The information contained in this ICSI Health Care Guideline is intended primarily for health professionals and the following expert audiences:

- physicians, nurses, and other health care professional and provider organizations;
- health plans, health systems, health care organizations, hospitals and integrated health care delivery systems;
- health care teaching institutions;
- health care information technology departments;
- medical specialty and professional societies;
- researchers;
- federal, state and local government health care policy makers and specialists; and
- employee benefit managers.

This ICSI Health Care Guideline should not be construed as medical advice or medical opinion related to any specific facts or circumstances. If you are not one of the expert audiences listed above you are urged to consult a health care professional regarding your own situation and any specific medical questions you may have. In addition, you should seek assistance from a health care professional in interpreting this ICSI Health Care Guideline and applying it in your individual case.

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**Health Care Guideline:**

**Hypertension Diagnosis and Treatment**

---

**Thirteenth Edition**  
**November 2010**

---

1. Screening and identification of elevated blood pressure $\geq 140/90^*$

2. Confirm elevated blood pressure

3. Complete initial assessment: evaluate, accurately stage and complete risk assessment

4. Is secondary cause suspected?  
   - Yes
   - No

5. Order additional workup/consider referral

6. Lifestyle modifications  
   +/- drug therapy

7. Blood pressure at goal?  
   - Yes
   - No

8. Change treatment:  
   - Add a second drug from another class  
   - Substitute an agent from another class  
   - Increase the dose of the initial drug

9. Blood pressure at goal?  
   - Yes
   - No

10. Resistant hypertension?  
    - Yes
    - No

11. Hypertension consultation

---

**Classification of Blood Pressure for Adults**

<table>
<thead>
<tr>
<th>BP Classification</th>
<th>SBP mmHg</th>
<th>DBP mmHg</th>
</tr>
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<tbody>
<tr>
<td>Normal</td>
<td>$&lt; 120$</td>
<td>$&lt; 80$</td>
</tr>
<tr>
<td>Prehypertension</td>
<td>120-139</td>
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<tr>
<td>Stage 1 hypertension</td>
<td>140-159</td>
<td>90-99</td>
</tr>
<tr>
<td>Stage 2 hypertension</td>
<td>$\geq 160$</td>
<td>$\geq 100$</td>
</tr>
</tbody>
</table>

---

* Refer to annotation for specific on **special population** goals for:  
  - Chronic kidney disease  
  - Cardiovascular disease  
  - Coronary artery disease or left ventricular hypertrophy  
  - Chronic heart failure  
  - Elderly – over age 60  
  - Type 2 diabetes mellitus

---

All algorithm boxes with an "A" and those that refer to other algorithm boxes link to annotation content.

Text in blue throughout the document also provides links.

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Disclosure of Potential Conflict of Interest

In the interest of full disclosure, ICSI has adopted a policy of revealing relationships work group members have with companies that sell products or services that are relevant to this guideline topic. It is not assumed that these financial interests will have an adverse impact on content. They are simply noted here to fully inform users of the guideline.

Patrick O'Connor receives grant support from NIH (includes NHLBI, NIDDK and NIA), 100% of which is administered through his organization.

Tony Woolley receives grant support from Novartis, 100% of which is administered through his organization.

Karen Margolis receives grant support from Bristol-Myers Squibb and NIH, 100% of which is administered through her organization. She also does consulting with the National Heart, Lung, and Blood Institute.

No other work group members have potential conflicts of interest to disclose.

Evidence Grading

A consistent and defined process is used for literature search and review for the development and revision of ICSI guidelines. Literature search terms for the current revision of this document include clinical trials, meta-analysis, and systematic review restricted to human studies published since June 2008 using the following search terms: clinical hypertension diagnosis and treatment.

Individual research reports are assigned a letter indicating the class of report based on design type: A, B, C, D, M, R, X.

Evidence citations are listed in the document utilizing this format: (Author, YYYY [report class]; Author, YYYY [report class] – in chronological order, most recent date first). A full explanation of ICSI's Evidence Grading System can be found on the ICSI Web site at http://www.icsi.org.

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<td>Consensus report</td>
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<td>Narrative review</td>
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<tr>
<td>X</td>
<td>Medical opinion</td>
</tr>
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Foreword

Scope and Target Population

Adults age 18 or older.

