Guidelines

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

Doreen M. Rabi, MD, MSc,
Ruth Sapir-Pichhadze, MD, MSc, PhD,
Meranda Nakhla, MD, MSc,
Sofia B. Ahmed, MD, MMS,
Sandria M. Dumanski, MD,
Sonia Butalia, BSc, MD, MSc,
Alexander A. Leung, MD, MPH,
Kevin C. Harris, MD, MHS,
Lyne Cloutier, RN, PhD,
Kelly B. Zarnke, MD, MSc,
Marcel Ruzicka, MD, PhD,
Swapnil Hiremath, MD, MPH,
Ross D. Feldman, MD,
Sheldon W. Tobe, MD, MSc,
Tavis S. Campbell, PhD, RPsych,
Simon L. Bacon, PhD,
Kara A. Nerenberg, MD, MSc,
George K. Dresser, MD, PhD,
Anne Fournier, MD,
Patrice Lindsay, RN, PhD,
Simon W. Rabkin, MD,
Ally P.H. Prebani, MD,
Steven Grover, MD, MPA,
George Honos, MD,
Jeffrey E. Alfonso, MD,
JoAnne Arcand, PhD, RD,
François Audibert, MD, MSc,
Geneviève Benoit, MD,
Jesse Bittman, MD,
Peter Bolli, MD,
Anne-Marie Côté, MD, MHS,
Janis Dionne, MD,
Andrew Don-Wauchoppe, MD,
Cedric Edwards, MD,
Tabassum Firoz, MD, MSc,
Jonathan Y. Gabor, MSc, MD,
Richard E. Gilbert, MBBS, PhD,
Jean C. Grégoire, MD,
Steven E. Gryn, MD,
Milan Gupta, MD,
Fady Hannah-Shmouni, MD,
Robert A. Hegele, MD,
Robert J. Herman, MD,
Michael D. Hill, MD, MSc,
Jonathan G. Howlett, MD,
Gregory L. Hundemer, MD, MPH,
Charlotte Jones, PhD, MD,
Robert J. Herman, MD,
Janusz Kaczorowski, PhD,
Nadia A. Khan, MD, MSc,
Laura M. Kuypers, MD,
Maxime Lamarre-Cliche, MD,
Kim L. Lavoie, PhD,
Lawrence A. Leiter, MD,
Richard Lewanczuk, MD, PhD,
Alexander G. Logan, MD,
Laura A. Magee, MD, MSc,
Birinder K. Mangat, MD, MPH,
Philip A. McFarlane, MD, PhD,
Donna McLean, RN, NP, PhD,
Andre Michaud, RN, PhD,
Alain Milot, MD, MSc,

Received for publication February 11, 2020. Accepted February 23, 2020.

Corresponding author: Dr Doreen M. Rabi, Division of Endocrinology and Metabolism, Department of Medicine, 3330 Hospital Drive NW, University of Calgary, Calgary, Alberta T2N 4N1, Canada. Tel.: +1-403-220-3319; fax: +1-403-210-8113.
E-mail: doreen.rabi@albertahealthservices.ca
See page 621 for disclosure information.
Gordon W. Moe, MD, MSc, S. Brian Penner, MD, Andrew Pipe, MD, Alexandre Y. Poppe, MD, Evelyne Rey, MD, MSc, Michael Roerecke, PhD, Ernesto L. Schiffrin, MD, PhD, Peter Selby, MBBS, MHSc, Mike Sharma, MD, Asghan Shoamanesh, MD, Praveena Sivapalan, MD, Raymond R. Townsend, MD, Karen Tran, MD, MHSc, Luc Trudeau, MD, Ross T. Tsuyuki, BSc (Pharm), PharmD, MSc, Michel Vallée, MD, PhD, Vincent Woo, MD, Alan D. Bell, and Stella S. Daskalopoulou, MD, MSc, DIC, PhD

