Clinical Practice Guidelines

2020 International Society of Hypertension Global Hypertension Practice Guidelines


The ISH Guidelines Committee extracted evidence-based content presented in recently published extensively reviewed guidelines and tailored ESSENTIAL and OPTIMAL standards of care in a practical format that is easy-to-use particularly in low, but also in high resource settings – by clinicians, but also nurses and community health workers, as appropriate. Although distinction between low and high resource settings often refers to high (HIC) and low- and middle-income countries (LMIC), it is well established that in HIC there are areas with low resource settings, and vice versa.

Herein optimal care refers to evidence-based standard of care articulated in recent guidelines1,2 and summarized here, whereas ESSENTIAL standards recognize that OPTIMAL standards would not always be possible. Hence essential standards refer to minimum standards of care. To allow specification of essential standards of care for low resource settings, the Committee was often confronted with the limitation or absence in clinical evidence, and thus applied expert opinion.

Section 1: Introduction

Context and Purpose of This Guideline

Statement of Remit

To align with its mission to reduce the global burden of raised blood pressure (BP), the International Society of Hypertension (ISH) has developed worldwide practice guidelines for the management of hypertension in adults, aged 18 years and older.

The ISH Guidelines Committee extracted evidence-based content presented in recently published extensively reviewed guidelines and tailored ESSENTIAL and OPTIMAL standards of care in a practical format that is easy-to-use particularly in low, but also in high resource settings – by clinicians, but also nurses and community health workers, as appropriate. Although distinction between low and high resource settings often refers to high (HIC) and low- and middle-income countries (LMIC), it is well established that in HIC there are areas with low resource settings, and vice versa.

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### Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABI</td>
<td>ankle-brachial index</td>
</tr>
<tr>
<td>ABPM</td>
<td>ambulatory blood pressure monitoring</td>
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<tr>
<td>ACE</td>
<td>angiotensin converting enzyme</td>
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<td>ARB</td>
<td>angiotensin AT-1 receptor blocker</td>
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<tr>
<td>ARNI</td>
<td>angiotensin receptor-neprilisin inhibitors</td>
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<tr>
<td>BMI</td>
<td>body mass index</td>
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<tr>
<td>BP</td>
<td>blood pressure</td>
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<tr>
<td>CAD</td>
<td>coronary artery disease</td>
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<tr>
<td>CCBs</td>
<td>calcium channel blockers</td>
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<tr>
<td>CKD</td>
<td>chronic kidney disease</td>
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<tr>
<td>COPD</td>
<td>chronic obstructive pulmonary disease</td>
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<tr>
<td>CVD</td>
<td>cardiovascular disease</td>
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<tr>
<td>DBP</td>
<td>diastolic blood pressure</td>
</tr>
<tr>
<td>DHP-CCB</td>
<td>dihydropyridine calcium channel blocker</td>
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<tr>
<td>DM</td>
<td>diabetes mellitus</td>
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<tr>
<td>DRI</td>
<td>direct renin inhibitor</td>
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<tr>
<td>ECG</td>
<td>electrocardiogram</td>
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<tr>
<td>eGFR</td>
<td>estimated glomerular filtration rate</td>
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<tr>
<td>ESC-ESH</td>
<td>European Society of Cardiology, European Society of Hypertension</td>
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<tr>
<td>HBPM</td>
<td>home blood pressure measurement</td>
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<tr>
<td>HDL</td>
<td>high density lipoprotein</td>
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<tr>
<td>HELLP</td>
<td>hemolysis, elevated liver enzymes and low platelets</td>
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<tr>
<td>HF</td>
<td>heart failure</td>
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<tr>
<td>HFpEF</td>
<td>heart failure with preserved ejection fraction</td>
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<tr>
<td>HFrEF</td>
<td>heart failure with reduced ejection fraction</td>
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<tr>
<td>HIC</td>
<td>high-income countries</td>
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<tr>
<td>HIIT</td>
<td>high intensity interval training</td>
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<tr>
<td>HIV</td>
<td>human immunodeficiency virus</td>
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<tr>
<td>HMOD</td>
<td>hypertension-mediated organ damage</td>
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<tr>
<td>IMT</td>
<td>intima media thickness</td>
</tr>
<tr>
<td>IRD</td>
<td>inflammatory rheumatic disease</td>
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<tr>
<td>ISH</td>
<td>International Society of Hypertension</td>
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<tr>
<td>LDH</td>
<td>lactate dehydrogenase</td>
</tr>
<tr>
<td>LDL-C</td>
<td>low-density lipoprotein cholesterol</td>
</tr>
<tr>
<td>LMIC</td>
<td>low- and middle-income countries</td>
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<tr>
<td>LV</td>
<td>left ventricular</td>
</tr>
<tr>
<td>LVH</td>
<td>left ventricular hypertrophy</td>
</tr>
<tr>
<td>MAP</td>
<td>mean arterial pressure</td>
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<tr>
<td>MRI</td>
<td>magnetic resonance imaging</td>
</tr>
<tr>
<td>MS</td>
<td>metabolic syndrome</td>
</tr>
<tr>
<td>NSAIDs</td>
<td>nonsteroidal anti-inflammatory drugs</td>
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<tr>
<td>PWV</td>
<td>pulse wave velocity</td>
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<tr>
<td>RAAS</td>
<td>renin angiotensin aldosterone system</td>
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<tr>
<td>RAS</td>
<td>renin-angiotensin system</td>
</tr>
<tr>
<td>RCT</td>
<td>randomized control trials</td>
</tr>
<tr>
<td>SBP</td>
<td>systolic blood pressure</td>
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<tr>
<td>SNRI</td>
<td>selective norepinephrine and serotonin reuptake inhibitors</td>
</tr>
<tr>
<td>SPC</td>
<td>single pill combination therapy</td>
</tr>
<tr>
<td>SRI</td>
<td>serotonin reuptake inhibitors</td>
</tr>
<tr>
<td>SSRI</td>
<td>selective serotonin reuptake inhibitors</td>
</tr>
<tr>
<td>s-UA</td>
<td>serum uric acid</td>
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<tr>
<td>T4</td>
<td>thyroxin 4</td>
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<tr>
<td>TIA</td>
<td>transient ischemic attack</td>
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<tr>
<td>TMA</td>
<td>thrombotic microangiopathy</td>
</tr>
<tr>
<td>TSH</td>
<td>thyroid stimulating hormone</td>
</tr>
<tr>
<td>TTE</td>
<td>two-dimensional transthoracic echocardiogram</td>
</tr>
<tr>
<td>UACR</td>
<td>urinary albumin creatinine ratio</td>
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</tbody>
</table>

In the Guidelines, differentiation between optimal and essential standards were not always possible, and were made in sections where it was most practical and sensible. The Guidelines Committee is also aware that some recommended essential standards may not be feasible in low resource settings, for example, out-of-office BP measurements, the requirement of multiple visits for the diagnosis of hypertension, or advising the use of single pill combination therapy. Although challenging to implement, these guidelines may aid in local initiatives to motivate policy changes and serve as an instrument to drive local improvements in standards of care. Every effort should be made to achieve essential standards of care to reduce hypertension-induced cardiovascular morbidity and mortality.

**Motivation**

Raised BP remains the leading cause of death globally, accounting for 10.4 million deaths per year. When reviewing global figures, an estimated 1.39 billion people had hypertension in 2010. However, BP trends show a clear shift of the highest BPs from high-income to low-income regions, with an estimated 349 million with hypertension in HIC and 1.04 billion in LMICs.

The large disparities in the regional burden of hypertension are accompanied by low levels of awareness, treatment and control rates in LMIC, when compared to HIC. In response to poor global awareness for hypertension (estimated 67% in HIC and 38% in LMIC), the ISH launched a global campaign to increase awareness of raised BP, namely the May Measurement Month initiative. Despite several initiatives, the prevalence of raised BP and adverse impact on cardiovascular morbidity and mortality are increasing globally, irrespective of income. It is therefore critical that population-based initiatives are applied to reduce the global burden of raised BP, such as salt-reduction activities and improving the availability of fresh fruit and vegetables. To improve the management of hypertension, the ISH has published in 2014 with the American Society of Hypertension, Clinical Practice Guidelines for the Management of Hypertension in the Community (See Section 11: Resources). Recently, we have observed a recent flurry of updated evidence-based guidelines arising mainly from high-income regions and countries, including the United States of America, Europe, United Kingdom, Canada and Japan. New developments include redefining hypertension, initiating treatment with a single pill combination therapy,
advising wider out-of-office BP measurement,\textsuperscript{2,10} and lower BP targets.\textsuperscript{1,2,8,11,12}

Low- and middle-income regions often follow the release of guidelines from high-income regions closely, as their resources and health systems to develop and implement local guidelines remain challenging. In Africa only 25\% of countries have hypertension guidelines\textsuperscript{13} and in many instances these guidelines are adopted from those of high-income regions. However, the adoption of guidelines from high-income regions are sometimes impractical as low resource settings are confronted with a substantial number of obstacles including severe lack of trained healthcare professionals, unreliable electricity in rural clinics, low access to basic office BP devices and limited ability to conduct basic recommended diagnostic procedures and poor access to affordable high-quality medications. In both low and high-income regions, the ambiguities of latest guidelines are often met with confusion among healthcare providers, anxiety among patients,\textsuperscript{14} and they resulted in a call for global harmonization.\textsuperscript{15} Guidelines from high-income regions may thus not fit global purpose.\textsuperscript{16}

**Guideline Development Process**

The 2020 ISH Global Hypertension Practice Guidelines were developed by the ISH Hypertension Guidelines Committee based on evidence criteria, (1) to be used globally; (2) to be fit for application in low and high resource settings by advising on essential and optimal standards; and (3) to be concise, simplified, and easy to use. They were critically reviewed and evaluated by numerous external hypertension experts from HIC and LMIC with expertise in the optimal management of hypertension and management in resource-constraint settings. These Guidelines were developed without any support from industry or other sources.