Aims

1. Increase the percentage of hypertensive patients, age 18 and older, whose blood pressure is in control. (Annotation #7)

2. Improve the assessment of hypertensive patients, age 18 and older. (Annotation #2)

3. Increase the percentage of hypertensive patients, age 18 and older, who receive patient education, with a focus on the use of non-pharmacological treatments. (Appendix C)

4. Increase the percentage of patients, age 18 and older, with uncontrolled hypertension who have a care plan. (Annotations #3, 6, 7)

5. Increase the percentage of hypertensive patients, age 18 and older, not at a blood pressure goal, who have a change in subsequent pharmacological therapy. (Annotation #8)

Clinical Highlights

- Confirmation of hypertension is based on the initial visit, plus one or more follow-up visits with at least two blood pressure measures at each visit. (Annotation #2; Aim #2)

- Standardized blood pressure measurement techniques (including out-of-office or home blood pressure measurements) should be employed when confirming an initially elevated blood pressure and for all subsequent measures during follow-up and treatment for hypertension. (Annotation #2, Appendix A; Aim #2)

- A thiazide-type diuretic should be considered as initial therapy in most patients with uncomplicated hypertension. (Annotation #6; Aim #1)

- Physician reluctance to initiate and intensify treatment is a major obstacle to achieving treatment goals. (Annotations #8, 10; Aims #3, 4)

- Systolic blood pressure level should be the major factor for the detection, evaluation and treatment of hypertension, especially in adults 50 years and older. (Annotation #7; Aim #2)

- Fewer than 50% of patients with hypertension will be controlled with a single drug. (Annotation #8; Aims #1, 4, 5)
Implementation Recommendation Highlights

The following system changes were identified by the guideline work group as key strategies for health care systems to incorporate in support of the implementation of this guideline.

1. Develop systems that provide for staff education on proper blood pressure measurement. (See Appendix A, "Standards for Blood Pressure Measurement.") Based on surveys that show the variability of blood pressure measurement, training sessions should be arranged by your medical facility (review the steps in Appendix A and the rationale that accompanies the document). Accurate, reproducible blood pressure measurement is important to correctly classify blood pressure. Inconsistencies may result from using defective equipment and not standardizing the technique. The education and training standards found in Appendix A are consistent with American Heart Association and National Heart, Lung, and Blood Institute recommendations.

2. Develop systems for providing patient education on hypertension management. (See Appendix C, "Recommended Education Messages.") The appendix contains educational messages that will support goals of patient education and self-involvement in ongoing hypertension management. Major components of the education message are:
   - basic information about "What is blood pressure?", what the blood pressure numbers mean, and how high blood pressure affects your life;
   - lifestyle modifications;
   - pharmacologic therapy; and
   - ongoing management.

3. Consider the use of motivational interviewing as a method for addressing behavior change. Motivational interviewing is defined as a client-centered, directive counseling style for eliciting behavior change by helping patients to explore and resolve ambivalence. Rather than telling a client what changes to make, the interviewer elicits "change talk" from them, taking into account an individual's priorities and values.

Related ICSI Scientific Documents

Guidelines

- Diagnosis and Initial Treatment of Ischemic Stroke
- Heart Failure in Adults
- Lipid Management in Adults
- Diagnosis and Management of Type 2 Diabetes Mellitus in Adults
- Preventive Services for Adults
- Stable Coronary Artery Disease
- Diagnosis and Treatment of Chest Pain and Acute Coronary Syndrome (ACS)
- Prevention and Management of Obesity (Mature Adolescents and Adults)
Algorithm Annotations

1. Screening and Identification of Elevated Blood Pressure Greater Than or Equal to 140/90

The entry point to this guideline is through the ICSI Preventive Services for Adults guideline. Patients should receive routine blood pressure screening and identification of elevated blood pressure in the manner recommended in that guideline.

2. Confirm Elevated Blood Pressure

Key Points:

- All elevated blood pressure readings should be confirmed.
- A standardized blood pressure measurement process is important for correctly identifying hypertensive patients.
- Self-monitoring of blood pressure should be encouraged in most patients.

If an elevated blood pressure reading has been obtained, the blood pressure level should be confirmed. Confirmation is based on the initial visit, plus one or more follow-up visits with at least two blood pressure readings at each visit. Explain the rationale, emphasize the reason for return and the need for confirmation of elevated blood pressure. Unconfirmed hypertension should be coded with ICD-9 code 796.2. Confirmation and follow-up recommendations are noted in Table 1, "JNC7 Classification of Blood Pressure for Adults Aged 18 Years and Older" and Table 2, "Recommendations for Follow-up Based on Initial Blood Pressure Measurements for Adults without End Organ Damage" later in this annotation.

