

Hypertension Canada guideline for the diagnosis and treatment of hypertension in adults in primary care

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Abstract

Background Canada has historically been among the world's leaders in hypertension care, but hypertension treatment and control rates have regressed in recent years. This guideline is intended to provide pragmatic primary care-focused recommendations to improve hypertension management in adults at the population level.

Methods We employed Grading of Recommendations Assessment, Development and Evaluation and ADAPTE frameworks in accordance with Appraisal of Guidelines for Research and Evaluation (AGREE II) quality and reporting standards to develop recommendations on managing hypertension for adults aged 18 years and older. We used the HEARTS framework—a model of care developed by the World Health Organization to improve hypertension control and reduce cardiovascular burden—to integrate these recommendations into streamlined, pragmatic, and evidence-based algorithms. The guideline committee predominantly comprised primary care providers and also included patient, methodology, and hypertension specialist representatives. Our process for managing competing interests adhered to Guidelines International Network principles.

Recommendations The 9 recommendations for managing hypertension in adults are grouped under the categories of diagnosis and treatment. Diagnostic recommendations include a standardized approach to measuring blood pressure (BP) and confirming hypertension, as well as providing a uniform definition for hypertension of $BP \geq 130/80$ mm Hg. Treatment recommendations include targeting a systolic $BP < 130$ mm Hg, implementing healthy lifestyle changes, and providing stepwise guidance on optimal medication choices for patients requiring pharmacotherapy.

Interpretation Our aim is to enhance the standard of hypertension care in the Canadian primary care setting. Accurate diagnosis and optimal treatment of hypertension can reduce adverse cardiovascular events and risk of death.

Hypertension is the most common modifiable risk factor for cardiovascular disease and death,¹ prevalent in about 1 in 4 adults in Canada.² Historically, Canada has been among the world's leaders in hypertension treatment and control rates.³ However, declining trends in hypertension treatment and control across Canada in recent years have raised concerns.^{4,5} This decline has been proposed to relate to discrepancies in optimal blood pressure (BP) targets, overly complex guideline recommendations, inadequate implementation strategies, and suboptimal engagement with front-line health care providers.⁶

Most hypertension is managed in primary care; therefore, improving hypertension care at the population level necessitates prioritizing primary care. To this end, Hypertension Canada has adopted a new 2-part guideline approach.⁷ As an adjunct to its forthcoming comprehensive guideline, Hypertension Canada has developed this primary care-focused hypertension guideline that comprises pragmatic recommendations for efficient implementation in everyday practice.

We used the World Health Organization's (WHO) Healthy-lifestyle counselling, Evidence-based treatment protocols, Access to essential medicines and technology, Risk-based cardiovascular disease management, Team-based care, Systems for monitoring (HEARTS) framework to integrate these recommendations into streamlined, pragmatic, and evidence-based algorithms for use in primary care in Canada. Designed to improve population-wide hypertension control and reduce cardiovascular disease burden, HEARTS outlines principles for optimal diagnostic procedures and simplified directive treatment algorithms along with monitoring and evaluation.⁸ HEARTS was initially developed within the Kaiser Permanente system in the United States, where hypertension control rates improved from 44% to 90% in just over a decade.^{9,10} HEARTS was not designed as a rigid protocol; rather, nations are encouraged to adapt the framework to meet their unique needs, and the framework has been successfully implemented in a host of countries to improve hypertension care.¹¹

Herein, we present the Hypertension Canada guideline recommendations and HEARTS-adapted algorithms for the diagnosis and treatment of hypertension in adults in Canadian primary care.

— Scope —

The target users for this guideline are primary care providers (family physicians, nurse practitioners, nurses, and pharmacists), policy-makers, and patients and caregivers affected by hypertension. Whereas this guideline is intended as a framework for managing most cases of hypertension in primary care, it is not intended to be applied directly to all clinical scenarios. Specifically, this guideline is not to be used to manage hypertension in children or in people who are pregnant or trying to become pregnant; separate guidelines are available for these patient populations.^{12,13} This guideline is designed as an adjunct to the forthcoming Hypertension Canada comprehensive guideline, to enhance implementation in the primary care setting. The upcoming comprehensive guideline will serve as a resource for more complex and nuanced aspects of hypertension management, such as resistant hypertension.

— Recommendations —

We formulated the guideline recommendations using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework (**Table 1**)¹⁴; they are summarized in **Table 2**. Along with each recommendation, we provide the supporting rationale and the values and preferences that the guideline committee prioritized, based on the existing literature and perspectives shared by primary care providers and patients.

Diagnosis

Blood pressure assessment with a validated automated device and using a standardized method is recommended (strong recommendation, moderate-certainty evidence).

Table 1. Interpretation of strength of recommendation and certainty of evidence using the Grading of Recommendations Assessment, Development and Evaluation approach¹⁴

STRENGTH OF RECOMMENDATION	INTERPRETATION
Strong	The desirable effects or consequences of an intervention clearly outweigh its undesirable effects or consequences
Conditional	The desirable effects or consequences of an intervention probably outweigh its undesirable effects or consequences
Certainty of evidence	
High	High confidence that the true effect lies close to that of the estimate of effect
Moderate	The true effect is likely to be close to the estimate of effect, but there is a possibility that it is substantially different
Low	The true effect may be substantially different from the estimate of effect
Very low	The true effect is likely to be substantially different from the estimate of effect

Rationale: Because detection and management of hypertension rely on accurate BP measurement, it is important to use a device that has been validated and confirmed for accuracy. Validated automated oscillometric devices are preferred to auscultatory sphygmomanometers as they are easier to use, less prone to human error and end-digit preference (ie, where the observer rounds off the last digit), and have better reproducibility.¹⁵ Validation demonstrates relative equivalency between the tested device and rigorously performed manual auscultatory measurements.¹⁶ Globally, only 10% of devices have evidence of validation for accuracy.¹⁷ In Canada, 90% of BP devices sold at pharmacies are validated compared with only 45% of BP devices sold by online retailers.¹⁸ Exceptions where automated devices are inaccurate and manual BP measurement is preferred include in patients with persistent or high burden of arrhythmias, and populations in which an automated device has not been validated (eg, children and pregnant people, for whom this guideline is not intended).¹⁶

Even when a validated automated device is used, the accuracy of BP measurement may be influenced by many factors.¹⁹⁻²¹ A standardized procedure with proper preparation and positioning, appropriate equipment, and multiple averaged measurements reduces variability (**Figure 1**).²² Meta-analyses show that standardized automated office BP provides BP measurements that closely approximate daytime ambulatory BP monitoring (ABPM) and home BP monitoring (HBPM).^{23,24} Nonstandardized office BP measurements result in readings that are on average 5 to 10 mm Hg higher than standardized measurements.²⁵ Measuring BP more than once with all values averaged reduces short-term variability.²⁶ The optimal number of measurements is uncertain, although most recent clinical trials have employed a protocol consisting of a 5-minute seated rest period, followed by 3 measurements at 1-minute intervals.²⁷⁻³⁰

Table 2. Recommendations on the diagnosis and treatment of hypertension in primary care

RECOMMENDATION	STRENGTH OF RECOMMENDATION	CERTAINTY OF EVIDENCE
Diagnosis		
BP assessment with a validated automated device and using a standardized method is recommended	Strong	Moderate
Out-of-office BP assessment is recommended to confirm the diagnosis of hypertension or to detect white-coat hypertension and masked hypertension	Strong	Moderate
The definition of hypertension in adults is recommended as BP $\geq 130/80$ mm Hg when measured with a validated device under optimal conditions	Strong	Moderate
Treatment		
Healthy lifestyle changes are recommended for all adults with hypertension	Strong	High
Pharmacotherapy initiation for hypertension is recommended for adults with BP $\geq 140/90$ mm Hg and for adults with systolic BP 130-139 mm Hg at high cardiovascular disease risk	Strong	High
Treatment, including healthy lifestyle changes with or without pharmacotherapy, is recommended for adults with hypertension to achieve a target systolic BP < 130 mm Hg, provided the treatment is well tolerated	Strong	High
For adults with hypertension requiring pharmacotherapy, low-dose combination therapy (ideally as a single-pill combination) is recommended as initial treatment, which includes drugs from 2 of the following 3 complementary classes of medications: ACEIs or ARBs, thiazide or thiazide-like diuretics, and long-acting dihydropyridine CCBs	Strong	Moderate
If BP remains above target despite 2-drug combination therapy, 3-drug combination therapy consisting of an ACEI or ARB, a thiazide or thiazide-like diuretic, and a long-acting dihydropyridine CCB is recommended	Strong	Moderate
If BP remains above target despite 3-drug combination therapy consisting of an ACEI or ARB; a thiazide or thiazide-like diuretic; and a long-acting dihydropyridine CCB at their maximally tolerated doses, the addition of spironolactone is suggested	Conditional	Moderate

ACEI—angiotensin-converting enzyme inhibitor, ARB—angiotensin II receptor blocker, BP—blood pressure, CCB—calcium channel blocker.

Values and preferences: The guideline committee placed a high value on using proper BP measurement technique and equipment to ensure accurate readings. As such, the recommendation prioritizes precision in BP assessment to ensure appropriate diagnosis and management. While recognizing that access to validated devices and standardized methods may be limited in some settings, this recommendation underscores the importance of maintaining measurement quality to reduce errors and improve clinical decision-making.

Out-of-office BP assessment is recommended to confirm the diagnosis of hypertension or to detect white-coat hypertension and masked hypertension (strong recommendation, moderate-certainty evidence).

Rationale: Out-of-office BP measurements (ABPM or HBPM) are useful to confirm the diagnosis of hypertension when office BP is elevated. Ambulatory BP monitoring measures BP at 20- to 30-minute intervals during both day and night.³¹ The standard protocol for HBPM involves measuring BP in duplicate twice daily for a week. Out-of-office BP measurements (particularly ABPM) correlate more closely with cardiovascular

events and death than office BP measurements do. For example, a large observational study of about 60,000 primary care patients found that 24-hour ambulatory systolic BP was strongly associated with cardiovascular death (hazard ratio [HR]=1.51, 95% CI 1.41 to 1.62) and all-cause death (HR=1.43, 95% CI 1.37 to 1.49), even after adjusting for office BP.³² Out-of-office BP assessment is also required to identify the common BP phenotypes of white-coat hypertension (BP elevated in office but not out of office, which is present in 15% to 30% of people with elevated office BP)³³ and masked hypertension (BP elevated out of office but not in office; prevalence of 10% to 15%).^{33,34}

When out-of-office BP measurements are not feasible owing to lack of accessibility, affordability, or adequate training for patients or caregivers, the diagnosis of hypertension can be confirmed with repeat office BP measurement using the standardized technique. Although reliance on single-visit office BP measurements to diagnose hypertension reduces specificity relative to ABPM,³⁵ it may need to be considered in certain circumstances, such as for patients with infrequent office visits who are unable or unwilling to perform out-of-office measurements.

Values and preferences: The guideline committee prioritized the importance of accurate hypertension diagnosis by emphasizing out-of-office BP assessment. The recommendation places a high value on minimizing misdiagnosis from white-coat hypertension or masked hypertension, which could lead to unnecessary treatment or missed cases of hypertension. Although accessibility and feasibility of out-of-office BP monitoring may vary across different settings, this recommendation places greater importance on diagnostic precision over potential challenges in implementation.

The definition of hypertension in adults is recommended as BP $\geq 130/80$ mm Hg when measured with a validated device under optimal conditions (strong recommendation, moderate-certainty evidence).

