

STATE-OF-THE-ART REVIEW

Hypertension in Canada: Past, Present, and Future



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Abstract

Canada has an extremely successful hypertension detection and treatment program. The aim of this review was to highlight the historic and current infrastructure and initiatives that have led to this success, and the outlook moving forward into the future. We discuss the evolution of hypertension awareness and control in Canada; contributions made by organizations such as the Canadian Hypertension Society, Blood Pressure Canada, and the Canadian Hypertension Education Program; the amalgamation of these organizations into Hypertension Canada; and the impact that Hypertension Canada has had on hypertension care in Canada. The important contribution that public policy and advocacy can have on prevention and control of blood pressure in Canada is described. We also highlight the importance of population-based strategies, health care access and organization, and accurate blood pressure measurement (including ambulatory, home, and automated office modalities) in optimizing hypertension prevention and management. We end by discussing how Hypertension Canada will move forward in the near and longer term to address the unmet residual risk attributable to hypertension and associated cardiovascular risk factors. Hypertension Canada will continue to strive to enhance hypertension prevention and control rates, thereby improving the quality of life and cardiovascular outcomes of Canadians, while at the same time creating a hypertension care model that can be emulated across the world.

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BLOOD PRESSURE CANADA AND THE CANADIAN HYPERTENSION EDUCATION PROGRAM

Historically, management of chronic conditions such as hypertension (HTN) was left to the discretion and initiative of individual family physicians and specialists. Because specialist access in Canada generally requires a referral from a family physician,

the vast majority of HTN care occurred, and still occurs, at a primary-care level. Screening, diagnosis, and control of HTN historically had been carried out in an uncoordinated manner; almost solely by primary-care providers (PCPs) with little involvement from secondary and tertiary care providers. The poor outcomes of this laissez-faire approach are well known in Canada where HTN control rates were only 13% in the late 1980s.¹

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In 1986, a joint federal/provincial government committee developed a HTN prevention and control strategy for Canada that had a main recommendation for creating a coalition of nongovernment and government organizations to implement actions for HTN prevention and control.² In 1990, the coalition (later known as Blood Pressure Canada) with the Canadian Hypertension Society developed consensus recommendations for lifestyles for prevention and control of HTN.³ In the 1990s, Blood Pressure Canada developed a series of guidelines for assessing blood pressure (BP), improving adherence to lifestyle and pharmacotherapy, home/self-assessment of BP and with the Canadian Hypertension Society, the first set of lifestyle recommendations that systematically assessed and graded evidence and recommendations, as well as provided an update to pharmacotherapy and diagnosis, and which through Hypertension Canada, continue being issued till today.^{4–9} Various short-lived implementation programs and resources were developed to increase the effect of the recommendations. In the late 1990s, driven by recognition that the control rate for HTN in the United States was twice as high as in Canada, Blood Pressure Canada led the development of an updated national HTN strategy.¹⁰ In considering how to operationalize the strategy, plans were created for a markedly enhanced HTN recommendations process (later named the Canadian Hypertension Education Program [CHEP]).¹¹

CHEP was designed to improve BP control by establishing the Recommendations Task Force with a unique process and rigor. However, it was quickly realized in creating CHEP that to be successful much work was needed with implementation, and an Implementation Task Force was established. Subsequently, it was recognized that there was a need to measure and assess what had been achieved, thus the creation of an Outcomes Task Force to use national administrative data to assess the effects of the guidelines. Then, when it looked like the process was not influencing individual practitioners enough, community and system initiatives were put in place that would allow achieving the desired objectives. Along the way, the need to focus not just on the medical model of physician–patient was recognized, so patients, the public, and other health care providers were engaged as well. Coincident with this was the need to prevent HTN rather than just detect and treat, hence the inclusion of public health and policy initiatives, coalitions, and so on. Some of these

newer areas are particularly highlighted in this review.