Standardized Office Blood Pressure Measurement

Accurate, reproducible blood pressure measurement is important to allow comparisons between blood pressure values and to correctly classify blood pressure. Incorrectly labeling a hypertensive patient as normotensive may increase risk for vascular events, since risk rises with increasing blood pressure. Labeling a patient with normal blood pressure as a hypertensive can affect insurability, employment, morbidity from medications, loss of time from work, and unnecessary lab and physician visits.

(Pickering, 2005 [R]; Hajjar, 2003 [D])

Standardized blood pressure technique should be employed when confirming an elevated reading and for all subsequent readings during follow-up and treatment for hypertension. See Appendix A, "Standards for Blood Pressure Measurement."

Confirmed elevated blood pressure should be classified as to the appropriate hypertension stage.

Out-of-Office Blood Pressure Measurement

Out-of-office, self-measured blood pressure readings provide important information regarding the diagnosis and treatment of hypertension and should be a routine component of blood pressure monitoring in most patients (Pickering, 2008 [R]). Home blood pressure monitoring identifies patients with white-coat hypertension, i.e., patients with elevated office blood pressure who lack evidence of hypertensive target organ damage, and who have normal out-of-office blood pressure readings, and home readings are a stronger predictor of subsequent cardiovascular events than are office readings. Moreover, home blood pressure measurements...
can identify patients with "masked hypertension," i.e., normal office and elevated home readings (Bobrie, 2004 [B]). Studies have shown that uncertainty about the "true blood pressure" is a common reason for lack of change in treatment during a clinic visit despite an elevated office blood pressure reading. Additional readings from self-monitoring will reduce this uncertainty. It is recommended that patients obtain two to three readings while rested in the seated position, both in the morning and at night for one week prior to a clinic visit (Pickering, 2008 [R]). Fully automated oscillometric devices using an appropriately sized upper arm cuff are preferred over aneroid devices or automated devices that measure blood pressure at the wrist or on the finger. Accuracy of the patient's automated device should be confirmed initially upon acquisition and periodically (e.g., annually) by the patient's health care professional (Canzanello, 2005 [D]). The general home blood pressure goal with treatment is less than 135/85 mmHg. Refer to Resources Table for additional blood pressure monitoring information.

24-Hour Blood Pressure Measurement

Ambulatory blood pressure monitoring provides information about blood pressure during daily activities and sleep. It is particularly helpful in the confirmation of white-coat or office hypertension. This phenomenon may be present in 20% to 35% of patients diagnosed with hypertension (Clement, 2003 [B]). In general, however, this diagnosis can be reliably established without ambulatory blood pressure monitoring in patients with elevated office readings who lack target organ damage, and who have accurately measured out-of-office blood pressure readings that are consistently less than 135/85 mmHg. Other clinical situations in which ambulatory blood pressure monitoring may be helpful include the assessment of drug resistance, hypotensive symptoms, episodic hypertension and suspected autonomic dysfunction. Ambulatory blood pressure monitoring predicts subsequent cardiovascular events more reliably than office blood pressure measurements. Ambulatory blood pressure monitoring may be inaccurate with atrial fibrillation. Thresholds for ambulatory hypertension are 140/85 mmHg for awake average, 120/70 mmHg for asleep average and 130/80 for 24-hour average blood pressure (Kikuya, 2007 [C]).

Table 1.

| JNC7 Classification of Blood Pressure for Adults Aged 18 Years and Older* |
|-----------------------------|-----------------------------|
| Blood pressure, mmHg        | Blood pressure, mmHg        |
| Normal**                    | Systolic (mmHg)             |
|                             | Diastolic (mmHg)             |
| Prehypertension             | less than 120               |
| Hypertension***             | or                          |
| Stage 1                     | greater than or equal to 160|
| Stage 2                     | or                          |

* Not taking antihypertensive drugs and not acutely ill. When systolic and diastolic pressure fall into different categories, the higher category should be selected to classify the individual’s blood pressure status. (Isolated systolic hypertension [ISH] is defined as SBP greater than or equal to 140 mmHg and DBP less than 90 mmHg and staged appropriately e.g., 170/82 mmHg is defined as Stage 2 [ISH].) In addition to classifying stages of hypertension on the basis of average blood pressure levels, clinicians should specify presence or absence of target organ disease and additional risk factors. This information is important for risk assessment and treatment.

** Optimal blood pressure with respect to cardiovascular risk is SBP less than 120 mmHg and DBP less than 80 mmHg. However, unusually low readings should be evaluated for clinical significance.