**Composition of the ISH Hypertension Guidelines Committee and Selection of External Reviewers**

The ISH Hypertension Guidelines Committee was composed of members of the ISH Council; they were included on the basis of (1) specific expertise in different areas of hypertension; (2) previous experience with the generation of hypertension guidelines, as well as (3) representation of different regions of the world. A similar strategy was followed concerning the selection of external reviewers with particular consideration of representatives from LMICs.

### Section 2: Definition of Hypertension

- In accordance with most major guidelines it is recommended that hypertension be diagnosed when a person’s systolic blood pressure (SBP) in the office or clinic is $\geq 140$ mm Hg and/or their diastolic blood pressure (DBP) is $\geq 90$ mm Hg following repeated examination (see below, Section 3). Table 1 provides a classification of BP based on office BP measurement, Table 2 provides ambulatory and home BP values used to define hypertension; these definitions apply to all adults (>18 year old). These BP categories are designed to align therapeutic approaches with BP levels.

- **High-normal BP** is intended to identify individuals who could benefit from lifestyle interventions and who would receive pharmacological treatment if compelling indications are present (see Section 9).

- Isolated systolic hypertension defined as elevated SBP ($\geq 140$ mm Hg) and low DBP ($<90$ mm Hg) is common in young and in elderly people. In young individuals, including children, adolescents and young adults, isolated systolic hypertension is the most common form of essential hypertension. However, it is also particularly common in the elderly, in whom it reflects stiffening of the large arteries with an increase in pulse pressure (difference between SBP and DBP).

- Individuals identified with confirmed hypertension (grade 1 and grade 2) should receive appropriate pharmacological treatment.

- Details of home-, office- and ambulatory BP measurement techniques are addressed in Section 3.

### Section 3: Blood Pressure Measurement and Diagnosis of Hypertension

#### Hypertension Diagnosis – Office BP Measurement

- The measurement of BP in the office or clinic is most commonly the basis for hypertension diagnosis and follow-up. Office BP should be measured according to recommendations shown in Table 3 and Figure 1.\textsuperscript{1,2,17,18}

- Whenever possible, the diagnosis should not be made on a single office visit. Usually 2–3 office visits at 1–4-week intervals (depending on the BP level) are required to confirm the diagnosis of hypertension. The diagnosis might be made on a single visit, if BP is $\geq 180/110$ mm Hg and there is evidence of cardiovascular disease (CVD).\textsuperscript{1,2,17,18}

- The recommended patient management according to office BP levels is presented in Table 4.

- If possible and available, the diagnosis of hypertension should be confirmed by out-of-office BP measurement (see below).\textsuperscript{1,2,19,21}

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### Table 1. Classification of Hypertension Based on Office Blood Pressure (BP) Measurement

<table>
<thead>
<tr>
<th>Category</th>
<th>Systolic (mm Hg)</th>
<th>Diastolic (mm Hg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal BP</td>
<td>&lt;130</td>
<td>and</td>
</tr>
<tr>
<td>High-normal BP</td>
<td>130–139</td>
<td>and/or</td>
</tr>
<tr>
<td>Grade 1 hypertension</td>
<td>140–159</td>
<td>and/or</td>
</tr>
<tr>
<td>Grade 2 hypertension</td>
<td>$\geq 160$</td>
<td>and/or</td>
</tr>
</tbody>
</table>

### Table 2. Criteria for Hypertension Based on Office-, Ambulatory (ABPM)-, and Home Blood Pressure (HBPM) Measurement

<table>
<thead>
<tr>
<th>SBP/DBP, mm Hg</th>
<th>Office BP</th>
<th>ABPM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\geq 140$ and/or $\geq 90$</td>
<td>$\geq 130$ and/or $\geq 80$</td>
</tr>
<tr>
<td>Night time (or asleep) average</td>
<td>$\geq 120$ and/or $\geq 70$</td>
<td>$\geq 135$ and/or $\geq 85$</td>
</tr>
</tbody>
</table>

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Hypertension Diagnosis – Office Blood Pressure Measurement

- **Initial evaluation:** Measure BP in both arms, preferably simultaneously. If there is a consistent difference between arms >10 mm Hg in repeated measurements, use the arm with the higher BP. If the difference is >20 mm Hg consider further investigation.

- **Standing blood pressure:** Measure in treated hypertensives after 1 min and again after 3 min when there are symptoms suggesting postural hypotension and at the first visit in the elderly and people with diabetes.
White Coat and Masked Hypertension

• The use of office and out-of-office (home or ambulatory) BP measurements identifies individuals with white coat hypertension, who have elevated BP only in the office (nonelevated ambulatory or home BP), and those with masked hypertension, who have nonelevated BP in the office but elevated BP out of the office (ambulatory or home).1,2,17–21,25–27 These conditions are common among both untreated subjects and those treated for hypertension. About 10%–30% of subjects attending clinics due to high BP have white coat hypertension and 10%–15% have masked hypertension.

• White coat hypertension: These subjects are at intermediate cardiovascular risk between normotensives and sustained hypertensives. The diagnosis needs confirmation with repeated office and out-of-office BP measurements. If their total cardiovascular risk is low and there is no hypertension-mediated organ damage (HMOD), drug treatment may not be prescribed. However, they should be followed with lifestyle modification, as they may develop sustained hypertension requiring drug treatment.1,2,17–21,25–27

• Masked hypertension: These patients are at similar risk of cardiovascular events as sustained hypertensives. The diagnosis needs confirmation with repeated office and out-of-office measurements. Masked hypertension may require drug treatment aiming to normalize out-of-office BP.1,2,17–21,25–27

Section 4: Diagnostic/Clinical Tests

Medical History

Patients with hypertension are often asymptomatic, however specific symptoms can suggest secondary hypertension or hypertensive complications that require further investigation. A complete medical and family history is recommended and should include:

Table 4. Blood Pressure Measurement Plan According to Office Blood Pressure Levels

<table>
<thead>
<tr>
<th>Office Blood Pressure Levels (mm Hg)</th>
<th>Remeasure within 3 years (1 year in those with other risk factors)</th>
<th>Confirm within a few days or weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;130/85</td>
<td>If possible confirm with out-of-office blood pressure measurement (high possibility of white coat or masked hypertension). Alternatively confirm with repeated office visits.</td>
<td></td>
</tr>
<tr>
<td>130–159/85–99</td>
<td>Remeasure within 3 years (1 year in those with other risk factors)</td>
<td>Confirm within a few days or weeks</td>
</tr>
<tr>
<td>≥160/100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Clinical Use of Home and Ambulatory Blood Pressure (BP) Monitoring

<table>
<thead>
<tr>
<th>Condition</th>
<th>Home Blood Pressure Monitoring</th>
<th>24-Hour Ambulatory Blood Pressure Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>As for office blood pressure (see above).</td>
<td>Routine working day.</td>
<td></td>
</tr>
<tr>
<td>As for office BP (see above).</td>
<td>Avoid strenuous activity. Arm still and relaxed during each measurement.</td>
<td></td>
</tr>
<tr>
<td>Validated electronic (oscilometric) upper-arm cuff device (<a href="http://www.stridebp.org">www.stridebp.org</a>, and Section 11: Resources)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Size according to the individual’s arm circumference</td>
<td></td>
<td></td>
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<tr>
<td>Before each visit to the health professional:</td>
<td></td>
<td></td>
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<tr>
<td>• 3–7-day monitoring in the morning (before drug intake if treated) and the evening.</td>
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</tr>
<tr>
<td>• Two measurements on each occasion after 5 min sitting rest and 1 min between measurements.</td>
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<td></td>
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<tr>
<td>• 1–2 measurements per week or month.</td>
<td></td>
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<tr>
<td>• 24-hour monitoring at 15–30 min intervals during daytime and nighttime.</td>
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<tr>
<td>• At least 20 valid daytime and 7 nighttime BP readings are required. If less, the test should be repeated.</td>
<td></td>
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</tr>
<tr>
<td>• Average home blood pressure after excluding readings of the first day ≥135 or 85 mm Hg indicates hypertension.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• 24-hour ambulatory blood pressure ≥130/80 mm Hg indicates hypertension (primary criterion).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Daytime (awake) ambulatory blood pressure ≥135/85 mm Hg and nighttime (asleep) ≥120/70 mm Hg indicates hypertension</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Imaging Techniques**