Rationale: Starting as low as with a systolic BP of 90 mm Hg, observational data have shown a continuous relationship between higher BP and risk for adverse cardiovascular outcomes.³⁶ Yet for clinical care and public health purposes, it is helpful to establish a categorical threshold to define hypertension. In the present guideline, we set the BP threshold to define hypertension in adults at 130/80 mm Hg, a threshold below what was previously recommended by Hypertension Canada.³¹

The rationale behind this change is based on observational and randomized controlled trial (RCT) data on the relationship between BP and the magnitude of cardiovascular risk. Meta-analysis of prospective study data has shown that the relative risk for major adverse cardiovascular events for people with BP $\geq 130-139/85-89$ mm Hg is 1.5-fold to 2.0-fold higher than for people with BP $< 120/80$ mm Hg, and a risk substantially higher than for those with BP 120-129/80-84 mm Hg.³⁷ Similarly, RCT data on the effects of more intensive BP-lowering treatments have consistently shown their effectiveness in reducing the risk for major adverse cardiovascular events for people with BP $\geq 130/80$ mm Hg (and in some cases for people with BP $< 130/80$ mm Hg), as discussed in the “Treatment” recommendations section.^{27,28,30,38-44} In adults with confirmed hypertension, routine testing should be performed to assess cardiovascular disease risk and screen for end-organ damage (Appendix 1 and Supplementary Table 1, available from CFPlus*).

Values and preferences: The guideline committee placed high value on early detection and intervention by defining hypertension at a lower threshold (BP 130/80 mm Hg) than in previous guidelines. This reflects a high value placed on aligning with emerging evidence that associates cardiovascular risk with lower BP levels. Although this lower threshold will increase the number of people labelled as having hypertension,

the recommendation emphasizes the benefits of earlier management in preventing long-term complications.

Treatment

Healthy lifestyle changes are recommended for all adults with hypertension (strong recommendation, high-certainty evidence).

Rationale: Unhealthy lifestyle habits play a major role in the development of hypertension and its associated cardiovascular morbidity and mortality. Thus, lifestyle modification should be advised for all people with hypertension. Dietary salt intake displays a nearly linear dose-response relationship with BP.⁴⁵ Data from RCTs show that reducing dietary sodium via a salt substitute among people aged 60 years or older with hypertension and a history of stroke led to a 13% decrease in major adverse cardiovascular events (rate ratio=0.87, 95% CI 0.80 to 0.94) and a 12% decrease in all-cause death (rate ratio=0.88, 95% CI 0.82 to 0.95) over about 5 years.⁴⁶ The WHO advises restriction of dietary sodium intake to less than 2 g per day.⁴⁷ Notably, more than 70% of dietary sodium intake from the typical Western diet comes from processed foods rather than table salt.⁴⁸

Increased dietary potassium intake (ie, from a diet rich in fruits and vegetables) is linked to lower BP and reduced cardiovascular risk.^{46,49-51} The WHO advises dietary potassium intake of more than 3.5 g per day.⁵² For patients with chronic kidney disease or those prescribed medications that may raise potassium (eg, angiotensin-converting enzyme inhibitors [ACEIs], angiotensin II receptor blockers [ARBs], and mineralocorticoid receptor antagonists), potassium should be monitored.

Hypertension and obesity (body mass index ≥ 30) are commonly comorbid conditions, and weight loss in these cases can improve BP control. A meta-analysis of RCTs on weight-reducing diets in adults with hypertension and obesity found a mean decline in systolic and diastolic BP of 4.5 mm Hg (95% CI 1.8 to 7.2 mm Hg) and 3.2 mm Hg (95% CI 1.5 to 4.8 mm Hg), respectively, although the reduction in BP occurred in a dose-dependent relationship with the magnitude of weight reduction.⁵³ Weight-reducing medications such as glucagon-like peptide 1 receptor agonists are also effective in improving BP. For instance, an RCT of semaglutide in adults with overweight or obesity showed that in addition to a 12% reduction in weight, mean systolic BP was also reduced by 5.1 mm Hg (95% CI 3.9 to 6.3 mm Hg).⁵⁴

Regular exercise can improve BP control. Dynamic aerobic exercise has been the most well-studied form of exercise, with meta-analysis data showing that among people with hypertension, mean systolic and diastolic BP improved by 6.9 and 4.9 mm Hg, respectively.⁵⁵ The WHO advises at least 150 to 300 minutes of moderate aerobic activity per week.^{31,56}

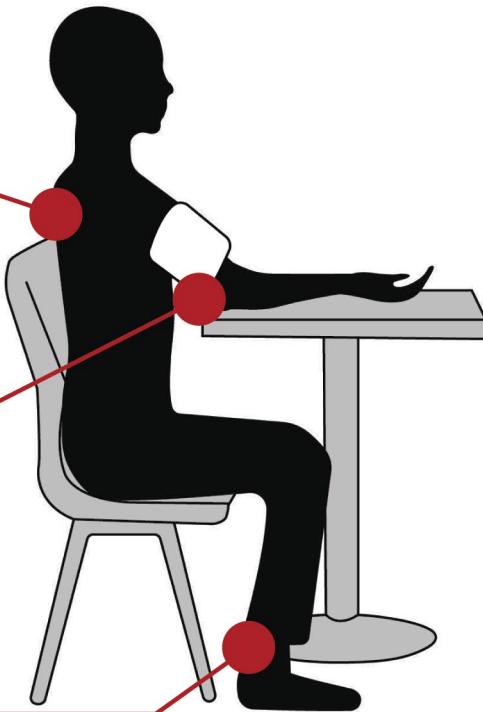
Reducing alcohol consumption lowers BP in a dose-dependent fashion with a suggested threshold effect.

*Appendices 1 to 5 and Supplementary Tables 1 to 10 are available from <https://www.cfp.ca>. Go to the full text of the article online and click on the CFPlus tab.

Figure 1. Optimal BP measuring technique

Optimal blood pressure measuring technique

- ✓ Sitting position
- ✓ Back supported
- ✓ Arm bare and supported
- ✓ Use a cuff size appropriate for arm
- ✓ Middle of the cuff at heart level
- ✓ Lower edge of the cuff 3 cm above elbow crease
- ✓ Ask patient not to talk or move during rest period and between measurements
- ✓ Legs uncrossed
- ✓ Feet flat on the floor

**Proper preparation:**

- Quiet and calm room
- No caffeine, tobacco, or exercise in the 30 minutes before the measurements

**Appropriate equipment:**

- Validated automated BP device (see <https://hypertension.ca/public/recommended-devices> or ask a pharmacist)
- Wide range of cuff sizes to select the appropriate size

Standardized protocol:

- If feasible, observe a rest period of 1-5 minutes before measurements
- Measure BP 3 times at 1-minute intervals
- Average and record all values



BP—blood pressure.

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Meta-analysis data demonstrate that among adults who consume 2 or fewer drinks per day, reducing alcohol intake had no effect on BP. However, for adults consuming 3, 4 to 5, or 6 or more drinks per day, reducing alcohol intake is associated with a mean reduction in systolic BP of 1.2 (95% CI 0.0 to 2.3 mm Hg), 3.0 (95% CI 2.0 to 4.0 mm Hg), and 5.5 mm Hg (95% CI 4.3 to 6.7 mm Hg), respectively.^{31,57,58}

Finally, although the effects of smoking on BP are only modest,⁵⁹ all people with hypertension should be counselled to stop smoking to reduce its associated risks of cardiovascular morbidity and death.⁶⁰

Values and preferences: The guideline committee prioritized the foundational role of healthy lifestyle changes in managing hypertension, recognizing their broad benefits beyond BP control. This recommendation reflects a high value placed on nonpharmacologic interventions that can improve overall health and reduce cardiovascular risk. Given that various healthy lifestyle changes have been shown to potentially reduce BP, the committee chose not to specify particular interventions in the recommendation, recognizing that people may have different values and preferences regarding which changes to prioritize.

Pharmacotherapy initiation for hypertension is recommended for adults with BP $\geq 140/90$ mm Hg and for adults with systolic BP of 130 to 139 mm Hg at high cardiovascular disease risk (strong recommendation, high-certainty evidence).

Rationale: When an adult is diagnosed with hypertension and their BP is $\geq 140/90$ mm Hg, pharmacologic treatment should be initiated. This is based on RCT data demonstrating that such individuals benefit from pharmacologic treatment, including 28% lower odds of stroke (odds ratio [OR]=0.72, 95% CI 0.55 to 0.94) and 22% lower odds of all-cause death (OR=0.78, 95% CI 0.67 to 0.92) over 5 years, irrespective of their baseline cardiovascular disease risk.^{39,61}

Pharmacologic treatment should also be started for adults with systolic BP of 130 to 139 mm Hg who are at high risk of cardiovascular disease (Box 1).^{30,62,63} This threshold is based on meta-analysis data of RCTs showing that adults at high baseline risk for cardiovascular disease with BP within this range benefit from a reduction in risk for major adverse cardiovascular events with pharmacologic treatment, primarily driven by a 60% decrease in stroke risk for every 10 mm Hg decrease in systolic BP achieved.^{39,64}

Clinicians should emphasize that pharmacologic treatment is to be used in combination with (and not as a replacement for) lifestyle modification, and that successful lifestyle modification may allow for down-titration or discontinuation of medications in the future. For adults with systolic BP of 130 to 139 mm Hg and not at high cardiovascular disease risk, healthy lifestyle changes alone should be emphasized, with BP reassessment

within 3 to 6 months. If systolic BP remains at 130 to 139 mm Hg and the person remains not at high cardiovascular disease risk, we advise BP reassessment every 6 to 12 months.

Values and preferences: The guideline committee prioritized timely initiation of pharmacotherapy to reduce cardiovascular risk, placing a high value on preventing complications associated with elevated BP by targeting people at the greatest risk. The committee recognizes that the benefit of pharmacotherapy initiation in people at lower risk (ie, systolic BP of 130 to 139 mm Hg without any high-risk conditions) is uncertain. This recommendation places lower value on pharmacotherapy avoidance, costs, and tolerability, as most agents are now available as low-cost generics and are well tolerated.

Treatment, including healthy lifestyle changes with or without pharmacotherapy, is recommended for adults with hypertension to achieve a target systolic BP < 130 mm Hg, provided the treatment is well tolerated (strong recommendation, high-certainty evidence).

Rationale: The recommended treatment target of systolic BP < 130 mm Hg is supported by current RCT evidence showcasing the benefits of more intensive BP control.^{27,28,30,39-44} A recent large meta-analysis of RCTs evaluating lower BP targets with pharmacotherapy (>70,000 participants) found that compared with a systolic BP target of ≥ 130 mm Hg, a systolic BP target of < 130 mm Hg led to a 22% reduction in major adverse cardiovascular events (HR=0.78, 95% CI 0.70 to 0.87) and an 11% reduction in all-cause death (HR=0.89, 95% CI 0.79 to 0.99).³⁸ Notably, this meta-analysis also showed that compared with a systolic BP target of < 140 mm Hg, a systolic BP target of < 120 mm Hg led to an 18% reduction in major adverse cardiovascular events (HR=0.82, 95% CI 0.74 to 0.91) and a possible reduction in all-cause death (HR=0.85, 95% CI 0.71 to 1.01).³⁸ The Systolic Blood Pressure Intervention Trial (SPRINT; comparing a systolic BP target of < 120 mm Hg vs < 140 mm Hg) reported a number needed to treat (NNT) of 61 for the primary cardiovascular composite

Box 1. High cardiovascular disease risk conditions*

- Established cardiovascular disease (coronary artery disease, heart failure, cerebrovascular disease, and peripheral artery disease)
- Diabetes mellitus (type 1 or type 2)
- Chronic kidney disease (eGFR < 60 mL/min/1.73 m² or albuminuria ≥ 3 mg/mmol)
- 10-year Framingham Risk Score $\geq 20\%$ ⁶²
- Age ≥ 75 years

eGFR—estimated glomerular filtration rate, ESC—European Society of Cardiology, SPRINT—Systolic Blood Pressure Intervention Trial.