Unique features of the CHEP included oversight by a steering committee of organizations representing primary care, government, the Heart and Stroke Foundation of Canada, and hypertension societies; annual updates to the recommendations; an evolving and extensive implementation program; and, later, an outcomes assessment and evaluation process.¹¹ The program was associated with large increases in diagnosis of HTN from 1992 to 2013 (57% to 84.3%), drug treatment (35% to 80%), and control of HTN (13% to 68%), and large reductions in the national rates of death and hospitalization from cardiovascular diseases (CVD) acute myocardial infarction, heart failure, and stroke.^{12–14} To our knowledge, hardly any other guideline or process of any kind has effected national rates of death and disability to this extent.

In the late 1990s, Blood Pressure Canada with the Canadian Hypertension Society developed a funded leadership position (chair) dedicated to the prevention and control of HTN.^{15,16} The HTN prevention and control chair has been in place since 2006. Guided by the chair, Blood Pressure Canada introduced 2 substantive new programs in 2006. One program was to educate, using lay language versions of the CHEP clinical recommendations, Canadians with or at risk for HTN.¹⁷ The other program was to educate the public and health care professionals about dietary sodium and to advocate for policies to reduce dietary sodium.¹⁸ The latter process led to a Blood Pressure Canada policy statement calling for a national strategy to reduce dietary sodium to recommended levels supported by 24 national health and scientific organizations. Blood Pressure Canada was subsequently represented on the intersectorial steering committee of the Canadian Dietary Sodium Strategy overseen by Health Canada 2007–2010. The Canadian Dietary Sodium Strategy called for a reduction in dietary sodium in Canada to 2300 mg/d by 2016 and has been a priority program for the provinces and territories of Canada.¹⁹ In 2009, a process was developed to merge Blood Pressure Canada, CHEP, and the Canadian Hypertension Society that culminated in the formation of Hypertension Canada in 2010. Appendix 2 of the full Pan Canadian Hypertension Framework²⁰ provides detailed information on the evolution of the effort to improve HTN control in Canada.

The trajectory of the HTN initiative in Canada continues upward. The ad hoc series of HTN

recommendations that occurred through the latter part of the 20th century has now evolved into an organized, structured process characterized by annual recommendation updates linked with systematized dissemination and implementation. This disease management process has few other chronic disease management comparators on a global basis. Notably, as the process has matured, it has taken a more comprehensive approach to risk management, including recommendations for health behaviors important for prevention of obesity and diabetes as well as HTN. Furthermore, CHEP is increasingly incorporating best practice recommendations for management of dyslipidemia and for smoking cessation—moving toward a more holistic position of CHEP providing guidance on best practices for reducing the risk for vascular disease. We would see this process continuing as both CHEP and Hypertension Canada develop as “primary prevention” initiatives.

The development of Hypertension Canada from its Canadian Hypertension Society and Blood Pressure Canada roots reflected the transition of the volunteer-led HTN initiative in Canada from a professional society to a disease-focused, not-for-profit organization. Notably, this transition follows that of other very successful cardiovascular organizations, including the American Heart Association, which started as group of concerned physicians and social workers in New York in the early 1900s. The future development of Hypertension Canada would be expected to be highly dependent on its future successes to favorably affect both the practice of health care professionals via CHEP but also the health behaviors of patients and the public. Furthermore, the most tangible benefit of the development of Hypertension Canada as an organization may well be its potential effect on policymakers who are instrumental in shaping public health policies to aid in HTN control and especially in prevention.

PUBLIC POLICY

Globally, HTN affects 40% of the world’s population age >25 and is the leading risk factor for death and disability.²¹ However, in hunter-gatherer populations, HTN is rare and BP does not increase with age.²²⁻²⁴ Notwithstanding genetic predisposition, HTN from an environmental perspective is attributed to high dietary salt/sodium (32%), obesity (32%), physical inactivity (17%), lack of dietary potassium (fruit and vegetables, 17%), and excessive alcohol consumption (3%).²⁵ In North America, the obesity epidemic largely has been attributed to

excess caloric consumption¹⁰; the ratio of saturated fats to polyunsaturated fats in diet also has a major effect on BP, hence poor diet contributes to about 80% of HTN.²⁵ Worldwide, diets are increasingly based on processed foods that are high in added salt/sodium, fats, and calories, and most diets lack fresh fruit, vegetables, meat, poultry, and fish.²⁶ Imbalanced, highly processed food diets are driving very high rates of HTN and noncommunicable diseases.^{21,26} Communities are increasingly structured in a fashion that discourages physical activity and mechanization of work sites similarly reduces physical activity. Finally, many areas of the world have a high prevalence of excess alcohol consumption.^{27,28}