*** Based on the average of two or more readings taken at each of two or more visits after an initial screening.


For patients with prehypertension, early intervention with healthy lifestyle changes could reduce blood pressure, decrease the rate of the progression of blood pressure to hypertensive levels with age, or prevent hypertension entirely.
Blood Pressure Screening Clarification

Because all stages of hypertension are associated with increased vascular events, the previous classifications of mild and moderate hypertension were discarded in favor of stages that emphasize these risks. The current classification emphasizes systolic as well as diastolic standards, as systolic hypertension has been associated with increased fatal and non-fatal cardiovascular events, and treatment has been shown to reduce cardiovascular morbidity and mortality (Chobanian, 2003 [R]; World Health Organization/International Society of Hypertension, 1999 [R]; Liu, 1998 [C]; Staessen, 1997 [A]; SHEP Cooperative Research Group, 1991 [A]).

A proposed follow-up schedule – based on the initial blood pressure level as well as prior diagnosis and treatment of cardiovascular disease and risk factors – is noted in Table 2 (Chobanian, 2003 [R]).

<table>
<thead>
<tr>
<th>Initial Blood Pressure, mm Hg*</th>
<th>Follow-Up Recommended†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Recheck in two years</td>
</tr>
<tr>
<td>Prehypertension</td>
<td>Recheck in one year††</td>
</tr>
<tr>
<td>Stage 1 hypertension</td>
<td>Confirm within two months††</td>
</tr>
<tr>
<td>Stage 2 hypertension</td>
<td>Evaluate or refer to source of care within one month. For those with high pressures (e.g., greater than 180/110 mm Hg), evaluate and treat immediately or within one week depending on clinical situation and complications.</td>
</tr>
</tbody>
</table>

*If systolic and diastolic categories are different, follow recommendations for shorter time follow-up (e.g., 160/86 mm Hg should be evaluated or referred to source of care within one month).
† Modify the scheduling or follow-up according to reliable information about past BP measurements, other cardiovascular risk factors, or target organ disease.
†† Provide advice about lifestyle modifications (see Annotation 6, “Lifestyle Modifications +/- Drug Therapy”).


Initial encounter is defined as an ICD-9 code of 796.2 ("Elevated blood pressure reading without diagnosis of hypertension. Note: this category is to be used to record an episode of elevated blood pressure in a patient in whom no formal diagnosis of hypertension has been made, or as an incidental finding").

This guideline encourages increased use of this 796.2 ICD-9 code because elevated blood pressure without hypertension is currently believed to be underreported.

3. Complete Initial Assessment: Evaluate, Accurately Stage and Complete Risk Assessment

Key Points:

• It is important to assess and accurately stage newly confirmed hypertension.

• A complete review of all medications (prescription and over-the-counter) and herbal supplements is very important.

The goal of the clinical evaluation in newly confirmed hypertension is to determine whether the patient has primary or secondary hypertension, target organ disease, and other cardiovascular risk factors (risk assessment).
Absolute risk of non-fatal and fatal cardiovascular diseases in individuals with hypertension is determined by the presence of non-hypertensive cardiovascular risk factors and the presence or absence of damage to the target organs of hypertension. The absolute risk increases progressively with the level of blood pressure, the number of non-hypertensive cardiovascular risk factors, and the severity and extent of target organ damage. Using information from the Framingham epidemiologic study, a 10-year coronary heart disease risk level can be estimated for an individual based on the combination of the individual's age, total high-density lipoprotein-cholesterol levels, systolic blood pressure level, smoking status, and whether the individual has diabetes and left ventricular hypertrophy by electrocardiogram (Levy, 1993 [R]). See Appendix B, "10-Year Cardiovascular Disease Risk Calculator (Risk Assessment)." This method of risk assessment makes clear the need not only to control blood pressure but to prevent target organ damage and control all cardiovascular risk factors to maximize risk reduction.

The decision to treat hypertension initially with both lifestyle modification and drugs is reasonable when absolute individual risk is high.

Specific values for the diagnosis and treatment of dyslipidemia are reviewed in the ICSI Lipid Management in Adults guideline.

- **Accurately Stage**

  This treatment guideline is designed to be used in new or previously diagnosed hypertensive patients in conjunction with the ICSI Preventive Services in Adults guideline. See Appendix A, "Standards for Blood Pressure Measurement."

<table>
<thead>
<tr>
<th>Hypertension Stages</th>
<th>Systolic</th>
<th>Diastolic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prehypertension</td>
<td>120-139</td>
<td>80-89</td>
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<tr>
<td>Stage 1 hypertension</td>
<td>140-159</td>
<td>90-99</td>
</tr>
<tr>
<td>Stage 2 hypertension</td>
<td>greater than or</td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>equal to 160</td>
<td>greater than or</td>
</tr>
<tr>
<td></td>
<td></td>
<td>equal to 100</td>
</tr>
</tbody>
</table>


When systolic and diastolic pressure fall into different categories, the higher category should be selected in classifying the individual's blood pressure status.