*Division of Endocrinology and Metabolism, Department of Medicine, University of Calgary, Calgary, Alberta, Canada; Departments of Family Medicine and Community Health Services, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; Division of Nephrology, Department of Medicine, McGill University and Centre for Outcomes Research and Evaluation, Research Institute of the McGill University Health Centre, Montreal, Quebec, Canada; Department of Pediatrics and Centre for Outcomes Research and Evaluation, McGill University, and Research Institute of the McGill University Health Centre, Montreal, Quebec, Canada; Department of Medicine, University of Calgary, Libin Cardiovascular Institute of Alberta, and Alberta Kidney Disease Network, Calgary, Alberta, Canada; Departments of Medicine and Community Health Sciences, O’Brien Institute for Public Health, and Libin Cardiovascular Institute, Cumming School of Medicine, University of Calgary, Alberta, Canada; O’Brien Institute for Public Health, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; Department of Nephrology, Department of Medicine, University of Ottawa, Ottawa, Ontario, Canada; University of Ottawa and the Ottawa Hospital Research Institute, Ottawa, Ontario, Canada; Winnipeg Regional Health Authority and the University of Manitoba, Winnipeg, Manitoba, Canada; Department of Medicine, University of Toronto, and Northern Ontario School of Medicine, Sudbury, Ontario, Canada; Department of Psychology, University of Calgary, Calgary, Alberta, Canada; Department of Health, Kinesiology, and Applied Physiology, Concordia University, and Montreal Behavioural Medicine Centre, CIUSSS-NIM, Montréal, Québec, Canada; Division of General Internal Medicine, Departments of Medicine, Obstetrics and Gynecology, and Community Health Sciences, University of Calgary, Calgary, Alberta, Canada; Schulich School of Medicine and Dentistry, Western University, London, Ontario, Canada; Centre Hospitalier Universitaire Sainte-Justine, Department of Pediatrics, Université de Montréal, Montréal, Québec, Canada; Department of Medicine, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; Heart and Stroke Foundation of Canada, Ottawa, Ontario, Canada; Vancouver Hospital, University of British Columbia, Vancouver, British Columbia, Canada; Division of Endocrinology and Metabolism, Department of Medicine, McMaster University, Hamilton, Ontario, Canada; Department of Medicine, McGill University, Montréal, Québec, Canada; Centre Hospitalier de l’Université de Montréal, Montréal, Québec, Canada; Faculty of Health Sciences, University of Ontario Institute of Technology, Oshawa, Ontario, Canada; Department of Obstetrics and Gynecology, CHU Sainte-Justine, Université de Montréal, Québec, Canada; Service de néphrologie, Centre Hospitalier Universitaire Sainte-Justine, Université de Montréal, Montréal, Québec, Canada; Division of General Internal Medicine, Department of Medicine, University of British Columbia, Vancouver, British Columbia, Canada; McMaster University, Hamilton, Ontario, Canada; Department of Medicine, McGill University, Montréal, Québec, Canada; Centre Hospitalier de l’Université de Montréal, Montréal, Québec, Canada; Faculty of Health Sciences, University of Ontario Institute of Technology, Oshawa, Ontario, Canada; Department of Obstetrics and Gynecology, CHU Sainte-Justine, Université de Montréal, Montréal, Québec, Canada; McMaster University, Hamilton, Ontario, Canada; Section on Endocrinology and Genetics, National Institute of Child Health and Human Development, National Institutes of Health, Bethesda, Maryland, USA; Division of General Medicine, Department of Medicine, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; Department of Clinical Neurosciences, Hutchison Brain Institute, Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; Department of Medicine, Libin Cardiovascular Institute and Cumming School of Medicine, University of Calgary, Calgary, Alberta, Canada; Department of Medicine, University of British Columbia, Montréal, Québec, Canada; Department of Medicine, Southern Medical Program, University of British Columbia, Kelowna, British Columbia, Canada; Department of Family and Emergency Medicine, Université de Montréal and CRCHUM, Montréal, Québec, Canada; Institut de Recherches Cliniques de Montréal (IRCM), Université de Montréal, Montréal, Québec, Canada; Université de Montréal et UQAM, Montréal, Québec, Canada; Li Ka Shing Knowledge Institute, St. Michael’s Hospital, University of Toronto, Toronto, Ontario, Canada; Department of Medicine, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Alberta, Canada; Mount Sinai Hospital, University Health Network, Toronto, Ontario, Canada; Department of Women and Children’s Health, St. Thomas’ Hospital, London, and Department of Life Course Sciences, Faculty of Life Sciences and Medicine, King’s College London, London, United Kingdom; Division of Nephrology, St. Michael’s Hospital, University of Toronto, Toronto, Ontario, Canada; Alberta Health Services and Covenant Health, Edmonton, Alberta, Canada; École des sciences infirmières, FMSS, Université de Sherbrooke, Sherbrooke, Quebec, Canada; École de pharmacie, Université de Montréal, Montréal, Quebec, Canada; École de pharmacie, Université de Sherbrooke, Sherbrooke, Quebec, Canada; Division of Prevention and Rehabilitation, University of Ottawa Heart Institute, Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada; Division of Neurosciences, University of Toronto, Montréal, Québec, Canada; Departments of Medicine and Obstetrics and Gynecology, CHU Sainte-Justine, University of Montréal, Montréal, Québec, Canada; Institute for Mental Health Policy Research, Centre for Addiction and Mental Health, Dalhousie University, Halifax, Nova Scotia, Canada; Centre for Addiction and Mental Health, University of Toronto, Toronto, Ontario, Canada; Centre for Addiction and Mental Health, University of Toronto, Toronto, Ontario, Canada; McMaster University, Hamilton, Ontario, Canada; Population Health Research Institute, Hamilton, Ontario, Canada; Division of General Internal Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, Canada; Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania, USA; Division of Internal Medicine, Department of Medicine, McGill University, Montréal, Québec, Canada; Department of Pharmacology, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, Alberta, Canada; Hôpital Maisonneuve-Rosemont, Université de Montréal, Montréal, Québec, Canada; Division of Endocrinology and Metabolism, University of Manitoba, Winnipeg, Manitoba, Canada; Department of Family and Community Medicine, University of Toronto, Toronto, Ontario, Canada; Division of Internal Medicine, Department of Medicine, McGill University, and Research Institute of the McGill University Health Centre, Montreal, Quebec, Canada.
Les lignes directrices 2020 d’Hypertension Canada pour la prévention, le diagnostic, l’évaluation des risques et le traitement de l’hypertension chez l’adulte et l’enfant fournissent aux professionnels de la santé et aux patients des conseils complets et fondés sur des données probantes. Hypertension Canada élabora ces lignes directrices en utilisant une méthodologie rigoureuse, en atténuant soigneusement le risque de partialité dans notre processus. Tous les projets de recommandations sont soumis à une évaluation critique par des experts en méthodologie, sans partialité, afin d’en garantir la qualité. Notre panel de lignes directrices est diversifié, comprenant de multiples groupes de professionnels de la santé (soins infirmiers, pharmacie, universitaire et médecins), et a travaillé de concert avec des experts en soins primaires et d’experts en mise en œuvre pour garantir une utilisation optimale. Les lignes directrices 2020 comprennent de nouvelles orientations sur la gestion de l’hypertension résistante et la prise en charge de l’hypertension chez les femmes qui planifient une grossesse.