Although important, efforts to provide education to improve diet and activity, and to reduce alcohol consumption have had almost no effect. It is well accepted that healthy public policies to create healthy environments and communities are required to encourage healthy choices in the places people work, live, and play.²⁹ In 2010, Hypertension Canada and the Hypertension Prevention and Control Chair (funded by the Heart and Stroke Foundation and the Canadian Institute for Health Research) oversaw the development of a new HTN strategy.³⁰ The new strategy was reviewed by major Canadian health and scientific organizations prioritizing advocacy for implementation of healthy food policies as the most important step to prevent and control HTN. In 2011, a Canadian Hypertension Advisory Committee of major national health and scientific organizations was formed to oversee implementation of the strategy.²⁰ The advisory committee has developed position statements that have broad support from the health and scientific community. These statements focus on the following:

- Restricting the marketing of unhealthy food to children;
- Using public funds to only purchase healthy foods;
- Implementing fiscal policy to tax unhealthy foods and subsidize healthy foods;
- Implementing easy-to-understand food labels that provide health implications;
- Implementing policies to reduce the effect of financial conflicts of interest (with the \$4 trillion per year food industry); and
- Enhancing research, monitoring, and evaluation on foods.

Other policies to reduce unhealthy alcohol consumption and to increase physical activity are highly recommended by the World Health Organization.^{28,31,32}

COMMUNITY-BASED INTERVENTIONS

The recent Canadian Health Measures Survey estimated that 1 in 5 Canadian adults has HTN and another 20% have BP in the prehypertensive range.³³ Although the rates for treatment and control of HTN in Canada have improved markedly over the past 30 years,³⁴ Canada, as most other countries, does not fare well in preventing or delaying the onset of HTN. The latest reports^{35,36} indicate that 85% of Canadians are not meeting the weekly physical activity recommendations; fruit and vegetable consumption is in decline; consumption of processed and fast foods as well as heavy alcohol consumption are on the rise; elevated rates of obesity and overweight remain virtually unchanged, putting roughly 60% of men and 45% of women at an increased health risk because of excess weight. To reverse these trends, effective prevention strategies integrated with primary health care must be urgently developed, rigorously evaluated, and widely implemented to prevent or delay the development of a cascade of debilitating and costly health complications associated with high BP.

Population-level interventions were identified as 1 of 2 mutually reinforcing prongs of action required to reduce the population burden of HTN in the 2011 Healthy Blood Pressure Framework developed by Hypertension Canada (the other being individual-level interventions focused on high-risk individuals).³⁰ A 2010 report on HTN prevention and control in the United States arrived at similar conclusions. The report pointed to a failure to translate public health and clinical knowledge into effective programs for prevention, treatment, and control of high BP as the reason for the persistence of HTN as a “neglected disease,” and emphasized the need for policy and system change to bridge public health and clinical care. Key recommendations included:

- A stronger focus on primary prevention through interventions to help reduce obesity;
- Support of healthy eating;
- An increase in physical activity; and
- Provision of community-based support for individuals with HTN through community-based programs and activities.³⁷

Community-based programs are the prime tools for implementing a population strategy of prevention. These programs encompass a wide range of interventions delivered synergistically in community settings to target an entire population. The rationale for targeting populations was best summarized in

seminal papers that “a large number of people at a small risk may give rise to more cases of disease than the small number who are at a high risk”³⁸ and that “the mass approach is inherently the only ultimate answer to the problem of a mass disease.”³⁹ There is little doubt that the most prevalent chronic health conditions today, including high BP, are largely the product of interactions among a small set of well-established, modifiable causes. The aim of population-based programs is to shift the distribution of these risk factors across the entire populations.