- **Risk Assessment**

  The risk for cardiovascular disease in patients with hypertension is determined not only by the level of blood pressure, but also by the presence or absence of target organ damage and other risk factors such as smoking, dyslipidemia and diabetes, as shown in the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. These factors independently modify the risk for subsequent cardiovascular disease, and their presence or absence is determined during the routine evaluation of patients with hypertension (i.e., history, physical examination, laboratory tests).

- **Medical History**

  The history should focus on modifiable lifestyle factors including weight change, dietary intake of sodium and cholesterol, level of exercise, psychosocial stressors, and patterns of alcohol and tobacco use.

  Determine all medications being used – including herbal supplements, over-the-counter, prescription and illicit drugs – as many agents may temporarily elevate blood pressure and/or adversely affect...
blood pressure control (Awe, 2005 [M]; Priya, 2000 [R]). See Appendix C, "Recommended Education Messages."

A family history of hypertension, cardiovascular disease, cerebrovascular disease, diabetes mellitus and dyslipidemia should be documented.

Assess for symptoms and signs of target organ disease and secondary hypertension via a directed history.

• **Physical examination**

  The initial physical examination should include the following:

  • Two or more blood pressure measurements separated by two minutes with the patient seated and after standing for at least two minutes in accordance with the recommended techniques as stated in Appendix A, "Standards for Blood Pressure Measurement"

  • Verification in the contralateral arm (if values are different, the higher value should be used)

  • Measurement of height, weight and waist circumference. Waist circumference provides incremental information regarding cardiovascular risk related to obesity (Yusuf, 2005 [C]; Baik, 2000 [B]; Lean, 1998 [D]). See ICSI guideline Prevention and Management of Obesity (Mature Adolescents and Adults) for additional information and instructions on how to measure waist circumference.

  • Funduscopic examination for hypertensive retinopathy (i.e., arteriolar narrowing, focal arteriolar constrictions, arteriovenous crossing changes, hemorrhages and exudates, disc edema). While the reproducibility of office funduscopic findings is poor, there are clinical findings (in particular, retinal hemorrhages, papilledema) that instruct important clinical decisions.

  • Examination of the neck for carotid bruits, distended veins or an enlarged thyroid gland

  • Examination of the heart for abnormalities in rate and rhythm, increased size, precordial heave, clicks, murmurs, and third and fourth heart sounds

  • Examination of the lungs for rales and evidence of bronchospasm

  • Examination of the abdomen for bruits, enlarged kidneys, masses and abnormal aortic pulsation

  • Examination of the extremities for diminished or absent peripheral arterial pulsations, bruits and edema

  • Neurological assessment

• **Initial laboratory studies**

  Initial lab screen should include 12-lead electrocardiogram, urinalysis, fasting blood glucose or A1c, hematocrit, serum sodium, potassium, creatinine (estimated or measured glomerular filtration rate), calcium and lipid profile (total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol and triglycerides). Additional laboratory and diagnostic studies may be required in individuals with suspected secondary hypertension and/or evidence of target organ disease (Chobanian, 2003 [R]).

  Some of these tests are needed for determining presence of target organ disease and possible causes of hypertension. Others relate to cardiovascular risk factors or provide baseline values for judging biochemical effects of therapy.

  Additional tests may be ordered at the discretion of the provider based on clinical findings. These may include but are not limited to complete blood count, chest x-ray, uric acid and urine microalbumin.
See Appendix D, "Clinical Evaluation of Confirmed Hypertension."


JNC7* Cardiovascular Risk Factors/Target Organ Damage

Major risk factors
Hypertension
Age (older than 55 for men, 65 for women)†
Diabetes mellitus**
Elevated LDL cholesterol
Low HDL cholesterol”
Estimated GFR less than 60 mL/min***
Microalbuminuria
Family history of premature cardiovascular disease (men younger than 55 or women younger than 65)
Obesity** (body mass index greater than or equal to 30 kg/m², waist circumference greater than 40 inches for men and greater than 35 inches in women)
Physical inactivity
Tobacco usage, particularly cigarettes

Target organ damage
Heart
Left ventricular hypertrophy
Angina/prior myocardial infarction
Prior coronary revascularization
Heart failure
Brain
Stroke or transient ischemic attack
Dementia
Chronic kidney disease
Peripheral arterial disease
Retinopathy

† Increased risk begins at approximately 55 and 65 for men and women, respectively. Adult Treatment Panel III used earlier age cut points to suggest the need for earlier action.
** Components of the metabolic syndrome. Reduced HDL and elevated triglycerides are components of the metabolic syndrome. Abdominal obesity is also a component of metabolic syndrome.
*** GFR indicates glomerular filtration rate.