- **Blood pressure:** New onset hypertension, duration, previous BP levels, current and previous antihypertensive medication, other medications/over-the-counter medicines that can influence BP, history of intolerance (side-effects) of antihypertensive medications, adherence to antihypertensive treatment, previous hypertension with oral contraceptives or pregnancy.
- **Risk factors:** Personal history of CVD (myocardial infarction, heart failure [HF], stroke, transient ischemic attacks [TIA], diabetes, dyslipidemia, chronic kidney disease [CKD], smoking status, diet, alcohol intake, physical activity, psychosocial aspects, history of depression). Family history of hypertension, premature CVD, familial hypercholesterolemia, diabetes.
- **Assessment of overall cardiovascular risk:** In line with local guidelines/recommendations (see risk scores in Section 11 at the end of the document).
- **Symptoms/signs of hypertension/coexistent illnesses:** Chest pain, shortness of breath, palpitations, claudication, peripheral edema, headaches, blurred vision, nocturia, hematuria, dizziness.
- **Symptoms suggestive of secondary hypertension:** Muscle weakness/tetany, cramps, arrhythmias (hypokalemia/primary aldosteronism), flash pulmonary edema (renal artery stenosis), sweating, palpitations, frequent headaches (phtoechromocytoma), snoring, daytime sleepiness (obstructive sleep apnea), symptoms suggestive of thyroid disease (see Section 10 for full list of symptoms).

**Physical Examination**

A thorough physical examination can assist with confirming the diagnosis of hypertension and the identification of HMOD and/or secondary hypertension and should include:

- **Circulation and heart:** Pulse rate/rhythm/character, jugular venous pulse/pressure, apex beat, extra heart sounds, basal crackles, peripheral edema, bruits (carotid, abdominal, femoral), radio-femoral delay.
- **Other organs/systems:** Enlarged kidneys, neck circumference >40 cm (obstructive sleep apnea), enlarged thyroid, increased body mass index (BMI)/waist circumference, fatty deposits and coloured striae (Cushing disease/syndrome).

**Laboratory Investigations and ECG**

- **Blood tests:** Sodium, potassium, serum creatinine and estimated glomerular filtration rate (eGFR). If available, lipid profile and fasting glucose.
- **Urine test:** Dipstick urine test.
- **12-lead ECG:** Detection of atrial fibrillation, left ventricular hypertrophy (LVH), ischemic heart disease.

**Additional Diagnostic Tests**

Additional investigations when indicated can be undertaken to assess and confirm suspicion of HMOD, coexistent diseases or/and secondary hypertension.

**Imaging Techniques**

- **Echocardiography:** LVH, systolic/diastolic dysfunction, atrial dilation, aortic coarctation.
- **Carotid ultrasound:** Plaques (atherosclerosis), stenosis.
- **Kidneys/renal artery and adrenal imaging:** Ultrasound/renal artery Duplex; CT-/MR-angiography: renal parenchymal disease, renal artery stenosis, adrenal lesions, other abdominal pathology.
- **Fundoscopy:** Retinal changes, hemorrhages, papilledema, tortuosity, nipping.
- **Brain CT/MRI:** Ischemic or hemorrhagic brain injury due to hypertension.

**Functional Tests and Additional Laboratory Investigations**

- **Ankle-brachial index:** Peripheral (lower extremity) artery disease.
- **Further testing for secondary hypertension if suspected:** Aldosterone-renin ratio, plasma free metanephrines, late-night salivary cortisol or other screening tests for cortisol excess.
- **Urine albumin/creatinine ratio**
- **Serum uric acid (s-UA) levels**
- **Liver function tests**

**Section 5: Cardiovascular Risk Factors**

**Diagnostic Approach**

- More than 50% of hypertensive patients have additional cardiovascular risk factors.
- The most common additional risk factors are diabetes (15%–20%), lipid disorders (elevated low-density lipoprotein-cholesterol [LDL-C] and triglycerides [30%]), overweight-obesity (40%), hyperuricemia (25%) and metabolic syndrome (40%), as well as unhealthy lifestyle habits (eg, smoking, high alcohol intake, sedentary lifestyle).
- The presence of one or more additional cardiovascular risk factors proportionally increases the risk of coronary, cerebrovascular, and renal diseases in hypertensive patients.

**Essential**

- An evaluation of additional risk factors should be part of the diagnostic workup in hypertensive patients particularly in the presence of a family history of CVD.
- Cardiovascular risk should be assessed in all hypertensive patients by easy-to-use scores based on BP levels and additional risk factors according to a simplified version of the approach proposed by ESC-ESH Guidelines (Table 6).1
- A reliable estimate of cardiovascular risk can be obtained in daily practice by including:
  - **Other Risk Factors:** Age (>65 years), sex (male>female), heart rate (>80 beats/min), increased body weight, diabetes, high LDL-C/triglyceride, family history of CVD, family history of hypertension, early-onset menopause, smoking habits, psychosocial or socioeconomic factors. **HMOD:** LVH (LVH with ECG), moderate-severe CKD (CKD; eGFR <60 ml/min/1.73m2), any other available measure of organ damage. **Disease:** previous coronary heart disease (CHD), HF, stroke, peripheral vascular disease, atrial fibrillation, CKD stage 3+.  

**Optimal**

- Evaluation of additional risk factors should be part of the diagnostic workup in hypertensive patients particularly in the presence of a family history of CVD.
End organs include the brain, the heart, the kidneys, central and peripheral arteries, and the eyes. While assessment of overall cardiovascular risk is important for the management of hypertension, additional detection of HMOD is unlikely to change the management of those patients already identified as high risk (ie, those with established CVD, stroke, diabetes, CKD, or familial hypercholesterolemia). However, it can provide important therapeutic guidance on (1) management for hypertensive patients with low or moderate overall risk through reclassification due to presence of HMOD, and (2) preferential selection of drug treatment based on the specific impact on HMOD.¹

Specific Aspects of HMOD and Assessment

- **Brain:** TIA or strokes are common manifestations of elevated BP. Early subclinical changes can be detected most sensitively by magnetic resonance imaging (MRI) and include white matter lesions, silent microinfarcts, microbleeds, and brain atrophy. Due to costs and limited availability brain MRI is not recommended for routine practice but should be considered in patients with neurologic disturbances, cognitive decline and memory loss.

- **Heart:** A 12-lead ECG is recommended for routine workup of patients with hypertension and simple criteria (Sokolow-Lyon index: SV1+RV5 ≥35 mm, Cornell index: SV3+RaVL ≥28 mm for men or ≥20 mm for women and Cornell voltage duration product: >2440 mm•ms) are available to detect presence of LVH. Sensitivity of ECG-LVH is very limited and a two-dimensional thoracic echocardiogram (TTE) is the method of choice to accurately assess LVH (left ventricular mass index [LVMI]: men >115 g/m²; women >95 g/m²) and relevant parameters including LV geometry, left atrial volume, LV systolic and diastolic function and others.

- **Kidneys:** Kidney damage can be a cause and consequence of hypertension and is best assessed routinely by simple renal function parameters (serum creatinine and eGFR) together with investigation for albuminuria (dipstick or urinary albumin creatinine ratio [UACR]) in early morning spot urine).

- **Arteries:** Three vascular beds are commonly assessed to detect arterial HMOD: (1) the carotid arteries through carotid ultrasound to detect atherosclerotic plaque burden/stenosis and intima media thickness (IMT); (2) the aorta by carotid-femoral pulse wave velocity (PWV) assessment to detect large artery stiffening; and (3) the lower extremity arteries by assessment of the ankle-brachial index (ABI). Although there is evidence to indicate that all three provide added value beyond traditional risk factors, their routine use is currently not recommended unless clinically indicated, that is, in patients with neurologic symptoms, isolated systolic hypertension, or suspected peripheral artery disease, respectively.

- **Eyes:** Fundoscopy is a simple clinical bedside test to screen for hypertensive retinopathy although interobserver and intraobserver reproducibility is limited. Fundoscopy is particularly important in hypertensive urgencies and emergencies to detect retinal hemorrhage, microaneurysms, and papilledema in patients with accelerated or malignant hypertension. Fundoscopy should be performed in patients with grade 2 hypertension, ideally by experienced examiners or alternative techniques to visualize the fundus (digital fundus cameras) where available.