*Criteria adapted from the SPRINT trial³⁰ and the 2024 ESC hypertension guidelines.⁶³

outcome (myocardial infarction, other acute coronary syndromes, stroke, heart failure, or death from cardiovascular causes) and an NNT of 90 for all-cause death.³⁰

Rather than recommending the more intensive BP target of systolic BP <120 mm Hg, we chose to recommend a more conservative systolic BP target of <130 mm Hg, given that research quality BP measures are generally 5 to 10 mm Hg lower than BP measures in the routine clinical care setting²⁵; modern-day RCTs studying intensive BP control included only people with baseline systolic BP \geq 130 mm Hg³⁸; most participants in large RCTs targeting a systolic BP <120 mm Hg did not achieve this target^{27,29,30}; and feedback from primary care providers and patients supported the recommendation. We do not recommend a specific diastolic BP target, given evidence that adults with a systolic BP <130 mm Hg are at relatively low cardiovascular risk even when diastolic BP is 70 to 90 mm Hg.⁶⁵

Although RCTs on intensive BP control have proven benefit in reducing cardiovascular events and risk of death,^{27,28,30,40-44} implementation of intensive BP control must be balanced against potential harms. A recent meta-analysis of RCTs on intensive BP targets showed significantly increased rates of the following adverse events (although the absolute risks as shown by the numbers needed to harm [NNH] were low): hypotension (NNH=508, 95% CI 309 to 1425), syncope (NNH=1701, 95% CI 991 to 5999), injurious falls (NNH=2941, 95% CI 1479 to 258,938), electrolyte abnormalities (NNH=3222, 95% CI 1150 to 4013), and acute kidney injury or acute renal failure (NNH=1657, 95% CI 693 to 4235).³⁸

Exceptions to targeting a systolic BP <130 mm Hg include patient-specific factors such as goals of care, frailty, fall risk, and orthostatic hypotension. In these scenarios, a higher systolic BP target may be required to minimize adverse effects, and we advise targeting a systolic BP as low as is reasonably achievable, although this threshold varies on a case-by-case basis, necessitating use of clinical discretion.

Values and preferences: The guideline committee placed a relatively high value on a simplified approach to hypertension management by adopting a single treatment target for all, irrespective of cardiovascular risk and comorbidities. While we recognize that some people may benefit from a lower target and some may tolerate only a higher target, this recommendation prioritizes ease of implementation and is a response to requests for more pragmatic and streamlined guidance to hypertension management in primary care.

For adults with hypertension requiring pharmacotherapy, low-dose combination therapy (ideally as a single-pill combination) is recommended as initial treatment, which includes drugs from 2 of the following 3 complementary classes of medications: ACEIs or ARBs, thiazide or thiazide-like diuretics, and long-acting

dihydropyridine calcium channel blockers (strong recommendation, moderate-certainty evidence).

Rationale: On average, ACEIs or ARBs, thiazide or thiazide-like diuretics, dihydropyridine calcium channel blockers (CCBs), and β -blockers reduce BP to a similar degree⁶⁶ and effectively lower cardiovascular risk when used at optimal doses.⁶⁷ However, the magnitude of reduction of cardiovascular risk (specifically for stroke) is less with β -blocker use for hypertension, and β -blockers are more likely to be discontinued because of adverse effects.⁶⁸ Given their less favourable benefit-to-risk ratio, β -blockers are not recommended as first-line therapy for hypertension unless a specific clinical indication is present, such as heart failure, angina, post-myocardial infarction, or heart rate or rhythm control.^{69,70} Angiotensin-converting enzyme inhibitors or ARBs, thiazide or thiazide-like diuretics, and dihydropyridine CCBs are well tolerated, provide similar cardiovascular risk protection, and should all be considered first-line agents for hypertension.^{67,71}

However, ACEIs and ARBs are teratogenic, particularly when taken in the second or third trimester of pregnancy, and should be avoided or discontinued in all people who are pregnant or trying to become pregnant.⁷² Moreover, all people of childbearing age should be counselled on the teratogenic risk of ACEIs and ARBs as part of the shared decision-making process.

Although thiazide-like diuretics were previously preferred over thiazide diuretics,³¹ an RCT comparing chlorthalidone and hydrochlorothiazide found similar efficacy in mitigating adverse cardiovascular events (HR=1.04, 95% CI 0.94 to 1.16), whereas hypokalemia incidence was higher with chlorthalidone (6.0% vs 4.4%, $P<.001$).⁷³

We recommend upfront combination therapy (ideally as a single-pill combination) with an ACEI or ARB plus either a thiazide or thiazide-like diuretic or a dihydropyridine CCB for adults with hypertension requiring pharmacologic treatment. About 70% of adults with hypertension will require more than 1 class of medication to achieve BP control,⁷⁴ a proportion projected to increase as BP targets are lowered.

Combining lower doses of different classes provides additive BP lowering effects while minimizing adverse effects.⁶⁶ Meta-analysis data show that single-pill combinations reduce mean systolic BP by 4.0 mm Hg (95% CI 0.1 to 7.9 mm Hg) beyond that achieved by free-equivalent combination therapy.⁷⁵ Single-pill combinations achieve BP control in about one-third more patients than with standard monotherapy (65% vs 48%, risk ratio [RR]=1.32, 95% CI 1.20 to 1.45).⁷⁶ Compared with free-drug combinations, single-pill combinations are associated with significantly better drug adherence (OR=1.21, 95% CI 1.03 to 1.43) and a possible trend toward better drug persistence (OR=1.54, 95% CI 0.95 to 2.49).⁷⁷ An observational study of more than 100,000 patients with hypertension showed that upfront combination therapy

reduced therapeutic inertia, as these patients were over 2-fold more likely to be on a multidrug prescription at 3 years than those started on monotherapy.⁷⁸ Notably, the patients started on combination therapy in this study also had a 16% (95% CI 10% to 21%) reduction in hospital admission for cardiovascular events and a 20% (95% CI 11% to 28%) reduction in all-cause death.⁷⁸

Single-pill combinations also yield substantial cost savings compared with their free-drug equivalents, with a 2009 Canadian study estimating a yearly cost savings of \$27 to \$45 million.⁷⁹ With regard to potential harms from use of single-pill combinations in the initial management of hypertension, meta-analysis data showed no difference in withdrawal from adverse events for single-pill combinations compared with free-drug combination use (OR=0.80, 95% CI 0.58 to 1.11)^{76,77} or standard-dose monotherapy (RR=1.19, 95% CI 0.83 to 1.69).⁷⁶ However, there is a higher incidence of dizziness with single-pill combinations than with standard-dose monotherapy (RR=1.54, 95% CI 1.08 to 2.19).⁷⁶

Values and preferences: The guideline committee placed a high value on initiating a combination of effective and well-tolerated drugs to reduce therapeutic inertia and increase time in target range. Single-pill combination agents are often available at lower cost than their individual components. While recognizing the potential uncertainty regarding which agent may cause intolerance in a combination pill, we placed lower value on this concern than on the benefits of timely and efficient treatment.

If BP remains above target despite 2-drug combination therapy, 3-drug combination therapy consisting of an ACEI or ARB, a thiazide or thiazide-like diuretic, and a long-acting dihydropyridine calcium channel blocker is recommended (strong recommendation, moderate-certainty evidence).

Rationale. Given the aforementioned benefits regarding effective BP and cardiovascular risk reduction relative to other medication classes (discussed under previous recommendation), we recommend using ACEIs or ARBs, thiazide or thiazide-like diuretics, and long-acting dihydropyridine CCBs preferentially in combination in adults with hypertension requiring pharmacotherapy.^{67,80,81} When 3 drugs are required to achieve BP control, we recommended combining all 3 of these complementary medication classes. Notably, ACEIs and ARBs should not be used in combination, as they increase the risk for adverse events including hyperkalemia, acute kidney injury, hypertension, and syncope, with no added clinical benefit.^{82,83} Recently, single-pill triple-combination therapy with ACEI or ARB, thiazide or thiazide-like diuretic, and dihydropyridine CCB has been shown to be effective in improving hypertension control⁸⁴⁻⁸⁶; however, this single pill is not yet available in Canada.

Values and preferences: The guideline committee prioritized the use of medications with well-established cardiovascular benefits over those for which such benefits have not been clearly demonstrated.

If BP remains above target despite 3-drug combination therapy consisting of an ACEI or ARB, a thiazide or thiazide-like diuretic, and a long-acting dihydropyridine calcium channel blocker at their maximally tolerated doses, the addition of spironolactone is suggested (conditional recommendation, moderate-certainty evidence).

Rationale: Resistant hypertension is present when BP remains above target despite adherence to the combination of an ACEI or ARB, thiazide or thiazide-like diuretic, and CCB at their maximally tolerated doses.⁶³ In this setting, the addition of spironolactone results in substantially greater BP reduction than with alternative fourth-line agents. The PATHWAY-2 RCT found that among adults with resistant hypertension, the mean reduction in systolic BP was greater with spironolactone than with placebo (8.7 mm Hg, 95% CI 7.7 to 9.7 mm Hg), doxazosin (4.0 mm Hg, 95% CI 3.0 to 5.0 mm Hg), and bisoprolol (4.5 mm Hg, 95% CI 3.5 to 5.5 mm Hg).⁸⁷ Mechanistic sub-analyses later showed that these findings related to a high proportion of dysregulated aldosterone production among people with resistant hypertension.⁸⁸ However, no prospective data exist that demonstrate improved cardiovascular outcomes with spironolactone compared with other antihypertensive agents.

The PATHWAY-2 trial showed no difference in serious adverse events or withdrawal for adverse events (including hyperkalemia and gynecomastia) with spironolactone versus doxazosin, bisoprolol, or placebo.⁸⁷ However, spironolactone is known to increase the risk of hyperkalemia, particularly in patients with chronic kidney disease (in whom spironolactone use is associated with a 3-fold higher risk of hyperkalemia-associated hospital admission)⁸⁹ and those taking other medications that raise potassium levels (eg, ACEIs or ARBs).⁹⁰ We advise monitoring serum potassium 2 to 4 weeks after spironolactone initiation and with any dose adjustment. Given the antiandrogen effects of spironolactone, males should be counselled on the risk of gynecomastia. For instance, in the Randomized Aldactone Evaluation Study (RALES) trial, which randomized patients with heart failure with reduced ejection fraction to spironolactone 25 mg versus placebo, 10% of males randomized to spironolactone developed gynecomastia, compared with 1% of males randomized to placebo.⁹¹

Patients with resistant hypertension should be considered for screening for secondary causes of hypertension and referral to specialist care. Specifically, given the high prevalence of primary aldosteronism among patients with resistant hypertension,⁹²⁻⁹⁵ screening with aldosterone and renin measurements (ideally before the introduction of spironolactone) should be performed.⁹⁶

Values and preferences: The guideline committee placed high value on the proven BP-lowering benefits of spironolactone compared with other fourth-line agents, while assigning lower value to potential adverse effects, including the risk of hyperkalemia, that may arise with its use. The lower strength of evidence for this recommendation reflects the limited data available on the long-term cardiovascular benefits of the treatment.

— Methods —

This guideline was developed by the volunteer Primary Care Guideline Committee of Hypertension Canada and was supported by Hypertension Canada. We followed GRADE¹⁴ and ADAPTE⁹⁷ frameworks to develop the recommendations in accordance with the Appraisal of Guidelines for Research and Evaluation (AGREE II) quality and reporting standards.⁹⁸

Composition of participating groups

The Primary Care Guideline Committee was selected by the Hypertension Canada Guideline Executive Committee. The guideline committee consisted of family medicine physicians (K.A.T., J.H., and G.C.), pharmacists (R.T.T. and S.C.G.), a nurse practitioner (J.B.), hypertension specialists (R.G. [co-chair], G.L.H. [co-chair], R.T.T., A.A.L., N.R.C.C., and E.L.S.), and a methodologist (N.S.) with expertise in guideline development and GRADE methodology. Additionally, a working group of 4 patient-partners with lived experience with hypertension (listed in Acknowledgements) was formed, which provided feedback throughout the guideline development process and led the creation of the associated patient support tool.

Selection of priority topics

During an in-person open forum session at the 2023 Canadian Hypertension Congress on October 23, 2023, with more than 200 primary care providers, hypertension providers, and patients with lived experience, there was a consensus request for the development of a streamlined, pragmatic, and evidence-based hypertension guideline specifically focused on primary care.