A point scale approach for estimating 10-year coronary heart disease risk can also be used. See Appendix B, "10-Year Cardiovascular Disease Risk Calculator (Risk Assessment)."
4. Is Secondary Cause Suspected?

The term "secondary hypertension" implies that a patient's blood pressure elevation is the result of an underlying discoverable disease process. Secondary causes account for only a small percentage of all documented cases of hypertension, but their detection is important as appropriate intervention may be curative and lead to reversal of hypertension.

Evaluate for features suggestive of secondary hypertension. Suspect a diagnosis of secondary hypertension in patients with an abrupt onset of symptomatic hypertension, with Stage 2 hypertension, hypertensive crisis, sudden loss of blood pressure control after many years of stability on drug therapy, drug resistant hypertension, and in those individuals with no family history of hypertension. Differential diagnosis of secondary hypertension includes:

- Chronic kidney disease/obstructive uropathy
- Thyroid and parathyroid disease
- Drugs (prescription, over-the-counter, herbal supplements, illicit drugs)
- Excessive alcohol use
- Obstructive sleep apnea
- Primary aldosteronism
- Renal artery stenosis
- Pheochromocytoma
- Cushing's syndrome
- Aortic coarctation
- Obesity

See Appendix E, "Suspicion of Secondary Hypertension."

Note recommendations for additional diagnostic procedures. Be sure advanced testing is correctly chosen and done properly to avert the need for repeat studies. This may require discussion with or referral to a specialist.

5. Order Additional Workup/Consider Referral

Consider appropriate referral or additional workup if secondary hypertension is identified or suspected.

If you suspect a diagnosis of secondary hypertension, it is recommended that you perform a phone consultation and/or refer the patient to a specialist early in order to confirm the most efficient and cost-effective approach to patient evaluation and management (Chobanian, 2003 [R]; Gifford Jr, 1989 [R]).

6. Lifestyle Modifications +/- Drug Therapy

Key Point:

- Lifestyle modifications should be the cornerstone of the initial therapy for hypertension.
- Multidisciplinary health care teams improve hypertension management.
A thiazide-type diuretic should be considered as initial therapy in most patients with uncomplicated hypertension.

For patients with Stage 2 hypertension, consider initial therapy with two drugs including a diuretic paired with one of the other recommended first-line drugs.

Clinical studies show that the blood-pressure-lowering effects of lifestyle modifications can be equivalent to drug monotherapy (Elmer, 2006 [A]). Lifestyle modification is best initiated and sustained through an educational partnership between the patient and a multidisciplinary health care team. While team members may vary by clinical setting, behavior change strategies should include nutrition, exercise, and smoking cessation services. Lifestyle modifications should be reviewed and reemphasized at least annually.

Some patient education should occur and be documented at every hypertension care visit. For recommended education messages, see Appendix C, "Recommended Education Messages."

Implementing team-based care including pharmacists and nurses should be considered an effective way to improve blood pressure control in hypertensive patients.

Recent clinical studies show that hypertensive patients are more likely to reach their blood pressure goal when a nurse or pharmacist is involved in their care (Carter, 2009 [M]). Trials also showed that guidelines were more likely to be followed and patients were more likely to be adherent to their medication regimen when a pharmacist was involved in their care (Carter, 2009 [A]). Clinical trials used a combination of face-to-face visits and phone calls with nurses and/or pharmacists and pharmacist-made treatment recommendations.