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**Table 6. Simplified Classification of Hypertension Risk according to additional Risk Factors, Hypertension-Mediated Organ Damage (HMOD), and Previous Disease**

<table>
<thead>
<tr>
<th>Other Risk Factors, HMOD, or Disease</th>
<th>High-Normal</th>
<th>Grade 1</th>
<th>Grade 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>SBP 130–139 DBP 85–89</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>≥1 risk factors</td>
<td>Low</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>HMOD, CKD grade 3, diabetes mellitus, CVD</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

*Example based on a 60 year old male patient. Categories of risk will vary according to age and sex.
Table 7. Drug/Substance Exacerbators and Inducers of Hypertension

<table>
<thead>
<tr>
<th>Drug/Substance32-43</th>
<th>Comments on Specific Drugs and Substances*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonsteroidal anti-inflammatory drugs (NSAIDs)</td>
<td>No difference or an increase of up to 3/1 mm Hg with celecoxib 3/1 mm Hg increase with nonselective NSAIDs No increase in blood pressure with aspirin NSAIDs can antagonize the effects of RAAS-inhibitors and beta blockers</td>
</tr>
<tr>
<td>Combined oral contraceptive pill</td>
<td>6/3 mm Hg increase with high doses of estrogen (&gt;50 mcg of estrogen and 1–4 mcg progestin)</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>2/1 mm Hg increase with SNRI (selective norepinephrine and serotonin reuptake inhibitors) Increased odds ratio of 3.19 of hypertension with tricyclic antidepressant use No increases in blood pressure with SSRI (selective serotonin reuptake inhibitors)</td>
</tr>
<tr>
<td>Acetaminophen</td>
<td>Increased relative risk of 1.34 of hypertension with almost daily acetaminophen use</td>
</tr>
<tr>
<td>Other medications</td>
<td>Steroids Antiretroviral therapy: inconsistent study findings for increased blood pressure Sympathomimetica: pseudoephedrine, cocaine, amphetamines Antimigraine serotonergics Recombinant human erythropoetin Calcineurin inhibitors Antiangiogenesis and kinase inhibitors 11 β-hydroxysteroid dehydrogenase type 2 inhibitors</td>
</tr>
<tr>
<td>Herbal and other substances44-45</td>
<td>Alcohol, ma-huang, ginseng at high doses, liquorice, St. John’s wort, yohimbine</td>
</tr>
</tbody>
</table>

*Average increase in blood pressure or risk of hypertension. However, the effect of these medications/ substances on blood pressure may highly vary between individuals.

and should be considered where clinically indicated and available. Serial assessment of HMOD (LVH and albuminuria) to monitor regression with antihypertensive treatment may be helpful to determine the efficacy of treatment in individual patients but this has not been sufficiently validated for most measures of HMOD.

Section 7: Exacerbators and Inducers of Hypertension

Background

Several medications and substances may increase BP or antagonize the BP-lowering effects of antihypertensive therapy in individuals (Table 7). It is important to note that the individual effect of these substances on BP can be highly variable with greater increases noted in the elderly, those with higher baseline BP, using antihypertensive therapy or with kidney disease.

Section 8: Treatment of Hypertension

8.1 Lifestyle Modifications

Healthy lifestyle choices can prevent or delay the onset of high BP and can reduce cardiovascular risk. Lifestyle modification is also the first line of antihypertensive treatment. Modifications in lifestyle can also enhance the effects of antihypertensive treatment. Lifestyle modifications should include the following (Table 8).47-64

Seasonal BP Variation65

BP exhibits seasonal variation with lower temperatures at higher temperatures and lower at lower temperatures. Similar changes occur in people traveling from places with cold to hot temperature, or the reverse. A meta-analysis showed average BP decline in summer of 5/3 mm Hg (systolic/diastolic), BP changes are larger in treated hypertensives and should be considered when symptoms suggesting overtreatment appear with temperature rise, or BP is increased during cold weather. BP below the recommended goal should be considered for possible downtitration, particularly if there are symptoms suggesting overtreatment.

8.2 Pharmacological Treatment

Contemporary data from over 100 countries66,67 suggest that on average, less than 50% of adults with hypertension receive BP-lowering medication, with few countries performing better than this and many worse. This is despite the fact that a difference in BP of 20/10 mm Hg is associated with a 50% difference in cardiovascular risk.65

The pharmacological treatment strategies recommended here (Figures 2–4) are largely compatible with those made in the most recent US2 and European guidelines.1,8

8.3 Adherence to Antihypertensive Treatment

Background

Adherence is defined as to the extent to which a person’s behaviors such as taking a medication, following a diet or executing lifestyle changes corresponds with agreed recommendations from a healthcare provider.74 Nonadherence to antihypertensive treatment affects 10%–80% of hypertensive patients and is one of the key drivers of suboptimal BP control.75-77 Poor adherence to antihypertensive treatment correlates with the magnitude of BP elevation and is an indicator of poor prognosis in hypertensive patients.78-81 The etiology of nonadherence to antihypertensive treatment is multifactorial and includes causes associated with the healthcare system, pharmacological therapy, the disease, patients and their socioeconomic status.74
<table>
<thead>
<tr>
<th>Lifestyle Modifications</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt reduction</td>
<td>There is strong evidence for a relationship between high salt intake and increased blood pressure.47 Reduce salt added when preparing foods, and at the table. Avoid or limit consumption of high salt foods such as soy sauce, fast foods and processed food including breads and cereals high in salt.</td>
</tr>
<tr>
<td>Healthy diet</td>
<td>Eating a diet that is rich in whole grains, fruits, vegetables, polyunsaturated fats and dairy products and reducing food high in sugar, saturated fat and trans fats, such as the DASH diet (<a href="http://www.dashforhealth.com).48">http://www.dashforhealth.com).48</a> Increase intake of vegetables high in nitrates known to reduce BP, such as leafy vegetables and beetroot. Other beneficial foods and nutrients include those high in magnesium, calcium and potassium such as avocados, nuts, seeds, legumes and tofu.49</td>
</tr>
<tr>
<td>Healthy drinks</td>
<td>Moderate consumption of coffee, green and black tea.50 Other beverages that can be beneficial include karkadé (hibiscus) tea, pomegranate juice, beetroot juice and cocoa.49</td>
</tr>
<tr>
<td>Moderation of alcohol consumption</td>
<td>Positive linear association exists between alcohol consumption, blood pressure, the prevalence of hypertension, and CVD risk.45 The recommended daily limit for alcohol consumption is 2 standard drinks for men and 1.5 for women (10 g alcohol/standard drink). Avoid binge drinking.</td>
</tr>
<tr>
<td>Weight reduction</td>
<td>Body weight control is indicated to avoid obesity. Particularly abdominal obesity should be managed. Ethnic-specific cut-offs for BMI and waist circumference should be used.42 Alternatively, a waist-to-height ratio &lt;0.5 is recommended for all populations.32,54</td>
</tr>
<tr>
<td>Smoking cessation</td>
<td>Smoking is a major risk factor for CVD, COPD and cancer. Smoking cessation and referral to smoking cessation programs are advised.15</td>
</tr>
<tr>
<td>Regular physical activity</td>
<td>Studies suggest that regular aerobic and resistance exercise may be beneficial for both the prevention and treatment of hypertension.56–58 Moderate intensity aerobic exercise (walking, jogging, cycling, yoga, or swimming) for 30 minutes on 5–7 days per week or HIIT (high intensity interval training) which involves alternating short bursts of intense activity with subsequent recovery periods of lighter activity. Strength training also can help reduce blood pressure. Performance of resistance/strength exercises on 2–3 days per week.</td>
</tr>
<tr>
<td>Reduce stress and induce mindfulness</td>
<td>Chronic stress has been associated to high blood pressure later in life.56 Although more research is needed to determine the effects of chronic stress on blood pressure, randomized clinical trials examining the effects of transcendental meditation/mindfulness on blood pressure suggest that this practice lowers blood pressure.58 Stress should be reduced and mindfulness or meditation introduced into the daily routine.</td>
</tr>
<tr>
<td>Complementary, alternative or traditional medicines</td>
<td>Large proportions of hypertensive patients use complementary, alternative or traditional medicines (in regions such as Africa and China)61,62 yet large-scale and appropriate clinical trials are required to evaluate the efficacy and safety of these medicines. Thus, use of such treatment is not yet supported.</td>
</tr>
<tr>
<td>Reduce exposure to air pollution and cold temperature</td>
<td>Evidence from studies support a negative effect of air pollution on blood pressure in the long-term.60,61</td>
</tr>
</tbody>
</table>

**Figure 2.** Pharmacological treatment of hypertension: general scheme. See Table 2 (Section 2) for equivalent BP levels based on ambulatory or home BP recordings.
Table 9. Ideal Characteristics of Drug Treatment

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Treatments should be evidence-based in relation to morbidity/mortality prevention.</td>
</tr>
<tr>
<td>2.</td>
<td>Use a once-daily regimen which provides 24-hour blood pressure control.</td>
</tr>
<tr>
<td>3.</td>
<td>Treatment should be affordable and/or cost-effective relative to other agents.</td>
</tr>
<tr>
<td>4.</td>
<td>Treatments should be well-tolerated.</td>
</tr>
<tr>
<td>5.</td>
<td>Evidence of benefits of use of the medication in populations to which it is to be applied.</td>
</tr>
</tbody>
</table>
**Recommendations: Adherence to Antihypertensive Therapy**

**ESSENTIAL**
- Evaluate adherence to antihypertensive treatment as appropriate at each visit and prior to escalation of antihypertensive treatment.
- Consider the following strategies to improve medication adherence:
  1. Reducing polypharmacy - use of single pill combinations
  2. Once-daily dosing over multiple times per day dosing
  3. Linking adherence behavior with daily habits
  4. Providing adherence feedback to patients
  5. Home BP monitoring
  6. Reminder packaging of medications
  7. Electronic adherence aids such as mobile phones or short messages services
  8. Multidisciplinary healthcare team approach (ie, pharmacists) to improve monitoring for adherence

**OPTIMAL**
- Objective indirect (ie, review of pharmacy records, pill counting, electronic monitoring devices) and direct (ie, witnessed intake of medications, biochemical detection of medications in urine or blood) are generally preferred over subjective methods to diagnose nonadherence to antihypertensive treatment.
- The most effective methods for management of non-adherence require complex interventions that combine counseling, self-monitoring, reinforcements and supervision.