With input from the primary care providers on the guideline committee and the patient-partner working group, and after review of existing hypertension guidelines (discussed below), the committee came to consensus on the priority topics for inclusion, encompassing diagnosis and management of hypertension. Additionally, in response to the provider request made at the congress, the committee decided to limit the number of recommendations to only those deemed most relevant to primary care.

Literature review and quality assessment

The guideline committee used the ADAPTE⁹⁷ framework to select international hypertension guidelines published

over the previous 10 years. The committee considered the quality and availability of evidence reviews, use of GRADE or similar grading frameworks to rate the strength of recommendations and certainty of evidence systematically and explicitly, clarity of recommendations, and publication time frames when selecting the source guidelines: American Heart Association,⁹⁹ WHO,⁷¹ and the European Society of Cardiology (ESC).⁶³ The committee used the existing evidence syntheses and GRADE levels from each of these source guidelines when developing the recommendations. The ESC guideline had the most recently updated recommendations (published in August 2024), with evidence tables updated to January 2024, with the exception of the Effects of Intensive Blood Pressure Lowering Treatment in Reducing Risk of Cardiovascular Events (ESPRIT) trial, which was published in June 2024.^{28,63}

Development of recommendations

The guideline committee meetings were held virtually on a monthly basis from July 25, 2024, to January 20, 2025. The committee reviewed the evidence from the source recommendations and made judgments about the effects of the interventions, feasibility, resources, patient values and preferences, and availability or accessibility issues. Each recommendation was discussed and either adapted or adopted. Consensus was desired; however, when a unanimous decision could not be reached, the committee voted, with consensus defined as more than 70%. We assigned the strength of each recommendation according to the GRADE framework, as strong (applying the terminology “recommended”) or conditional (applying the terminology “suggested”).¹⁴ Further information on how each recommendation was adapted from the source guidelines is available in Appendix 1, Supplementary Tables 2 to 10, available from **CFPlus**.*

In addition, the committee used HEARTS to develop streamlined algorithms for hypertension diagnosis and treatment to optimize implementation into the Canadian primary care setting, which incorporate and align with the recommendations in this guideline.⁸

External review

The preliminary guideline was posted on the Hypertension Canada website from September 27, 2024, through October 25, 2024, for external review. Family physicians, pharmacists, nurses, hypertension specialists, and patients and caregivers from across Canada were invited to review the guideline and provide feedback via an online survey with both English and French versions. Requests for feedback were emailed using mailing lists from major national organizations representing these stakeholders (listed in the Acknowledgements section), including requests for patient-specific feedback from established patient-partners from Hypertension Canada and the Heart

and Stroke Foundation of Canada. We received 143 responses (45 pharmacists, 26 family physicians, 25 other physicians, 19 nurse practitioners, 14 nurses, 10 patients and 4 researchers). The feedback was collated, reviewed, and incorporated to update both the recommendations and HEARTS-derived algorithms (as appropriate) upon collective review by the guideline committee. The responses to frequent comments and questions received are detailed in Appendix 2, available from **CFPlus**.*

Management of competing interests

Competing interests for all guideline committee members were managed according to Hypertension Canada policies, which are informed by Guidelines International Network principles (Appendix 3, available from **CFPlus**).¹⁰⁰ On appointment, all members agreed to avoid direct competing interests with companies that could be affected by the guideline and provided written disclosure of all financial and nonfinancial interests relevant to the guideline topic. Verbal updates on competing interests were requested at the beginning of every committee meeting. The conflict-of-interest oversight committee reviewed the disclosures and made judgments about conflicts. Guideline chairs were required to be free of relevant financial competing interests throughout the guideline development process. Two committee members with potentially relevant disclosures related to pharmaceutical companies were permitted to join in the discussion about pharmacotherapy recommendations but were excluded from voting on these topics. Notably, only generic medications were discussed.

Funding came solely from Hypertension Canada, which receives its funding from the following sources: device endorsement revenue (63%); investment income (18%); certification program revenue (7%); grants and sponsorships (4%), including from a health technology company; registration fees (4%); membership dues (4%); and donations (<1%). No funding is received from pharmaceutical companies. Hypertension Canada funded the guideline and assembled the committee; however, it had no role in developing the recommendations or supporting resources. No sponsorship was accepted for this guideline, and no companies were allowed to participate in the guideline process.

— Implementation —

Consistent with the guideline recommendations, the committee adapted the HEARTS framework to develop suggested algorithms for the diagnosis (**Figure 2**) and treatment (**Figure 3**) of hypertension in the Canadian primary care setting.⁸ Standardized protocols are effective in improving population-wide BP control.

A recent meta-analysis of RCTs demonstrated that standardized treatment protocols reduce mean systolic and diastolic BP by 6.7 mm Hg (95% CI 3.7 to 9.8 mm Hg)

and 2.6 mm Hg (95% CI 1.2 to 4.1 mg Hg), respectively, compared with usual care.¹⁰¹ With broad adoption, specific algorithms can reduce drug costs through bulk drug purchasing and make standardized education and task-sharing more efficient and less costly.¹¹

Factors we considered for the recommended drug selection within the algorithm included efficacy, tolerability, cost, coverage, availability, protection from future drug shortages, and ability to split pills (Appendix 2, available from **CFPlus**).* Based on these, we selected a combination pill with irbesartan and hydrochlorothiazide as the preferred initial combination therapy at this time, although the initial combination will be periodically reconsidered given availability and new evidence to suggest more cost-effective choices. Acceptable alternative single-pill combination therapies currently available in Canada are listed in **Table 3**.

Importantly, the cost of most single-pill combinations is generally lower than the cost for the equivalent individual components. It should be noted that the lower BP thresholds adopted for both defining hypertension and treatment targets relative to previous Hypertension Canada guidelines means that a higher number of people will be labelled as having hypertension, which may have meaningful personal implications (eg, stigma, insurance).³¹ However, the committee thought that the contemporary evidence strongly supports the lower thresholds to promote early detection of, and intervention for, hypertension, which will translate into mitigating long-term cardiovascular complications at the population level.

The HEARTS framework has a well-established implementation policy to engage primary care and optimize guideline uptake, which will be leveraged for this purpose within Canada.⁸ This includes active engagement with primary care centres, along with the development of knowledge transfer tools to support health care providers and patients. These tools include a downloadable patient support tool, to be made widely available for posting in clinics and provision to patients as educational handouts (Appendix 4, available from **CFPlus**).* Additional free online resources for health care providers and patients are listed in Appendix 5, available from **CFPlus**.*

Timely dissemination of the guideline content and implementation tools will take place via the Hypertension Canada website (<https://hypertension.ca>) and network, social media, podcasts, and national primary care conferences. Successful implementation will be tracked via downloads of the patient support tool, traffic to the guideline website, and prospective trends on hypertension treatment and control rates, which Hypertension Canada has traditionally captured via the Canadian Health Measures Survey.⁵

Hypertension Canada will update this guideline when new data pertinent to the diagnosis and treatment of hypertension emerge or when new cost-effective antihypertensive combination pills become available in Canada.

Other guidelines

Hypertension Canada has adopted a new 2-part guideline approach. This primary care–focused guideline was developed at the request of primary care providers for more pragmatic guidance on managing hypertension in routine clinical practice. An upcoming comprehensive guideline will be updated on a rolling topic-by-topic basis beginning later this year.⁷ Currently, we are undertaking a prioritization exercise to determine the topics to be updated and the order in which these updates will occur. The comprehensive guideline will serve as a resource for more complex and nuanced aspects of hypertension management.

The recommendations within this guideline were developed based on evidence syntheses and adaptation of

recommendations from the American Heart Association,⁹⁹ ESC,⁶³ and WHO hypertension guidelines.⁷¹ Compared with the 2020 Hypertension Canada guideline,³¹ the present guideline encourages initial low-dose combination therapy. Additionally, a common request from primary care providers in developing this guideline was to provide a single BP threshold definition for hypertension and a single BP treatment target. Therefore, in contrast to the 2020 Hypertension Canada guideline³¹ but consistent with other international guidelines^{63,99} and based upon updated evidence on the benefits of more intensive BP lowering,^{27-30,38} we adopted the definition of hypertension as BP $\geq 130/80$ mm Hg, and the treatment target of systolic BP < 130 mm Hg.