### Table 3. Lifestyle Modifications to Prevent and Manage Hypertension

<table>
<thead>
<tr>
<th>Modification</th>
<th>Recommendation</th>
<th>Approximate Systolic Blood Pressure Reduction (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight reduction</td>
<td>Maintain normal body weight (body mass index 18.5-24.9 kg/m²).</td>
<td>5-20 mmHg/10 kg</td>
</tr>
<tr>
<td>Adopt DASH** eating plan</td>
<td>Consume a diet rich in fruits, vegetables and low-fat dairy products, with a reduced content of saturated and total fat.</td>
<td>8-14 mmHg</td>
</tr>
<tr>
<td>Dietary sodium reduction</td>
<td>Reduce dietary sodium intake to no more than 100 mmol per day (2.4 g sodium or 6 g sodium chloride).</td>
<td>2-8 mmHg</td>
</tr>
<tr>
<td>Physical activity</td>
<td>Engage in regular aerobic physical activity such as brisk walking (at least 30-45 minutes per day, most days of the week).</td>
<td>4-9 mmHg</td>
</tr>
<tr>
<td>Moderation of alcohol consumption</td>
<td>Limit consumption to no more than two drinks (e.g., 24 oz. beer, 10 oz. wine, or 3 oz. 80 proof whiskey) per day in most men and to no more than one drink per day in women and lighter-weight persons.</td>
<td>2-4 mmHg</td>
</tr>
<tr>
<td>Increase dietary potassium intake</td>
<td>Increase dietary potassium intake to 4.7 gm per day (this is the amount provided in the DASH diet).</td>
<td>2-4 mm Hg</td>
</tr>
</tbody>
</table>

*For overall cardiovascular risk reduction, stop smoking.

**DASH indicates Dietary Approaches to Stop Hypertension.

The effects of implementing these modifications are dose- and time-dependent and could be greater for some individuals.


Weight Reduction and Maintenance

Hypertension is closely correlated with excess body weight (National High Blood Pressure Education Program Working Group, 1993 [R]). Approximately 50% of hypertensive patients are overweight (Romero, 2007 [D]). In the Framingham study, 60% to 70% of hypertension could be attributed to being overweight or obese (Kannel, 1993 [B]).

Research studies have documented the positive effects of weight reduction as a strategy for blood pressure control (Trials of Hypertension Prevention Collaborative Research Group, The, 1992 [A]). In adults with hypertension, meta-analysis shows that weight loss through diet or use of orlistat is related to a modest reduction of blood pressure by up to 6 mmHg systolic and 3 mmHg diastolic; however, use of sibutramine increased blood pressure despite weight loss (Horvath, 2008 [M]). Whenever indicated, weight reduction should be recommended. Even an initial loss of as little as 10 pounds can have a beneficial effect on blood pressure. Weight loss can also improve the efficacy of antihypertensive medications and the cardiovascular risk profile.

Initial weight loss and long-term weight control are both enhanced by a regular exercise program.

Patient education and/or nutritional counseling should be provided.

(Moore, 2005 [D]; Chobanian, 2003 [R]; Flegal, 2002 [D]; Appel, 1997 [A])

Dietary Interventions

Use of a DASH (Dietary Approaches to Stop Hypertension) eating plan has been shown in cohort studies to reduce incidence of congestive heart failure by 25% and incidence of stroke by 17% in women (Fung, 2008 [B]). In overweight or obese adults with elevated blood pressure, compared to the DASH diet alone, the combination of the DASH diet with exercise and weight loss resulted in greater declines in blood pressure and left ventricular mass (Blumenthal, 2010 [A]).

A relationship between dietary sodium intake and blood pressure has been demonstrated in multiple clinical and epidemiological studies (Law, 2000 [R]). Modest sodium restriction may also reduce the amount of antihypertensive medications required (Appel, 2001 [A]). However, individuals vary in response to a reduced sodium intake. Among hypertensives, African Americans, older patients and patients with renal disease seem to be more sodium sensitive (Sacks, 2001 [A]).

(Whelton, 1998 [A]; Neaton, 1993 [A])

Moderation of Alcohol Intake

Alcohol consumption has complex effects on the cardiovascular system. Alcohol consumption raises both systolic and diastolic pressures, but its effects appear to be greater on systolic pressure. Significant elevations in blood pressure have been shown in individuals who consumed an average of at least three standard drinks per day compared with non-drinkers. Alcoholism may cause hypertension, and an alcoholic is less likely to respond to any hypertension treatment recommendations (Friedman, 1990 [R]). Some persons may develop transitory hypertension during the first days of detoxification. Alcohol is a concentrated calorie source that does not provide any nutrients, so reducing alcohol intake can hasten weight reduction and may decrease triglyceride levels. Although cohort studies suggest that modest alcohol consumption may reduce the rate of myocardial ischemic events, alcohol use of up to 2 ounces per day neither increases nor decreases total mortality or cardiovascular mortality in those with hypertension (Beulens, 2007 [B]). The recommendation is to not exceed a daily alcohol intake of one ounce of ethanol. One ounce (30 mL) of ethanol is equivalent to two drinks per day. It is recommended that men have no more than one ounce of ethanol per day (two drinks) and women have no more than 0.5 ounce of ethanol per day (one drink). One drink is 12 ounces of beer, 5 ounces of wine or 1.5 ounces of 80 proof liquor.

