consider useful. Feel free to ask them to explain any word or information that is not clear. Take all the time you need to read and understand this form before making your decision.

Objectives and summary of the research project

The research objective is to assess knowledge, perception and practice of Québec health professionals with regard to out of office and in-office blood pressure (BP) measurement methods. Blood pressure measurement (BPM) is a vital aspect in hypertension management. Inconsistency in BPM can result into treatment inaccuracies and potential increased cardiovascular risk. Guidelines for BPM methods are published by Hypertension Canada and available for all the health professionals. However, those guidelines need to be put into practice and implemented. Since health professionals play an important role in hypertension management, a clearer picture of their knowledge, perception and practice with regard to BPM is needed. As not much data is available in Canada, we therefore intend to identify if a gap exist between guidelines and knowledge, perception and practice of health professionals regarding BPM methods.

Nature and duration of your participation

Your participation in this research project consist of completing the electronic questionnaire. The total time required to complete the questionnaire is about 20 minutes.

Risks and disadvantages

No risk is associated with your participation. The time devoted to the project, is about 20 minutes total duration, which remains the only drawback. It is possible that to answer some questions causes you unpleasant feelings. If this happens, please contact the researcher. This will guide you to a resource able to help you.

Advantages or benefits

No individual benefit will be offered. Participating in this research offers an opportunity to reflect on advancement of knowledge and to improve practice regarding BP measurement and hypertension management.

Compensation or incentive

For your participation in this research, we offer you the possibility to participate in a draw. Your participation could entitle you to win a free registration at the Hypertension Canada congress in September 2020 or a free registration to a 15.5 hour accredited online training course offered by la Société québécoise d'hypertension arterial (SQHA). The study includes doctors, pharmacists and nurses. One prize will be awarded in each group of health professionals. If you wish to participate in the draw, please click on the link provided at the end of the questionnaire. We will inform the winner by email.

Confidentiality

The data collected by this study is kept confidential and will under no circumstances lead to the identification of participants. The data collected will be kept in a database from UQTR that is a secured and protected by a password. The only people who will have access to this database are myself

(Shweta Todkar), my supervisor (Dr.Lyne Cloutier) and my co-supervisor (Dr. Raj Padwal). All these people have signed a confidentiality agreement. The data will be destroyed after using for the advancement of scientific knowledge and will not be used for purposes other than those described in this document. The results of the research, which will be disseminated in my thesis, scientific journals and congresses in form of poster or oral presentations that does not identify the participants.

Voluntary participation

Your participation in this study is voluntary. You are entirely free to participate or not to refuse to answer questions or to withdraw at any time without damage and without providing any explanation. Participating or not participating in the research will not affect the services to which you are entitled. If you choose to withdraw from the study, your data will not be saved and will be automatically discarded.

Head of Research

To get more information or have any questions concerning this research project, you may contact Madame Shweta Kiran Todkar on (819) 376 5011 poste: 3475. You may also contact my supervisor Dr. Lyne Cloutier on (819) 376 5011 poste: 3466

Monitoring of ethical aspects of research

This research was approved by the Ethics Committee for Research Involving Human beings of the Université du Québec à Trois-Rivières and a certificate bearing number **CER-19-259-07.22** was issued on 16 September 2019.

For any questions or complaints regarding this ethical research, you should contact the Secretary of the Ethics Research Committee of the Université du Québec à Trois-Rivières, by phone (819) 376-5011, ext 2129 or CEREH@uqtr.ca by email.

Commitment of the researcher's

I, Shweta Kiran Todkar agree to conduct this study in accordance with all ethical standards that apply to projects involving human participants.

Annexe 5. Methodology - Consent form (French)

FORMULAIRE D'INFORMATION ET DE CONSENTEMENT

Titre du projet	La mesure de la pression artérielle chez les professionnels de la santé au Québec : une étude descriptive qui évalue les connaissances, la perception et la pratique en les soins de santé primaires.
Chercheuse	Shweta Kiran Todkar candidate au doctorat en sciences biomédicales, (1654) Department des sciences infirmières, Université du Québec à Trois-Rivières.
Directrice	Lyne Cloutier, inf. PhD Professeure titulaire Département des sciences infirmières, Université du Québec à Trois-Rivières
Co-directeur	Dr. Raj Padwal, MD MSc. Professeur Département de médecine, Université de l'Alberta.
Sources de financement	Société québécoise d'hypertension artérielle (SQHA) et Canadian Queen Elizabeth II Diamond Jubilee Scholarship (QES)
Déclaration des conflits d'intérêts	Aucun

Préambule

Votre participation à la recherche, qui vise à mieux comprendre vos connaissances, votre perception et votre pratique concernant les méthodes de mesure de la pression artérielle, serait grandement appréciée. Cependant, avant d'accepter de participer à ce projet et de signer ce formulaire d'information et de consentement, veuillez prendre le temps de lire ce formulaire. Il vous aidera à comprendre ce qu'implique votre éventuelle participation à la recherche de sorte que vous puissiez prendre une décision éclairée à ce sujet.

Ce formulaire peut contenir des mots que vous ne comprenez pas. Nous vous invitons à communiquer avec le chercheur responsable du projet ou avec un membre de son équipe de recherche pour poser toutes les questions que vous jugerez utiles. Sentez-vous libre de leur demander de vous expliquer tout mot ou renseignement qui n'est pas clair. Prenez tout le temps dont vous avez besoin pour lire et comprendre ce formulaire avant de prendre votre décision.

Objectifs et résumé du projet de recherche

Les objectifs de ce projet de recherche sont d'évaluer les connaissances, la perception et la pratique des professionnels de la santé québécoise en matière de méthodes de mesure de la pression artérielle (PA) à domicile et en clinique. La mesure de la pression artérielle est un aspect essentiel de la gestion de l'hypertension. Des mesures inadéquates peuvent se traduire par un traitement moins efficace et une augmentation du risque cardiovasculaire. Hypertension Canada publie des lignes directrices sur la mesure de la pression artérielle et les met à la disposition de tous les professionnels de la santé.

Cependant, ces lignes directives doivent être mises en pratique et appliquées. Étant donné que les professionnels de la santé jouent un rôle important dans la gestion de l'hypertension, il est nécessaire de disposer d'un portrait plus clair de leurs connaissances, de leur perception et de leur pratique en matière de la mesure de la pression artérielle. Peu de données sont disponibles au Canada à cet égard et notre étude permettra donc de déterminer s'il existe un écart entre les recommandations et les connaissances, la perception et la pratique des professionnels de la santé en ce qui concerne les méthodes la mesure de la pression artérielle.

Nature et durée de votre participation
Votre participation à ce projet de recherche consiste à remplir le questionnaire électronique. Le temps total nécessaire pour remplir le questionnaire est d'environ 20 minutes.

Risques et inconvénients
Aucun risque n'est associé à votre participation. Le temps consacré au projet, soit environ 20 minutes, demeure le seul inconvénient. Il est possible que le fait de répondre à certaines questions suscite chez vous des sentiments désagréables. Si cela se produit, n'hésitez pas à communiquer avec le chercheur. Celui-ci pourra vous guider vers une ressource en mesure de vous aider.

Avantages ou bénéfices
Aucun avantage individuel ne sera offert. Le fait de participer à cette recherche vous offre une occasion de réfléchir à l'avancement des connaissances et d'améliorer les pratiques en matière de mesure de la pression artérielle et de gestion de l'hypertension.

Compensation ou incitatif
Pour votre participation à cette recherche, nous vous offrons la possibilité de participer à un tirage au sort. Votre participation pourrait vous mériter une inscription gratuite au congrès d'Hypertension Canada en septembre 2020 ou encore une inscription gratuite à une formation en ligne de 15,5 heures accréditées la Société québécoise d'hypertension artérielle. L'étude s'adresse à trois groupes de professionnels de la santé et le tirage d'un prix aura lieu parmi chaque groupe de professionnels de la santé. Si vous souhaitez participer au tirage au sort, veuillez cliquer sur le lien fourni à la fin du questionnaire. Nous informerons le gagnant par courrier électronique.

Confidentialité
Les données recueillies sont entièrement confidentielles et ne pourront en aucun cas mener à votre identification. Les données recueillies seront conservées dans une base de données UQTR protégée par un mot de passe. Les seules personnes qui y auront accès seront moi-même (Shweta Todkar), ma directrice (Dr. Lyne Cloutier) et mon co-directeur (Dr. Raj Padwal). Toutes ces personnes ont signé un engagement à la confidentialité.
Les données seront détruites après avoir été utilisées pour l'avancement des connaissances scientifiques et ne seront pas utilisées à d'autres fins que celles décrites dans le présent document. Les résultats de la recherche, seront diffusés sous forme de thèse, d'articles dans des périodiques

scientifiques et présentés dans des congrès scientifiques sous forme d'affiches ou de conférences mais les participants ne seront pas identifiés.

Participation volontaire
Votre participation à cette étude se fait sur une base volontaire. Vous êtes entièrement libre de participer ou non, de refuser de répondre à certaines questions ou de vous retirer en tout temps sans préjudice et sans avoir à fournir d'explications. Si vous vous retirez de l'étude, les données ne seront pas enregistrées et seront automatiquement détruites.

Responsable de la recherche
Pour obtenir de plus amples renseignements ou pour toute question concernant ce projet de recherche, vous pouvez communiquer avec Madame Shweta Kiran Todkar au (819) 376 5011 poste: 3475. Vous pouvez également contacter ma directrice, Dr Lyne Cloutier au (819) 376 5011 poste: 3466.

Surveillance des aspects éthique de la recherche
Cette recherche est approuvée par le comité d'éthique de la recherche avec des êtres humains de l'Université du Québec à Trois-Rivières et un certificat portant le numéro **CER-19-259-07.22** a été émis le 16 septembre 2019.
Pour toute question ou plainte d'ordre éthique concernant cette recherche, vous devez communiquer avec la secrétaire du comité d'éthique de la recherche de l'Université du Québec à Trois-Rivières, par téléphone (819) 376-5011, poste 2129 ou par courrier électronique CEREH@uqtr.ca.

Engagement de la chercheuse ou du chercheur
Moi, Shweta Kiran Todkar, je m'engage à procéder à cette étude conformément à toutes les normes éthiques qui s'appliquent aux projets comportant des participants humains.

Annexe 6. Methodology - Certificate of ethics

3128

UQTR

Savoir.
Surprendre.

CERTIFICAT D'ÉTHIQUE DE LA RECHERCHE AVEC DES ÊTRES HUMAINS

En vertu du mandat qui lui a été confié par l'Université, le Comité d'éthique de la recherche avec des êtres humains a analysé et approuvé pour certification éthique le protocole de recherche suivant :

Titre : **Québec health professionals and blood pressure measurement : a descriptive study assessing knowledge, perception and practice in primary care settings**

Chercheur(s) : Shweta Kiran Todkar
Département des sciences infirmières

Organisme(s) : SQHA et QES

N° DU CERTIFICAT : **CER-19-259-07.22**

PÉRIODE DE VALIDITÉ : **Du 16 septembre 2019 au 16 septembre 2020**

En acceptant le certificat éthique, le chercheur s'engage à :

- Aviser le CER par écrit des changements apportés à son protocole de recherche avant leur entrée en vigueur;
- Procéder au renouvellement annuel du certificat tant et aussi longtemps que la recherche ne sera pas terminée;
- Aviser par écrit le CER de l'abandon ou de l'interruption prématurée de la recherche;
- Faire parvenir par écrit au CER un rapport final dans le mois suivant la fin de la recherche.

Bruce Maxwell
Président du comité

Fanny Longpré
Secrétaire du comité

Décanat de la recherche et de la création

Date d'émission : 16 septembre 2019

Annexe 7. Methodology- Acceptance email of société québécoise d'hypertension artérielle (SQHA) concerning incentives

La Société québécoise
D'HYPERTENSION ARTÉRIELLE
SQHA

SIÈGE SOCIAL

SQHA
C.P. 22
Succursale Ahuntsic
Montréal (Québec)
H3L 3N5

514.337.3937
info@hypertension.qc.ca

sqha.hypertension.qc.ca

Montréal, le 7 octobre 2019

Université du Québec à Trois-Rivières
Laboratoire du Dre Lyne Cloutier
A/S Madame Shweta Kiran Todkar
3351, boulevard des Forges, local 4803
Trois-Rivières (Québec)
G9A 5H7

OBJET : Collaboration - Étude transversale descriptive - Mesures de pression artérielle

Madame Todkar,

Nous sommes heureux de vous informer que votre demande concernant l'obtention de 3 inscriptions à la Formation en ligne destinée aux professionnels de la santé et offerte par la Société québécoise d'hypertension artérielle (SQHA), a été acceptée par les membres du Conseil d'administration de la SQHA lors de la réunion du 3 octobre 2019. Chaque catégorie de participants aura ainsi le droit à une inscription gratuite pour cette formation en hypertension artérielle.

Comme vous l'avez suggéré, nous aimerions qu'un encart publicitaire (voir fichier joint) soit ajouté sur votre page d'accueil afin de souligner l'apport de la Société dans votre étude.

Je vous prierai de bien vouloir fournir les noms des 3 lauréats à notre Directrice générale, Madame France Boulianne, afin de leur permettre d'avoir accès au site.

En vous souhaitant la meilleure des chances dans ce projet,

Cordialement,

Guy Rousseau PhD
Président

Annexe 8. Methodology - Acceptance email of Hypertension Canada concerning incentives

Re: IMP- Request for collaboration

Angelique Berg <angelique.berg@hypertension.ca>
Mon 10/14/2019 10:11 PM

To: Cloutier, Lyne <Lyne.Cloutier@uqtr.ca>
Cc: Paul Landers <paul.landers@hypertension.ca>; Todkar, Shweta Kiran <Shweta.Kiran.Todkar@uqtr.ca>; rpadwal@ualberta.ca <rpadwal@ualberta.ca>

Hello, Lyne:

Many thanks for your kind words, and for your career-long engagement in Hypertension Canada and support of the Congress. Thank you also for revisiting this request.

While we came in well under our targets, we believe we have a strong formula for success, and this are happy to support the request for three free registrations. We also appreciate how this project will promote the Congress, and are grateful for your support. I have copied Paul Landers on this message, who is your point of contact on this from here forward.

It was lovely to see you all in Edmonton — although we could always use more visiting time!

Hope everyone had a great Thanksgiving week-end,
Angelique

Annexe 9. Methodology- Acceptance email from ordre des infirmières et infirmiers du Québec (OIIQ)

RE: projet de recherche UQTR

Marleau, Daniel <daniel.marleau@oiiq.org>
Thu 9/5/2019 2:37 PM
To: Cloutier, Lyne <Lyne.Cloutier@uqtr.ca>
Cc: Todkar, Shweta Kiran <Shweta.Kiran.Todkar@uqtr.ca>

Bonjour Mesdames Cloutier et Todkar,

Je confirme que l'OIIQ accepte de vous fournir une liste des infirmières et infirmiers ayant consenti à ce que leurs coordonnées soient transmises à un tiers aux fins de recherche, moyennant la réception d'une copie du certificat d'éthique de l'université et de la signature d'une entente de confidentialité et sécurité des données.

J'espère le tout conforme à vos attentes.

Cordialement,

Daniel Marleau, Analyste en intelligence d'affaires
Direction, Optimisation et performance
4200, rue Molson, Montréal (Québec) H1Y 4V4
514 935-2501 ou 1 800 363-6048, **poste 228**

OIIQ, au nom de la santé des Québécois.

Annexe 10. Acceptance email from fédération des médecins omnipraticiens du Québec (FMOQ)

RE: collaboration UQTR-FMOQ

Julie Corbeil <jcorbeil@fmoq.org>

Fri 9/20/2019 9:22 AM

To: Lyne.Cloutier@uqtr.ca <Lyne.Cloutier@uqtr.ca>; Todkar, Shweta Kiran <Shweta.Kiran.Todkar@uqtr.ca>
Cc: Claude Guimond <cguimond@fmoq.org>; Marie Ruel <mruel@fmoq.org>

Bonjour Mesdames Cloutier et Todkar,

Nous confirmons que la FMOQ accepte de publier dans son infolettre la publicité concernant la réalisation de l'étude de Madame Shweta Todkar « La mesure de la pression artérielle chez les professionnels de la santé au Québec : une étude descriptive évaluant les connaissances, la perception et la pratique. » moyennant la réception d'une copie du certificat d'éthique de l'université.

Merci et bonne journée !