Figure 2. Suggested algorithm for the diagnosis of hypertension in primary care

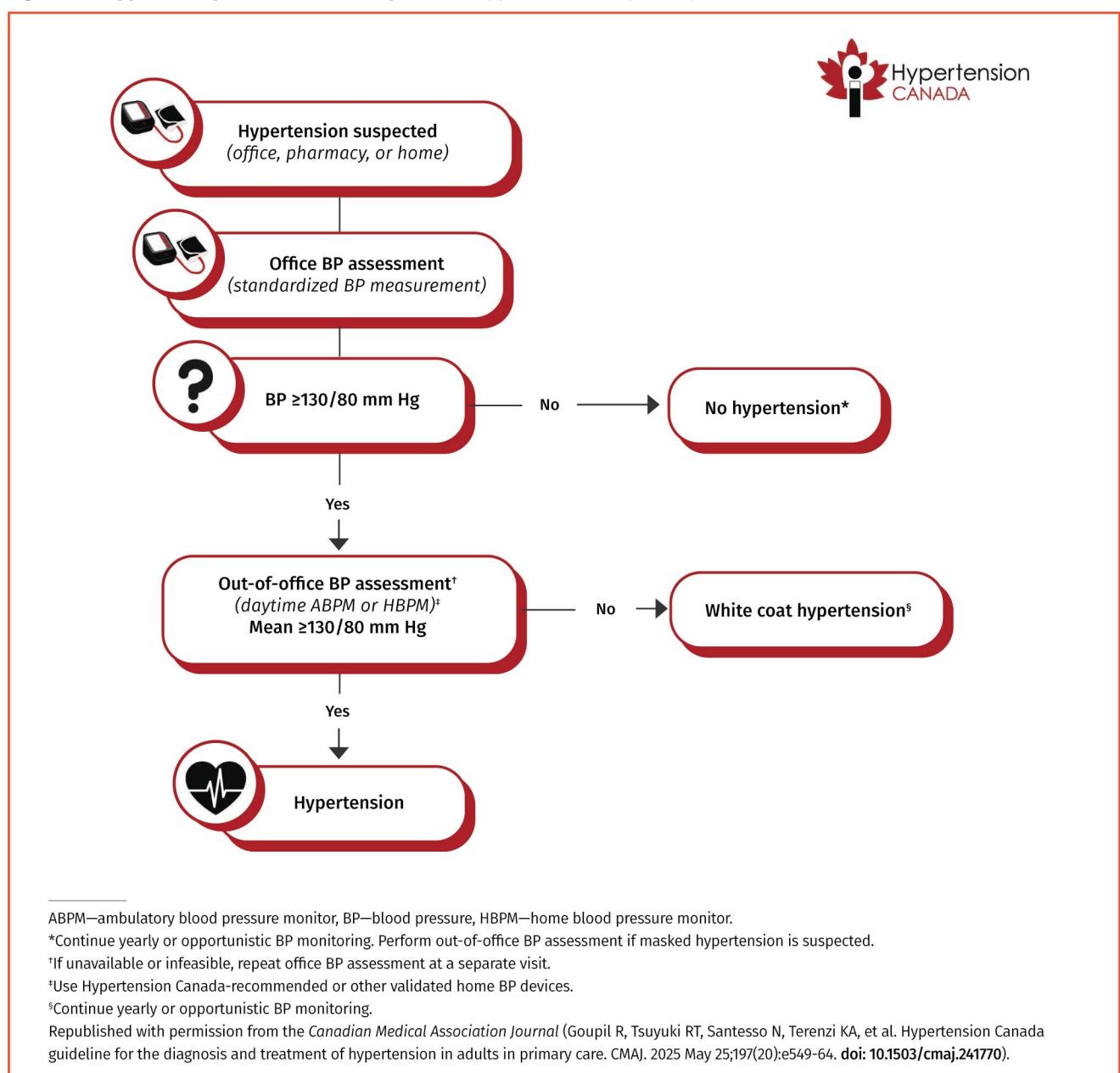


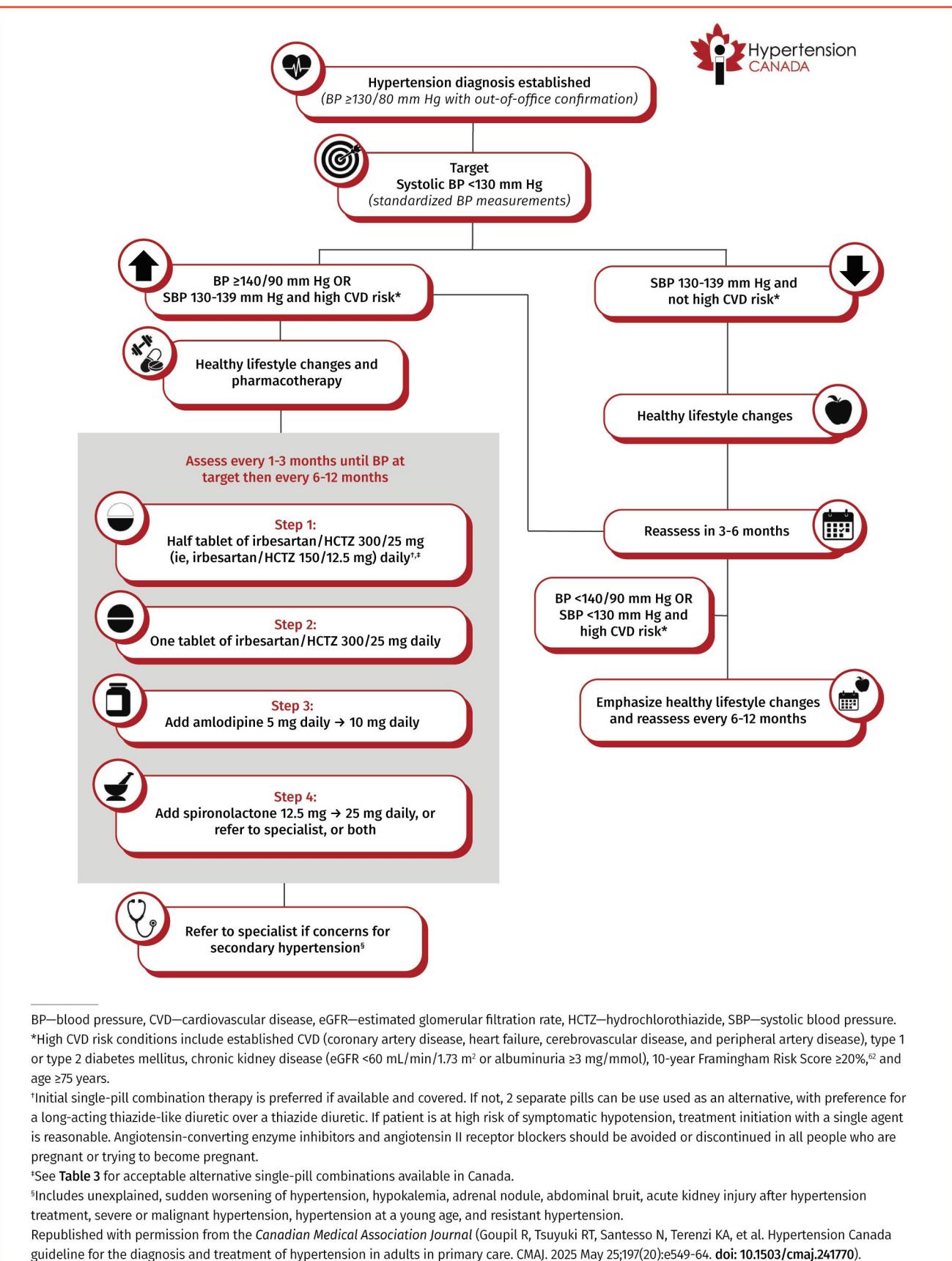
Figure 3. Suggested algorithm for the treatment of hypertension in primary care (not intended for use in pregnancy)

Table 3. Available single-pill antihypertensive medication combinations in Canada and associated costs

SINGLE-PILL COMBINATIONS	COST FOR 30 DAYS OF COMBINATION PILLS, \$*	COST FOR 30 DAYS OF INDIVIDUAL DRUG EQUIVALENTS, \$*
ARB + thiazide or thiazide-like diuretic		
Irbesartan-hydrochlorothiazide	6.55	7.31
Telmisartan-hydrochlorothiazide	6.29	6.95
Olmesartan-hydrochlorothiazide	8.12	8.76
Candesartan-hydrochlorothiazide	7.33	7.25
ACEI + thiazide or thiazide-like diuretic		
Lisinopril-hydrochlorothiazide	7.51	6.31
Perindopril-indapamide	8.58	12.04
ARB + long-acting dihydropyridine CCB		
Telmisartan-amlodipine	16.42	12.47

ACEI—angiotensin-converting enzyme inhibitor, ARB—angiotensin II receptor blocker, CCB—calcium channel blocker.

*Drug costs obtained from <https://www.ramq.gouv.qc.ca/fr>, <https://www.formulary.health.gov.on.ca/formulary>, and <https://pharmacareformularysearch.gov.bc.ca>.

Gaps in knowledge

These recommendations are informed by the best level of evidence available to date. Ongoing research will continue to inform and advance hypertension care. Although a large armamentarium of antihypertensive medications already exists, a number of new drug classes have recently been developed.^{102–104} Furthermore, renal denervation provides a potential future interventional approach to improve BP control.¹⁰⁵ The role of these novel management approaches in future hypertension algorithms remains to be seen.

Limitations

Although we did not conduct new evidence reviews to support these recommendations, numerous reviews have been conducted by different organizations. Therefore, to reduce duplication of research and to expedite creation of a new primary care–focused guideline, we reviewed the evidence from high-quality, recently published guidelines. Correspondingly, the strength and certainty of the evidence of the recommendations were based on literature available at the time the source guidelines performed their evidence syntheses (the most recent being the 2024 ESC guideline). We acknowledge that the source guidelines were not developed using a Canadian context; however, we considered the feasibility, acceptability, resources, and other issues in Canada when adapting the recommendations.

Further, some aspects of the recommendations lack Canada-specific evidence. For instance, when using cardiovascular risk calculators to determine whether an individual is at high cardiovascular disease risk, several risk calculators are available.^{62,106–109} However, none are Canada-specific and it is uncertain which is most accurate within Canada.

Our guideline committee also attempted to incorporate NNT and NNH to demonstrate the risks and benefits relevant to each recommendation. These metrics were available for intensive BP targets, but not for all recommendations, and instead we used syntheses of descriptive summaries of effects. Finally, with the goal of developing pragmatic primary care–specific management recommendations, more nuanced details of hypertension management are not included in this guideline. For instance, topics such as how best to integrate care with ever-evolving complementary treatments (eg, statins, sodium-glucose cotransporter 2 inhibitors, and glucagon-like peptide 1 receptor antagonists) to lower cardiovascular risk among patients with hypertension and other comorbidities were beyond the scope of this guideline. Such topics will be addressed with the forthcoming Hypertension Canada comprehensive guideline.

Conclusion

We aimed to provide pragmatic, evidence-based recommendations and algorithms to improve the standard for care for hypertension management in the Canadian primary care setting. Successful uptake of this guideline will serve to improve hypertension treatment and control at the population level.

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Contributors

All authors contributed to the conception and design of the work, and the acquisition, analysis, and interpretation of data. **Dr Rémi Gouipil** and **Dr Gregory L. Hundemer** drafted the manuscript, and all authors revised it critically for important intellectual content. All authors gave final approval of the version to be published and agreed to be accountable for all aspects of the work.

Competing interests

Dr Rémi Gouipil reports receiving research grants from the Canadian Institutes of Health Research (CIHR), the Kidney Foundation of Canada, and Fonds de recherche du Québec-Santé, Université de Montréal, and holds unpaid positions as a board member of the Canadian Society of Nephrology and Vice-president of the Société québécoise d'hypertension artérielle. **Dr Ross T. Tsuyuki** reports receiving a research grant from Sanofi Canada and an editor-in-chief stipend from the *Canadian Pharmacists Journal*, as well as consulting fees from Shoppers Drug Mart. He holds volunteer positions as president and past president of the Board of Directors of Hypertension Canada. **Dr Kristin A. Terenzi** reports consulting fees, honoraria, and travel support from, as well as participation on data safety monitoring boards with AstraZeneca, Astella, Amgen, AbbVie, Aspen, Allergan, Bayer, Boehringer Ingelheim, Lundbeck, Novartis, Novo Nordisk, Pfizer, Moderna, GlaxoSmithKline, Eli Lilly, and Takeda. **Dr Jeffrey Habert** reports consulting fees from Otsuka, Eli Lilly, Amgen, Idorsia, Eisai, and Elvium; speaker fees, and participation on scientific planning committees with Boehringer Ingelheim, Eli Lilly, Elvium, Bausch and Lomb, AstraZeneca, Novartis, Lundbeck, Novo Nordisk, Janssen, Eisai, HLS, Otsuka, Idorsia, Pfizer, Amgen, AbbVie, GlaxoSmithKline, Bayer, and Valeo; and meeting support from Eli Lilly and Idorsia. He was co-chair for the Thrombosis Canada clinical guidelines, co-author of the 2023 Canadian Network for Mood and Anxiety Treatments (CANMAT) guideline, and co-author of the Canadian sleep consensus on insomnia. **Dr Habert** is the physician lead of the Holland-Davis Family Health Organization and a director for the CPD Network Physician Organization. **Dr Gemma Cheng** received an honorarium from the Montreal Chinese Hospital Foundation for a lecture on type 2 diabetes and hypertension. **Dr Stephanie C. Gysel** reports funding from Novo Nordisk and University Health Foundation; consulting fees from Novartis Canada, Amgen Canada, Pfizer Canada, and Kye Pharma; honoraria from Novartis Canada, Amgen Canada, and Pfizer Canada; and travel support from Amgen Canada. **Dr Jill Bruneau** reports receiving research grants from CIHR, and travel support from Memorial University of Newfoundland to attend the Canadian Women's Heart Health Alliance Conference, and from Hypertension Canada to attend the Nurse Practitioner Conference of Canada. She reports participating in the Knowledge Translation Working Group, Canadian Women's Heart Health Alliance and is a member of the Hypertension Canada Board of Directors (both positions unpaid). Bruneau reports use of intrauterine devices (IUD) simulator, expertise, and sponsorship from Bayer for the purposes of Nurse Practitioner Education only (paid to institution). **Dr Alexander A. Leung** reports receiving the Heart and Stroke Foundation of Canada's National New Investigator Award and Petro Canada's Young Innovator Award in Community Health, as well as the Calgary Centre for Clinical Research, Cumming School of Medicine, and Alberta Health Services Clinical Research Fund Seed Grant (all paid to institution). Dr Leung also reports receiving an honorarium as a clinical expert for the Canadian Agency for Drugs and Technologies in Health Scientific Advice Program. **Dr Norman R.C. Campbell** reports serving as chair of Alberta Health Professionals for the Environment, past chair of the Canadian Hypertension Coalition, special advisor to the World Hypertension League Board, consultant for the Pan American Health Organization's HEARTS in the Americas program, consultant with Resolve to Save Lives, and consultant for the Crowfoot Primary Care Clinic. **Dr Ernesto L. Schiffrin** reports receiving a project grant from CIHR, consulting fees from Boehringer Ingelheim International, and payment for participating in a speaker's bureau from Idorsia. Dr Schiffrin served on the Hypertension Canada Budget Committee. **Dr Gregory L. Hundemer** reports receiving research grants from CIHR, the Kidney Foundation of Canada, and The Ottawa Hospital Academic Medical Organization, and is the Lorna Jocelyn Wood Chair for Kidney Research (Ottawa Hospital Research Institute).