I. Accurate measurement of BP in children

**Recommendations**
1. BP should be measured regularly in children 3 years of age or older by a health care professional using standardized pediatric techniques (Table 15) (Grade D).
2. BP may be measured with a mercury sphygmomanometer, aneroid sphygmonanometer, or oscillometric device (Grade D). Abnormal oscillometric values should be confirmed with auscultation (Grade C).
3. BP varies with age, sex, and height in children and, therefore, BP values should be compared with norms for age, sex, and height (Table 16; Grade D).

II. Criteria for diagnosis of hypertension in children

**New recommendations for 2020**
- Simplified diagnostic thresholds can also (in addition to or as an alternative to normative tables) be used to diagnose hypertension in children and adolescents.

New criteria for diagnosis of hypertension in children have been introduced in an effort to simplify diagnosis, whereby BP thresholds can be considered. These changes were on the basis of evidence from a longitudinal cohort of 1225 participants from the Bogalusa Heart Study with 27 years of follow-up and repeated BP measurements from childhood to adulthood comparing the traditional definitions vs a simplified approach. The latter used the following BP thresholds: 120/80 for children ages 6-11 years and 130/85 for children ages 12-17 years. Both definitions were equally predictive of adulthood hypertension and subclinical cardiovascular outcomes. When BP is greater than the 95th percentile, a simplified approach is also recommended for staging of hypertension using the 95th percentile alone; this is intended to eliminate the need for using BP tables with the 99th percentile.

- Consider assessing non-HDL cholesterol when evaluating cardiovascular risk in children and adolescents with hypertension.

Non-HDL cholesterol could be considered when analyzing the lipid profile of children with hypertension.

Higher non-HDL cholesterol, above the ideal threshold of 3.1 mmol/L, has been associated with higher body mass index and higher DBP. Furthermore, high non-HDL cholesterol has been associated with two- to threefold increased odds of coronary artery atherosclerotic lesions identified in autopsies on 15- to 34-year-old accident victims.