Pour le Dr Claude Guimond
Directeur de la Formation professionnelle à la FMOQ

Julie Corbeil
Secrétaire de direction – Formation professionnelle
Fédération des médecins omnipraticiens du Québec
2, Place Alexis Nihon, 20e étage
2000-3500, boul. De Maisonneuve Ouest
Westmount (Québec) H3Z 3C1
jcorbeil@fmoq.org | Bureau : 514 878-1911 poste 289

Annexe 11. Acceptance email from ordre des pharmaciens du Québec (OPQ)

ORDRE DES **PHARMACIENS** DU QUÉBEC

Présent pour vous

Bureau de la Présidence ***PAR COURRIEL***

Montréal, le 11 septembre 2019

Madame Lyne Cloutier
Professeure titulaire
Département des sciences infirmières
Université du Québec à Trois-Rivières
3351, boulevard des Forges
Trois-Rivières (Québec) G9A 5H7
Lyne.cloutier@uqtr.ca

Objet : Appui à votre projet de recherche

Madame,

L'Ordre des pharmaciens du Québec appuie avec intérêt la demande de certification pour votre projet de recherche ayant pour objectif d'évaluer les connaissances, la perception et la pratique des professionnels de la santé exerçant en première ligne à l'égard des différentes mesures de la pression artérielle.

L'Ordre des pharmaciens du Québec a pour mission de veiller à la protection du public en encourageant les pratiques pharmaceutiques de qualité et en faisant la promotion de l'usage approprié des médicaments au sein de la société. La vision de l'Ordre est d'être l'organisme de référence et d'avant-garde favorisant la contribution optimale du pharmacien aux soins du patient et au système de santé, en collaboration avec les autres professionnels et intervenants du milieu.

Nous avons pris connaissance de la description de votre projet, il est tout à fait cohérent avec nos objectifs et nos valeurs, visant notamment à informer le grand public et les professionnels de la santé sur le bon usage des médicaments et les modes d'évaluation menant à cet usage approprié. À terme, votre projet permettra d'améliorer les connaissances quant aux meilleures pratiques et stratégies d'intervention auprès des prescripteurs et dispensateurs de médicaments antihypertenseurs. Par ailleurs, sachez que nous apprécions la teneur interdisciplinaire de vos travaux.

Vous pouvez donc compter sur notre appui et notre soutien. Nous allons assurément suivre vos travaux.

Veuillez recevoir, Madame, nos sincères salutations.

Le président,

Bertrand Bolduc, pharmacien, MBA, IAS.A

BB/mnc

266, rue Notre-Dame Ouest, bureau 301, Montréal (Québec) H2Y 1T6
Téléphone : 514 284-9588 | sans frais : 1 800 363-0324 | Télécopieur : 514 284-3420 | www.opq.org

Annexe 12. Methodology - Recruitment of physicians through newsletter invitation

08/11/2019

Dexter

Participez à une étude portant sur la mesure de la pression artérielle

Vous souhaitez faire progresser les connaissances et influencer les lignes directrices et la pratique ? En voici l'occasion si vous pratiquez en première ligne. Votre participation consiste à remplir un questionnaire en ligne (20 minutes). Vous courrez alors la chance de gagner une inscription gratuite au congrès d'Hypertension Canada en septembre 2020 ou encore à une formation en ligne accréditée de 15,5 heures de la Société québécoise d'hypertension artérielle. L'étude a obtenu le certificat d'éthique de l'UQTR.
Date limite : 30 novembre

Questionnaire en français | Questionnaire en anglais

https://infolettre.fmoq.org/t/ViewEmailArchive/y/FCE0596D5BDF2577/C67FD2F38AC4859C/

(Page 5,6)

Annexe 13- Methodology- Recruitment of pharmacist through newsletter invitation

Pharmaciens et mesure de la pression artérielle

Participez à un projet de recherche

Vous êtes pharmacien communautaire et souhaitez faire progresser les connaissances et influencer les lignes directrices et la pratique en ce qui concerne la mesure de la pression artérielle? C'est possible en participant à un projet de recherche mené au Département des sciences infirmières de l'Université du Québec à Trois-Rivières.

En évaluant les connaissances, les perceptions et la pratique des professionnels de la santé, dont les pharmaciens, à l'égard des différentes mesures de la pression artérielle, ce projet permettra essentiellement de dresser un portrait des pratiques afin d'identifier les forces, les besoins et les pistes de développement pour les professionnels de la santé. Vous pouvez contribuer à ce projet en complétant le questionnaire en ligne d'une vingtaine de minutes.

Questionnaire (français) Questionnaire (anglais)

https://www.opq.org/wp-content/uploads/2020/08/5212_38_fr-CA_0_La_Depeche_20_nov_2019.html

(Page 3)

Annexe 14. Methodology - Recruitment of nurses thorough email invitation

Chères infirmières,
Chers infirmiers,

Souhaitez-vous faire progresser les connaissances et influencer les lignes directrices et la pratique?

En voici l'occasion si vous exercez en première ligne.

Votre participation consiste à compléter un questionnaire en ligne (20 minutes).

Votre participation pourrait vous mériter un des deux prix suivants:

• une **inscription gratuite** au congrès d'Hypertension Canada en septembre 2020 ou
• une **inscription gratuite** à une formation en ligne accréditée de 15,5 heures de la Société québécoise d'hypertension artérielle.

Pour débuter le questionnaire, cliquez sur le lien suivant: http://www.uqtr.ca/Infirmiere_pa ou copiez-le dans votre navigateur.

Pour accéder au questionnaire en version anglaise, veuillez cliquer sur le lien suivant: **http://www.uqtr.ca/Nurse_bpm** ou copiez-le dans votre navigateur.

Nous vous remercions pour votre participation et vous souhaitons une excellente journée.

Lyne Cloutier, inf. PhD Professeure titulaire
Département des sciences infirmières
Université du Québec à Trois-Rivières
3351 Boulevard des Forges, Trois-Rivières (Qc) G9A 5H7
(819) 376-5011 poste 3466 | Local 4862, Santé

Membre, GIRAS
(Groupe interdisciplinaire de recherche appliquée en santé)

** Ce message est approuvé par l'Ordre des Infirmières et Infirmiers du Québec.*

Annexe 15. Methodology – Recruitment reminder first and second for nurses

22/11/2019 DERNIER RAPPEL - Participez à une étude portant sur la mesure de la pression artérielle

Chères infirmières,
Chers infirmiers,

Merci d'avoir accepté de compléter le questionnaire sur la mesure de la pression artérielle si vous l'avez déjà fait. Si vous n'avez pas eu l'occasion de participer, sachez que votre collaboration est essentielle pour la réussite du projet. Le questionnaire prend 20 minutes à compléter.

DERNIER RAPPEL

Votre participation peut vous donner droit à **une inscription gratuite à Hypertension Canada en septembre 2020** ou à **un cours de formation en ligne accrédité de 15,5 heures de la Société québécoise d'hypertension artérielle.**

Pour débuter le questionnaire, cliquez sur le lien suivant ou copiez-le dans votre navigateur. Vous pouvez répondre en français ou en anglais.

En français: http://www.uqtr.ca/Infirmiere_pa

En anglais :http://www.uqtr.ca/Nurse_bpm

https://blogue.uqtr.ca/?wysija-page=1&controller=email&action=view&email_id=523&wysijap=subscriptions&user_id=164 1/2

Nous vous remercions pour votre participation et vous souhaitons une excellente journée.

Lyne Cloutier, inf. PhD Professeure titulaire
Département des sciences infirmières
Université du Québec à Trois-Rivières
3351 Boulevard des Forges, Trois-Rivières (Qc) G9A 5H7
(819) 376-5011 poste 3466 | Local 4862, Santé

Membre, GIRAS
(Groupe interdisciplinaire de recherche appliquée en santé)

** Ce message est approuvé par l'Ordre des Infirmières et Infirmiers du Québec.*

Annexe 16. Methodology – Recruitment reminder first and second for physicians

First

Collaborations

Participez à une étude portant sur la mesure de la pression artérielle

Les médecins québécois ont des besoins spécifiques et une pratique assez unique en ce qui a trait à l'hypertension artérielle. Cette recherche vise à mettre cette réalité de l'avant, mais également à pouvoir énoncer les besoins encore à combler sur le plan du soutien essentiel en ressources de première ligne.

Vous souhaitez faire progresser les connaissances et influencer les lignes directrices et la pratique ? En voici l'occasion si vous pratiquez en première ligne. Votre participation consiste à remplir un questionnaire en ligne (20 minutes). Vous courez alors la chance de gagner une inscription gratuite au congrès d'Hypertension Canada en septembre 2020 ou encore à une formation en ligne accréditée de 15,5 heures de la Société québécoise d'hypertension artérielle. L'étude a obtenu le certificat d'éthique de l'UQTR. Date limite : 6 décembre

Questionnaire français **Questionnaire anglais**

https://infolettre.fmoq.org/t/ViewEmailArchive/y/374ACED36F29D4C7/C67FD2F38AC4859C/

(Page 5)

Second

Dexter

Les médecins québécois ont des besoins spécifiques et une pratique assez unique en ce qui a trait à l'hypertension artérielle. Cette recherche vise à mettre cette réalité de l'avant, mais également à pouvoir énoncer les besoins encore à combler sur le plan du soutien essentiel en ressources de première ligne.

Vous souhaitez faire progresser les connaissances et influencer les lignes directrices et la pratique ? En voici l'occasion si vous pratiquez en première ligne. Votre participation consiste à remplir un questionnaire en ligne (20 minutes). Vous courez alors la chance de gagner une inscription gratuite au congrès d'Hypertension Canada en septembre 2020 ou encore à une formation en ligne accréditée de 15,5 heures de la Société québécoise d'hypertension artérielle. L'étude a obtenu le certificat d'éthique de l'UQTR. Date limite : 10 janvier 2020

Questionnaire français   **Questionnaire anglais**

https://infolettre.fmoq.org/t/ViewEmailArchive/y/FA5F0F238748EA5B/C67FD2F38AC4859C/

(Page 5)

Annexe 17. Methodology – Recruitment reminder for pharmacists

RAPPEL : PHARMACIENS ET MESURE DE LA PRESSION ARTÉRIELLE

Participez à un projet de recherche

Merci d'avoir accepté de remplir le questionnaire sur la mesure de la pression artérielle si vous l'avez déjà fait. Si vous n'avez pas eu l'occasion de participer, sachez que votre collaboration est essentielle pour la réussite du projet.

Vous êtes pharmacien communautaire et souhaitez faire progresser les connaissances et influencer les lignes directrices et la pratique en ce qui concerne la mesure de la pression artérielle? C'est possible en participant à un projet de recherche mené au département des sciences infirmières de l'Université du Québec à Trois-Rivières.

En évaluant les connaissances, les perceptions et la pratique des professionnels de la santé, dont les pharmaciens, à l'égard des différentes mesures de la pression artérielle, ce projet permettra essentiellement de dresser un portrait des pratiques afin d'identifier les forces, les besoins et les pistes de développement pour les professionnels de la santé. Vous pouvez contribuer à ce projet en complétant le questionnaire en ligne d'une **vingtaine de minutes**.

Répondre au questionnaire

https://www.opq.org/wp-content/uploads/2020/08/5219_38_fr-CA_0_La_Depeche_02_dec_2019.html

(Page 4,5)

Annexe 18. Methodology - Questionnaire for nurses and pharmacists (English)

Blood pressure measurement : Questionnaire

Nom :__________________________

Code permanent : ____________________

SECTION 1 / 5 : HOME BLOOD PRESSURE MEASUREMENT (HBPM)

For the following questions, check the box that corresponds to your answer.

		a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg
1.1.	**What is the recommended diagnostic threshold for hypertension with HBPM?** *SBP: Systolic blood pressure, DBP: Diastolic blood pressure*	☐ a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	☐ b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	☐ c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	☐ d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg

		a. 3 days	b. 5 days	c. 7 days	d. I do not know
1.2.	**How many consecutive days of measurements should be taken with HBPM?**	☐ a. 3 days	☐ b. 5 days	☐ c. 7 days	☐ d. I do not know

1.3. How many measurements should be taken each day with HBPM?

- ☐ a. Several measurements at different time during the day over a few days
- ☐ b. Twice in the morning and twice in the evening
- ☐ c. Three times in the morning and three times in the evening
- ☐ d. I do not know

		a. True	b. False	c. It makes no difference	d. I do not know
1.4.	**When calculating the mean value for HBPM, the values from the first day should be discarded.**	☐ a. True	☐ b. False	☐ c. It makes no difference	☐ d. I do not know

		a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
1.5.	**I believe that HBPM is useful for patients when treating hypertension.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
1.6.	**I believe that patients can measure their BP correctly at home.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
1.7.	**I believe that HBPM can be used for making therapeutic decisions.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
1.8.	**I believe that HBPM should be considered as part of standard hypertensive care.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree

		a. I do not know/ I am not sure	b. Very Few (< 25%)	c. Some (≥ 25%)	d. Most of them (≥ 50%)	e. Almost all (≥ 80%)
1.9.	**In your practice, what is the proportion of patients using HBPM?**	☐ a. I do not know/ I am not sure	☐ b. Very Few (< 25%)	☐ c. Some (≥ 25%)	☐ d. Most of them (≥ 50%)	☐ e. Almost all (≥ 80%)

		a. Never	b. Rarely (< 25% of the time)	c. Occasionally (≥ 25% of the time)	d. Frequently (≥ 50% of the time)	e. Almost always (≥ 80% of the time)
1.10.	**How frequently is education provided to your patients regarding HBPM?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
1.11.	**In your practice, how frequently do you recommend HBPM to your patients?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)

1.12. Identify up to four potential barriers that limit your interest for using HBPM.

- ☐ a. Device cost for patients
- ☐ b. Patient anxiety
- ☐ c. Patient unwillingness to perform HBPM
- ☐ d. Low patient reliability to report HBPM readings
- ☐ e. Insufficient time to teach patient about home BP monitoring
- ☐ f. Insufficient time to calculate an average
- ☐ g. Low reimbursement fees for health professionals
- ☐ h. Other, please specify

SECTION 2 / 5 : AMBULATORY BLOOD PRESSURE MEASUREMENT (ABPM)

For the following questions, check the box that corresponds to your answer.

		a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg
2.1.	**What is the recommended diagnostic threshold for hypertension with mean 24-hour ABPM?**	☐ a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	☐ b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	☐ c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	☐ d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg
2.2.	**What is the recommended diagnostic threshold for hypertension with day-time ABPM?**	☐ a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	☐ b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	☐ c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	☐ d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg

		a. 20–30 minutes	b. 30–60 minutes	c. It has little impact	d. I do not know
2.3.	**What interval should be used for day-time measurement with ABPM?**	☐ a. 20–30 minutes	☐ b. 30–60 minutes	☐ c. It has little impact	☐ d. I do not know
2.4.	**What interval should be used for night-time measurement with ABPM?**	☐ a. 20–30 minutes	☐ b. 30–60 minutes	☐ c. It has little impact	☐ d. I do not know

		a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
2.5.	**I believe that ABPM is useful for patients in treating hypertension.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
2.6.	**I believe that ABPM is well tolerated by patients.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
2.7.	**I believe that my patients have easy access to ABPM.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
2.8.	**I believe that ABPM is necessary to confirm values obtained in the office.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree

		a. I do not know/ I am not sure	b. Very Few (< 25%)	c. Some (≥ 25%)	d. Most of them (≥ 50%)	e. Almost all (≥ 80%)
2.9.	**In your practice, what is the proportion of patients for which ABPM is prescribed?**	☐ a. I do not know/ I am not sure	☐ b. Very Few (< 25%)	☐ c. Some (≥ 25%)	☐ d. Most of them (≥ 50%)	☐ e. Almost all (≥ 80%)

		a. Never	b. Rarely (< 25% of the time)	c. Occasionally (≥ 25% of the time)	d. Frequently (≥ 50% of the time)	e. Almost always (≥ 80% of the time)
2.10.	**How frequently is education provided to your patients regarding ABPM?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
2.11.	**In your practice, how frequently do you recommend ABPM to your patients?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)

2.12. Identify up to four potential barriers that limit your interest for using ABPM.

- ☐ a. Cost of the test for the patients
- ☐ b. Patients' lack of access to ABPM
- ☐ c. Patients' incapacity to complete test due to discomfort
- ☐ d. Patient preference
- ☐ e. Non-availability of ABPM at my workplace
- ☐ f. Costs covering ABPM are not covered
- ☐ g. Insufficient time to analyse the results
- ☐ h. Other, please specify

SECTION 3 / 5 : AUTOMATED BLOOD PRESSURE MEASUREMENT (AOBP)

AOBP is a measurement method performed using an automated device that provides multiple BP readings.