Several recent Canadian initiatives have shown encouraging results, some of them focusing on high-risk subgroups. These initiatives demonstrated both feasibility and benefits of implementing community- and pharmacy-based programs for the prevention and management of high BP in Canada. Cardiovascular Health Awareness Program (CHAP) is a patient-centered, interdisciplinary, multipronged, community-led CVD and stroke prevention and management program targeted at older adults. CHAP integrates community-based cardiovascular health promotion and chronic disease management activities through partnerships with primary care providers, community pharmacists, public health, locally recruited and trained older adult peer health educator volunteers, and community agencies. Local lead organizations run regular CHAPs in community pharmacies. Participants are referred to pharmacies by family physicians and through local advertising efforts. BP readings and other information relevant to the completion of a CVD and stroke risk assessment, such as physical activity, diet, body mass index (BMI), and smoking status, are recorded by peer health educator volunteers. These results are shared with the family physician, the regular pharmacist, and the participants themselves using action summaries and a secure, Internet-based portal. The age-matched peer health-oriented educators also provide participants with educational messages about lifestyle modification, refer to locally available resources, support adherence to prescribed therapies, and encourage and support involvement in self-care.

CHAP was rigorously evaluated using a community cluster randomized controlled trial involving 39 medium-sized communities (with populations of 10,000–60,000) in Ontario. More than 13,000 people age ≥ 65 in the CHAP communities attended cardiovascular risk assessment and education sessions that included BP measurement with automated BP devices. The sessions were run with the

assistance of almost 600 volunteers in community-based pharmacies over a 10-week period. Adjusting for hospital admission rates in the year before the intervention, after 1 year, CHAP was associated with a 9% reduction in hospital admissions at the population level for stroke, acute myocardial infarction, and congestive heart failure among residents aged ≥ 65 years ($P = .002$) relative to communities that did not implement CHAP.⁸

It is worth noting that the CHAP program has been recognized nationally and internationally as an innovative and successful program and that the results of CHAP were used as the main evidence supporting screening for HTN in the recently published recommendations by the Canadian Task Force on Preventive Health Care (CTFPHC)⁴⁰ and by the US Preventive Services Task Force.⁴¹

Effective, integrated health promotion programs and policies are the best tools to counteract the epidemics of obesity, hypertension, diabetes, heart disease, and stroke that are emerging worldwide.

EVOLUTION AND ROLE OF HEALTH CARE SYSTEMS IN HYPERTENSION CONTROL IN CANADA

Health care in Canada is universal, funded jointly by the federal and provincial governments, but it is delivered and administered through provincial and territorial government structures according to conditions set out by the federal Canada Health Act. The effectiveness of the contribution of a practitioner-based approach to improvement in HTN detection and control in Canada is unquestionable. However, significant care gaps still exist.^{42,43} When these care gaps are explored, it becomes apparent that many exist because of individuals who cannot, will not, or do not, access the health care system on a regular basis. In Canada, as in other countries, the role of the health care system in HTN prevention is apparent. Healthy food policies, policies regarding risk factors such as smoking, and other noncommunicable disease public health measures are well accepted as means by which HTN can be prevented and cardiovascular risk reduced. However, the evolution of Canada's health care system provides a further opportunity to close the care gaps in HTN detection, treatment, and control.

Perhaps the first care gap lies in the percentage of the population who are unaware of their HTN. This implies that screening efforts should be strengthened. However, population-based screening either

outside or isolated from primary-care settings has not been shown to be of benefit in terms of improving HTN treatment or control rates and, in fact, can actually have unintended adverse consequences.⁴⁴ Accordingly, focus has shifted to screening within a primary-care setting, where not only can disease be identified, but it also can be treated and followed, maintaining continuity of care. However, this does not address those individuals who do not access primary care on a regular or scheduled basis. Thus, rather than focusing on HTN management as an individual disease issue, health care across Canada is shifting toward alignment with principles of the medical home model.⁴⁵ In this model of care, each individual in the population has a PCP, supported to provide high-quality health care. The universal Canadian health care system ideally facilitates a process whereby each person in the population can have access to a PCP. Thus, the health of the entire population would be addressed, and no person would be excluded from care. The latter is also in keeping with the health systems shift to the "Triple Aim" approach to provide better care for individuals, better health for populations, and lower per capita costs, which speaks to health of populations.⁴⁶ Accordingly, with each person in the population having a PCP, no care gaps should theoretically exist: Each eligible individual should be screened for HTN with appropriate follow up and ongoing continuity of care for control of the disease.