**Recommendations**
1. Using OBPMs, children can be diagnosed as hypertensive if SBP or DBP is at the 95th percentile or greater for age, sex, and height, measured on at least 3 separate occasions (Grade C), or if SBP or DBP is > 120/80 mm Hg in children 6-11 years of age, or greater than 130/85 mm Hg in children 12-17 years of age (Grade C; revised recommendation).
2. If the SBP and/or DBP is at the 95th percentile or greater, BP should be staged. Stage 1 is defined by BP between the 95th percentile and 95th percentile plus 12 mm Hg. Stage 2 is defined by BP > 95th
The BP should be recorded to the closest 2 mm Hg on the manometer (or 1 mm Hg on electronic devices).

Keep in mind that potential false positive results should be considered in the setting of:

- Interfering drugs
- Incorrect patient preparation and positioning (for plasma metanephrine measures)
- Mild elevation of screening values (ie, less than twofold the upper limit of normal)
- Normal values on repeat testing
- Only 1 abnormal biochemical test in the panel of assays
- Atypical imaging results for pheochromocytoma
- A low pretest probability of pheochromocytoma
- Acute illness/hospitalization

In the presence of borderline biochemical test results or potentially false positive results, repeat testing may be performed and/or the clonidine suppression test may be used. This should be done before imaging is requested to avoid identifying potential incidentalomas.

Imaging (eg, computed tomography, magnetic resonance, with or without iodine I-131 meta-iodobenzylguanidine scintigraphy) should generally be performed only after biochemical confirmation of disease.

Definitive treatment is surgical resection. Preoperative planning is recommended for blood pressure control and volume expansion.

- Treatment

1. Cardiogenic risk factors should be assessed in hypertensive children (Grade C).

IV. Routine laboratory tests for the investigation of children with hypertension

Recommendations

1. Routine tests that should be performed for the investigation of all children with hypertension include:
   - Blood chemistry (sodium, potassium, chloride, total CO₂, and creatinine; Grade D);

---

**Table 14. Pheochromocytoma**

<table>
<thead>
<tr>
<th>Screening and diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>I To screen for pheochromocytoma:</td>
</tr>
<tr>
<td>A Twenty-four-hour urinary total metanephrines and catecholamines (sensitivity 90%-95%) or 24-hour urine fractionated metanephrines (sensitivity of approximately 95%) should be measured. Concomitant measurement of 24-hour urine creatinine should also be performed to confirm accurate collection</td>
</tr>
<tr>
<td>B Plasma free metanephrines and free normetanephrines, where available, might also be considered (sensitivity up to 99%)</td>
</tr>
<tr>
<td>C Urinary vanillylmandelic acid measurements should not be used for screening</td>
</tr>
<tr>
<td>II Keep in mind that potential false positive results should be considered in the setting of:</td>
</tr>
<tr>
<td>A Interfering drugs</td>
</tr>
<tr>
<td>B Incorrect patient preparation and positioning (for plasma metanephrine measures)</td>
</tr>
<tr>
<td>C Mild elevation of screening values (ie, less than twofold the upper limit of normal)</td>
</tr>
<tr>
<td>D Normal values on repeat testing</td>
</tr>
<tr>
<td>E Only 1 abnormal biochemical test in the panel of assays</td>
</tr>
<tr>
<td>F Atypical imaging results for pheochromocytoma</td>
</tr>
<tr>
<td>G A low pretest probability of pheochromocytoma</td>
</tr>
<tr>
<td>H Acute illness/hospitalization</td>
</tr>
<tr>
<td>III In the presence of borderline biochemical test results or potentially false positive results, repeat testing may be performed and/or the clonidine suppression test may be used. This should be done before imaging is requested to avoid identifying potential incidentalomas</td>
</tr>
</tbody>
</table>

Treatment

I Definitive treatment is surgical resection. Preoperative planning is recommended for blood pressure control and volume expansion.

A. β-Blockade should be started 10-14 days preoperatively. Typical options include phenoxybenzamine (a long-acting, nonselective irreversible β-blocker), prazosin, or doxazosin.

B. Other antihypertensive medications may be added as necessary but diuretics should be avoided if possible. Oral β-blockers may be considered after achieving adequate β-blockade to control tachycardia and prevent arrhythmias during surgery.

C. Volume replacement and liberal sodium intake should be encouraged because volume contraction is common in this condition. Intravenous volume expansion in the perioperative period is recommended to prevent postoperative shock.

Postoperatively, long-term follow-up is recommended with urinary or plasma metanephrine levels to screen for recurrence, especially in those with a genetic predisposition.