For the following questions, check the box that corresponds to your answer.

		a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg
3.1.	**What is the recommended diagnostic threshold for hypertension with AOBP?**	☐ a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	☐ b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	☐ c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	☐ d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg

		a. True	b. False	c. It makes no difference	d. I do not know
3.2.	**When AOBP is used, pre-programed multiple measurements are automatically averaged.**	☐ a. True	☐ b. False	☐ c. It makes no difference	☐ d. I do not know
3.3.	**A 5 min rest period is recommended before measuring BP with AOBP.**	☐ a. True	☐ b. False	☐ c. It makes no difference	☐ d. I do not know

3.4.	BP should be measured with the patient seated on an examination table.	a. True	b. False	c. It makes no difference	d. I do not know

		a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
3.5.	I believe that AOBP measurement is superior to OBPM (non-AOBP).	a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
3.6.	I believe that AOBP measurement is equivalent to both awake ABPM and HBPM.	a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
3.7.	I believe that AOBP should be used to make therapeutic decisions.	a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
3.8.	I believe that I have sufficient knowledge to perform and use AOBP correctly.	a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree

		a. Never	b. Rarely (< 25% of the time)	c. Occasionally (≥ 25% of the time)	d. Frequently (≥ 50% of the time)	e. Almost always (≥ 80% of the time)
3.9.	In your practice, how frequently do you measure BP with AOBP?	a. Never	b. Rarely (< 25% of the time)	c. Occasionally (≥ 25% of the time)	d. Frequently (≥ 50% of the time)	e. Almost always (≥ 80% of the time)

3.10. Which automated device do you mostly use for AOBP?

- a. None, we do not use AOBP
- b. I do not know / I am not sure
- c. BpTRU BPM100
- d. Omron HEM 907XL
- e. Microlife WatchBP Office
- f. Welch Allyn ProBP 2400
- g. Other, please specify

3.11. Identify up to three potential barriers that limit your interest for using AOBP.

- a. Cost of device for physicians
- b. Non-availability of AOBP device at my office/workplace
- c. Not having a room to leave patient unattended for BP measurement
- d. Insufficient time to follow guidelines when measuring BP with AOBP
- e. Other, please specify

SECTION 4 / 5 : OFFICE BLOOD PRESSURE MEASUREMENT (OBPM)

OBPM (non-AOBP) is a measurement method performed using an electronic oscillometric device for BP measurement.

For the following questions, check the box that corresponds to your answer.

		a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg
4.1.	What is the recommended diagnostic threshold for hypertension with OBPM for the general population?	a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg

		a. 40 to 59%	b. 60 to 79%	c. 80 to 100%	d. I do not know
4.2.	What percentage of the arm circumference should the length of the cuff bladder cover?	a. 40 to 59%	b. 60 to 79%	c. 80 to 100%	d. I do not know

		a. True	b. False	c. It makes no difference	d. I do not know
4.3.	When measuring BP, the back should be supported in order to get valid results.	a. True	b. False	c. It makes no difference	d. I do not know
4.4.	When measuring BP, the arm should be positioned below heart level.	a. True	b. False	c. It makes no difference	d. I do not know

4.5. When measuring blood pressure in office during the initial visit how many measurements should be performed?

- a. One measurement is sufficient
- b. Two measurements and the average should be used
- c. Three measurements, the first result is discarded and the second and third should be averaged
- d. Three BP measurements and all three results should be averaged
- e. I do not know

		a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
4.6.	I believe that I measure BP according to the recommended guidelines.	a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
4.7.	I believe that my colleagues (doctor, nurse and pharmacist) measure BP according to the recommended guidelines.	a. Strongly Disagree	b. Disagree	c. Neither Agree nor	d. Agree	e. Strongly Agree

				Disagree		
4.8.	**I believe that using a standardized OBPM is overly time consuming for my practice.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
4.9.	**I believe my office is not properly set up for me to measure BP in a standardized manner.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree

		a. Never	b. Rarely (< 25% of the time)	c. Occasionally (≥ 25% of the time)	d. Frequently (≥ 50% of the time)	e. Almost always (≥ 80% of the time)
4.10.	**In your practice, how frequently do you measure BP with OBPM (non-AOBP)?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)

4.11. What is the routine method used to measure BP in your clinic?

- ☐ a. I do not know/ I am not sure
- ☐ b. Using a manual mercury sphygmomanometer
- ☐ c. Using an aneroid device
- ☐ d. Using an electronic oscillometric device (not automated for multiple measurements)
- ☐ e. Using an electronic oscillometric device (automated for multiple measurements)

4.12. In your practice, which is the most common method used to measure BP for obese patients?

- ☐ a. I do not know / I am not sure
- ☐ b. Standard upper arm cuff
- ☐ c. Large or extra-large upper arm cuff
- ☐ d. Thigh cuffs
- ☐ e. Standard cuff applied on wrist
- ☐ f. Wrist cuff applied on wrist
- ☐ g. Standard cuff applied on lower arm

4.13. Identify up to three potential barriers that limit your interest for using OBPM.

- ☐ a. Non-availability of electronic oscillometric device (non-automated)
- ☐ b. Insufficient resources and equipment to measure BP
- ☐ c. Insufficient time to follow guidelines when measuring BP
- ☐ d. Insufficient time to calculate an average
- ☐ e. Non-availability of education material in my primary setting
- ☐ f. Other, please specify

SECTION 5 / 5 : GENERAL QUESTIONS

For the following general questions, check the box that corresponds to your answer.

5.1. What is your age group?

☐ a. < 30 years ☐ b. 30-39 years ☐ c. 40-49 years ☐ d. 50-59 years ☐ e. ≥ 60 years

5.2. Indicate your sex.

☐ a. Male ☐ b. Female ☐ c. Decline to answer

5.3. Indicate your profession.

- ☐ Nurse
- ☐ Other, please specify

		a. ≤3 years	b. 4-10 years	c. ≥ 11 years
5.4.	**How many years have you been practicing your profession?**	☐ a. ≤3 years	☐ b. 4-10 years	☐ c. ≥ 11 years
5.5.	**How many full-time years have you been in primary care practice?**	☐ a. ≤3 years	☐ b. 4-10 years	☐ c. ≥ 11 years

		a. Yes, theoretical only (articles, conferences)	b. Yes, practical only	c. Yes, theoretical and practical	d. Never received training
5.6.	**During your years of practice, have you ever received specific training on BP measurement?**	☐ a. Yes, theoretical only (articles, conferences)	☐ b. Yes, practical only	☐ c. Yes, theoretical and practical	☐ d. Never received training

		a. Hypertension Canada	b. La société québécoise d'hypertension artérielle (SQHA)	c. I am a member of both societies	d. Neither of them
5.7.	**Which hypertension societies are you a member of?**	☐ a. Hypertension Canada	☐ b. La société québécoise d'hypertension artérielle (SQHA)	☐ c. I am a member of both societies	☐ d. Neither of them

Annexe 19. Methodology - Questionnaire for nurses and pharmacists (French)

8/10/2021 Questionnaire « Mesure de la pression artérielle: Questionnaire »

Mesure de la pression artérielle: Questionnaire

Nom :____________________________

Code permanent : ______________________

SECTION 1 / 5 : MESURE DE LA PRESSION ARTÉRIELLE À DOMICILE (MPAD)

Pour les questions suivantes, cochez la case qui correspond à votre choix de réponse.

		a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg
1.1.	**Pour la MPAD, quel est le seuil diagnostique recommandé pour l'hypertension?** *PAS : Pression artérielle systolique, PAD : Pression artérielle diastolique*	☐ a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	☐ b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	☐ c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	☐ d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg

		a. 3 jours	b. 5 jours	c. 7 jours	d. Je ne sais pas
1.2.	**Pour la MPAD, pendant combien de jours consécutifs la pression artérielle devrait-elle être mesurée?**	☐ a. 3 jours	☐ b. 5 jours	☐ c. 7 jours	☐ d. Je ne sais pas

1.3. Pour la MPAD, combien de mesures de la pression artérielle devraient être réalisées chaque jour?

- ☐ a. Plusieurs lectures à différents moments durant la journée, et ce pendant quelques jours
- ☐ b. Deux fois le matin, puis deux fois le soir
- ☐ c. Trois fois le matin, puis trois fois le soir
- ☐ d. Je ne sais pas

		a. Vrai	b. Faux	c. Cela ne fait pas de différence	d. Je ne sais pas
1.4.	**Pour la MPAD, lors du calcul de la moyenne, les mesures de la première journée ne devraient pas être incluses.**	☐ a. Vrai	☐ b. Faux	☐ c. Cela ne fait pas de différence	☐ d. Je ne sais pas

		a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord
1.5.	**Je crois que la MPAD est utile pour le suivi des patients traités pour l'hypertension.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
1.6.	**Je crois que les patients peuvent mesurer adéquatement leur pression artérielle à domicile.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
1.7.	**Je crois que la MPAD peut être utilisée pour prendre des décisions thérapeutiques.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
1.8.	**Je crois que la MPAD devrait être considérée comme faisant partie des soins standards pour l'hypertension.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord

		a. Je ne sais pas/ Je ne suis pas certain	b. Très peu (< 25%)	c. Quelques-uns (≥ 25%)	d. La plupart (≥ 50%)	e. Presque tous (≥ 80%)
1.9.	**Dans votre pratique, qu'elle est la proportion de patients utilisant la MPAD?**	☐ a. Je ne sais pas/ Je ne suis pas certain	☐ b. Très peu (< 25%)	☐ c. Quelques-uns (≥ 25%)	☐ d. La plupart (≥ 50%)	☐ e. Presque tous (≥ 80%)

		a. Jamais	b. Rarement (< 25% du temps)	c. À l'occasion (≥ 25% du temps)	d. Fréquemment (≥ 50% du temps)	e. Presque toujours (≥ 80% du temps)
1.10.	**À quelle fréquence vos patients obtiennent-ils de l'enseignement relativement à la MPAD?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
1.11.	**Dans votre pratique, à quelle fréquence recommandez-vous la MPAD à vos patients?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)

1.12. Identifiez jusqu'à quatre éléments potentiels que vous considérez comme étant des barrières qui limitent votre intérêt à utiliser la MPAD.

- ☐ a. Coût de l'appareil pour le patient
- ☐ b. Anxiété du patient
- ☐ c. Réticence du patient à réaliser la MPAD
- ☐ d. Faible fiabilité du patient pour transmettre les résultats de la MPAD
- ☐ e. Manque de temps pour enseigner la MPAD au patient
- ☐ f. Manque de temps pour calculer une moyenne
- ☐ g. Rémunération insuffisante pour les professionnels de la santé
- ☐ h. Autre, veuillez spécifier

SECTION 2 / 5 : MONITORAGE AMBULATOIRE DE LA PRESSION ARTÉRIELLE (MAPA)

Pour les questions suivantes, cochez la case qui correspond à votre choix de réponse.

https://oraprdnt.uqtr.uquebec.ca/pls/protege/biqw010.imprimer_questionnaire?owa_no_questionnaire=12919&owa_no_version_questionnaire=1 1/4

		a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg
2.1.	**Quel est le seuil diagnostique de l'hypertension pour un MAPA de 24 heures?**	☐ a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	☐ b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	☐ c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	☐ d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg
2.2.	**Quel est le seuil diagnostique de l'hypertension pour un MAPA de jour?**	☐ a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	☐ b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	☐ c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	☐ d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg

		a. 20-30 minutes	b. 30-60 minutes	c. Cela a peu d'impact	d. Je ne sais pas
2.3.	**Lors de la réalisation du MAPA, à quel intervalle les lectures devraient-elles s'effectuer durant le jour?**	☐ a. 20-30 minutes	☐ b. 30-60 minutes	☐ c. Cela a peu d'impact	☐ d. Je ne sais pas
2.4.	**Lors de la réalisation d'un MAPA, à quel intervalle les lectures devraient-elles s'effectuer durant la nuit?**	☐ a. 20-30 minutes	☐ b. 30-60 minutes	☐ c. Cela a peu d'impact	☐ d. Je ne sais pas

		a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord
2.5.	**Je crois que le MAPA est utile pour les patients lors du traitement de leur hypertension.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
2.6.	**Je crois que le MAPA est bien toléré par les patients.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
2.7.	**Je crois que mes patients ont facilement accès à un MAPA.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
2.8.	**Je crois qu'un MAPA est nécessaire pour confirmer les valeurs obtenues en clinique.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord

		a. Je ne sais pas/ Je ne suis pas certain	b. Très peu (< 25%)	c. Quelques-uns (≥ 25%)	d. La plupart (≥ 50%)	e. Presque tous (≥ 80%)
2.9.	**Dans votre pratique, quelle est la proportion de patients pour qui un MAPA est prescrit?**	☐ a. Je ne sais pas/ Je ne suis pas certain	☐ b. Très peu (< 25%)	☐ c. Quelques-uns (≥ 25%)	☐ d. La plupart (≥ 50%)	☐ e. Presque tous (≥ 80%)

		a. Jamais	b. Rarement (< 25% du temps)	c. À l'occasion (≥ 25% du temps)	d. Fréquemment (≥ 50% du temps)	e. Presque toujours (≥ 80% du temps)
2.10.	**À quelle fréquence vos patients obtiennent-ils de l'enseignement relativement au MAPA?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
2.11.	**Dans votre pratique, à quelle fréquence recommandez-vous un MAPA à vos patients?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)

2.12. Identifiez jusqu'à quatre éléments potentiels que vous considérez comme étant des barrières qui limitent votre intérêt à utiliser le MAPA.

- ☐ a. Coût de l'examen pour le patient
- ☐ b. Accès restreint à cet examen pour le patient
- ☐ c. Incapacité du patient à compléter l'examen en raison de l'inconfort
- ☐ d. Préférence du patient
- ☐ e. MAPA non-disponible sur mon lieu de travail
- ☐ f. Les frais liés aux MAPA ne sont pas couverts
- ☐ g. Manque de temps pour analyser les résultats
- ☐ h. Autre, veuillez spécifier

SECTION 3 / 5 : MESURE DE LA PRESSION ARTÉRIELLE EN CLINIQUE – OSCILLOMÉTRIQUE EN SÉRIE (MPAC-OS)

La MPAC-OS est une méthode de mesure utilisant un appareil automatisé réalisant plusieurs lectures de la pression artérielle.

Pour les questions suivantes, cochez la case qui correspond à votre choix de réponse.

		a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg
3.1.	**Pour la MPAC-OS, quel est le seuil diagnostique recommandé pour l'hypertension?**	☐ a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	☐ b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	☐ c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	☐ d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg

		a. Vrai	b. Faux	c. Cela ne fait pas de différence	d. Je ne sais pas
3.2.	**Les appareils utilisés pour la MPAC-OS calculent automatiquement la**	☐ a. Vrai	☐ b. Faux	☐ c. Cela ne fait	☐ d. Je ne sais pas

	moyennes des mesures réalisées.			pas de différence	
3.3.	**Pour la MPAC-OS, une période de repos de 5 minutes est recommandée avant la mesure.**	a. Vrai	b. Faux	c. Cela ne fait pas de différence	d. Je ne sais pas
3.4.	**Le patient devrait être assis sur une table d'examen pour mesurer sa pression artérielle.**	a. Vrai	b. Faux	c. Cela ne fait pas de différence	d. Je ne sais pas

		a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord
3.5.	**Je crois la MPAC-OS est supérieure aux mesures réalisées en clinique.**	a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord
3.6.	**Je crois que la MPAC-OS est équivalente aux résultats de la MPAD et du MAPA de jour.**	a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord
3.7.	**Je crois que la MPAC-OS devrait être employée pour prendre des décisions thérapeutiques.**	a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord
3.8.	**Je crois posséder les connaissances nécessaires pour réaliser une MPAC-OS et utiliser l'appareil adéquatement.**	a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord

		a. Jamais	b. Rarement (< 25% du temps)	c. À l'occasion (≥ 25% du temps)	d. Fréquemment (≥ 50% du temps)	e. Presque toujours (≥ 80% du temps)
3.9.	**Dans votre pratique, à quelle fréquence mesurez-vous la pression artérielle à l'aide de la MPAC-OS?**	a. Jamais	b. Rarement (< 25% du temps)	c. À l'occasion (≥ 25% du temps)	d. Fréquemment (≥ 50% du temps)	e. Presque toujours (≥ 80% du temps)

3.10. Quel appareil de MPAC-OS utilisez-vous principalement pour mesurer la pression artérielle dans votre lieu de pratique?