**Section 9: Common and Other Comorbidities and Complications of Hypertension**

**Background**
- Hypertensive patients have several common and other comorbidities that can affect cardiovascular risk and treatment strategies.
- The number of comorbidities increases with age, with the prevalence of hypertension and other diseases.
- Common comorbidities include coronary artery disease (CAD), stroke, CKD, HF, and COPD.
- Uncommon comorbidities include rheumatic diseases and psychiatric diseases.
- Uncommon comorbidities are largely underestimated by guidelines and frequently treated with drugs often self-prescribed and possibly interfering with BP control.
- Common and uncommon comorbidities should be identified and managed according to available evidence.

**Common Comorbidities and Complications**

**Hypertension and Coronary Artery Disease (CAD)**
- A strong epidemiological interaction exists between CAD and hypertension that accounts for 25%–30% of acute myocardial infarctions.
- Lifestyle changes are recommended (smoking cessation, diet and exercise).
- BP should be lowered if ≥140/90 mm Hg and treated to a target <130/80 mm Hg (<140/80 in elderly patients).
- RAS blockers, beta-blockers irrespective of BP levels with or without calcium channel blockers (CCBs) are first-line drugs in hypertensive patients.
- Lipid-lowering treatment with an LDL-C target <55 mg/dL (1.4 mmol/L).
- Antiplatelet treatment with acetyl salicylic acid is routinely recommended.

**Hypertension and Previous Stroke**
- Hypertension is the most important risk factor for ischemic or hemorrhagic stroke.
- Stroke can be largely prevented by BP control.
- BP should be lowered if ≥140/90 mm Hg and treated to a target <130/80 mm Hg (<140/80 in elderly patients).
- RAS blockers, CCBs, and diuretics are first-line drugs.
- Lipid-lowering treatment is mandatory with a LDL-C target <70 mg/dL (1.8 mmol/L) in ischemic stroke.
- Antiplatelet treatment is routinely recommended for ischemic stroke, but not hemorrhagic stroke, and should be carefully considered in patients with hemorrhagic stroke only in the presence of a strong indication.

**Hypertension and Heart Failure (HF)**
- Hypertension is a risk factor for the development of HF with reduced ejection fraction (HFrEF), and with preserved ejection fraction (HFpEF). Clinical outcome is worse and mortality is increased in hypertensive patients with HF.
- Lifestyle changes are recommended (diet and exercise).
- Treating hypertension has a major impact on reducing the risk of incident HF and HF hospitalization. BP should be lowered if ≥140/90 mm Hg and treated to a target <130/80 mm Hg but >120/70 mm Hg.
- RAS blockers, beta-blockers, and mineralocorticoid receptor antagonists are all effective in improving clinical outcome in patients with established HFrEF, whereas for diuretics, evidence is limited to symptomatic improvement. CCBs are indicated in case of poor BP control.
- Angiotensin receptor-neprilysin inhibitor (ARNI; sacubitril-valsartan) is indicated for the treatment of HFrEF as an alternative to ACE inhibitors or ARBs also in hypertensive populations. The same treatment strategy can be applied to patients with HFpEF even if the optimal treatment strategy is not known.

**Hypertension and Chronic Kidney Disease (CKD)**
- Hypertension is a major risk factor for the development and progression of albuminuria and any form of CKD.
- A lower eGFR is associated with resistant hypertension, masked hypertension, and elevated nighttime BP values.
- The effects of BP lowering on renal function (and albuminuria) are dissociated from cardiovascular benefit.
- BP should be lowered if ≥140/90 mm Hg and treated to a target <130/80 mm Hg (<140/80 in elderly patients).
- RAS-inhibitors are first-line drugs because they reduce albuminuria in addition to BP control. CCBs and diuretics (loop-diuretics if eGFR <30 ml/min/1.73m²) can be added.
- eGFR, microalbuminuria and blood electrolytes should be monitored.

**Hypertension and Chronic Obstructive Pulmonary Disease (COPD)**
- Hypertension is the most frequent comorbidity in patients with COPD.
• BP should be lowered if ≥140/90 mm Hg and treated to a target <130/80 mm Hg (<140/80 in elderly patients).
• Lifestyle changes (smoking cessation) are mandatory.93
• Environmental (air) pollution should be considered and avoided if possible.93
• Hypertension management should be similar to the general hypertensive populations.

HIV/AIDS
• People living with HIV are at increased cardiovascular risk.40
• There may be a drug interaction with CCB under most of the antiretroviral therapies.
• Hypertension management should be similar to the general hypertensive populations.

Management of Comorbidities
In addition to BP control, the therapeutic strategy should include lifestyle changes, body weight control and the effective treatment of the other risk factors to reduce the residual cardiovascular risk.1
• Lifestyle changes as in Table 8.
• LDL-cholesterol should be reduced according to risk profile: (1) >50% and <70 mg/dL (1.8 mmol/L) in hypertension and CVD, CKD, DM or no CVD and high risk; (2) >50% and <100 mg/dL (2.6 mmol/L) in high-risk patients; (3) <115 mg/dL (3 mmol/L) in moderate-risk patients.138
• Fasting serum glucose levels should be reduced below 126 mg/dL (7 mmol/L) or HbA1c below 7% (53 mmol/mol).1
• s-UA should be maintained below 6.5 mg/dL (0.387 mmol/L), and <6 mg/dL (0.357 mmol/L) in patients with gout.94
• Antiplatelet therapy should be considered in patients with CVD (secondary prevention only).95
• Serum triglyceride lowering should be considered if >200 mg/dL (2.3 mmol/L) particularly in patients with hypertension and DM. Possible additional benefits using fenofibrate in low HDL/high triglyceride subgroup.

Metabolic Syndrome (MS)
• Patients with hypertension and MS have a high-risk profile.
• The diagnosis of MS should be made by separate evaluation of single components.
• The treatment of MS is based on changes in lifestyle (diet and exercise).
• The treatment of hypertension and MS should include BP control as in the general population and treatment of additional risk factors based on level and overall cardiovascular risk (SCORE and/or ASCVD calculator).

Other Comorbidities
(See Table 10).

Hypertension and Inflammatory Rheumatic Diseases (IRD)
• IRD (rheumatoid arthritis, psoriasis-arthritis, etc) are associated with an increased prevalence of hypertension under diagnosed and poorly controlled.99,100
• IRD show an increase in cardiovascular risk only partially related to cardiovascular risk factors.99
• Rheumatoid arthritis is predominant among IRD.
• The presence of IRD should increase 1 step of cardiovascular risk.99
• BP should be lowered as in the general population, preferentially with RAS-inhibitors (evidence of an overactive RAAS)100 and CCBs.
• Underlying diseases should be effectively treated by reducing inflammation and by avoiding high doses of NSAIDs.
• Lipid-lowering drugs should be used according to cardiovascular risk profile (SCORE/ASCVD calculator) also considering the effects of biologic drugs.103

Hypertension and Psychiatric Diseases
• The prevalence of hypertension is increased in patients with psychiatric disorders and in particular depression.101,102
• According to guidelines, psychosocial stress and major psychiatric disorders increase the cardiovascular risk.
• Depression has been associated with cardiovascular morbidity and mortality, suggesting the importance of BP control.101
• BP should be lowered as in the general population, preferentially with RAS-inhibitors and diuretics with a lesser rate of pharmacological interactions under antidepressants. CCBs and alpha1-blockers should be used with care in patients with orthostatic hypotension (eg, SRIs).
• The risk of pharmacologic interactions, ECG abnormalities and postural BP changes must be considered.
• Beta-blockers (not metoprolol) should be used in presence of drug-induced tachycardia (antidepressant, antipsychotic drugs).103
• Additional risk factors should be managed according to cardiovascular risk profile (SCORE/ASCVD calculator, see Section 11: Resources).
10.1 Resistant Hypertension

**Background**
Resistant hypertension is defined as seated office BP >140/90 mm Hg in a patient treated with three or more antihypertensive medications at optimal (or maximally tolerated) doses including a diuretic and after excluding pseudoresistance (poor BP measurement technique, white coat effect, nonadherence and suboptimal choices in antihypertensive therapy) as well as the substance/drug-induced hypertension and secondary hypertension. Resistant hypertension affects around 10% of hypertensive individuals, has a negative impact on well-being and increases the risk of coronary artery disease, chronic HF, stroke, end-stage renal disease, and all-cause mortality. Approximately 50% of patients diagnosed with resistant hypertension have pseudoresistance rather than true resistant hypertension.