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References

1. Global Cardiovascular Risk Consortium; Magnussen C, Ojeda FM, Leong DP, et al. Global Effect of Modifiable Risk Factors on Cardiovascular Disease and Mortality. *N Engl J Med.* 2023 Oct 5;389(14):1273-85. doi: [10.1056/NEJMoa2206916](https://doi.org/10.1056/NEJMoa2206916). Epub 2023 Aug 26.
2. DeGuire J, Clarke J, Rouleau K, Roy J, et al. *Health Rep.* 2019 Feb 20;30(2):14-21. doi: [10.25318/82-003-x201900200002](https://doi.org/10.25318/82-003-x201900200002).
3. NCD Risk Factor Collaboration (NCD-Risc). Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019: a pooled analysis of 1201 population-representative studies with 104 million participants. *Lancet.* 2021 Sep 11;398(10304):957-80. doi: [10.1016/S0140-6736\(21\)01330-1](https://doi.org/10.1016/S0140-6736(21)01330-1). Epub 2021 Aug 24. Erratum in: *Lancet.* 2022 Feb 5;399(10324):520. doi: [10.1016/S0140-6736\(22\)00061-7](https://doi.org/10.1016/S0140-6736(22)00061-7).
4. Leung AA, Williams JVA, McAlister FA, Campbell NRC, et al. Hypertension Canada's Research and Evaluation Committee. Worsening Hypertension Awareness, Treatment, and Control Rates in Canadian Women Between 2007 and 2017. *Can J Cardiol.* 2020 May;36(5):732-9. doi: [10.1016/j.cjca.2020.02.092](https://doi.org/10.1016/j.cjca.2020.02.092). Epub 2020 Apr 13.
5. Leung AA, Williams JVA, Padwal RS, McAlister FA. Prevalence, Patient Awareness, Treatment, and Control of Hypertension in Canadian Adults With Common Comorbidities. *CJC Open.* 2024 May;29(6):1099-1107. doi: [10.1016/j.cjco.2024.05.012](https://doi.org/10.1016/j.cjco.2024.05.012).
6. Leung AA, Bell A, Tsuyuki RT, Campbell NRC. Refocusing on hypertension control in Canada. *CMAJ.* 2021 Jun 7;193(23):e854-5. doi: [10.1503/cmaj.210140](https://doi.org/10.1503/cmaj.210140).
7. Gouipil R, Tsuyuki RT, Terenzi KA, Santesso N, et al. Ushering in a New Era of Hypertension Canada Guidelines: A Roadmap of What Lies Ahead. *Can J Cardiol.* 2025 Jan;41(1):159-62. doi: [10.1016/j.cjca.2024.10.020](https://doi.org/10.1016/j.cjca.2024.10.020). Epub 2024 Oct 24.
8. World Health Organization. HEARTS technical package for cardiovascular disease management in primary health care: risk-based CVD management. Geneva: World Health Organization; 2020 Jul 13. 80p.
9. Jaffe MG, Lee GA, Young JD, Sidney S, et al. Improved blood pressure control associated with a large-scale hypertension program. *JAMA.* 2013 Aug 21;310(7):699-705. doi: [10.1001/jama.2013.108769](https://doi.org/10.1001/jama.2013.108769).
10. Jaffe MG, Young JD. The Kaiser Permanente Northern California Story: Improving Hypertension Control From 44% to 90% in 13 Years (2000 to 2013). *J Clin Hypertens (Greenwich).* 2016 Apr;18(4):260-1. doi: [10.1111/jch.12803](https://doi.org/10.1111/jch.12803). Epub 2016 Mar 3.
11. Campbell NRC, Ordunez P, Giraldo G, Rodriguez Morales YA, et al. WHO HEARTS: A Global Program to Reduce Cardiovascular Disease Burden: Experience Implementing in the Americas and Opportunities in Canada. *Can J Cardiol.* 2021 May;37(5):748-55. doi: [10.1016/j.cjca.2020.12.004](https://doi.org/10.1016/j.cjca.2020.12.004). Epub 2020 Dec 10.
12. Butalia S, Audibert F, Côté AM, Firoz T, et al; Hypertension Canada. Hypertension Canada's 2018 Guidelines for the Management of Hypertension in Pregnancy. *Can J Cardiol.* 2018 May;34(5):526-31. doi: [10.1016/j.cjca.2018.02.021](https://doi.org/10.1016/j.cjca.2018.02.021). Epub 2018 Mar 1.
13. Dionne JM, Harris KC, Benoit G, Feber J, et al. Hypertension Canada's 2017 Guidelines for the Diagnosis, Assessment, Prevention, and Treatment of Pediatric Hypertension. *Can J Cardiol.* 2017 May;33(5):577-85. doi: [10.1016/j.cjca.2017.03.007](https://doi.org/10.1016/j.cjca.2017.03.007). Epub 2017 Mar 14.
14. Guyatt GH, Oxman AD, Vist GE, Kunz R, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ.* 2008 Apr 26;336(7650):924-6. doi: [10.1136/bmj.39489.470347.AD](https://doi.org/10.1136/bmj.39489.470347.AD).
15. Muntner P, Shimbo D, Carey RM, Charleston JB, et al. Measurement of Blood Pressure in Humans: A Scientific Statement From the American Heart Association. *Hypertension.* 2019 May;73(5):e35-66. doi: [10.1161/HYP.0000000000000087](https://doi.org/10.1161/HYP.0000000000000087).
16. Stergiou GS, Alpert S, Mieke S, Asmar R, et al. A Universal Standard for the Validation of Blood Pressure Measuring Devices: Association for the Advancement of Medical Instrumentation/European Society of Hypertension/International Organization for Standardization (AAMI/ESH/ISO) Collaboration Statement. *Hypertension.* 2018 Mar;71(3):368-74. doi: [10.1161/HYPERTENSIONAHA.117.10237](https://doi.org/10.1161/HYPERTENSIONAHA.117.10237). Epub 2018 Jan 31.
17. Picone DS, Campbell NRC, Schutte AE, Olsen MH, et al. Validation Status of Blood Pressure Measuring Devices Sold Globally. *JAMA.* 2022 Feb 15;327(7):680-1. doi: [10.1001/jama.2021.24464](https://doi.org/10.1001/jama.2021.24464).
18. Chan JCH, Vandermeer I, Picone DS, et al. Validity of home blood pressure devices sold in Canada. *CJC Open.* 2024;6:54-6.
19. Kallioinen N, Hill A, Horswill MS, Ward HE, et al. Sources of inaccuracy in the measurement of adult patients' resting blood pressure in clinical settings: a systematic review. *J Hypertens.* 2017 Mar;35(3):421-41. doi: [10.1097/HJH.0000000000000197](https://doi.org/10.1097/HJH.0000000000000197).
20. Ishigami J, Charleston J, Miller ER III, Matsushita K, et al. Effects of Cuff Size on the Accuracy of Blood Pressure Readings: The Cuff(SZ) Randomized Crossover Trial. *JAMA Intern Med.* 2023 Oct 1;183(10):1061-8. doi: [10.1001/jamainternmed.2023.3264](https://doi.org/10.1001/jamainternmed.2023.3264).
21. Liu H, Zhao D, Sabit A, Pathiravasan CH, et al. Arm Position and Blood Pressure Readings: The ARMS Crossover Randomized Clinical Trial. *JAMA Intern Med.* 2024 Dec 1;184(12):1436-42. doi: [10.1001/jamainternmed.2024.5213](https://doi.org/10.1001/jamainternmed.2024.5213).
22. Cheung AK, Whelton PK, Muntner P, Schutte AE, et al. International Consensus on Standardized Clinic Blood Pressure Measurement—A Call to Action. *Am J Med.* 2023 May;136(5):438-45.e1. doi: [10.1016/j.amjmed.2022.12.015](https://doi.org/10.1016/j.amjmed.2022.12.015). Epub 2023 Jan 6.
23. Pappaccogli M, Di Monaco S, Perlo E, Burrello J, et al. Comparison of Automated Office Blood Pressure With Office and Out-Of-Office Measurement Techniques. *Hypertension.* 2019 Feb;73(2):481-90. doi: [10.1161/HYPERTENSIONAHA.118.12079](https://doi.org/10.1161/HYPERTENSIONAHA.118.12079).
24. Roerecke M, Kaczorowski J, Myers MG. Comparing Automated Office Blood Pressure Readings With Other Methods of Blood Pressure Measurement for Identifying Patients With Possible Hypertension: A Systematic Review and Meta-analysis. *JAMA Intern Med.* 2019 Mar 1;179(3):351-62. doi: [10.1001/jamainternmed.2018.6551](https://doi.org/10.1001/jamainternmed.2018.6551).

25. Drawz PE, Agarwal A, Dwyer JP, Horwitz E, et al. Concordance Between Blood Pressure in the Systolic Blood Pressure Intervention Trial and in Routine Clinical Practice. *JAMA Intern Med.* 2020 Dec 1;180(12):1655-63. doi: 10.1001/jamainternmed.2020.5028.

26. Einstadter D, Bolen SD, Misak JE, Bar-Shain DS, et al. Association of Repeated Measurements With Blood Pressure Control in Primary Care. *JAMA Intern Med.* 2018 Jun 1;178(6):858-60. doi: 10.1001/jamainternmed.2018.0315.

27. Zhang W, Zhang S, Deng Y, Wu S, et al. Trial of Intensive Blood-Pressure Control in Older Patients with Hypertension. *N Engl J Med.* 2021 Sep 30;385(14):1268-79. doi: 10.1056/NEJMoa2111437.

28. Liu J, Li Y, Ge J, Yan X, et al. Lowering systolic blood pressure to less than 120 mm Hg versus less than 140 mm Hg in patients with high cardiovascular risk with and without diabetes or previous stroke: an open-label, blinded-outcome, randomised trial. *Lancet.* 2024 Jul 20;404(10449):245-55. doi: 10.1016/S0140-6736(24)01028-6. Epub 2024 Jun 27.

29. Bi Y, Li M, Liu Y, Li T, et al. Intensive Blood-Pressure Control in Patients with Type 2 Diabetes. *N Engl J Med.* 2025 Mar 27;392(12):1155-67. doi: 10.1056/NEJMoa2412006. Epub 2024 Nov 16.

30. SPRINT Research Group; Wright JT Jr, Williamson JD, Whelton PK, et al. A Randomized Trial of Intensive versus Standard Blood-Pressure Control. *N Engl J Med.* 2015 Nov 26;373(22):2103-16. doi: 10.1056/NEJMoa1511939. Epub 2015 Nov 9. Erratum in: *N Engl J Med.* 2017 Dec 21;377(25):2506. doi: 10.1056/NEJMx170008.

31. Rabi DM, McBrien KA, Sapir-Pichhadze R, Nakha M, et al. Hypertension Canada's 2020 Comprehensive Guidelines for the Prevention, Diagnosis, Risk Assessment, and Treatment of Hypertension in Adults and Children. *Can J Cardiol.* 2020 May;36(5):596-624. doi: 10.1016/j.cjca.2020.02.086.

32. Staplin N, de la Sierra A, Rulifson LM, Emberson JR, et al. Relationship between clinic and ambulatory blood pressure and mortality: an observational cohort study in 59,124 patients. *Lancet.* 2023 Jun 17;401(10393):2041-50. doi: 10.1016/S0140-6736(23)00733-X. Epub 2023 May 5.

33. Franklin SS, Thijss L, Hansen TW, O'Brien E, et al. White-coat hypertension: new insights from recent studies. *Hypertension.* 2013 Dec;62(6):982-7. doi: 10.1161/HYPERTENSIONAHA.113.01275. Epub 2013 Sep 16.

34. Thakkar HV, Pope A, Anpalahan M. Masked Hypertension: A Systematic Review. *Heart Lung Circ.* 2020 Jan;29(1):102-11. doi: 10.1016/j.hlc.2019.08.006. Epub 2019 Aug 16.

35. Gurguis-Blake JM, Evans CV, Webber EM, Coppola EL, et al. Screening for Hypertension in Adults: Updated Evidence Report and Systematic Review for the US Preventive Services Task Force. *JAMA.* 2021 Apr 27;325(16):1657-69. doi: 10.1001/jama.2020.21669.