An essential requirement for the medical home model is the ability to establish and work in inter-professional teams. Physicians are an expensive resource whose training provides them with certain knowledge and skills. However, there are other health care professionals such as chronic disease nurses, pharmacists, dietitians, and lifestyle coaches who have complementary knowledge and skills. Together, such a team can better meet the varied needs of the patient with chronic disease. Accordingly, in most provinces in Canada, primary care is being organized into practice groups of variable size, which involve interprofessional teams. Furthermore, the practice groups are allocated resources to meet patient needs, including access to appropriate data collection and management tools. These would include shared electronic medical records (EMRs) and disease registries or disease registry functionality. Within teams, individuals work to their highest scope to provide cost-effective care. Finally, the primary-care practice team also establishes relationships and interacts in a formalized manner with health care providers in the community and within

other parts of the health care system, such as specialty care. Together this represents the concept of a “medical neighborhood.” Thus, to summarize, Canadian health care is moving toward every individual having a “medical home within a medical neighborhood.” In this manner, comprehensiveness of care and system integration are achieved, leading to better care of patients with chronic diseases such as HTN.

The provincial health systems are adapting to support the medical home model as well as the outcomes of Triple Aim. Historically, the formalized health care system dealt exclusively with acute care issues and population health services such as public health or home-care services. Primary care was traditionally delivered by individual family physicians who worked independent of any control or accountability to the formal health care system. Yet, they were remunerated by claiming fee-for-service payments from the government. Now, in some cases, to support teams and provide the necessary infrastructure, primary care is being incorporated as part of the formal health care system with physicians becoming either employees of, or contractors to, the system. However, most primary care continues to be provided by physician-led clinics or organizations, but the funding and remuneration mechanisms have been designed to support the principles of ongoing, comprehensive primary care with associated deliverables and accountabilities. Additionally, the health care systems are evolving to help support primary care and chronic disease management through providing access to data.

RECENT DEVELOPMENTS IN CHEP TO IMPROVE ACCURACY IN BP MEASUREMENT AND DIAGNOSIS OF HTN IN CANADA

The 2015 CHEP recommendations featured a new series of updated recommendations for the diagnosis and monitoring of BP. The knowledge transfer efforts to implement these new recommendations are an important focus of Hypertension Canada.

No discussion of HTN care is complete without consideration of the challenges and pitfalls caused by improper BP measurement. Accurate BP measurement is of critical importance as it is required to properly diagnose HTN, assess cardiovascular risk, determine the need for antihypertensive therapy, and monitor treatment effect and BP control. Use of calibrated equipment and standardized measurement techniques are essential to ensuring

accurate measurement.^{47,48} Unfortunately, in real-world contemporary clinical practice, standardized BP measurements are rarely taken. Many pitfalls exist that can undermine BP measurement accuracy and these have been reviewed elsewhere.⁴⁸⁻⁵⁰ As a result, BP readings obtained in routine Canadian clinical practice are, on average, 9/6 mm Hg higher than standardized measurements.⁵¹ Thus, inaccurate measurement has a pervasive and widespread adverse effect on diagnosis and management of HTN in Canada.

To address these challenges, in 2015, CHEP made 2 major changes to the recommendations for BP measurement and the diagnosis of HTN in Canada.^{49,52} The first recommendation relates to the preferential use of electronic upper arm devices instead of auscultation for BP measurement. The second recommendation endorses the use of out-of-office measurement techniques to confirm all new diagnoses of HTN. The crafting and implementation of these new diagnostic recommendations serves as an example of the CHEP model in action. It also underscores the substantial efforts that are required to modify HTN care on a national level, as there are significant barriers and challenges to the widespread implementation of these recommendations that must be overcome.