- a. Aucun, nous n'utilisons pas la MPAC-OS
- b. Je ne sais pas/Je ne suis pas certain
- c. BpTRU BPM100
- d. Omron HEM 907XL
- e. Microlife WatchBP Office
- f. Welch Allyn ProBP 2400
- g. Autre, veuillez spécifier

3.11. Identifiez jusqu'à trois éléments potentiels que vous considérez comme étant des barrières qui limitent votre intérêt à utiliser la MPAC-OS.

- a. Coût de l'appareil pour les médecins
- b. MPAC-OS non-disponible sur mon lieu de travail
- c. Absence d'espace dédié pour la mesure de la pression artérielle
- d. Manque de temps pour réaliser la MPAC-OS selon les lignes directrices
- e. Autre, veuillez spécifier

SECTION 4 / 5 : MESURE DE LA PRESSION ARTÉRIELLE EN CLINIQUE (MPAC)

La MPAC est une méthode de mesure de la pression artérielle réalisée à l'aide d'un appareil électronique oscillométrique en présence d'un professionnel de la santé.

Pour les questions suivantes, cochez la case qui correspond à votre choix de réponse.

		a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg
4.1.	**Avec la MPAC, quel est le seuil diagnostique recommandé pour l'hypertension pour la population générale?**	a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg

		a. 40 à 59%	b. 60 à 79%	c. 80 à 100%	d. Je ne sais pas
4.2.	**Quel pourcentage de la circonférence du bras la longueur de la chambre pneumatique du brassard devrait-elle recouvrir?**	a. 40 à 59%	b. 60 à 79%	c. 80 à 100%	d. Je ne sais pas

		a. Vrai	b. Faux	c. Cela ne fait pas de différence	d. Je ne sais pas
4.3.	**Lors de la mesure de la pression artérielle, le dos devrait être appuyé afin que les résultats obtenus soient valides.**	a. Vrai	b. Faux	c. Cela ne fait pas de différence	d. Je ne sais pas
4.4.	**Lors de la mesure de la pression artérielle, le bras devrait être positionné plus bas que le niveau du cœur.**	a. Vrai	b. Faux	c. Cela ne fait pas de différence	d. Je ne sais pas

4.5. Pour la mesure de la pression artérielle en clinique au cours de la visite initiale, combien de mesures devrait-on effectuer?

- a. Une mesure suffit
- b. Deux mesures et la moyenne doit être utilisée
- c. Trois mesures, le premier résultat est écarté et c'est la moyenne des deux dernières qui est utilisée
- d. Trois mesures, et c'est la moyenne des trois mesures qui est utilisée
- e. Je ne sais pas

		a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord
4.6.	**Je crois que je mesure la pression artérielle conformément aux lignes**	a.	b. En	c. Ni en	d. En	e.

	directrices.	Fortement en désaccord	désaccord	désaccord, ni en accord	accord	Fortement en accord
4.7.	Je crois que mes collègues (médecins, infirmières et pharmaciens) mesurent la pression artérielle conformément aux lignes directrices.	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
4.8.	Je crois que mesurer la pression artérielle de manière standardisée nécessite trop de temps pour être intégré dans ma pratique professionnelle.	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
4.9.	Je crois que l'aménagement de mon lieu de travail est inadéquat pour me permettre de mesurer la pression artérielle de manière standardisée.	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord

		a. Jamais	b. Rarement (< 25% du temps)	c. À l'occasion (≥ 25% du temps)	d. Fréquemment (≥ 50% du temps)	e. Presque toujours (≥ 80% du temps)
4.10.	Dans votre pratique, à quelle fréquence mesurez-vous la pression artérielle à l'aide d'un appareil oscillométrique électronique (sans mesures multiples automatisées)	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)

4.11. Quelle est la méthode usuelle pour mesurer la pression artérielle dans votre milieu de pratique?

- ☐ a. Je ne sais pas/Je ne suis pas certain
- ☐ b. Utiliser un sphygmomanomètre au mercure
- ☐ c. Utiliser un appareil anaéroïde
- ☐ d. Utiliser un appareil oscillométrique électronique (sans mesures multiples automatisées)
- ☐ e. Utiliser un appareil oscillométrique électronique (avec mesures multiples automatisées)

4.12. Dans votre milieu de pratique, quelle est la méthode usuelle pour mesurer la pression artérielle chez les patients obèses?

- ☐ a. Je ne sais pas/Je ne suis pas certain
- ☐ b. Brassard standard, appliqué au-dessus du coude
- ☐ c. Brassard large ou extra-large, appliqué au-dessus du coude
- ☐ d. Brassard pour cuisse, appliqué au-dessus du coude
- ☐ e. Brassard standard, appliqué au niveau du poignet
- ☐ f. Brassard pour poignet, appliqué au niveau du poignet
- ☐ g. Brassard standard, appliqué au niveau de l'avant-bras

4.13. Identifiez jusqu'à trois éléments potentiels que vous considérez comme étant des barrières qui limitent votre intérêt à utiliser la MPAC.

- ☐ a. MPAC non-disponible sur mon lieu de travail
- ☐ b. Manque de ressources et d'équipements pour mesurer la pression artérielle
- ☐ c. Manque de temps pour suivre les lignes directrices portant sur la MPAC
- ☐ d. Manque de temps pour calculer une moyenne
- ☐ e. Matériel éducatif non-disponible à mon lieu de pratique
- ☐ f. Autre, veuillez spécifier

SECTION 5 / 5 : QUESTIONS GÉNÉRALES

Pour les questions suivantes, cochez la case qui correspond à votre choix de réponse.

5.1. À quel groupe d'âge appartenez-vous?

☐ a. < 30 ans ☐ b. 30-39 ans ☐ c. 40-49 ans ☐ d. 50-59 ans ☐ e. ≥ 60 ans

5.2. Indiquez votre sexe.

☐ a. Masculin ☐ b. Féminin ☐ c. Je préfère ne pas répondre

5.3. Indiquez votre profession.

- ☐ Infirmière
- ☐ Autre, veuillez spécifier

		a. ≤ 3 ans	b. 4-10 ans	c. ≥ 11 ans
5.4.	Depuis combien d'années pratiquez-vous votre profession?	☐ a. ≤ 3 ans	☐ b. 4-10 ans	☐ c. ≥ 11 ans
5.5.	Combien d'années avez-vous exercé à temps complet dans un contexte de soins de première ligne?	☐ a. ≤ 3 ans	☐ b. 4-10 ans	☐ c. ≥ 11 ans

		a. Oui, une formation théorique uniquement (articles, conférences, etc.)	b. Oui, une formation pratique uniquement	c. Oui, une formation théorique et pratique	d. Non, jamais reçu de formation
5.6.	Durant vos années de pratique, avez-vous déjà reçu de la formation spécifique sur la mesure de la pression artérielle?	☐ a. Oui, une formation théorique uniquement (articles, conférences, etc.)	☐ b. Oui, une formation pratique uniquement	☐ c. Oui, une formation théorique et pratique	☐ d. Non, jamais reçu de formation

		a. Hypertension Canada	b. La société québécoise d'hypertension artérielle (SQHA)	c. Je suis membre de ces deux sociétés	d. Je ne suis pas membre d'aucune de ces sociétés
5.7.	De quelle(s) société(s) dédiée à l'hypertension êtes-vous membre?	☐ a. Hypertension Canada	☐ b. La société québécoise d'hypertension artérielle (SQHA)	☐ c. Je suis membre de ces deux sociétés	☐ d. Je ne suis pas membre d'aucune de ces sociétés

Annexe 21. Methodology - Questionnaire for physicians (English)

Blood pressure measurement : Questionnaire

Nom :___________________________

Code permanent : _________________

SECTION 1 / 5 : HOME BLOOD PRESSURE MEASUREMENT (HBPM)

For the following questions, check the box that corresponds to your answer.

		a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg
1.1.	**What is the recommended diagnostic threshold for hypertension with HBPM?** *SBP: Systolic blood pressure, DBP: Diastolic blood pressure*	☐ a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	☐ b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	☐ c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	☐ d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg

		a. 3 days	b. 5 days	c. 7 days	d. I do not know
1.2.	**How many consecutive days of measurements should be taken with HBPM?**	☐ a. 3 days	☐ b. 5 days	☐ c. 7 days	☐ d. I do not know

1.3. How many measurements should be taken each day with HBPM?

- ☐ a. Several measurements at different time during the day over a few days
- ☐ b. Twice in the morning and twice in the evening
- ☐ c. Three times in the morning and three times in the evening
- ☐ d. I do not know

		a. True	b. False	c. It makes no difference	d. I do not know
1.4.	**When calculating the mean value for HBPM, the values from the first day should be discarded.**	☐ a. True	☐ b. False	☐ c. It makes no difference	☐ d. I do not know

		a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
1.5.	**I believe that HBPM is useful for patients when treating hypertension.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
1.6.	**I believe that patients can measure their BP correctly at home.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
1.7.	**I believe that HBPM can be used for making therapeutic decisions.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
1.8.	**I believe that HBPM should be considered as part of standard hypertensive care.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree

		a. I do not know/ I am not sure	b. Very Few (< 25%)	c. Some (≥ 25%)	d. Most of them (≥ 50%)	e. Almost all (≥ 80%)
1.9.	**In your practice, what is the proportion of patients using HBPM?**	☐ a. I do not know/ I am not sure	☐ b. Very Few (< 25%)	☐ c. Some (≥ 25%)	☐ d. Most of them (≥ 50%)	☐ e. Almost all (≥ 80%)

		a. Never	b. Rarely (< 25% of the time)	c. Occasionally (≥ 25% of the time)	d. Frequently (≥ 50% of the time)	e. Almost always (≥ 80% of the time)
1.10.	**How frequently is education provided to your patients regarding HBPM?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
1.11.	**In your practice, how frequently do you use HBPM for diagnostic purposes?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
1.12.	**In your practice, how frequently do you use HBPM to make therapeutic decisions?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
1.13.	**In your practice, how frequently do you use HBPM for follow-up purposes?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)

1.14. Identify up to four potential barriers that limit your interest for using HBPM.

- ☐ a. Device cost for patients
- ☐ b. Patient anxiety
- ☐ c. Patient unwillingness to perform HBPM
- ☐ d. Low patient reliability to report HBPM readings
- ☐ e. Insufficient time to teach patient about home BP monitoring
- ☐ f. Insufficient time to calculate an average
- ☐ g. Low reimbursement fees for doctors
- ☐ h. Other, please specify

SECTION 2 / 5 : AMBULATORY BLOOD PRESSURE MEASUREMENT (ABPM)

For the following questions, check the box that corresponds to your answer.

		a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg
2.1.	**What is the recommended diagnostic threshold for hypertension with mean 24-hour ABPM?**	☐ a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	☐ b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	☐ c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	☐ d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg
2.2.	**What is the recommended diagnostic threshold for hypertension with day-time ABPM?**	☐ a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	☐ b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	☐ c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	☐ d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg

		a. 20–30 minutes	b. 30–60 minutes	c. It has little impact	d. I do not know
2.3.	**What interval should be used for day-time measurement with ABPM?**	☐ a. 20–30 minutes	☐ b. 30–60 minutes	☐ c. It has little impact	☐ d. I do not know
2.4.	**What interval should be used for night-time measurement with ABPM?**	☐ a. 20–30 minutes	☐ b. 30–60 minutes	☐ c. It has little impact	☐ d. I do not know

		a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
2.5.	**I believe that ABPM is useful for patients in treating hypertension.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
2.6.	**I believe that ABPM is well tolerated by patients.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
2.7.	**I believe that my patients have easy access to ABPM.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
2.8.	**I believe that ABPM is necessary to confirm values obtained in the office.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree

		a. I do not know/ I am not sure	b. Very Few (< 25%)	c. Some (≥ 25%)	d. Most of them (≥ 50%)	e. Almost all (≥ 80%)
2.9.	**In your practice, what is the proportion of patients for which ABPM is prescribed?**	☐ a. I do not know/ I am not sure	☐ b. Very Few (< 25%)	☐ c. Some (≥ 25%)	☐ d. Most of them (≥ 50%)	☐ e. Almost all (≥ 80%)

		a. Never	b. Rarely (< 25% of the time)	c. Occasionally (≥ 25% of the time)	d. Frequently (≥ 50% of the time)	e. Almost always (≥ 80% of the time)
2.10.	**How frequently is education provided to your patients regarding ABPM?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
2.11.	**In your practice, how frequently do you use ABPM for diagnostic purposes?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
2.12.	**In your practice, how frequently do you use ABPM to make therapeutic decisions?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
2.13.	**In your practice, how frequently do you use ABPM for follow-up purposes?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)

2.14. Identify up to four potential barriers that limit your interest for using ABPM.

- ☐ a. Cost of the test for the patients
- ☐ b. Patients' lack of access to ABPM
- ☐ c. Patients' incapacity to complete test due to discomfort
- ☐ d. Patient preference
- ☐ e. Non-availability of ABPM at my workplace
- ☐ f. Low reimbursement fees for doctors
- ☐ g. Insufficient time to analyse the results
- ☐ h. Other, please specify

SECTION 3 / 5 : AUTOMATED BLOOD PRESSURE MEASUREMENT (AOBP)

AOBP is a measurement method performed using an automated device that provides multiple BP readings.

For the following questions, check the box that corresponds to your answer.

		a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg
3.1.	**What is the recommended diagnostic threshold for hypertension with AOBP?**	☐ a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	☐ b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	☐ c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	☐ d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg

		a. True	b. False	c. It makes no difference	d. I do not know
3.2.	**When AOBP is used, pre-programed multiple measurements are automatically averaged.**	☐ a. True	☐ b. False	☐ c. It makes no difference	☐ d. I do not know
3.3.	**A 5 min rest period is recommended before measuring BP with AOBP.**	☐ a. True	☐ b. False	☐ c. It makes no difference	☐ d. I do not know
3.4.	**BP should be measured with the patient seated on an examination table.**	☐ a. True	☐ b. False	☐ c. It makes no difference	☐ d. I do not know

		a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
3.5.	**I believe that AOBP measurement is superior to OBPM (non-AOBP).**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
3.6.	**I believe that AOBP measurement is equivalent to both awake ABPM and HBPM.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
3.7.	**I believe that AOBP should be used to make therapeutic decisions.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
3.8.	**I believe that I have sufficient knowledge to perform and use AOBP correctly.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree

		a. Never	b. Rarely (< 25% of the time)	c. Occasionally (≥ 25% of the time)	d. Frequently (≥ 50% of the time)	e. Almost always (≥ 80% of the time)
3.9.	**In your practice, how frequently do you use AOBP for hypertension screening?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
3.10.	**In your practice, how frequently do you use AOBP for diagnostic purposes?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
3.11.	**In your practice, how frequently do you use AOBP for therapeutic and follow-up purposes?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)

3.12. Which automated device do you mostly use for AOBP?

- ☐ a. None, we do not use AOBP
- ☐ b. I do not know / I am not sure
- ☐ c. BpTRU BPM100
- ☐ d. Omron HEM 907XL
- ☐ e. Microlife WatchBP Office
- ☐ f. Welch Allyn ProBP 2400
- ☐ g. Other, please specify

3.13. Identify up to three potential barriers that limit your interest for using AOBP.

- [ ] a. Cost of device for physicians
- [ ] b. Non availability of AOBP device at my office/workplace
- [ ] c. Not having a room to leave patient unattended for BP measurement
- [ ] d. Insufficient time to follow guidelines when measuring BP with AOBP
- [ ] e. Other, please specify

SECTION 4 / 5 : OFFICE BLOOD PRESSURE MEASUREMENT (OBPM)

OBPM (non-AOBP) is a measurement method performed using an electronic oscillometric device for BP measurement.