**Recommendations**
- If seated office BP >140/90 mm Hg in patients managed with three or more antihypertensive medications at optimal (or maximally tolerated) doses including a diuretic, first exclude causes of pseudoresistance (poor BP measurement technique, white coat effect, nonadherence and suboptimal choices in antihypertensive therapy), and substance-induced increases in BP.
- Consider screening patients for secondary causes as appropriate (refer to Section 10.2).
- Optimize the current treatment regimen including health behavior change and diuretic-based treatment (maximally tolerated doses of diuretics, and optimal choice of diuretic: use of thiazide-like rather than thiazide diuretics, and initiation of loop diuretics for eGFR <30 ml/min/1.73m² or clinical volume overload).
- Add a low dose of spironolactone as the 4th line agent in those whose serum potassium is <4.5 mmol/L and whose eGFR is >45 ml/min/1.73m² to achieve BP targets. If spironolactone is contraindicated or not tolerated, amiloride, doxazosin, eplerenone, clonidine, and beta-blockers are alternatives, or any available antihypertensive class not already in use.

10.2 Secondary Hypertension

**Background**
A specific cause of secondary hypertension can be identified in 5%–10% of hypertensive patients. Early diagnosis of secondary hypertension and the institution of appropriate targeted treatment have the potential to cure hypertension in some patients or improve BP control/reduce the number of prescribed antihypertensive medications in others. The most common types of secondary hypertension in adults are renal parenchymal disease, renovascular hypertension, primary aldosteronism, chronic sleep apnea, and substance/drug-induced.

**Recommendations**
- Consider screening for secondary hypertension in (1) patients with early onset hypertension (<30 years of age) in particular in the absence of hypertension risk factors (obesity, metabolic syndrome, familial history etc.), (2) those with resistant hypertension, (3) individuals with sudden deterioration in BP control, (4) hypertensive urgency and emergency, (5) those presenting with high probability of secondary hypertension based on strong clinical clues.
- In patients with resistant hypertension, investigations for secondary hypertension should generally be preceded by exclusion of pseudoresistant hypertension and drug/substance-induced hypertension.
- Basic screening for secondary hypertension should include a thorough assessment of history, physical examination (see clinical clues), basic blood biochemistry (including serum sodium, potassium, eGFR, TSH), and dipstick urine analysis.
- Further investigations for secondary hypertension (additional biochemistry/imaging/others) should be carefully chosen based on information from history, physical examination and basic clinical investigations.
- Consider referring for further investigation and management of suspected secondary hypertension to a specialist center with access to appropriate expertise and resources.

10.3 Hypertension in Pregnancy

Hypertension in pregnancy is a condition affecting 5%–10% of pregnancies worldwide. Maternal risks include placental abruption, stroke, multiple organ failure (liver, kidney), disseminated vascular coagulation. Fetal risks include intrauterine growth retardation, preterm birth, intrauterine death. Hypertension in pregnancy includes the following conditions:
- **Preexisting hypertension:** Starts before pregnancy or <20 weeks of gestation, and lasts >6 weeks postpartum with proteinuria.
### Table 11. Features of Secondary Hypertension

<table>
<thead>
<tr>
<th>Secondary Hypertension</th>
<th>Clinical History and Physical Examination</th>
<th>Basic Biochemistry and Urine Analysis</th>
<th>Further Diagnostic Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renal parenchymal disease</td>
<td>• Personal/familial history of CKD</td>
<td>• Proteinuria, hematuria, leukocyturia on dipstick urine analysis • Decreased estimated GFR</td>
<td>• Kidney ultrasound</td>
</tr>
<tr>
<td>Primary aldosteronism</td>
<td>• Symptoms of hypokalemia (muscle weakness, muscle cramps, tetany)</td>
<td>• Spontaneous hypokalemia or diuretic-induced hypokalemia on blood biochemistry (50%–60% of patients are normokalemic). • Elevated plasma aldosterone-renin activity ratio</td>
<td>• Confirmatory testing (eg, intravenous saline suppression test) • Imaging of adrenals (adrenal computed tomography) • Adrenal vein sampling</td>
</tr>
<tr>
<td>Renal artery stenosis</td>
<td>• Abdominal bruit • Bruits over other arteries (ie, carotid and femoral arteries) • Drop in estimated GFR &gt;30% after exposure to ACE-inhibitors/ARBs • For suspected atherosclerotic RAS, history of flash pulmonary edema or history of atherosclerotic disease or presence of cardiovascular risk factors • For suspected fibromuscular dysplasia, young women with onset of hypertension &lt;30 years</td>
<td>• Decrease in estimated GFR</td>
<td>• Imaging of renal arteries (duplex ultrasound, abdominal computed tomography or magnetic resonance angiograms depending on availability and patient’s level of renal function)</td>
</tr>
<tr>
<td>Pheochromocytoma</td>
<td>• Headaches • Palpitations • Perspiration • Pallor • History of labile hypertension</td>
<td>• Increased plasma levels of metanephrines • Increased 24-hour urinary fractional excretion of metanephrines and catecholamines</td>
<td>• Abdominal/pelvic computational tomography or MRI</td>
</tr>
<tr>
<td>Cushing’s syndrome and disease</td>
<td>• Central obesity • Purple striae • Facial rubor • Signs of skin atrophy • Easy bruising • Dorsal and supraclavicular fat pad • Proximal muscle weakness</td>
<td>• Hypokalemia • Increased late-night salivary cortisol</td>
<td>• Dexamethasone suppression tests118 • 24 hour urinary free cortisol • Abdominal/ pituitary imaging</td>
</tr>
<tr>
<td>Coarctation of the aorta</td>
<td>• Higher blood pressure in upper than lower extremities • Delayed or absent femoral pulses</td>
<td></td>
<td>• Echocardiogram • Computational tomography angiogram • Magnetic resonance angiogram</td>
</tr>
<tr>
<td>Obstructive sleep apnea</td>
<td>• Increased BMI • Snoring • Daytime sleepiness • Gasping or choking at night • Witnessed apneas during sleep • Nocturia</td>
<td></td>
<td>• Home sleep apnea testing (eg, level 3 sleep study) • Overnight polysomnography testing</td>
</tr>
<tr>
<td>Thyroid disease</td>
<td>• Symptoms of hyperthyroidism: heat intolerance, weight loss, tremor, palpitations • Symptoms of hypothyroidism: cold intolerance, weight gain, dry brittle hair</td>
<td>• TSH, Free T4</td>
<td></td>
</tr>
</tbody>
</table>

- **Gestational hypertension**: Starts >20 weeks of gestation, and lasts <6 weeks postpartum.
- **Preexisting hypertension plus superimposed gestational hypertension** with proteinuria.
- **Preeclampsia**: Hypertension with proteinuria (>300 mg/24 h or ACR >30 mg/mmol [265 mg/g]). Predisposing factors are preexisting hypertension, hypertensive disease during previous pregnancy, diabetes, renal disease, first- or multiple pregnancy, autoimmune disease (SLE). Risks are fetal growth restriction, preterm birth.
- **Eclampsia**: Hypertension in pregnancy with seizures, severe headaches, visual disturbance, abdominal pain, nausea and vomiting, low urinary output: Immediate treatment and delivery required.
- **HELLP (hemolysis, elevated liver enzymes, low platelets) syndrome**: Immediate treatment and delivery required.
Hypertension Measurement in Pregnancy

Office BP measurement following guidelines. Take office BP measurement using a manual auscultatory device, or an automated upper-arm cuff device which has been validated specifically in pregnancy and preeclampsia (list of validated devices at www.striep.org).

ABPM or home BP monitoring using devices validated specifically in pregnancy and preeclampsia to evaluate white coat hypertension, DM, nephropathy.

Investigation of Hypertension in Pregnancy

Urine analysis, full blood count, liver enzymes, hematocrit, serum creatinine and s-UA. Test for proteinuria in early pregnancy (preexisting renal disease) and second half of pregnancy (preeclampsia). A dipstick test >1+ should be followed up with UACR in a single spot urine; UACR <30 mg/mmol excludes proteinuria.