Recommendation to Preferentially Measure BP Electronically. Traditionally, BP has most commonly been measured using auscultation (listening with a stethoscope). To perform auscultation correctly, certain steps (eg, inflating the cuff above the auscultatory gap, deflating the cuff at the proper speed, recording systolic [SBP] and diastolic [DBP] BP correctly without rounding off) must be performed carefully and properly.^{49,50} In contrast, use of electronic automated (oscillometric) devices removes the potential for these human errors. Educational programs to improve provider auscultatory technique have been attempted, but have had limited success in sustainably improving technique.⁴⁹ The phasing out of mercury sphygmomanometers, which by default increases use of frequently uncalibrated and therefore inaccurate aneroid devices, has further reduced the ability to perform accurate auscultatory measurements.

For these reasons, CHEP now recommends that providers preferentially use electronic (oscillometric) devices instead of auscultation to measure BP. The CHEP Task Force concluded that greater use of validated electronic monitors on a national level would lead to more accurate measurement inside and outside the office setting. When performing

electronic BP measurement in the office setting, multiple readings are preferred. Providers can manually initiate each measurement and can use an automated office blood pressure (AOBP) device. AOBP devices can take multiple (3–6, depending on the device) preprogrammed BP measurements with the patient seated alone in the office examining room.⁵³ This can provide a more standardized and reproducible BP measurement because the white-coat effect is partly eliminated.⁵⁴ AOBP also frees providers so that other tasks may be performed while the BP is being measured. Several studies have shown that mean AOBP readings are comparable to daytime ambulatory BP readings; therefore, a mean AOBP of SBP ≥ 135 mm Hg or DBP ≥ 85 mm Hg is considered high.⁵⁵

Recommendation to Use Out-of-Office Measurement to Confirm Diagnosis of HTN. The second major change in the 2015 CHEP diagnostic guidelines aimed at reducing inaccurate measurement and improper diagnosis is the endorsement to use out-of-office measurements to confirm the diagnosis of hypertension. Out-of-office techniques include ambulatory BP measurement (ABPM) and home BP measurement (HBPM).

The recommendation for greater use of out-of-office measurement is aimed primarily at ensuring detection of white-coat hypertension. White-coat hypertension is defined as elevated BP in the office ($\geq 140/90$ mm Hg) but normal out-of-office readings ($< 135/85$ mm Hg daytime ABPM or HBPM and/or $< 130/80$ mm Hg 24-hour ABPM).³² The white-coat effect will falsely elevate BP and result in widespread overdiagnosis of HTN in $\leq 30\%$ of individuals. Thus, proper recognition of white-coat hypertension avoids unnecessary initiation of drug treatment in a large number of Canadians.

Out-of-office measurements are preferred to office measurements because they better predict mortality and cardiovascular events.^{56–58} Based on these prognostic studies, an ABPM daytime mean of $\geq 135/85$ mm Hg or an overall ABPM 24-hour mean of $\geq 130/80$ mm Hg is considered high. For HBPM, a mean of $\geq 135/85$ is considered elevated. Importantly, use of out-of-office BP expedites the diagnosis of HTN, which is important in high-risk hypertensive patients, in whom early treatment and control was associated with reductions in cardiovascular events.^{59–61}

Challenges in the Implementation of Greater Use of Out-of-Office Measurement. Several barriers exist to increasing the use of out-of-office measurement for the diagnosis of HTN in Canada. ABPM is not

widely available in this country, which limits the ability to perform large numbers of studies. ABPM is not reimbursed by most provincial health plans; therefore, providers have to bear the cost of initiating and maintaining ABPM programs. These costs include approximately \$2000 to \$2500 for each monitor; 30 to 45 minutes of provider time to perform each study; and maintenance and battery costs. The expertise required to correctly interpret ABPM studies also is limited. Providers will need to be educated or expert-led interpretation services established.

HBPM is more widely available than ABPM—approximately 50% of Canadians living with HTN own a home BP monitor.⁶² However, patients may use devices that are not validated or that do not adhere to proper measurement techniques.⁶³ Self-reported readings can be problematic—patients often do not perform the recommended number of readings or fail to report all of their readings to their physician.⁶³ Additionally, physicians may not calculate the mean BP and use it to make therapeutic adjustments.⁶⁴ Real-time teltransmission of readings to physicians' EMR systems is a potential solution to some of these barriers; however, the infrastructure required for BP telemonitoring needs to be cost-effectively installed before BP telemonitoring becomes a reality.^{64,65}

These implementation barriers illustrate the amount of effort required to properly disseminate and implement national guidelines. In fact, crafting of a given recommendation marks only the beginning of the work. Accordingly, the knowledge translation process to implement the 2015 CHEP diagnostic recommendation changes and overcome aforementioned barriers is expected to last well into the next decade.