For the following questions, check the box that corresponds to your answer.

		a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg
4.1.	**What is the recommended diagnostic threshold for hypertension with OBPM for the general population?**	☐ a. Mean SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg	☐ b. Mean SBP ≥ 135 mmHg and/or DBP ≥ 85 mmHg	☐ c. Mean SBP ≥ 130 mmHg and/or DBP ≥ 80 mmHg	☐ d. Mean SBP ≥ 120 mmHg and/or DBP ≥ 80 mmHg

		a. 40 to 59%	b. 60 to 79%	c. 80 to 100%	d. I do not know
4.2.	**What percentage of the arm circumference should the length of the cuff bladder cover?**	☐ a. 40 to 59%	☐ b. 60 to 79%	☐ c. 80 to 100%	☐ d. I do not know

		a. True	b. False	c. It makes no difference	d. I do not know
4.3.	**When measuring BP, the back should be supported in order to get valid results.**	☐ a. True	☐ b. False	☐ c. It makes no difference	☐ d. I do not know
4.4.	**When measuring BP, the arm should be positioned below heart level.**	☐ a. True	☐ b. False	☐ c. It makes no difference	☐ d. I do not know

4.5. When measuring blood pressure in office during the initial visit how many measurements should be performed?

- [ ] a. One measurement is sufficient
- [ ] b. Two measurements and the average should be used
- [ ] c. Three measurements, the first result is discarded and the second and third should be averaged
- [ ] d. Three BP measurements and all three results should be averaged
- [ ] e. I do not know

		a. Strongly Disagree	b. Disagree	c. Neither Agree nor Disagree	d. Agree	e. Strongly Agree
4.6.	**I believe that I measure BP according to the recommended guidelines.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
4.7.	**I believe my colleagues (doctor, nurse and pharmacist) measure BP according to the recommended guidelines.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
4.8.	**I believe that using a standardized OBPM is overly time consuming for my practice.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree
4.9.	**I believe my office is not properly set up for me to measure BP in a standardized manner.**	☐ a. Strongly Disagree	☐ b. Disagree	☐ c. Neither Agree nor Disagree	☐ d. Agree	☐ e. Strongly Agree

		a. Never	b. Rarely (< 25% of the time)	c. Occasionally (≥ 25% of the time)	d. Frequently (≥ 50% of the time)	e. Almost always (≥ 80% of the time)
4.10.	**In your practice, how frequently do you use OBPM for hypertension screening?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
4.11.	**In your practice, how frequently do you use OBPM for diagnostic purposes?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)
4.12.	**In your practice, how frequently do you use OBPM to make therapeutic decisions?**	☐ a. Never	☐ b. Rarely (< 25% of the time)	☐ c. Occasionally (≥ 25% of the time)	☐ d. Frequently (≥ 50% of the time)	☐ e. Almost always (≥ 80% of the time)

4.13. What is the routine method used to measure BP in your clinic?

- [ ] a. I do not know/ I am not sure
- [ ] b. Using a manual mercury sphygmomanometer
- [ ] c. Using an aneroid device
- [ ] d. Using an electronic oscillometric device (not automated for multiple measurements)

- [ ] e. Using an electronic oscillometric device (automated for multiple measurements)

4.14. In your practice, which is the most common method used to measure BP for obese patients?

- [ ] a. I do not know / I am not sure
- [ ] b. Standard upper arm cuff
- [ ] c. Large or extra-large upper arm cuff
- [ ] d. Thigh cuff applied on upper arm
- [ ] e. Standard cuff applied on wrist
- [ ] f. Wrist cuff applied on wrist
- [ ] g. Standard cuff applied on lower arm

4.15. Identify up to three potential barriers that limit your interest for using OBPM.

- [ ] a. Non-availability of electronic oscillometric device (non-automated)
- [ ] b. Insufficient resources and equipment to measure BP
- [ ] c. Insufficient time to follow guidelines when measuring BP
- [ ] d. Insufficient time to calculate an average
- [ ] e. Non-availability of education material in my primary setting
- [ ] f. Other, please specify

SECTION 5 / 5 : GENERAL QUESTIONS

For the following general questions, check the box that corresponds to your answer.

5.1. What is your age group?

- [ ] a. < 30 years
- [ ] b. 30-39 years
- [ ] c. 40-49 years
- [ ] d. 50-59 years
- [ ] e. ≥ 60 years

5.2. Indicate your sex.

- [ ] a. Male
- [ ] b. Female
- [ ] c. Decline to answer

5.3. Indicate your profession.

- [ ] Family medicine
- [ ] Other, please specify

		a. ≤3 years	b. 4-10 years	c. ≥ 11 years
5.4.	How many years have you been practicing your profession?	☐ a. ≤3 years	☐ b. 4-10 years	☐ c. ≥ 11 years
5.5.	How many full-time years have you been in primary care practice?	☐ a. ≤3 years	☐ b. 4-10 years	☐ c. ≥ 11 years

		a. Yes, theoretical only (articles, conferences)	b. Yes, practical only	c. Yes, theoretical and practical	d. Never received training
5.6.	During your years of practice, have you ever received specific training on BP measurement?	☐ a. Yes, theoretical only (articles, conferences)	☐ b. Yes, practical only	☐ c. Yes, theoretical and practical	☐ d. Never received training

		a. Hypertension Canada	b. La société québécoise d'hypertension artérielle (SQHA)	c. I am a member of both societies	d. Neither of them
5.7.	Which hypertension societies are you a member of?	☐ a. Hypertension Canada	☐ b. La société québécoise d'hypertension artérielle (SQHA)	☐ c. I am a member of both societies	☐ d. Neither of them

Annexe 21. Methodology - Questionnaire for physicians (French)

8/10/2021 Questionnaire « Mesure de la pression artérielle: Questionnaire »

Mesure de la pression artérielle: Questionnaire

Nom :______________________

Code permanent : ________________

SECTION 1 / 5 : MESURE DE LA PRESSION ARTÉRIELLE À DOMICILE (MPAD)

Pour les questions suivantes, cochez la case qui correspond à votre choix de réponse.

		a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg
1.1.	**Pour la MPAD, quel est le seuil diagnostique recommandé pour l'hypertension?** *PAS : Pression artérielle systolique, PAD : Pression artérielle diastolique*	☐ a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	☐ b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	☐ c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	☐ d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg

		a. 3 jours	b. 5 jours	c. 7 jours	d. Je ne sais pas
1.2.	**Pour la MPAD, pendant combien de jours consécutifs la pression artérielle devrait-elle être mesurée?**	☐ a. 3 jours	☐ b. 5 jours	☐ c. 7 jours	☐ d. Je ne sais pas

1.3. Pour la MPAD, combien de mesures de la pression artérielle devraient être réalisées chaque jour?

- ☐ a. Plusieurs lectures à différents moments durant la journée, et ce pendant quelques jours
- ☐ b. Deux fois le matin, puis deux fois le soir
- ☐ c. Trois fois le matin, puis trois fois le soir
- ☐ d. Je ne sais pas

		a. Vrai	b. Faux	c. Cela ne fait pas de différence	d. Je ne sais pas
1.4.	**Pour la MPAD, lors du calcul de la moyenne, les mesures de la première journée ne devraient pas être incluses.**	☐ a. Vrai	☐ b. Faux	☐ c. Cela ne fait pas de différence	☐ d. Je ne sais pas

		a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord
1.5.	**Je crois que la MPAD est utile pour le suivi des patients traités pour l'hypertension.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
1.6.	**Je crois que les patients peuvent mesurer adéquatement leur pression artérielle à domicile.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
1.7.	**Je crois que la MPAD peut être utilisée pour prendre des décisions thérapeutiques.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
1.8.	**Je crois que la MPAD devrait être considérée comme faisant partie des soins standards pour l'hypertension.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord

		a. Je ne sais pas/ Je ne suis pas certain	b. Très peu (< 25%)	c. Quelques-uns (≥ 25%)	d. La plupart (≥ 50%)	e. Presque tous (≥ 80%)
1.9.	**Dans votre pratique, qu'elle est la proportion de patients utilisant la MPAD?**	☐ a. Je ne sais pas/ Je ne suis pas certain	☐ b. Très peu (< 25%)	☐ c. Quelques-uns (≥ 25%)	☐ d. La plupart (≥ 50%)	☐ e. Presque tous (≥ 80%)

		a. Jamais	b. Rarement (< 25% du temps)	c. À l'occasion (≥ 25% du temps)	d. Fréquemment (≥ 50% du temps)	e. Presque toujours (≥ 80% du temps)
1.10.	**À quelle fréquence vos patients obtiennent-ils de l'enseignement relativement à la MPAD?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
1.11.	**Dans votre pratique, à quelle fréquence utilisez-vous la MPAD à des fins diagnostiques?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
1.12.	**Dans votre pratique, à quelle fréquence utilisez-vous la MPAD pour prendre des décisions thérapeutiques?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
1.13.	**Dans votre pratique, à quelle fréquence utilisez-vous la MPAD à des fins de suivi?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)

https://oraprdnt.uqtr.uquebec.ca/pls/protege/biqw010.imprimer_questionnaire?owa_no_questionnaire=12917&owa_no_version_questionnaire=1 1/5

1.14. Identifiez jusqu'à quatre éléments potentiels que vous considérez comme étant des barrières qui limitent votre intérêt à utiliser la MPAD.

- ☐ a. Coût de l'appareil pour le patien
- ☐ b. Anxiété du patient
- ☐ c. Réticence du patient à réaliser la MPAD
- ☐ d. Faible fiabilité du patient pour transmettre les résultats de la MPAD
- ☐ e. Manque de temps pour enseigner la MPAD au patient
- ☐ f. Manque de temps pour calculer une moyenne
- ☐ g. Honoraires peu élevés pour les médecins
- ☐ h. Autre, veuillez spécifier

SECTION 2 / 5 : MONITORAGE AMBULATOIRE DE LA PRESSION ARTÉRIELLE (MAPA)

Pour les questions suivantes, cochez la case qui correspond à votre choix de réponse.

		a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg
2.1.	**Quel est le seuil diagnostique de l'hypertension pour un MAPA de 24 heures?**	☐ a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	☐ b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	☐ c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	☐ d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg
2.2.	**Quel est le seuil diagnostique de l'hypertension pour un MAPA de jour?**	☐ a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	☐ b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	☐ c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	☐ d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg

		a. 20-30 minutes	b. 30-60 minutes	c. Cela a peu d'impact	d. Je ne sais pas
2.3.	**Lors de la réalisation du MAPA, à quel intervalle les lectures devraient-elles s'effectuer durant le jour?**	☐ a. 20-30 minutes	☐ b. 30-60 minutes	☐ c. Cela a peu d'impact	☐ d. Je ne sais pas
2.4.	**Lors de la réalisation d'un MAPA, à quel intervalle les lectures devraient-elles s'effectuer durant la nuit?**	☐ a. 20-30 minutes	☐ b. 30-60 minutes	☐ c. Cela a peu d'impact	☐ d. Je ne sais pas

		a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord
2.5.	**Je crois que le MAPA est utile pour les patients lors du traitement de leur hypertension.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
2.6.	**Je crois que le MAPA est bien toléré par les patients.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
2.7.	**Je crois que mes patients ont facilement accès à un MAPA.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
2.8.	**Je crois qu'un MAPA est nécessaire pour confirmer les valeurs obtenues en clinique.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord

		a. Je ne sais pas/ Je ne suis pas certain	b. Très peu (< 25%)	c. Quelques-uns (≥ 25%)	d. La plupart (≥ 50%)	e. Presque tous (≥ 80%)
2.9.	**Dans votre pratique, quelle est la proportion de patients pour qui un MAPA est prescrit?**	☐ a. Je ne sais pas/ Je ne suis pas certain	☐ b. Très peu (< 25%)	☐ c. Quelques-uns (≥ 25%)	☐ d. La plupart (≥ 50%)	☐ e. Presque tous (≥ 80%)

		a. Jamais	b. Rarement (< 25% du temps)	c. À l'occasion (≥ 25% du temps)	d. Fréquemment (≥ 50% du temps)	e. Presque toujours (≥ 80% du temps)
2.10.	**À quelle fréquence vos patients obtiennent-ils de l'enseignement relativement au MAPA?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
2.11.	**Dans votre pratique, à quelle fréquence utilisez-vous un MAPA à des fins diagnostiques?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
2.12.	**Dans votre pratique, à quelle fréquence utilisez-vous un MAPA pour prendre des décisions thérapeutiques?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
2.13.	**Dans votre pratique, à quelle fréquence utilisez-vous un MAPA à des fins de suivi?**	☐ a. Jamais	☐ b. Rarement	☐ c. À l'occasion	☐ d. Fréquemment	☐ e. Presque toujours

			(< 25% du temps)	(≥ 25% du temps)	(≥ 50% du temps)	(≥ 80% du temps)

2.14. Identifiez jusqu'à quatre éléments potentiels que vous considérez comme étant des barrières qui limitent votre intérêt à utiliser la MAPA.

- ☐ a. Coût de l'examen pour le patient
- ☐ b. Accès restreint à cet examen pour le patient
- ☐ c. Incapacité du patient à compléter l'examen en raison de l'inconfort
- ☐ d. Préférence du patient
- ☐ e. MAPA non-disponible sur mon lieu de travail
- ☐ f. Honoraires peu élevés pour les médecins
- ☐ g. Manque de temps pour analyser les résultats
- ☐ h. Autre, veuillez spécifier

SECTION 3 / 5 : MESURE DE LA PRESSION ARTÉRIELLE EN CLINIQUE – OSCILLOMÉTRIQUE EN SÉRIE (MPAC-OS)

La MPAC-OS est une méthode de mesure utilisant un appareil automatisé réalisant plusieurs lectures de la pression artérielle.

Pour les questions suivantes, cochez la case qui correspond à votre choix de réponse.

		a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg
3.1.	**Pour la MPAC-OS, quel est le seuil diagnostique recommandé pour l'hypertension?**	☐ a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	☐ b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	☐ c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	☐ d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg

		a. Vrai	b. Faux	c. Cela ne fait pas de différence	d. Je ne sais pas
3.2.	**Les appareils utilisés pour la MPAC-OS calculent automatiquement la moyennes des mesures réalisées.**	☐ a. Vrai	☐ b. Faux	☐ c. Cela ne fait pas de différence	☐ d. Je ne sais pas
3.3.	**Pour la MPAC-OS, une période de repos de 5 minutes est recommandée avant la mesure.**	☐ a. Vrai	☐ b. Faux	☐ c. Cela ne fait pas de différence	☐ d. Je ne sais pas
3.4.	**Le patient devrait être assis sur une table d'examen pour mesurer sa pression artérielle.**	☐ a. Vrai	☐ b. Faux	☐ c. Cela ne fait pas de différence	☐ d. Je ne sais pas

		a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord
3.5.	**Je crois la MPAC-OS est supérieure aux mesures réalisées en clinique.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
3.6.	**Je crois que la MPAC-OS est équivalente aux résultats de la MPAD et du MAPA de jour.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
3.7.	**Je crois que la MPAC-OS devrait être employée pour prendre des décisions thérapeutiques.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
3.8.	**Je crois posséder les connaissances nécessaires pour réaliser une MPAC-OS et utiliser l'appareil adéquatement.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord

		a. Jamais	b. Rarement (< 25% du temps)	c. À l'occasion (≥ 25% du temps)	d. Fréquemment (≥ 50% du temps)	e. Presque toujours (≥ 80% du temps)
3.9.	**Dans votre pratique, à quelle fréquence utilisez-vous la MPAC-OS à des fins de dépistage de l'hypertension?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
3.10.	**Dans votre pratique, à quelle fréquence utilisez-vous la MPAC-OS à des fins diagnostiques?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
3.11.	**Dans votre pratique, à quelle fréquence utilisez-vous la MPAC-OS pour prendre des décisions thérapeutiques ou à des fins de suivi?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)

3.12. Quel appareil de MPAC-OS utilisez-vous principalement pour mesurer la pression artérielle dans votre lieu de pratique?

- ☐ a. Aucun, nous n'utilisons pas la MPAC-OS
- ☐ b. Je ne sais pas/Je ne suis pas certain
- ☐ c. BpTRU BPM100
- ☐ d. Omron HEM 907XL
- ☐ e. Microlife WatchBP Office

- [ ] f. Welch Allyn ProBP 2400
- [ ] g. Autre, veuillez spécifier

3.13. Identifiez jusqu'à trois éléments potentiels que vous considérez comme étant des barrières qui limitent votre intérêt à utiliser la MPAC-OS.

- [ ] a. Coût de l'appareil pour les médecins
- [ ] b. MPAC-OS non-disponible sur mon lieu de travail
- [ ] c. Absence d'espace dédié pour la mesure de la pression artérielle
- [ ] d. Manque de temps pour réaliser la MPAC-OS selon les lignes directrices
- [ ] e. Autre, veuillez spécifier

SECTION 4 / 5 : MESURE DE LA PRESSION ARTÉRIELLE EN CLINIQUE (MPAC)

La MPAC est une méthode de mesure de la pression artérielle réalisée à l'aide d'un appareil électronique oscillométrique en présence d'un professionnel de la santé.