Ultrasound of kidneys and adrenals, free plasma metanephrines (if clinical features of phaeochromocytoma); Doppler ultrasound of uterine arteries (after 20 weeks of gestation) is useful to detect those at higher risk of gestational hypertension, preeclampsia, and intrauterine growth retardation.

Prevention of Preeclampsia

Women at high risk (hypertension in previous pregnancy, CKD, autoimmune disease, diabetes, chronic hypertension), or moderate risk (first pregnancy in a woman >40 years, pregnancy interval >10 years, BMI >35 kg/m², family history of preeclampsia, multiple pregnancies): 75–162 mg aspirin at weeks 12–36. Oral calcium supplementation of 1.5–2 g/day is recommended in women with low dietary intake (>600 mg/day).

Management of Hypertension in Pregnancy

- **Mild hypertension:** Drug treatment at persistent BP >150/95 mm Hg in all women. Drug treatment at persistent BP >140/90 mm Hg in gestational hypertension, preexisting hypertension with superimposed gestational hypertension; hypertension with subclinical HMOD at any time during pregnancy. First choices: methyldopa, beta-blockers (labetalol), and dihydropyridine-calcium channel blockers (DHP-CCBs) (nifedipine [not capsular], nicardipine). Contraindicated: RAS blockers (ACE-I, ARB, direct renin inhibitors [DRI]) due to adverse fetal and neonatal outcomes.

- **Severe hypertension:** At BP >170 mm Hg systolic and/or >110 mm Hg diastolic: immediate hospitalization is indicated (emergency). Treatment with intravenous labetalol (alternative intravenous nicardipine, esmolol, hydralazine, urapidil), oral methyldopa or DHP-CCBs (nifedipine [not capsular] nicardipine). Add magnesium (hypertensive crisis to prevent eclampsia). In pulmonary edema: nitroglycerin intravenous infusion. Sodium-nitroprusside should be avoided due to the danger of fetal cyanide poisoning with prolonged treatment.

- **Delivery in gestational hypertension or preeclampsia:** At week 37 in asymptomatic women. Expedite delivery in women with visual disturbances, hemostatic disorders.

- **Blood pressure postpartum:** If hypertension persists, any of recommended drugs except methyldopa (postpartum depression).

- **Breastfeeding:** All antihypertensives excreted into breast milk at low concentrations. Avoid atenolol, propranolol, nifedipine (high concentration in milk). Prefer long acting CCBs. Refer to prescribing information.

- **Long-term consequences of gestational hypertension:** Increased risk of hypertension and CVD (stroke, ischemic heart disease) in later life.

Lifestyle adjustment

Lifestyle adjustment and annual checkups (BP, metabolic factors)

10.4 Hypertensive Emergencies

Definition of Hypertensive Emergencies and Their Clinical Presentation

A hypertensive emergency is the association of substantially elevated BP with acute HMOD. Target organs include the retina, brain, heart, large arteries, and the kidneys. This situation requires rapid diagnostic workup and immediate BP reduction to avoid progressive organ failure. Intravenous therapy is usually required. The choice of antihypertensive treatment is predominantly determined by the type of organ damage. Specific clinical presentations of hypertensive emergencies include:

- **Malignant hypertension:** Severe BP elevation (commonly >200/120 mm Hg) associated with advanced bilateral retinopathy (hemorrhages, cotton wool spots, papilledema).

- **Hypertensive encephalopathy:** Severe BP elevation associated with lethargy, seizures, cortical blindness and coma in the absence of other explanations.

- **Hypertensive thrombotic microangiopathy:** Severe BP elevation associated with hemolysis and thrombocytopenia in the absence of other causes and improvement with BP-lowering therapy.

- **Other presentations of hypertensive emergencies include:** severe BP elevation associated with cerebral hemorrhage, acute stroke, acute coronary syndrome, cardiacogenic pulmonary edema, aortic aneurysm/dissection, and severe preeclampsia and eclampsia.

Patients with substantially elevated BP who lack acute HMOD are not considered a hypertensive emergency and can typically be treated with oral antihypertensive therapy.

Clinical Presentation and Diagnostic Workup

The clinical presentation of a hypertensive emergency can vary and is mainly determined by the organ(s) acutely affected. There is no specific BP threshold to define a hypertensive emergency.

Symptoms include headaches, visual disturbances, chest pain, dyspnea, neurologic symptoms, dizziness, and more unspecific presentations.

Medical history: preexisting hypertension, onset and duration of symptoms, potential causes (nonadherence with prescribed antihypertensive drugs, lifestyle changes, concomitant use of BP elevating drugs [NSAIDS, steroids, immune-suppressants, sympathomimetics, cocaine, antiangiogenic therapy]).

**Thorough physical examination:** Cardiovascular and neurologic assessment. Laboratory analysis: hemoglobin,
### Table 12. Hypertensive Emergencies Requiring Immediate BP Lowering

<table>
<thead>
<tr>
<th>Clinical Presentation</th>
<th>Timeline and Target BP</th>
<th>First Line Treatment</th>
<th>Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malignant hypertension with or without TMA or acute renal failure</td>
<td>Several hours, MAP −20% to −25%</td>
<td>Labetalol Nicardipine</td>
<td>Nitroprusside Urapidil</td>
</tr>
<tr>
<td>Hypertensive encephalopathy</td>
<td>Immediate, MAP −20% to −25%</td>
<td>Labetalol Nicardipine</td>
<td>Nitroprusside</td>
</tr>
<tr>
<td>Acute ischaemic stroke and SBP &gt;220 mm Hg or DBP &gt;120 mm Hg</td>
<td>1 h, MAP −15%</td>
<td>Labetalol Nicardipine</td>
<td>Nitroprusside</td>
</tr>
<tr>
<td>Acute ischaemic stroke with indication for thrombolytic therapy and SBP &gt;185 mm Hg or DBP &gt;110 mm Hg</td>
<td>1 h, MAP −15%</td>
<td>Labetalol Nicardipine</td>
<td>Nitroprusside</td>
</tr>
<tr>
<td>Acute hemorrhagic stroke and SBP &gt;180 mm Hg</td>
<td>Immediate, 130&lt;SBP&lt;180 mm Hg</td>
<td>Labetalol Nicardipine</td>
<td>Urapidil</td>
</tr>
<tr>
<td>Acute coronary event</td>
<td>Immediate, SBP &lt;140 mm Hg</td>
<td>Nitroglycerine Labetalol</td>
<td>Urapidil</td>
</tr>
<tr>
<td>Acute cardiogenic pulmonary edema</td>
<td>Immediate, SBP &lt;140 mm Hg</td>
<td>Nitroprusside or nitroglycerine (with loop diuretic)</td>
<td>Urapidil (with loop diuretic)</td>
</tr>
<tr>
<td>Acute aortic disease</td>
<td>Immediate, SBP &lt;120 mm Hg and heart rate &lt;60 bpm</td>
<td>Esmolol and nitroprusside or nitroglycerine or nicardipine</td>
<td>Labetalol or metoprolol</td>
</tr>
<tr>
<td>Eclampsia and severe preeclampsia/HELLP</td>
<td>Immediate, SBP &lt;160 mm Hg and DBP &lt;105 mm Hg</td>
<td>Labetalol or nicardipine and magnesium sulphate</td>
<td></td>
</tr>
</tbody>
</table>

Adapted from van den Born et al.127

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Platelets, creatinine, sodium, potassium, lactate dehydrogenase (LDH), haptoglobin, urinalysis for protein, urine sediment. **Examinations:** Fundoscopy, ECG. **Optimal** Additional investigations may be required and indicated depending on presentation and clinical findings and may be essential in the context: troponins (chest pain), chest x-ray (congestion/fluid overload), transthoracic echocardiogram (cardiac structure and function), CT/MRI brain (cerebral hemorrhage/stroke), CT-angiography thorax/abdomen (acute aortic disease). Secondary causes can be found in 20%–40% of patients presenting with malignant hypertension and appropriate diagnostic workup to confirm or exclude secondary forms is indicated.

**Diagnostic Tests and Acute Therapeutic Management**

The overall therapeutic goal in patients presenting with hypertensive emergencies is a controlled BP reduction to safer levels to prevent or limit further hypertensive damage while avoiding hypotension and related complications. There is a lack of randomized controlled trial data to provide clear cut guidance on BP targets and times within which these should be achieved. Most recommendations are based on expert consensus. The type of acute HMOD is the main determinant of the preferred treatment choice. The timeline and magnitude of BP reduction is strongly dependent on the clinical context. For example, acute pulmonary edema and aortic dissection require rapid BP reduction, whereas BP levels not exceeding 220/120 mm Hg are generally tolerated in acute ischemic stroke for certain periods. Table 12 provides a general overview of timelines and BP targets as well as preferred antihypertensive drug choices with most common clinical presentations. Availability of drugs and local experience with individual drugs are likely to influence the choice of drugs. Labetalol and nicardipine are generally safe to use in all hypertensive emergencies and should be available wherever hypertensive emergencies are being managed. Nitroglycerin and nitroprusside are specifically useful in hypertensive emergencies including the heart and the aorta.