THE FUTURE OF GUIDELINES IMPLEMENTATION

Improvements in diagnostic testing, genetic, and pathophysiologic understanding, and the development of new prevention strategies and treatments for HTN, holds the promise of continued improvements in patient outcomes and quality of life. Translating these advances into clinical practice change for health care practitioners, and better health behaviors and greater adherence to proven therapies for patients, will ultimately determine how successful these advances are. In Canada, greater adherence to the CHEP clinical practice guidelines has been directly associated with

improved cardiovascular outcomes.¹³ This observation provides strong support for the clinical practice guidelines enterprise, that starts with knowledge generation (critical appraisal of the evidence and distillation of evidence-based practice recommendations for what should and should not be done), proceeds to knowledge translation and dissemination (including tailoring of the messages to meet the needs of health care practitioners and patients living in different regions), and finally evaluation of the effectiveness of the process. Promising future trends in this area include the universal adoption of EMR systems, continuing professional health education (CPHE) development and dissemination, and the use of communication technology and social media to transmit health messages to patients. These trends will positively affect implementation of guidelines, speeding the uptake of new health technologies and methods as well as providing the means for evaluation and ultimately providing the evidence to further refine and improve the clinical practice guidelines.

The EMR holds great promise for improving patient care, particularly when patients are able to access the record and receive prompts from the health care server. The EMR becomes more powerful still when it is loaded with updated evidence-based clinical practice guidelines leading to evidence-based prompts and reminders for health care practitioners and patients. Audit and feedback, for example, can improve professional practice and health care outcomes.⁶⁶ EMRs have already demonstrated improved management of diabetes in primary-care practices in many jurisdictions. This will only be enhanced when patients' personal software and devices for activity level and other tools yet to be developed, are brought together in one place. We developed quality indicators from the CHEP clinical practice recommendations and used them to query a data set from >250,000 primary-care patients in Ontario, Canada. This allowed us to evaluate the uptake of current practice recommendations. When a practice gap is found, this data can then be used to determine if interventions to improve adherence to the recommendations are effective. The true potential for EMR systems will occur when they are used universally, are linked to patients' personal health records and other health information, have guideline-based prompts and reminders embedded in them, and can provide sufficient quality of data that evaluation is possible.

CPHE is a key component of transmitting new and updated clinical practice recommendations to

clinicians to change their health behaviors. Based on Knowles' adult learning theory principles, the goal is to not only increase knowledge, skills, and attitudes but to change practice behaviors as well.⁶⁷ Small-group workshops in particular have demonstrated efficacy in changing physician behavior and health outcome.⁶⁸ A process available today has the potential to dramatically improve practice, by keeping health care providers functioning at the top of their scope by keeping them updated with the latest clinical practice recommendations. Funding from health agencies can support accredited education programs that demonstrate that clinical practice is consistent with updated guidelines. For example, clinicians can attend local education small-group workshops with accredited modules presented by local key opinion leaders trained to be facilitators. For those without these local education groups, regional meetings can provide 4 workshops in a daylong program quarterly, and an electronic version using the principles of distributed community engaged learning.⁶⁹ Three months after the educational event, attendees will complete a reflection exercise including a chart review of 5 patients related to the case presented to show that they are achieving the guidelines-specific quality indicator. This will demonstrate whether the clinician is following the relevant practice recommendations, and provides an excellent return on investment for the educational funding. All the components for continuous health care provider education are available today, and should be linked together to keep the health care workforce practicing at the top of scope.