36. Rapsomaniki E, Timmis A, George J, Pujades-Rodriguez M, et al. Blood pressure and incidence of twelve cardiovascular diseases: lifetime risks, healthy life-years lost, and age-specific associations in 1.25 million people. *Lancet.* 2014 May 31;383(9932):1899-911. doi: 10.1016/S0140-6736(14)60685-1.

37. Guo X, Zhang X, Guo L, Li Z, et al. Association between pre-hypertension and cardiovascular outcomes: a systematic review and meta-analysis of prospective studies. *Curr Hypertens Rep.* 2013 Dec;15(6):703-16. doi: 10.1007/s11906-013-0403-y.

38. Whelton PK, O'Connell S, Mills KT, He J. Optimal Antihypertensive Systolic Blood Pressure: A Systematic Review and Meta-Analysis. *Hypertension.* 2024 Nov;81(11):2329-39. doi: 10.1161/HYPERTENSIONAHA.124.23597. Epub 2024 Sep 12.

39. Blood Pressure Lowering Treatment Trialists' Collaboration. Pharmacological blood pressure lowering for primary and secondary prevention of cardiovascular disease across different levels of blood pressure: an individual participant-level data meta-analysis. *Lancet.* 2021 May 1;397(10285):1625-36. doi: 10.1016/S0140-6736(21)00590-0. Erratum in: *Lancet.* 2021 May 22;397(10288):1884. doi: 10.1016/S0140-6736(21)01069-2.

40. Verdecchia P, Staessen JA, Angeli F, de Simone G, et al. Usual versus tight control of systolic blood pressure in non-diabetic patients with hypertension (Cardio-Sis): an open-label randomised trial. *Lancet.* 2009 Aug 15;374(9689):525-33. doi: 10.1016/S0140-6736(09)61340-4. Erratum in: *Lancet.* 2009 Sep 12;374(9693):880.

41. SPS3 Study Group; Benavente OR, Coffey CS, Conwit R, et al. Blood-pressure targets in patients with recent lacunar stroke: the SPS3 randomised trial. *Lancet.* 2013 Aug 10;382(9891):507-15. doi: 10.1016/S0140-6736(13)60852-1. Epub 2013 May 29. Erratum in: *Lancet.* 2013 Aug 10;382(9891):506.

42. Vaduganathan M, Claggett BL, Juraschek SP, Solomon SD. Assessment of Long-term Benefit of Intensive Blood Pressure Control on Residual Life Span: Secondary Analysis of the Systolic Blood Pressure Intervention Trial (SPRINT). *JAMA Cardiol.* 2020 May 1;5(5):576-81. doi: 10.1001/jamacardio.2019.6192.

43. SPRINT Research Group; Lewis CE, Fine LJ, Bedhu S, et al. Final Report of a Trial of Intensive versus Standard Blood-Pressure Control. *N Engl J Med.* 2021 May 20;384(20):1921-30. doi: 10.1056/NEJMoa1901281.

44. Blood Pressure Lowering Treatment Trialists' Collaboration. Age-stratified and blood-pressure-stratified effects of blood-pressure-lowering pharmacotherapy for the prevention of cardiovascular disease and death: an individual participant-level data meta-analysis. *Lancet.* 2021 Sep 18;398(10305):1053-64. doi: 10.1016/S0140-6736(21)01921-8. Epub 2021 Aug 27.

45. Huang L, Trieu K, Yoshimura S, Neal B, et al. Effect of dose and duration of reduction in dietary sodium on blood pressure levels: systematic review and meta-analysis of randomised trials. *BMJ.* 2020 Feb 24;368:m315. doi: 10.1136/bmj.m315.

46. Neal B, Wu Y, Feng X, Zhang R, et al. Effect of Salt Substitution on Cardiovascular Events and Death. *N Engl J Med.* 2021 Sep 16;385(12):1067-77. doi: 10.1056/NEJMoa2105675. Epub 2021 Aug 29.

47. World Health Organization. Guideline: Sodium intake for adults and children. Geneva: World Health Organization; 2012 Dec 25. p. 56.

48. Mattes RD, Donnelly D. Relative contributions of dietary sodium sources. *J Am Coll Nutr.* 1991;10:383-93.

49. Mente A, O'Donnell M, Rangarajan S, McQueen M, et al. Urinary sodium excretion, blood pressure, cardiovascular disease, and mortality: a community-level prospective epidemiological cohort study. *Lancet.* 2018 Aug 11;392(10146):496-506. doi: 10.1016/S0140-6736(18)31376-X. Epub 2018 Aug 9.

50. Aburto NJ, Hanson S, Gutierrez H, Hooper L, et al. Effect of increased potassium intake on cardiovascular risk factors and disease: systematic review and meta-analyses. *BMJ.* 2013 Apr 3;346:f1378. doi: 10.1136/bmj.f1378.

51. O'Donnell M, Mente A, Rangarajan S, McQueen MJ, et al. Urinary sodium and potassium excretion, mortality, and cardiovascular events. *N Engl J Med.* 2014 Aug 14;371(7):612-23. doi: 10.1056/NEJMoa1311889. Erratum in: *N Engl J Med.* 2014 Sep 25;371(13):1267.

52. World Health Organization. Guideline: Potassium intake for adults and children. Geneva: World Health Organization; 2012 Dec 25. 52p.

53. Semlitsch T, Krenn C, Jeitler K, Berghold A, et al. Long-term effects of weight-reducing diets in people with hypertension. *Cochrane Database Syst Rev.* 2021 Feb 8;2(2):CD008274. doi: 10.1002/14651858.CD008274.pub4.

54. Wilding JPH, Batterham RL, Calanha S, Davies M, et al. Once-Weekly Semaglutide in Adults with Overweight or Obesity. *N Engl J Med.* 2021 Mar 18;384(11):989-1002. doi: 10.1056/NEJMoa2032183. Epub 2021 Feb 10.

55. Fagard RH, Cornelissen VA. Effect of exercise on blood pressure control in hypertensive patients. *Eur J Cardiovasc Prev Rehabil.* 2007;14:12-7.

56. World Health Organization. WHO guidelines on physical activity and sedentary behaviour. Geneva: World Health Organization; 2020 Nov 25. 104p.

57. Roerecke M, Kaczorowski J, Tobe SW, Gmel G, et al. The effect of a reduction in alcohol consumption on blood pressure: a systematic review and meta-analysis. *Lancet Public Health.* 2017 Feb;2(2):e108-20. doi: 10.1016/S2468-2667(17)30003-8. Epub 2017 Feb 7.

58. Liu F, Liu Y, Sun X, Yin Z, et al. Race- and sex-specific association between alcohol consumption and hypertension in 22 cohort studies: A systematic review and meta-analysis. *Nutr Metab Cardiovasc Dis.* 2020 Jul 24;30(8):1249-59. doi: 10.1016/j.numecd.2020.03.018. Epub 2020 Mar 27.

59. Primatesta P, Falaschetti E, Gupta S, Marmot MG, et al. Association between smoking and blood pressure: evidence from the health survey for England. *Hypertension.* 2001 Feb;37(2):187-93. doi: 10.1161/01.hyp.37.2.187.

60. Yang JJ, Yu D, Shu XO, Wen W, et al. Reduction in total and major cause-specific mortality from tobacco smoking cessation: a pooled analysis of 16 population-based cohort studies in Asia. *Int J Epidemiol.* 2022 Jan 6;50(6):2070-81. doi: 10.1093/ije/dyab087. Epub 2021 Feb 5.

61. Sundström J, Arima H, Jackson R, Turnbull F, et al. Effects of blood pressure reduction in mild hypertension: a systematic review and meta-analysis. *Ann Intern Med.* 2015 Feb 3;162(3):184-91. doi: 10.7326/M14-0773.

62. D'Agostino RB Sr, Vasan RS, Pencina MJ, Wolf PA, et al. General cardiovascular risk profile for use in primary care: the Framingham Heart Study. *Circulation.* 2008 Feb 12;117(6):743-53. doi: 10.1161/CIRCULATIONAHA.107.699579. Epub 2008 Jan 22.

63. McEvoy JW, McCarthy CP, Bruno RM, Brouwers S, et al. 2024 ESC Guidelines for the management of elevated blood pressure and hypertension. *Eur Heart J.* 2024 Oct 7;45(38):3912-4018. doi: 10.1093/eurheartj/ehae178. Erratum in: *Eur Heart J.* 2025 Apr 7;46(14):1300. doi: 10.1093/eurheartj/ehaf031.

64. Thomopoulos C, Parati G, Zanchetti A. Effects of blood-pressure-lowering treatment on outcome incidence. 12. Effects in individuals with high-normal and normal blood pressure: overview and meta-analyses of randomized trials. *J Hypertens.* 2017 Nov;35(11):2150-60. doi: 10.1097/HJH.0000000000001547.

65. Beddhu S, Chertow GM, Cheung AK, Cushman WC, et al. Influence of Baseline Diastolic Blood Pressure on Effects of Intensive Compared With Standard Blood Pressure Control. *Circulation.* 2018 Jan 9;137(2):134-43. doi: 10.1161/CIRCULATIONAHA.117.030848. Epub 2017 Oct 11.

66. Law MR, Wald NJ, Morris JK, et al. Value of low dose combination treatment with blood pressure lowering drugs: analysis of 354 randomised trials. *BMJ.* 2003 Jun 28;326(7404):1427. doi: 10.1136/bmj.326.7404.1427.

67. Ettiehd H, Emdin CA, Kiran A, Anderson SG, et al. Blood pressure lowering for prevention of cardiovascular disease and death: a systematic review and meta-analysis. *Lancet.* 2016 Mar 5;387(10022):957-67. doi: 10.1016/S0140-6736(15)01225-8. Epub 2015 Dec 24.

68. Wiyosone CS, Bradley H, Mayosi BM, Maroney R, et al. Beta-blockers for hypertension. *Cochrane Database Syst Rev.* 2007 Jan 24;(1):CD002003. doi: 10.1002/14651858.CD002003.pub2. Update in: *Cochrane Database Syst Rev.* 2012 Aug 15;(8):CD002003. doi: 10.1002/14651858.CD002003.pub3.

69. Andrade JG, Aguilar M, Atzema C, Bell A, et al. The 2020 Canadian Cardiovascular Society/Canadian Heart Rhythm Society Comprehensive Guidelines for the Management of Atrial Fibrillation. *Can J Cardiol.* 2020 Dec;36(12):1847-1948. doi: 10.1016/j.cjca.2020.09.001. Epub 2020 Oct 22.

70. McDonald M, Virani S, Chan M, Ducharme A, et al. CCS/CHFS Heart Failure Guidelines Update: Defining a New Pharmacologic Standard of Care for Heart Failure With Reduced Ejection Fraction. *Can J Cardiol.* 2021 Apr;37(4):531-46. doi: 10.1016/j.cjca.2021.01.017.

71. World Health Organization. Guideline for the pharmacological treatment of hypertension in adults. Geneva: World Health Organization; 2021 Aug 24. p. 61.

72. Fitton CA, Steiner MFC, Autcott L, Pell JP, et al. In-utero exposure to antihypertensive medication and neonatal and child health outcomes: a systematic review. *J Hypertens.* 2017 Nov;35(11):2123-37. doi: 10.1097/HJH.0000000000001456.

73. Ishani A, Cushman WC, Leatherman SM, Lew RA, et al. Chlorthalidone vs. Hydrochlorothiazide for Hypertension-Cardiovascular Events. *N Engl J Med.* 2022 Dec 29;387(26):2401-10. doi: 10.1056/NEJMoa2212270. Epub 2022 Dec 14.

74. Gu Q, Burt VL, Dillon CF, et al. Trends in antihypertensive medication use and blood pressure control among United States adults with hypertension: the National Health And Nutrition Examination Survey, 2001 to 2010. *Circulation.* 2012;126:2105-14.

75. Parati G, Kjeldsen S, Coca A, Cushman WC, et al. Adherence to Single-Pill Versus Free-Equivalent Combination Therapy in Hypertension: A Systematic Review and Meta-Analysis. *Hypertension*. 2021 Feb;77(2):692-705. doi: 10.1161/HYPERTENSIONAHA.120.15781. Epub 2021 Jan 4.