Pour les questions suivantes, cochez la case qui correspond à votre choix de réponse.

		a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg
4.1.	**Avec la MPAC, quel est le seuil diagnostique recommandé pour l'hypertension pour la population générale?**	☐ a. PAS moyenne ≥ 140 mmHg et/ou PAD moyenne ≥ 90 mmHg	☐ b. PAS moyenne ≥ 135 mmHg et/ou PAD moyenne ≥ 85 mmHg	☐ c. PAS moyenne ≥ 130 mmHg et/ou PAD moyenne ≥ 80 mmHg	☐ d. PAS moyenne ≥ 120 mmHg et/ou PAD moyenne ≥ 80 mmHg

		a. 40 à 59%	b. 60 à 79%	c. 80 à 100%	d. Je ne sais pas
4.2.	**Quel pourcentage de la circonférence du bras la longueur de la chambre pneumatique du brassard devrait-elle recouvrir?**	☐ a. 40 à 59%	☐ b. 60 à 79%	☐ c. 80 à 100%	☐ d. Je ne sais pas

		a. Vrai	b. Faux	c. Cela ne fait pas de différence	d. Je ne sais pas
4.3.	**Lors de la mesure de la pression artérielle, le dos devrait être appuyé afin que les résultats obtenus soient valides.**	☐ a. Vrai	☐ b. Faux	☐ c. Cela ne fait pas de différence	☐ d. Je ne sais pas
4.4.	**Lors de la mesure de la pression artérielle, le bras devrait être positionné plus bas que le niveau du cœur.**	☐ a. Vrai	☐ b. Faux	☐ c. Cela ne fait pas de différence	☐ d. Je ne sais pas

4.5. Pour la mesure de la pression artérielle en clinique au cours de la visite initiale, combien de mesures devrait-on effectuer?

- [ ] a. Une mesure suffit
- [ ] b. Deux mesures et la moyenne doit être utilisée
- [ ] c. Trois mesures, le premier résultat est écarté et c'est la moyenne des deux dernières qui est utilisée
- [ ] d. Trois mesures, et c'est la moyenne des trois mesures qui est utilisée
- [ ] e. Je ne sais pas

		a. Fortement en désaccord	b. En désaccord	c. Ni en désaccord, ni en accord	d. En accord	e. Fortement en accord
4.6.	**Je crois que je mesure la pression artérielle conformément aux lignes directrices.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
4.7.	**Je crois que mes collègues (médecins, infirmières et pharmaciens) mesurent la pression artérielle conformément aux lignes directrices.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
4.8.	**Je crois que mesurer la pression artérielle de manière standardisée nécessite trop de temps pour être intégré dans ma pratique professionnelle.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord
4.9.	**Je crois que l'aménagement de mon lieu de travail est inadéquat pour me permettre de mesurer la pression artérielle de manière standardisée.**	☐ a. Fortement en désaccord	☐ b. En désaccord	☐ c. Ni en désaccord, ni en accord	☐ d. En accord	☐ e. Fortement en accord

		a. Jamais	b. Rarement (< 25% du temps)	c. À l'occasion (≥ 25% du temps)	d. Fréquemment (≥ 50% du temps)	e. Presque toujours (≥ 80% du temps)
4.10.	**Dans votre pratique, à quelle fréquence utilisez-vous la MPAC à des fins de dépistage de l'hypertension?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
4.11.	**Dans votre pratique, à quelle fréquence utilisez-vous la MPAC à des fins diagnostiques?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)
4.12.	**Dans votre pratique, à quelle fréquence utilisez-vous la MPAC pour prendre des décisions thérapeutiques?**	☐ a. Jamais	☐ b. Rarement (< 25% du temps)	☐ c. À l'occasion (≥ 25% du temps)	☐ d. Fréquemment (≥ 50% du temps)	☐ e. Presque toujours (≥ 80% du temps)

4.13. Quelle est la méthode usuelle pour mesurer la pression artérielle dans votre lieu de pratique?

- ☐ a. Je ne sais pas/Je ne suis pas certain
- ☐ b. Utiliser un sphygmomanomètre au mercure
- ☐ c. Utiliser un appareil anaéroïde
- ☐ d. Utiliser un appareil oscillométrique électronique (sans mesures multiples automatisées)
- ☐ e. Utiliser un appareil oscillométrique électronique (avec mesures multiples automatisées)

4.14. Dans votre pratique, quelle est la méthode usuelle pour mesurer la pression artérielle chez les patients obèses?

- ☐ a. Je ne sais pas/Je ne suis pas certain
- ☐ b. Brassard standard, appliqué au-dessus du coude
- ☐ c. Brassard large ou extra-large, appliqué au-dessus du coude
- ☐ d. Brassard pour cuisse, appliqué au-dessus du coude
- ☐ e. Brassard standard, appliqué au niveau du poignet
- ☐ f. Brassard pour poignet, appliqué au niveau du poignet
- ☐ g. Brassard standard, appliqué au niveau de l'avant-bras

4.15. Identifiez jusqu'à trois éléments potentiels que vous considérez comme étant des barrières qui limitent votre intérêt à utiliser la MPAC.

- ☐ a. MPAC non-disponible sur mon lieu de travail
- ☐ b. Manque de ressources et d'équipements pour mesurer la pression artérielle
- ☐ c. Manque de temps pour suivre les lignes directrices portant sur la MPAC
- ☐ d. Manque de temps pour calculer une moyenne
- ☐ e. Matériel éducatif non-disponible à mon lieu de pratique
- ☐ f. Autre, veuillez spécifier

SECTION 5 / 5 : QUESTIONS GÉNÉRALES

Pour les questions suivantes, cochez la case qui correspond à votre choix de réponse.

5.1. À quel groupe d'âge appartenez-vous?

☐ a. < 30 ans ☐ b. 30-39 ans ☐ c. 40-49 ans ☐ d. 50-59 ans ☐ e. ≥ 60 ans

5.2. Indiquez votre sexe.

☐ a. Masculin ☐ b. Féminin ☐ c. Je préfère ne pas répondre

5.3. Indiquez votre profession.

- ☐ Médecin de famille
- ☐ Autre, veuillez spécifier

		a. ≤ 3 ans	b. 4-10 ans	c. ≥ 11 ans
5.4.	Depuis combien d'années pratiquez-vous votre profession?	☐ a. ≤ 3 ans	☐ b. 4-10 ans	☐ c. ≥ 11 ans
5.5.	Combien d'années avez-vous exercé à temps complet dans un contexte de soins de première ligne?	☐ a. ≤ 3 ans	☐ b. 4-10 ans	☐ c. ≥ 11 ans

		a. Oui, une formation théorique uniquement (articles, conférences, etc.)	b. Oui, une formation pratique uniquement	c. Oui, une formation théorique et pratique	d. Non, jamais reçu de formation
5.6.	Durant vos années de pratique, avez-vous déjà reçu de la formation spécifique sur la mesure de la pression artérielle?	☐ a. Oui, une formation théorique uniquement (articles, conférences, etc.)	☐ b. Oui, une formation pratique uniquement	☐ c. Oui, une formation théorique et pratique	☐ d. Non, jamais reçu de formation

		a. Hypertension Canada	b. La société québécoise d'hypertension artérielle (SQHA)	c. Je suis membre de ces deux sociétés	d. Je ne suis pas membre d'aucune de ces sociétés
5.7.	De quelle(s) société(s) dédiée à l'hypertension êtes-vous membre?	☐ a. Hypertension Canada	☐ b. La société québécoise d'hypertension artérielle (SQHA)	☐ c. Je suis membre de ces deux sociétés	☐ d. Je ne suis pas membre d'aucune de ces sociétés

Special document

Annexe 22. Reference list of poster presentation for scoping review

Todkar, SK, Padwal R, Chauvette S, Cloutier L. (2019, September). A scoping review for knowledge, perception and practice of health professionals regarding blood pressure measurement methods. Poster Presented at Canadian Hypertension Congress, Edmonton, Alberta, Canada.

Todkar,SK, Padwal R, Cloutier L._"*Health professionals and blood pressure measurement: scoping review and protocol for knowledge, perception and practice* " Poster Presented at UQTR le concours d'affiches scientifiques ; 2019 March 20; UQTR Trois Rivières, Quebec, Canada.

Todkar,SK, Padwal R, Cloutier L. "Health professionals and blood pressure measurement: scoping review and protocol for knowledge, perception and practice " Poster Presented at 28th European meeting on hypertension and cardiovascular protection; 2018 Jun 8-11; Barcelona, Spain.

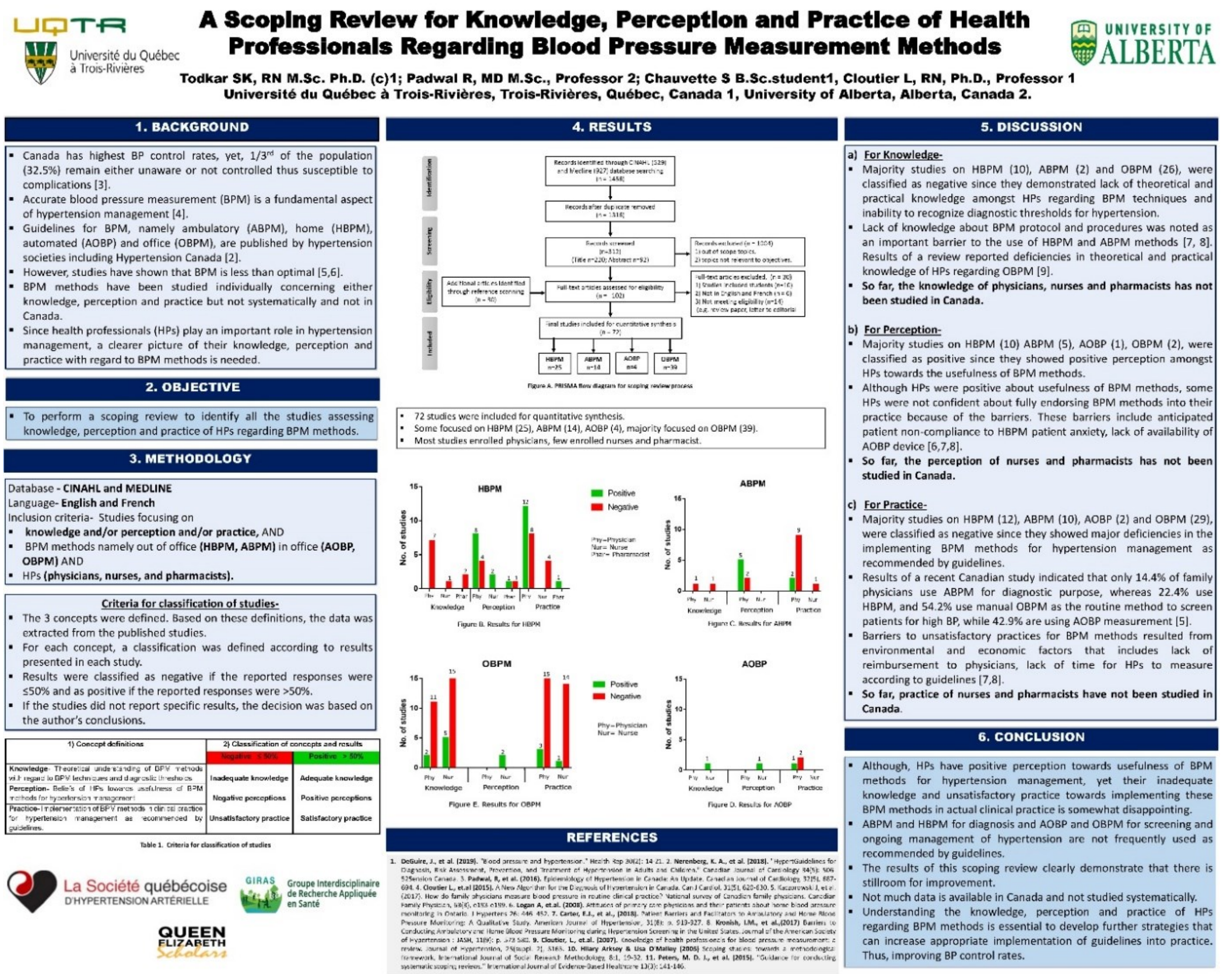
Todkar, SK, Padwal R, Leclerc AM & Cloutier L. "Scoping review of knowledge, perception and practices of health professionals in regard to home blood pressure measurement." Poster Presented at: UQTR concours d'affiches scientifiques ; 2018 Mar 21-22; UQTR Trois Rivieres, Quebec, Canada.

Todkar,SK Padwal R, Leclerc AM & Cloutier L. "Scoping review of knowledge, perception and practices of health professionals in regard to home blood pressure measurement". Poster Presented at: L'hypertension artérielle et le cerveau, 26e Réunion scientifique annuelle; 2018 Jan 25-26;Quebec,Canada.

Todkar, SK Padwal R, Leclerc AM & Cloutier L. "Scoping review of knowledge, perception and practices of health professionals in regard to home blood pressure measurement." Poster Presented at Canadian hypertension Congress; 2017 Oct 12-14; Toronto, Canada.

Todkar, SK & Cloutier L. "Assessment of knowledge, perception and practices of Canadian health care professionals in regard to blood pressure measurement in primary health care settings. A review". Poster Presented at: Le rein et l`hypertension artérielle, 25e Réunion Scientifique Annuelle; 2017 Jan19-20;Montreal, Canada.

Annexe 23. Posters for scoping review



A Scoping Review for Knowledge, Perception and Practice of Health Professionals Regarding Blood Pressure Measurement Methods

Université du Québec à Trois-Rivières

UNIVERSITY OF ALBERTA

Todkar SK, RN M.Sc. Ph.D. (c)1; Padwal R, MD M.Sc., Professor 2; Chauvette S B.Sc.student1, Cloutier L, RN, Ph.D., Professor 1
Université du Québec à Trois-Rivières, Trois-Rivières, Québec, Canada 1, University of Alberta, Alberta, Canada 2.

1. BACKGROUND

- Canada has highest BP control rates, yet, 1/3rd of the population (32.5%) remain either unaware or not controlled thus susceptible to complications [3].
- Accurate blood pressure measurement (BPM) is a fundamental aspect of hypertension management [4].
- Guidelines for BPM, namely ambulatory (ABPM), home (HBPM), automated (AOBP) and office (OBPM), are published by hypertension societies including Hypertension Canada [2].
- However, studies have shown that BPM is less than optimal [5,6].
- BPM methods have been studied individually concerning either knowledge, perception and practice but not systematically and not in Canada.
- Since health professionals (HPs) play an important role in hypertension management, a clearer picture of their knowledge, perception and practice with regard to BPM methods is needed.

2. OBJECTIVE

- To perform a scoping review to identify all the studies assessing knowledge, perception and practice of HPs regarding BPM methods.

3. METHODOLOGY

Database - **CINAHL and MEDLINE**
Language- **English and French**
Inclusion criteria- Studies focusing on

- **knowledge and/or perception and/or practice,** AND
- BPM methods namely out of office **(HBPM, ABPM)** in office **(AOBP, OBPM)** AND
- HPs **(physicians, nurses, and pharmacists).**

Criteria for classification of studies-

- The 3 concepts were defined. Based on these definitions, the data was extracted from the published studies.
- For each concept, a classification was defined according to results presented in each study.
- Results were classified as negative if the reported responses were ≤50% and as positive if the reported responses were >50%.
- If the studies did not report specific results, the decision was based on the author's conclusions.

1) Concept definitions	2) Classification of concepts and results	
	Negative ≤ 50%	Positive > 50%
Knowledge- Theoretical understanding of BPM methods with regard to BPM techniques and diagnostic thresholds	Inadequate knowledge	Adequate knowledge
Perception- Beliefs of HPs towards usefulness of BPM methods for hypertension management	Negative perceptions	Positive perceptions
Practice- Implementation of BPM methods in clinical practice for hypertension management as recommended by guidelines.	Unsatisfactory practice	Satisfactory practice

Table 1. Criteria for classification of studies

La Société québécoise D'HYPERTENSION ARTÉRIELLE

GIRAS Groupe Interdisciplinaire de Recherche Appliquée en Santé

QUEEN ELIZABETH Scholars

4. RESULTS

Figure A. PRISMA flow diagram for scoping review process

- 72 studies were included for quantitative synthesis.
- Some focused on HBPM (25), ABPM (14), AOBP (4), majority focused on OBPM (39).
- Most studies enrolled physicians, few enrolled nurses and pharmacist.