III. Assessment of overall cardiovascular risk in hypertensive children

Recommendations

1. Cardiovascular risk factors should be assessed in hypertensive children (Grade C).

IV. Routine laboratory tests for the investigation of children with hypertension

Recommendations

1. Routine tests that should be performed for the investigation of all children with hypertension include:
   - Blood chemistry (sodium, potassium, chloride, total CO₂, and creatinine; Grade D);

---

**Table 15. Standard approach for BP measurement in children (Grade D)**

1. Children who will undergo BP measurement should avoid stimulant medications before evaluation. At the time of evaluation, the child should be seated in a quiet room for 5 minutes with back supported before the measurement of blood pressure.

2. The right arm is the preferred location for BP measurement for comparison with normative data because of the possibility of coarctation of the aorta, which might result in an erroneously low BP measurement being obtained in the left arm.

3. A cuff size with a bladder width that is at least 40% of the arm circumference and the cuff bladder length should cover 80%-100% of the circumference of the arm. The arm should be bare and supported with the BP cuff at heart level. To obtain accurate measurements in children a range of pediatric and adult cuff sizes should be available.

4. The pressure should be increased rapidly to 30 mm Hg above the level at which the radial pulse is extinguished.

5. The stethoscope should be placed below the bottom edge of the cuff and above the antecubital fossa. The bell or diaphragm of the stethoscope should be held gently and steadily over the brachial artery.

6. The control valve should be opened so that the rate of deflation of the cuff is approximately 2 mm Hg per heartbeat.

7. The systolic level—the first appearance of a clear tapping sound (phase I Korotkoff)—and the diastolic level (the point at which the sounds disappear; phase V Korotkoff) should be recorded. In some children, Korotkoff sounds can be heard to 0 mm Hg. If Korotkoff sounds persist as the level approaches 0 mm Hg, then the point of muffling of the sound is used (phase IV Korotkoff) to indicate the diastolic pressure.

8. The BP should be recorded to the closest 2 mm Hg on the manometer (or 1 mm Hg on electronic devices).

BP, blood pressure.
Table 16. Determining normative data for BP values in children (Grade D)

1. The BP tables use growth parameters as defined in the CDC growth charts
2. The normative BP data obtained with the auscultatory method includes the US National Health and Nutrition Examination Survey, 1999-2000. Normative BP data for oscillometric measurements are now available
3. To determine BP percentile, use the standard CDC height charts to determine the height percentile
4. Measure the child’s blood pressure. Use the appropriate gender table. Locate the child’s age on the left side of the table and follow the age row horizontally across the table to the intersection of the line for the height percentile as shown in the vertical column
5. The 50th, 90th, 95th, and 99th percentiles are defined for systolic and diastolic blood pressure on the basis of gender, age, and height

BP, blood pressure; CDC, Centers for Disease Control and Prevention.

Table 17. History and physical examination of children (Grade C)

1. Medical history
   Symptoms
   • Of hypertension
   • Of an underlying disorder*
   Past medical history
   • For underlying cause of hypertension* (including neonatal history)
     Identify other cardiovascular risk factors including inactivity, smoking, and dietary factors
     Family history

2. Patient physical examination
   • Height, weight, and body mass index
     Vital signs including upper and lower limb blood pressures
   • Evaluation for signs of end organ damage
   • Fundi, cardiovascular, and neurologic systems
   • Evaluation for underlying cause of hypertension*

* Systems to review include renal, cardiovascular, endocrine, and neurologic, as well as medications/drugs and sleep disorders.
**Recommendations**

1. Initial therapy should be monotherapy.
   i. Recommended monotherapy choices are:
      a. An ACE inhibitor (Grade C);
      b. An ARB (Grade C); or
      c. A long-acting dihydroypridine CCB (Grade D).
   ii. An alternate option is a β-blocker (Grade D) although they are less preferable because of the side effect profile in children.
   iii. If there are adverse effects, another drug from this group should be substituted.

2. If BP goals are not achieved with standard-dose monotherapy for ≥ 6 months, children should be referred to an expert in pediatric hypertension (Grade D).

3. ACE inhibitors (Grade C) and ARBs (Grade D) are not recommended as first-line agents in black patients and β-blockers are not recommended as first-line agents in children with asthma or diabetes (type 1 or type 2), and high-performance athletes (Grade D).

**X. Goals of therapy for children with hypertension**

**Recommendations**

1. The treatment goal is office BP (systolic and diastolic) < 95th percentile (Grade D). The goal for ABPM is BP (systolic and diastolic) < 95th percentile (Grade D).

2. For patients with risk factors or target organ damage the goal is BP (systolic and diastolic) < 90th percentile (Grade D).