76. Salam A, Kanukula R, Atkins E, Wang X, et al. Efficacy and safety of dual combination therapy of blood pressure-lowering drugs as initial treatment for hypertension: a systematic review and meta-analysis of randomized controlled trials. *J Hypertens*. 2019 Sep;37(9):1768-74. doi: 10.1097/HJH.00000000000002096.

77. Gupta AK, Arshad S, Poulter NR. Compliance, safety, and effectiveness of fixed-dose combinations of antihypertensive agents: a meta-analysis. *Hypertension*. 2010;55:399-407.

78. Rea F, Corrao G, Merlini L, et al. Initial antihypertensive treatment strategies and therapeutic inertia. *Hypertension*. 2018;72:846-53.

79. Stankus V, Hemmelgarn B, Campbell NR, Chen G, et al. Reducing costs and improving hypertension management. *Can J Clin Pharmacol*. 2009 Winter;16(1):e151-5. Epub 2009 Feb 4.

80. MacDonald TM, Williams B, Webb DJ, Morant S, et al. Combination Therapy Is Superior to Sequential Monotherapy for the Initial Treatment of Hypertension: A Double-Blind Randomized Controlled Trial. *J Am Heart Assoc*. 2017 Nov 18;6(11):e006986. doi: 10.1161/JAHA.117.006986.

81. Egan BM, Bandyopadhyay D, Shaftman SR, Wagner CS, et al. Initial monotherapy and combination therapy and hypertension control the first year. *Hypertension*. 2012 Jun;59(6):1124-31. doi: 10.1161/HYPERTENSIONAHA.112.194167. Epub 2012 May 7.

82. Fried LF, Emanuele N, Zhang JH, Brophy M, et al. Combined angiotensin inhibition for the treatment of diabetic nephropathy. *N Engl J Med*. 2013 Nov 14;369(20):1892-903. doi: 10.1056/NEJMoa1303154. Epub 2013 Nov 9. Erratum in: *N Engl J Med*. 2014;370(18):A7255.

83. ONTARGET Investigators; Yusuf S, Teo KK, Pogue J, et al. Telmisartan, ramipril, or both in patients at high risk for vascular events. *N Engl J Med*. 2008 Apr 10;358(15):1547-59. doi: 10.1056/NEJMoa0801317. Epub 2008 Mar 11.

84. Ojji DB, Salam A, Sani MU, Ogha OS, et al. Low-Dose Triple-Pill vs Standard-Care Protocols for Hypertension Treatment in Nigeria: A Randomized Clinical Trial. *JAMA*. 2024 Oct 1;332(13):1070-9. doi: 10.1001/jama.2024.18080.

85. Rodgers A, Salam A, Schutte AE, Cushman WC, et al. Efficacy and Safety of a Novel Low-Dose Triple Single-Pill Combination Compared With Placebo for Initial Treatment of Hypertension. *J Am Coll Cardiol*. 2024 Dec 10;84(24):2393-2403. doi: 10.1016/j.jacc.2024.08.025. Epub 2024 Aug 31.

86. Webster R, Salam A, de Silva HA, Selak V, et al. Fixed Low-Dose Triple Combination Antihypertensive Medication vs Usual Care for Blood Pressure Control in Patients With Mild to Moderate Hypertension in Sri Lanka: A Randomized Clinical Trial. *JAMA*. 2018 Aug 14;320(6):566-79. doi: 10.1001/jama.2018.10359. Erratum in: *JAMA*. 2018 Nov 13;320(18):1940. doi: 10.1001/jama.2018.17363.

87. Williams B, MacDonald TM, Morant S, Webb DJ, et al. Spironolactone versus placebo, bisoprolol, and doxazosin to determine the optimal treatment for drug-resistant hypertension (PATHWAY-2): a randomised, double-blind, crossover trial. *Lancet*. 2015 Nov 21;386(10008):2059-68. doi: 10.1016/S0140-6736(15)00257-3. Epub 2015 Sep 20.

88. Williams B, MacDonald TM, Morant SV, Webb DJ, et al. Endocrine and haemodynamic changes in resistant hypertension, and blood pressure responses to spironolactone or amiloride: the PATHWAY-2 mechanisms substudies. *Lancet Diabetes Endocrinol*. 2018 Jun;6(6):464-75. doi: 10.1016/S2213-8587(18)30071-8. Epub 2018 Apr 11. Erratum in: *Lancet Diabetes Endocrinol*. 2018 Aug;6(8):e16. doi: 10.1016/S2213-8587(18)30211-0.

89. Yang CT, Kor CT, Hsieh YP. Long-Term Effects of Spironolactone on Kidney Function and Hyperkalemia-Associated Hospitalization in Patients with Chronic Kidney Disease. *J Clin Med*. 2018 Nov 21;7(11):459. doi: 10.3390/jcm7110459.

90. Hundemer GL, Sood MM. Hyperkalemia with RAAS inhibition: Mechanism, clinical significance, and management. *Pharmacol Res*. 2021 Oct;172:105835. doi: 10.1016/j.phrs.2021.105835. Epub 2021 Aug 23.

91. Pitt B, Zannad F, Remme WJ, Cody R, et al. The effect of spironolactone on morbidity and mortality in patients with severe heart failure. Randomized Aldactone Evaluation Study Investigators. *N Engl J Med*. 1999 Sep 2;341(10):709-17. doi: 10.1056/NEJM199909023411001.

92. Cohen JB, Cohen DL, Herman DS, Leppert JT, et al. Testing for Primary Aldosteronism and Mineralocorticoid Receptor Antagonist Use Among U.S. Veterans: A Retrospective Cohort Study. *Ann Intern Med*. 2021 Mar;174(3):289-97. doi: 10.7326/M20-4873. Epub 2020 Dec 29.

93. Xu Z, Yang J, Hu J, Song Y, et al. Primary Aldosteronism in Patients in China With Recently Detected Hypertension. *J Am Coll Cardiol*. 2020 Apr 28;75(16):1913-22. doi: 10.1016/j.jacc.2020.02.052.

94. Brown JM, Siddiqui M, Calhoun DA, Carey RM, et al. The Unrecognized Prevalence of Primary Aldosteronism: A Cross-sectional Study. *Ann Intern Med*. 2020 Jul;173(1):10-20. doi: 10.7326/M20-0065. Epub 2020 May 26.

95. Monticone S, Burrello J, Tizzani D, Bertello C, et al. Prevalence and Clinical Manifestations of Primary Aldosteronism Encountered in Primary Care Practice. *J Am Coll Cardiol*. 2017 Apr 11;69(14):1811-20. doi: 10.1016/j.jacc.2017.01.052.

96. Funder JW, Carey RM, Mantero F, Murad MH, et al. The Management of Primary Aldosteronism: Case Detection, Diagnosis, and Treatment: An Endocrine Society Clinical Practice Guideline. *J Clin Endocrinol Metab*. 2016 May;101(5):1889-916. doi: 10.1210/jc.2015-4061. Epub 2016 Mar 2.

97. Fervers B, Burgers JS, Haugh MC, Latrelle J, et al. Adaptation of clinical guidelines: literature review and proposition for a framework and procedure. *Int J Qual Health Care*. 2006 Jun;18(3):167-76. doi: 10.1093/intqhc/mzi108.

98. Brouwers MC, Kho ME, Brownman GP, Burgers JS, et al. AGREE II: advancing guideline development, reporting and evaluation in health care. *CMAJ*. 2010 Dec 14;182(18):e839-42. doi: 10.1503/cmaj.090449. Epub 2010 Jul 5.

99. Whelton PK, Carey RM, Aronow WS, Casey DE Jr, et al. 2017 ACC/AHA/AAPA/ABC/ACPM/AGS/APA/ASH/ASPC/NMA/PCNA Guideline for the Prevention, Detection, Evaluation, and Management of High Blood Pressure in Adults: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Hypertension*. 2018 Jun;71(6):1269-1324. doi: 10.1161/HYP.000000000000066. Epub 2017 Nov 13. Erratum in: *Hypertension*. 2018 Jun;71(6):e136-9. doi: 10.1161/HYP.0000000000000075. Erratum in: *Hypertension*. 2018 Sep;72(3):e33. doi: 10.1161/HYP.0000000000000080.

100. Schünemann HJ, Al-Ansary LA, Forland F, Kersten S, et al. Guidelines International Network: Principles for Disclosure of Interests and Management of Conflicts in Guidelines. *Ann Intern Med*. 2015 Oct 6;163(7):548-53. doi: 10.7326/M14-1885.

101. Satheesh G, Dhurjati R, Jha V, Schutte AE, et al. Effectiveness and Safety of Using Standardized Treatment Protocols for Hypertension Compared to Usual Care: A Meta-Analysis of Randomized Clinical Trials. *J Clin Hypertens (Greenwich)*. 2025 Jan;27(1):e14950. doi: 10.1111/jch.14950. Epub 2024 Dec 10.

102. Desai AS, Webb DJ, Taubel J, Casey S, et al. Zilebesiran, an RNA Interference Therapeutic Agent for Hypertension. *N Engl J Med*. 2023 Jul 20;389(3):228-38. doi: 10.1056/NEJMoa2208391.

103. Freeman MW, Halvorsen YD, Marshall W, Pater M, et al. Phase 2 Trial of Baxdrostat for Treatment-Resistant Hypertension. *N Engl J Med*. 2023 Feb 2;388(5):395-405. doi: 10.1056/NEJMoa2213169. Epub 2022 Nov 7.

104. Schlaich MP, Bellet M, Weber MA, Danaeitash P, et al. Dual endothelin antagonist aprocitentan for resistant hypertension (PRECISION): a multicentre, blinded, randomised, parallel-group, phase 3 trial. *Lancet*. 2022 Dec 3;400(10367):1927-37. doi: 10.1016/S0140-6736(22)02034-7. Epub 2022 Nov 7. Erratum in: *Lancet*. 2023 Jan 28;401(10373):268. doi: 10.1016/S0140-6736(23)00119-8.

105. Sesa-Ashton G, Nolde JM, Muente I, Carnagarin R, et al. Long-Term Blood Pressure Reductions Following Catheter-Based Renal Denervation: A Systematic Review and Meta-Analysis. *Hypertension*. 2024 Jun;81(6):e63-70. doi: 10.1161/HYPERTENSIONAHA.123.22314. Epub 2024 Mar 20.

106. Khan SS, Matsushita K, Sang Y, Ballew SH, et al. Development and Validation of the American Heart Association's PREVENT Equations. *Circulation*. 2024 Feb 6;149(6):430-49. doi: 10.1161/CIRCULATIONAHA.123.067626. Epub 2023 Nov 10. Erratum in: *Circulation*. 2024 Mar 12;149(11):e956. doi: 10.1161/CIR.0000000000001230.

107. SCORE working group and ESC Cardiovascular risk collaboration. SCORE2 risk prediction algorithms: new models to estimate 10-year risk of cardiovascular disease in Europe. *Eur Heart J*. 2021 Jul 1;42(25):2439-54. doi: 10.1093/euroheartj/ehab309.

108. Goff DC Jr, Lloyd-Jones DM, Bennett G, Coady S, et al. 2013 ACC/AHA guideline on the assessment of cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2014 Jun 24;129(25 Suppl 2):S49-73. doi: 10.1161/01.cir.0000437741.48606.98. Epub 2013 Nov 12. Erratum in: *Circulation*. 2014 Jun 24;129(25 Suppl 2):S74-5.

109. WHO CVD Risk Chart Working Group. World Health Organization cardiovascular disease risk charts: revised models to estimate risk in 21 global regions. *Lancet Glob Health*. 2019 Oct;7(10):e1332-45. doi: 10.1016/S2214-109X(19)30318-3. Epub 2019 Sep 2. Erratum in: *Lancet Glob Health*. 2023 Feb;11(2):e196. doi: 10.1016/S2214-109X(22)00522-8.

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