Communication Technology. The availability of mobile, wireless communication is exploding worldwide, and cell phone penetrance in vulnerable populations is increasing dramatically, which provides the potential for disseminating health information to patients. The accessibility of SMS (short message service) is almost universal even where wireless coverage is weak. This permits the exploration of this inexpensive mobile telecommunication technology as a promising application in interventions to improve health services and promote behavior change among vulnerable populations (M. Maar unpublished data, 2015). Text messaging for health interventions is massively scalable and inexpensive, and can be tailored based on age, sex, and ethnicity of a target group, and the ability to send time-sensitive information. Electronic portals have the potential to bring together components of the EMR, the patients' personal health record, their

electronic health devices, and data coming from the labs. Social media can play a role in disseminating reminders and educational messages about the components of the health data from each of these sources to the patients. Data demonstrating cost-effectiveness is still lacking and is an area waiting to be researched.⁷⁰ Twitter accounts for chronic illnesses have the potential to keep patients updated with the latest evidence-based information as well. These electronic systems easily can be designed to have an evaluation component built in, to keep the continuous quality improvement cycle functioning. Health communication through SMS messaging, health portals, and social media is in its infancy but has the potential to reshape the dissemination of health information, individually and across a nation or around the world.

LOOKING THROUGH A GLASS DARKLY: THE FUTURE OF HTN PREVENTION AND CONTROL IN CANADA

By all indications, it is the best of times for the HTN control initiative in Canada. The country has the highest nationally reported control rates globally at 68%⁷¹—with only US control rates at 50% even approaching our control numbers. Furthermore, there has been a parallel dramatic reduction in the rates of those with HTN who are unaware of the diagnosis—decreased from 43% in 1991 to 17% in the last published national survey.¹² As well, the on-treatment rate for patients with HTN has increased significantly (from 34% to 80%).

Paralleling the increase in control numbers, Canada has seen a significant increase in antihypertensive prescription rates¹³ and acceleration in the decline in age- and sex-standardized HTN-related cardiovascular mortality and morbidity rates.¹⁴ These achievements can be ascribed to several determinants including:

- A reasonably available and well-funded medical and public health systems, and
- A very effective volunteer-led hypertension knowledge translation program (*viz*, the CHEP of Hypertension Canada).⁷²

Although the largest effect on Canadian HTN control rates for programs like CHEP has been seen over the past decade, this initiative should be viewed as an overnight success 35 years in the making. When the Canadian Hypertension Society (the

predecessor of Hypertension Canada) was first formed in the early 1980s, developing HTN guidelines was seen as one of its key mandates. The effort has grown since then, and especially with the development of the CHEP model in the early 2000s.

To appreciate the potential future for HTN prevention and control and the potential development of the HTN initiatives in Canada (*ie*, Hypertension Canada and CHEP), both the opportunities and the threats need to be understood. In regard to potential threats, despite the clear successes in Canada toward controlling HTN, there are significant dark clouds on the horizon. First and foremost is the appreciation that the rate of improvement in BP control seems to be flattening out. Most recent Canadian statistics show little change in treatment and control rates from those reported almost 6 to 8 years ago.⁷³ Furthermore, those populations most at risk, (*ie*, among those who are unaware and untreated), are largely outside of the current health care system—with little being done to change those circumstances. Furthermore, although there are Canadian-made innovations in workplace and community programs to improve control of HTN, like the CHAP program, these innovations have not been broadly implemented in Canada.⁷⁴

Beyond the limitations in the ability to further improve control rates of HTN are the even bigger challenges in making headway in preventing the disease. Prevalence of HTN in Canada is trending upward. Furthermore, efforts to institute public health policies to minimize risk factors for the development of HTN have had limited success. Obesity rates in Canada are increasing. Although Canadian processed foods are among the saltiest in the world, little progress has been made in curbing food processors in this regard.^{75,76} Even more troubling is the appreciation that the national pipeline for developing innovations in HTN seems to be drying up. Canadian investments in HTN research both by pharmaceutical companies and federally have declined. Most troubling, the pipeline of Canadian cardiovascular scientists (including those in HTN) is declining.⁷⁷

Notwithstanding the dark clouds, there are silver linings and may be even a little sunlight. These rays of light would relate to both the potential future of the HTN initiative in Canada and to development of health care systems to better support the prevention and control of HTN and other atherosclerotic risk factors.

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