Figure B. Results for HBPM

Figure C. Results for ABPM

Figure E. Results for OBPM

Figure D. Results for AOBP

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5. DISCUSSION

a) **For Knowledge-**

- Majority studies on HBPM (10), ABPM (2) and OBPM (26), were classified as negative since they demonstrated lack of theoretical and practical knowledge amongst HPs regarding BPM techniques and inability to recognize diagnostic thresholds for hypertension.
- Lack of knowledge about BPM protocol and procedures was noted as an important barrier to the use of HBPM and ABPM methods [7, 8]. Results of a review reported deficiencies in theoretical and practical knowledge of HPs regarding OBPM [9].
- **So far, the knowledge of physicians, nurses and pharmacists has not been studied in Canada.**

b) **For Perception-**

- Majority studies on HBPM (10) ABPM (5), AOBP (1), OBPM (2), were classified as positive since they showed positive perception amongst HPs towards the usefulness of BPM methods.
- Although HPs were positive about usefulness of BPM methods, some HPs were not confident about fully endorsing BPM methods into their practice because of the barriers. These barriers include anticipated patient non-compliance to HBPM patient anxiety, lack of availability of AOBP device [6,7,8].
- **So far, the perception of nurses and pharmacists has not been studied in Canada.**

c) **For Practice-**

- Majority studies on HBPM (12), ABPM (10), AOBP (2) and OBPM (29), were classified as negative since they showed major deficiencies in the implementing BPM methods for hypertension management as recommended by guidelines.
- Results of a recent Canadian study indicated that only 14.4% of family physicians use ABPM for diagnostic purpose, whereas 22.4% use HBPM, and 54.2% use manual OBPM as the routine method to screen patients for high BP, while 42.9% are using AOBP measurement [5].
- Barriers to unsatisfactory practices for BPM methods resulted from environmental and economic factors that includes lack of reimbursement to physicians, lack of time for HPs to measure according to guidelines [7,8].
- **So far, practice of nurses and pharmacists have not been studied in Canada.**

6. CONCLUSION

- Although, HPs have positive perception towards usefulness of BPM methods for hypertension management, yet their inadequate knowledge and unsatisfactory practice towards implementing these BPM methods in actual clinical practice is somewhat disappointing.
- ABPM and HBPM for diagnosis and AOBP and OBPM for screening and ongoing management of hypertension are not frequently used as recommended by guidelines.
- The results of this scoping review clearly demonstrate that there is stillroom for improvement.
- Not much data is available in Canada and not studied systematically.
- Understanding the knowledge, perception and practice of HPs regarding BPM methods is essential to develop further strategies that can increase appropriate implementation of guidelines into practice. Thus, improving BP control rates.

HEALTH PROFESSIONALS AND BLOOD PRESSURE MEASUREMENT: SCOPING REVIEW AND PROTOCOL FOR KNOWLEDGE, PERCEPTION AND PRACTICE

Todkar S[1], Ph.D. student biomedical sciences; Padwal R, MD MSC[2], Professor; Cloutier L[1], RN, Ph.D., Full Professor,
Université du Québec à Trois-Rivières, Canada[1] University of Alberta, Canada [2]

1-INTRODUCTION

- Hypertension affects 40% of the global adult population aged ≥ 25years [1].
- In Canada, approximately 23% of adult population have been diagnosed with hypertension [2].
- Even with significant improvement in BP control rates, one third of the population (32.5%) remain either unaware or not controlled thus susceptible to complications (coronary heart disease, chronic kidney disease, stroke) [3].
- Accurate blood pressure measurement (BPM) is a fundamental aspect of hypertension management [4].
- Inconsistency in BPM results into treatment inaccuracies and increased cardiovascular risk [4].
- Guidelines regarding BPM methods, namely in office, that includes office (OBPM) and automated (AOBP) and out of office, that includes ambulatory (ABPM) and home (HBPM), have been clearly established by hypertension societies across the globe including Hypertension Canada [5]. However, studies have been published stating that BPM is less than optimal [4,5].
- Since health professionals (HP) play an important role in BPM and hypertension management, a clearer picture of the knowledge, perception and practice of HP is needed.

2-OBJECTIVE

- **To perform scoping review and identify literature relevant to knowledge, perception and practice of HP regarding in office and out of office BPM methods.**

3-METHODOLOGY

- Literature search databases- **CINAHL and MEDLINE.**
- Language - **English and French.**
- Inclusion criteria- Studies included had to have a focus on one of the 3 themes: **knowledge, perception, practice**, AND BPM methods in office *(OBPM or AOBP)* or out of office (HBPM or ABPM) AND HP (**physicians, nurses, pharmacist**).
- Exclusion criteria- Studies including students (medicine, nursing and pharmacy) were excluded.

4-RESULTS

- 74 relevant studies were identified, 68 met the inclusion criteria.
- Majority of studies enrolled physicians, whereas few studies enrolled nurses and pharmacist.
- Due to a lesser number of studies on AOBP (1) and ABPM (7), the results displayed in graphics are for OBPM and HBPM

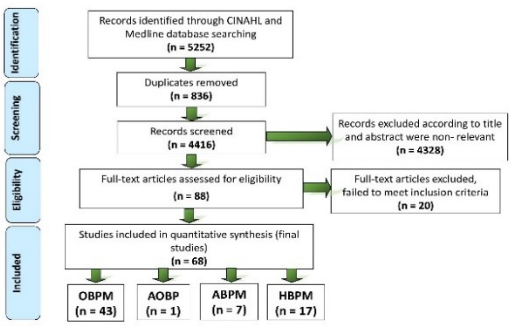

Figure: 1 Flow chart for literature search (Adapted from PRISMA flow diagram (2009)

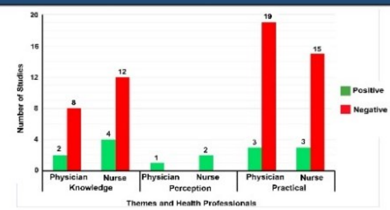

Figure 2. Results for office BP measurement

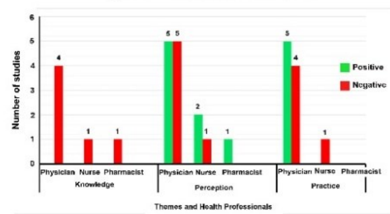

Figure 3. Results for home BP measurement

5-DISCUSSION

1. **OBPM**

- **Knowledge:** Majority of the studies found a general lack of knowledge among physicians and nurses regarding correct BPM techniques (ex. unable to identify reference values for diagnosis of HTN).
- **Perception:** Very few studies (3) assessed this aspect. However, the ones identified showed positive perception among physicians and nurses towards usefulness of OBPM method in clinic. So far, perception of the HP has not been studied in Canada.
- **Practice:** Majority of the studies showed unsatisfactory practice regarding implementing OBPM method to measure BP correctly for diagnosis and management of hypertension. Results of these studies showed that majority of the physicians and nurses are still using the auscultatory technique to measure BP in clinic.
- So far, knowledge, perception and practice of pharmacists have not been studied.

2. **AOBP**

- **Knowledge and perception**: So far, knowledge and perception of HP have not been studied.
- **Practice:** So far, there is only one study available for AOBP that partially studied the practice of Canadian physicians and the results showed that only 31.1% physicians were using AOBP method for diagnosis of hypertension [6]. So far, practice of nurses and pharmacists have not been studied.

3. **ABPM**

- **Knowledge**: So far, knowledge of HP has not been studied for ABPM.
- **Perception:** Majority of the studies identified showed positive perception among majority of physicians towards usefulness of ABPM for diagnostic purpose and ongoing management of hypertension.
- **Practice:** Majority of the studies identified showed unsatisfactory practice among physicians and nurses towards utilizing ABPM in clinical practice for diagnostic purpose. So far, practice of nurses and pharmacist have not been studied in Canada.

4. **HBPM**

- **Knowledge:** Majority of the studies found inadequate knowledge concerning HBPM guidelines and unable to correctly recognize reference values for the diagnosis of hypertension using HBPM. So far, knowledge of HP has not been studied in Canada.
- **Perception:** Mixed results were found. Some studies showed positive perception among physicians and nurses while others showed less positive perception towards usefulness of HBPM for diagnostic purpose and follow-up.
- **Practice:** Results showed unsatisfactory practices among majority of the physicians and nurses towards implementing HBPM for diagnostic purpose and recommending HBPM to their patients.
- So far, knowledge, perception and practice of nurses and pharmacist have not been studied in Canada.

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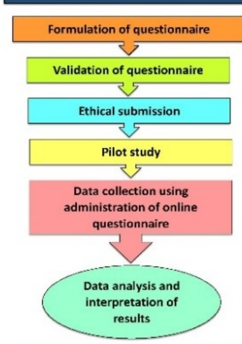
6-FUTURE WORK (PROTOCOL OF STUDY)



Following are some examples of themes for questions that will be used in the online questionnaire.

Knowledge

1. **Thresholds for diagnosis of hypertension using OBPM/ AOBP/ ABPM/HBPM.**
2. **Proper BP protocol.**

Perception

1. **Perception towards usefulness of ABPM.**
2. **Perception on the ability of the patients to perform HBPM.**

Practice

1. **Routine BPM method used for screening of hypertension.**
2. **Routine BPM method used for follow-up of patients with antihypertensive treatment.**

7-CONCLUSION

- **Correct knowledge, positive perceptions, and a practice that is up to par with the guidelines for BPM methods are essential components for accurate BPM.**
- **The present scoping review suggests that despite the different guidelines, majority of the HP across the globe have showed a lack of knowledge, less positive perceptions and an unsatisfactory practice towards BPM methods.**
- **There is a need to further explore the knowledge in this area and identify the gap between the guidelines and actual knowledge, perception and practice of HP in primary care setting, especially in Canada where not much data is available.**
- **This in turn will allow for implementation of strategies to reduce the gap between guidelines and practice.**

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SCOPING REVIEW OF KNOWLEDGE, PERCEPTION AND PRACTICES OF HEALTH PROFESSIONALS IN REGARD TO HOME BLOOD PRESSURE MEASUREMENT

Université du Québec à Trois-Rivières

UNIVERSITY OF ALBERTA

Todkar SK, inf.Msc[1], Padwal R, MD MSC[2], Leclerc AM, inf.Ph.D(c)[1], Cloutier L, inf.Ph.D[1]

Université du Québec à Trois-Rivières, Québec[1], University of Alberta, Alberta[2]

BACKGROUND

- Approximately 23% of Canadian population represent a major risk factor for cardiovascular diseases (1).
- Blood pressure control rate has improved progressively from 13.2% in 1992 to 64.6% in 2007 and to 68.1% (2013) most recently, but a 1/3rd of the population (32.5%) remains either unaware or not controlled thus susceptible to complications (1,2).
- Blood pressure measurement (BPM) is a fundamental aspect of hypertension management. Guidelines regarding BPM have been widely available in Canada (3).
- Home BPM (HBPM) is strongly recommended in performing out of office measurement specifically for diagnostic purpose (3) .
- Health professionals (HP) play important role in BPM and hypertension management. Therefore it is necessary that HP follow the recommended procedures to measure BP accurately and also ensure their patients have adequate training to measure their BP at home (4). However it has been seen that HBPM practices among patients are suboptimal (5).
- Knowledge, perception and practices of HP was assessed in different countries but very little has been done in Canada.

OBJECTIVE

To review the literature relevant to knowledge, perception and practices of health professionals regarding HBPM.

METHODOLOGY FOR REVIEW

- **Literature search data base**- CINAHL and MEDLINE databases.
- **Language**- English and French.
- **Inclusion criteria**- Studies included focused on the **3 domains knowledge, perception, practices,** and **method of BPM (HBPM)** and **health professionals** (HP) respectively

RESULTS FOR HBPM

- 67 relevant studies were identified, 16 met the inclusion criteria.
- 12 studies enrolled physicians, 3 nurses and 1 pharmacists
- 8 (50%) studies were web based surveys.

Table1: Overall results of scoping review

YEAR	AUTHORS	COUNTRY	HP			Knowledge			Perception			Practices		
			Phy	Nur	Pha	-	+/-	+	-	+/-	+	-	+/-	+
2003	Cheng	USA	✓											
2006	Tisler	Hungary	✓											
2008	Logan	Canada	✓											
2010	Kobayashi	Japan	✓											
2010	Obara	Japan	✓											
2011	Boivin	France	✓											
2011	Steinmann	USA	✓											
2012	Obara	Japan			✓									
2012	Tsakiri	Greece	✓											
2013	Jones	UK	✓	✓										
2013	McManus	UK	✓											
2013	Tirabassi	USA	✓	✓										
2014	Sugano	Japan	✓											
2016	Fletcher	UK	✓											
2016	Ishikuro	Japan		✓										
2017	Kaczorowski	Canada	✓											
Total	16	16	14	3	1	5	1	0	0	5	7	1	3	5

Note** [Phy=Physicians, Nur= Nurses, Pha= pharmacist]
[+=positive, - = negative, +/-= mixed or less positive]

TABLE 2: Results of Scoping review from selected HBPM studies

Authors(Year) Country Guidelines	Participants, Sample, Response rate (%)	Domains assessed (no. of questions) K	Pc	Pr	Study Instrument (Mode Of distribution)	Barriers identified
Cheng (2003)[7] USA JNCVII 2003, ASH 1996	Physicians N=138 (81%)		X (19)		Self-administered questionnaire (Online)	• Large number of phone calls and office visits from patients. • Concern about elevated readings (both truly and incorrectly) caused by improper sphygmomanometer use.
Tisler (2006)[8] Hungary ESH 2003, 2005	Physicians N= 405 (58%)		X (21)		Self-administered questionnaire (Online)	• Use of non-validated devices. • Patients preoccupation with blood pressure. • Lack of proper patient training in the measurement technique.
Logan (2008)[9] Canada CHEP, 2007, AHA 2005	Physicians N=478 (34%)		X (28)		Self-administered questionnaire (Online)	• Lack of reliable device purchase. • Lack of standard measurement protocols. • Lack of proper measurement technique training and specific instructions on handling and interpreting results.
Kobayashi (2010)[10] Japan JSH 2004	In 2004-05 Physicians N=1966 (90%) In 2007-08 N=2995 (88%)	X (1)		X (5)	Self-administered questionnaire (Paper)	• Physicians' age, specialty and work place influenced their knowledge and practice (i.e younger physicians working in hospitals preferred HBPM then the older physicians)
Obara (2010)[11] Japan JSH 2004, JNC VII 2003, ESH 2007, ISH 2003	In 2004-05 Physicians N= 1966 (90%) In 2007-08 Physicians N=2995 (88%)	X (NA)		X (NA)	Self-administered questionnaire (Paper)	• Lack of knowledge on recommendation of number of HBP measurements. • Lack of documentation and evaluation of measured values. • Lack of patient counselling regarding HBPM values and its variability.
Boivin (2011)[12] France ESH 2007, HAS 2005	Physicians N=214 (84%)		X (12)		Self-administered questionnaire (Phone)	• Lack of reliability of devices • Lack of patient reliability • Patient anxiety.
Steinmann (2011)[13] USA JNC VII 2003, ESH 2003	Physicians N=69 (63%)		X (28)		Self-administered questionnaire (Paper)	• Device efficacy and device cost. • Methods to record and display HBPM readings. • Perceived patient barriers (physical in capabilities, poor eye sight, and anxiety).
Obara (2012)[14] Japan JSH 2009,JNCVII2003, ASH 2008, ESH 2007	Pharmacist N=859 (68%)	X (NA)	X (NA)		Self-administered questionnaire (Paper)	• Lack of availability of devices for patients. • Unclear role of pharmacist in JSH guidelines. • Lack of knowledge..
Tsakiri (2012)[15] Greece ESH 2008 & 2010, ASH 2008, JSH 2003	Physicians N=366 (87.4%)	X (7)		X (8)	Self-administered questionnaire (Phone)	• Device inaccuracy and device cost. • Unreliable measurement. • Patient anxiety and patient unwillingness. • Patient s obsession with HBPM. • Lack of knowledge.
Jones (2013)[16] UK NICE, 2011	Physicians N=13 (NA) Nurses N=3 (NA)		X (NA)		Questionnaire (semi structured interviews)	• Procedures for ensuring patients measure BP correctly. • Patient self-confidence & self-management. • Validity of device and home readings. • Effort and cost required for training for wider implementation of self-titration.
McManus (2013)[17] UK NICE 2011, ESH 2008	Physicians N=625 (67%)		X (NA)	X (NA)	Self-administered questionnaire (Online)	• Lack of recognition that self-monitored BP is lower than Clinic BP. • Lack of use of HBPM for diagnostic purpose. • Patient anxiety.
Tirabassi (2013)[18] USA JNCVII 2003	Physicians N=1000 (45.2%) Nurses N=254 (52.6%)		X (113)		Self-administered questionnaire (Online)	• Device cost . • Problems associated with HBPM use (patient can't afford it, pt. doesn't need it, pt. won't use it, won't use correctly).
Sugano (2014)[19] Japan JSH 2009, JNCVII 2003 ESH 2010	Physicians N= 330 (NA)	X (NA)			Self-administered questionnaire (Paper)	• Lack of information on use of HBPM to improve long-term patients' prognostic outcomes. • Lack of JSH guideline information about diagnostic, prognostic and therapeutic values of HBPM.
Fletcher (2016)[20] UK, NICE 2011, CHEP 2015	Physicians N=300 (88%)		X (NA)	X (NA)	Self-administered questionnaire (Online)	• Lack of appropriate thresholds for diagnosis with HBPM. • Lack of training for patients on HBPM. • Lack of methods to display results of HBPM.
Ishikuro (2016)[21] Japan JSH, 2004	Nurses N=6002 (61.8%)	X (8)	X (3)	X (3)	Self-administered questionnaire (Online)	• Lack of knowledge. • Lack of patient counselling about device.
Kaczorowski (2017)[3] Canada CHEP, 2015	Physicians N= 774 (16.2%)			X (8)	Self-administered questionnaire (Online)	• Cost of devices & financial barriers at patient and physician level. • Poor measurement techniques. • Failure to follow recommended guidelines.