**Specific Situations**

- **Sympathetic hyperreactivity:** If intoxication with amphetamines, sympathomimetics or cocain is suspected as cause of presentation with a hypertensive emergency use of benzodiazepines should be considered prior to specific antihypertensive treatment. Phentolamine, a competitive alpha-receptor blocking agent and clonidine, a centrally sympatholytic agent with additional sedative properties are useful if additional BP-lowering therapy is required. Nicardipine and nitroprusside are suitable alternatives.

- **Pheochromocytoma:** The adrenergic drive associated with pheochromocytoma responds well to phentolamine. Beta-blockers should only be used once alpha-blockers have been introduced to avoid acceleration of hypertension. Urapidil and nitroprusside are additional suitable options.

- **Preeclampsia/eclampsia:** See Section 10.3: Hypertension in Pregnancy.

**Follow-Up**

Patients who experienced a hypertensive emergency are at increased risk of cardiovascular and renal disease. Thorough investigation of potential underlying causes and assessment of HMOD is mandatory to avoid recurrent presentations with hypertensive emergencies. Similarly, adjustment and simplification of antihypertensive therapy paired with advice for lifestyle modification.
will assist to improve adherence and long-term BP control. Regular and frequent follow-up (monthly) is recommended until target BP and ideally regression of HMOD has been achieved.

10.5 Ethnicity, Race and Hypertension
Hypertension prevalence, treatment and control rates vary significantly according to ethnicity. Such differences are mainly attributed to genetic differences, but lifestyle and socioeconomic status possibly filters through into health behaviors such as diet – which appear to be major contributors.

Populations From African Descent
- Black populations, whether residing in Africa, the Caribbean, United States, or Europe, develop hypertension and associated organ damage at younger ages, have a higher frequency of resistant and nighttime hypertension, and a higher risk of kidney disease, stroke, HF, and mortality, other than other ethnic groups.
- This increased cardiovascular risk may be due to physiological differences including a suppressed RAAS, altered renal sodium handling, increased cardiovascular reactivity, and early vascular aging (large artery stiffness).
- Management of hypertension:
  - Wherever possible, annual screening for hypertension is advised for adults 18 years and older.
  - Lifestyle modification should place additional focus on salt restriction, increased intake of vegetables and fruits (potassium intake), weight management, and reducing alcohol intake.
  - First-line pharmacological therapy is recommended as a single pill combination including a thiazide diuretic plus CCB or CCB plus ARB (see Sections 8 and 12).
  - Among RAS-inhibitors, ARBs maybe preferred as angioedema is about 3 times more likely to occur with ACE inhibitors among black patients.

Populations From Asia
- Ethnic-specific characteristics are recognized for East Asian populations. Hypertensive patients have a greater likelihood of salt-sensitivity accompanied with mild obesity. When compared to Western populations, East Asian people present a higher prevalence of stroke (particularly hemorrhagic stroke) and nonischemic HF.
- Morning hypertension and nighttime hypertension are also more common in Asia, compared with European populations.
- South Asian populations originating from the Indian subcontinent have a particularly high risk for cardiovascular and metabolic diseases, including CAD and type 2 DM. With large hypertensive populations residing in India and China, clinical trials in these populations are required to advise whether current treatment approaches are ideal.
- Management of hypertension:
  - South East Asia: Standard treatment as indicated in these guidelines is advised, until more evidence becomes available.

Section 11: Resources
- 2019 ESC Guidelines on diabetes, prediabetes, and cardiovascular diseases developed in collaboration with

- The HOPE Asia Network contributes largely to evidence for this region: [Kario K et al. HOPE Asia (Hypertension Cardiovascular Outcome Prevention and Evidence in Asia) Network. The HOPE Asia Network for “zero” cardiovascular events in Asia. *J Clin Hypertens* 2018; 20:212–214].

- World Health Organization, HEARTS Technical Package: [https://www.who.int/cardiovascular_diseases/hearts/en/]: The HEARTS package contains free modules (in English, French, Spanish, and Russian) on, for example, healthy-lifestyle counseling; Risk based charts, but particularly for Team-based care which is particularly relevant in low resource settings where task-sharing is highly relevant: https://apps.who.int/iris/bitstream/handle/10665/260424/WHO-NMH-NVI-18.4-eng.pdf;jsessionid=7AC6EC215FEB390CBD989898B69C4705C?sequence=1.

- Cardiovascular Risk Scores: Several scoring systems are available. Some are based only on European populations, for example, SCORE.
  - SCORE: http://www.heartscore.org/en_GB/access
  - The following scores also take ethnicity into account.
  - ASCVD: https://tools.acc.org/ldl/ascvd_risk_estimator/index.html#/calulate/estimator/

- World Heart Federation Roadmap to the Management and Control of Raised Blood Pressure provides guidance on achieving the target of a relative reduction of the prevalence of raised blood pressure by 25% by 2025: https://www.world-heart-federation.org/cvd-roadmaps/whf-global-roadmaps/hypertension/

- Based on this Roadmap, an Africa-specific roadmap was also developed: [Dzudie A, Rayner B, Ojji D, Schutte AE, et al. Roadmap to achieve 25% hypertension control in Africa by 2025. *Global Heart* 2018; 13:45–59].

### Listings of Validated Electronic Blood Pressure Devices That Were Independently Assessed for Accuracy

- STRIDE BP: https://stridebp.org/
- British and Irish Hypertension Society: https://bihsoc.org/bp-monitors/
- German Hypertension Society: https://www.hochdruckliga.de/messgeraete-mit-pruefsiegel.html
- Hypertension Canada: https://hypertension.ca/hypertension-and-you/managing-hypertension/measuring-blood-pressure/devices/

### Blood Pressure Management in Pediatric Populations

Section 12: Hypertension Management at a Glance

**Diagnosis**
- Normal BP level (<130/85 mmHg)
  - Remasure after 3 years (1 year in those with other risk factors)
- High-normal BP level (130–139/85–89 mmHg)
- Hypertension BP level (≥140/90 mmHg)
- Take 2 more readings – use the average of 2nd–3rd
  - ≥130/85 mmHg
  - Remasure in 2–3 office visits. If possible confirm with home or ambulatory BP monitoring
- Repeated office BP ≥140/90 mmHg indicates hypertension, particularly if home BP ≥135/85 mmHg or 24 h ambulatory BP ≥133/80 mmHg

* Use a validated upper arm-cuff device with appropriate cuff size for the individual patient.

**Evaluation**
- History & Physical Exam
  - Exclude drug-induced hypertension
  - Evaluate for organ damage
  - Assess total CV risk
  - Search for symptoms/signs of secondary hypertension
- Lab Tests
  - Serum sodium, potassium & creatinine
  - Lipid profile & glucose
  - Urine dipstick
  - 12 lead ECG
- Additional Tests
  - If necessary for suspected organ damage or secondary hypertension

**Treatment**
- **Grade 1 Hypertension:** 140–159/90–99 mmHg
  1. Start lifestyle interventions
  2. Start drug treatment in:
     - High-risk patients (CVD, CKD, diabetes, organ damage, or aged 50–80 years)
     - All others with persistent BP elevation after 3–6 months of lifestyle intervention
- **Grade 2 Hypertension:** ≥160/100 mmHg
  1. Start drug treatment immediately
  2. Start lifestyle intervention

**Lifestyle Interventions**
- Stop smoking
- Regular exercise
- Lose weight
- Salt reduction
- Healthy diet and drinks
- Lower alcohol intake

**Drug Therapy Steps**
Use any drugs available and include as many of those below as possible. Consider monotherapy in low-risk grade 1 hypertension and in patients aged >80 years or frail. Simplify regimen with once daily dosing and single pill combinations.

**Non-Black Patients**
1. Low dose ACEI/ARB* + DHP-CCB
2. Increase to full dose
3. Add thiazide/thiazide-like diuretic
4. Add spironolactone or, if not tolerated or contraindicated, amiodone, doxazosin, eplerenone, clocinidine or beta-blocker

**Black Patients**
1. Low dose ARB + DHP-CCB or DHP-CCB + thiazide/thiazide-like diuretic
2. Increase to full dose
3. Add diuretic or ARB ACEI
4. Add spironolactone or, if not tolerated or contraindicated, amiodone, doxazosin, eplerenone, clonidine or beta-blocker

* No ACEI/ARB in women with or planning pregnancy

**Monitoring**
- **Target**
  - Reduce BP by at least 20/10 mmHg, ideally to < 140/90 mmHg
  - Individualize for elderly based on frailty
- **Monitor**
  - BP control (achieve target within 3 months)
  - Adverse effects
  - Long-term adherence
- **Referral**
  - If BP still uncontrolled, or other issue, refer to care provider with hypertension expertise

*ISh 2020 ESSENTIAL recommendations (minimum standards of care).*
Figure 6. ISH 2020 recommendations (evidence-based standards of care).
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