DISCUSSION

KNOWLEDGE

- Knowledge was a less studied aspect. Of 6 studies identified 5 studies showed lack of knowledge. Lack of knowledge was seen among studies performed in Europe and Asia. Majority of HPs were unable to correctly recognize the reference values, correct technique and HBPM guidelines. So far, no Canadian study has assessed knowledge of HP regarding HBPM.

PERCEPTION

- Perception was the most studied aspect. Of 12 studies identified, 7 studies showed positive perception towards the use of HBPM while 5 found less positive perception. Less positive perceptions were seen among studies performed in USA, Canada, Europe, and UK. So far only 1 study in Canada assessed the perception of HP and identified less positive perception. Yet majority of HP recognized importance of HBPM in hypertension management and are recommending it to their patients.

PRACTICES

- Practice was moderately studied aspect as compared to knowledge. Of 9 studies identified, 5 studies showed satisfactory practices while 4 found less satisfactory practices. Less satisfactory practices were seen among studies performed in France, Japan and Canada. More than half of the physicians still use manual OBPM (54.2%) and continue to use techniques that are not recommended by CHEP (6). On contrary, studies performed in Europe demonstrated majority of physicians used HBPM for diagnosis and ongoing management of hypertension (15,17,20).

CONCLUSION

- **Knowledge, perception and good practices are essential components of accurate BPM.**
- **The present scoping review suggest that despite the CHEP recommendations, Canadian physicians still use suboptimal BPM for screening and diagnosis of hypertension and majority do not follow the recommended techniques for BPM (6).**
- **Not much data is available in Canada and although the results could be similar to the results found in other countries.**
- **However, there is a need to identify the gap between recommended guidelines and actual knowledge, perception and practices in primary care. This will enable implementation strategies to reduce the gap**

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ASSESSMENT OF KNOWLEDGE, PERCEPTION AND PRACTICES OF CANADIAN HEALTH CARE PROFESSIONALS IN REGARD TO BLOOD PRESSURE MEASUREMENT IN PRIMARY HEALTH CARE SETTINGS. A REVIEW

UQTR Université du Québec à Trois-Rivières

Todkar, S K inf., MSc[1], étudiante PhD sciences biomédicales & Cloutier L inf., PhD Professeure titulaire[1],
Département des Sciences Infirmières, Université du Québec à Trois-Rivières

GIRAS Groupe Interdisciplinaire de Recherche Appliquée en Santé

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BACKGROUND

- Blood pressure control rate has improved progressively from 13.2% in 1992 to 64.6% in 2007 and to 68.1% (2013) most recently, but a one third of the population (32.5%) remains either unaware or not controlled thus susceptible to complications (1,2).
- The guidelines with regard to the accepted BPM methodology are clearly described and have been widely available in Canada to improve blood pressure control.
- Important changes have taken place recently in the diagnostic algorithm including the addition of automated blood pressure measurement (AOBP) (3).
- However, knowledge, perception and practices of health care professionals (HCP) has not been assessed since the implementation of those changes.
- With the goal to improve blood pressure screening and hypertension management, we intend to assess the 3 domains with regard to all BPM methods in primary health care settings across Canada.
- A validated questionnaire will be developed and pretested. A review of all studies having previously assessed these BPM methods will be performed to identify key concepts and results

OBJECTIVE

To review the literature relevant to knowledge, perception and practices of health care professionals in regard to office (OBPM, AOBP) and ambulatory measurements (ABPM, HBPM)

METHODOLOGY FOR POSTER

1. **Data base**- CINAHL and Medline
2. **Language**- English
3. **Key words** - BPM, monitoring, determination AND HBPM, OBPM, AOBP, ABPM AND knowledge, perception, practices, AND doctors, physicians, nurses, pharmacists.
4. **Inclusion criteria**- Literature included focused on the 3 domains, 3 methods of BPM (HBPM, OBPM, ABPM) and health care professionals respectively

RESULTS FOR HBPM LITERATURE REVIEW

Authors, Year, Country, GUIDELINES	Aim	Population (N)	Domain: Knowledge (No. Of Items)	Domain: Perception (No. Of Items)	Domain: Practices (No. Of Items)	Instrument (mode of distribution)	Results
Cheng C.et.al 2003 USA JNC VII 2003 ASH 1996	To assess community and university based primary care physician opinions about HBPM.	Primary care physicians (138)	-	✓ (19)	-	Web based questionnaire	Perceptions were positive. •94% were positive with HBPM use for treating hypertension. •46% agreed HBPM could enhance compliance. •52% perceived HBPM could cause problem in treating hypertension. •Community-based PCP were more positive than university-based PCP to believe in the benefits of HBPM use.
Tisler A, et.al 2006 Hungary ESH 2003&2005	To obtain the views of Hungarian primary care physicians about HBPM.	Primary care physicians (405)	-	✓ (N/A)	✓ (N/A)	Web based questionnaire	Perceptions were positive. •90% PCP recommended HBPM often or almost all the time to their patients. •75% considered results of HBPM of either considerable or extreme importance. Practices were satisfactory. •93.5% use HBPM for diagnostic purpose, whereas 98.2% use HBPM for therapeutic purpose.
Logan AG et.al 2007 Ontario, CA JNC VII 2003 ESH 2003 CHEP 2007	To assess the attitudes of Primary care physicians and their hypertensive patients on the use of HBPM to manage hypertension.	Primary care physicians (478)	-	✓ (N/A)	✓ (N/A)	Self-administered questionnaire	**<u>Perceptions were less positive</u>.** •Only 13% physicians preferred HBPM to office or ambulatory readings for diagnostic purpose whereas as 19% for guide therapy. •52% PCP considered HBPM as part of standard hypertension care in their community. **<u>Practices were satisfactory by patients, and less satisfactory by physicians</u>.** •Majority of the hypertensive patients 84% use HBPM. •63% PCP encouraged their hypertensive patients to use HBPM. •PCP preferred office or ambulatory to HBPM to make diagnostic and therapeutic decisions.
Tirabassi J,et.al 2010 Atlanta, USA JNC VII 2003	To assess primary care provider's attitudes related to recommending HBPM.	Family practitioners (539) Internists (461) Nurse practitioners (254)	-	✓ (113) .	-	Web based questionnaire	**<u>Perceptions were less positive.</u>** •32% FP recommended HBPM to >90% of their patients •26% interns recommended HBPM to <40% of their patients. •Majority 40% NP`s recommended HBPM to >90%patients. This shows NP`s were more positive to recommend HBPM than the PCP.
Steinmann WC et.al 2011 USA JNC VII 2003 ESH 2003 & 2008	To assess the attitude, practices of primary care physicians and specialist regarding HBPM	Primary care physicians (36) Subspecialist (33)	-	✓ (N/A)	✓ (N/A)	Self-administered questionnaire	Perceptions were positive. •Both groups consider that HBPM as the standard part of their practice Practices were satisfactory. •100% clinicians and 75% PCP use HBPM for diagnostic purpose •90% of PCP and clinicians use and recommend HBPM to their patients for therapeutic purpose r practice.
Obara T et.al 2012 Japan JSH 2009 JNC VII 2003 ESH 2007 ASH 2008	To investigate the status of Japanese pharmacists awareness and attitude toward HBPM.	Community pharmacist (708) Hospital pharmacist (117)	✓ (N/A)	✓ (N/A)	-	Self-administered questionnaire	**<u>Knowledge was less adequate</u>** •52.2% CP and 49.9% HP were aware of JSH HBPM guidelines, whereas 90% both CP & HP were aware of JSH 2004 guidelines. •Only 15% both CP & HP had correct knowledge about reference values. Perceptions were positive. •90% CP & HP considered HBPM important than clinic BP. •71.9% CP & 48.7% HP recommended HBPM to their patients.
McManus RJ,et.al 2014 UK NICE 2011	To ascertain current views and practice of primary care physicians on HBPM.	Primary care physicians (625)	-	✓ (N/A)	✓ (N/A)	Web based questionnaire	**<u>Perceptions were negative.</u>** •Majority of PCP consider HBPM as complementary to ABPM. Practices were satisfactory. •90% PCP were aware of self-monitoring among their patient. •83% PCP use HBPM for ongoing management of hypertension.

ANALYSIS FOR HBPM

- HBPM can be used in the diagnosis of hypertension (CHEP guidelines, 2016).
- 10 studies corresponding to criteria were identified. Out of these 7 studies with strong evidence to inclusion criterias were selected.
- Majority of studies included physicians and only one study included pharmacist and nurses.

Knowledge:

- 1 study assessed the knowledge of pharmacists. Authors concluded that knowledge was inadequate (Obara T,et.al.2012,Japan). From the above 7 studies, no study assessed the knowledge of physicians and nurses.

Perception:

- 4 out of 7 studies showed positive perception of PCP towards use of HBPM, whereas 2 studies showed less positive perception (Logan AG et.al,2007,CA) & (Tirabassi J,et.al2010,USA). Only 1 study showed negative perception (McManus RJ,et.al,2014, UK).

Practices:

- 3 out of 4 studies demonstrated that practices of PCP were satisfactory, whereas only 1 study showed less satisfactory practices among physicians (Logan AG et.al,2007,CA).

OBPM

- We are still collecting more information about the studies done on OBPM in Canada and worldwide.
- Some studies have assessed (OBPM) knowledge and practice of Canadian family physicians some 25 years ago, and a more recently nurses in Québec.Both studies had identified shortfalls in knowledge and practices (4,5).
- No recent articles addressing the issue in Canada has been identified.

ABPM and AOPB

- Studies identified have mainly focused on validation of the devices and the usefulness of BPM methods for the diagnosis and management of hypertension.
- So far, to our best knowledge, no studies have been found addressing more specifically the knowledge, perception and practices of health care professionals.

DISCUSSION

<u>Knowledge</u>:

- The literature review for HBPM gives the idea that so far no studies are conducted to assess knowledge of physicians and nurses about HBPM. Only one study assessed the knowledge of pharmacist which was found to be inadequate.

<u>Perception:</u>

- One of our selected study assessed the perception of nurses about HBPM and 40% NP were positive about HBPM. While studies conducted on physicians show they have a mixed perception about HBPM use.

<u>Practices:</u>

- No studies assessed the practices of nurses about HBPM, whereas studies that assessed the practices of physicians about HBPM were found to be satisfactory. However, a study done in Ontario suggested less satisfaction among physicians

CONCLUSION

- For accurate BP measurement, knowledge, perception and good practices are essential components.
- However, these themes (knowledge, perception, practices) were not studied in detail in regard to BPM methods (HBPM, OBPM, ABPM, AOBP) particularly in Canada.
- **Therefore, our main goal is to study these themes among Canadian HCP and to identify the gap between recommended guidelines and actual practices at primary care center to design new protocols to eliminate the gap**

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Annexe 24. Reference list of poster presentation for study on nurses, physicians, and pharmacists

Todkar SK, Padwal R, Cloutier L. (2021, May). *"Knowledge, perception, and practice of Quebec health professionals for ambulatory and clinic blood pressure measurement methods: Preliminary results."* Poster Presented at the 2021 Hypertension Canada Virtual Congress; 2021 May 13-14; in mode virtual, Canada.

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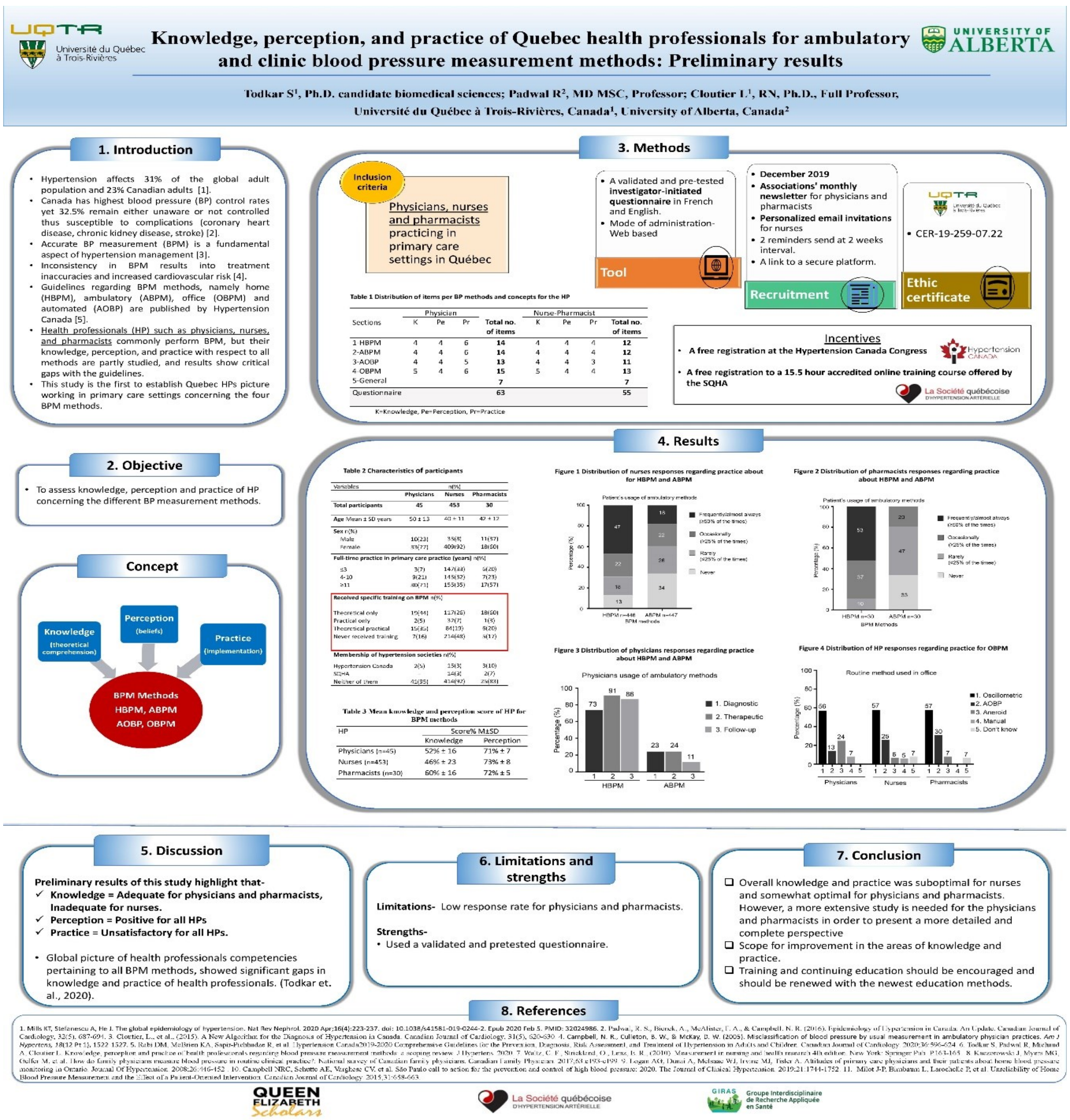
Todkar SK, Padwal R, Cloutier L. (2021, January). *"Québec physicians and the measurement of blood pressure; preliminary results of their knowledge, perceptions and practices"* Oral presentation at the 29e Réunion scientifique annuelle de la SQHA, la thématique maladies cardiovasculaires et COVID-19 - De multiples cibles en jeu; 2021 January 22; en mode Virtual, Canada.

Annexe 25. Posters for study on nurses, physicians, and pharmacists

Hypertension Canada congress 2021



ESH congress 2021

SQHA congress 2021