(Maheswaran, 1991 [D])
Adequate Physical Activity

Epidemiological studies suggest that regular aerobic physical activity may be beneficial for both prevention and treatment of hypertension, to enable weight loss, for functional health status, and to diminish all-cause mortality and risk of cardiovascular disease. Thirty to forty-five minutes of brisk walking or other activity most days of the week at target heart rate ([220-age] x 75% = target heart rate) is adequate, inexpensive and effective (Pate, 1995 [R]). However, regular physical activity of even lower intensity and duration has been shown to be associated with about a 20% decrease in mortality in cohort studies (Leitzmann, 2007 [B]). Other aerobic activities (biking, swimming, jogging, etc.) may be more enjoyable. Resistive isotonic activities, when done as the only form of exercise training, are not recommended to lower blood pressure in hypertensive patients.

(World Hypertension League, 1991 [R])

Potassium

High dietary potassium intake is associated with lower blood pressure. While data from individual trials have been inconsistent, meta-analyses have documented a blood-pressure-lowering effect (Appel, 2009 [R]). There is no direct evidence that potassium supplementation lowers blood pressure chronically (Whelton, 1997 [M]; Fotherby, 1992 [A]; Cappuccio, 1991 [M]).

Tobacco Avoidance

Recent data using ambulatory blood pressure monitoring suggests that nicotine may indeed increase blood pressure and could account for some degree of blood pressure lability (Bolinder, 1998 [C]). In addition, it is a major risk factor for atherosclerotic cardiovascular disease. At each visit, establish tobacco use status.

Relaxation and Stress Management

Although studies have not demonstrated a significant long-term effect of relaxation methods on blood pressure reduction, relaxation therapy may enhance an individual’s quality of life and may have independent effects on lowering coronary heart disease risk (Eisenberg, 1993 [M]; Johnston, 1991 [R]).

Drug Therapy

A thiazide-type diuretic should be considered as initial therapy in most patients with uncomplicated hypertension (Wright, 2010 [M]; Appel, 2002 [R]). Because thiazide-type diuretics have been shown to be as good or superior to other drug classes in preventing cardiovascular disease morbidity and mortality, they should be considered preferred initial therapy in most patients (Chobanian, 2003 [R]). However, studies support the use of specific alternative drugs as initial therapy in the presence of specific co-existing diseases. Diuretics have been shown to be as good or superior to other classes of drug therapy in preventing cardiovascular disease morbidity and mortality, and they are inexpensive (Psaty, 2003 [M]; ALLHAT Officers, Coordinators for the ALLHAT Collaborative Research Group, The, 2002 [A]). Thiazide-type diuretics are especially useful for patients age 55 years or older with hypertension and additional risk factors for cardiovascular disease including the metabolic syndrome and for patients age 60 years or older with isolated systolic hypertension (Wright, 2008 [A]; ALLHAT Officers, Coordinators for the ALLHAT Collaborative Research Group, The, 2000 [A]). The risk of diabetes mellitus is higher with diuretic and beta-blockers than other first-line choices, and this may be a consideration for patients at higher risk for this disorder (Elliott, 2007 [M]). Studies have demonstrated the cost effectiveness in older patients of selecting drugs using evidence-based guidelines (Fischer, 2004 [M]). In patients for whom diuretics are contraindicated or poorly tolerated, use of an ACE inhibitor, angiotensin receptor blocker, beta-blocker or calcium antagonist is appropriate. Other considerations when selecting initial drug therapy include age, race, cost, drug interactions, side effects and quality of life issues. See Appendix F, "Therapies," and Appendix G, "Cost of Antihypertensive Drugs." In general, diuretics and calcium channel blockers appear to be more effective as an initial treatment of hyper-
tension in African Americans. The lowest recommended dose of the chosen drug should be used initially. If tolerated, the dose can be increased or additional medications added to achieve goal blood pressure.

Other classes of drugs should be reserved for special situations or as additive therapy. See Appendix F, "Therapies." Co-existing medical conditions may also justify the use of one of these classes of drugs. An example is the use of an ACE inhibitor in a patient with heart failure or diabetic nephropathy. Please see ICSI’s Diagnosis and Management of Type 2 Diabetes Mellitus in Adults guideline for further information. ACE inhibitors and angiotensin receptor blockers have been shown to be beneficial for patients with renal disease (both diabetic and non-diabetic) by reducing proteinuria and slowing the rate of decline in renal function (Jafar, 2003 [M]; Agodoa, 2001 [A]; Brenner, 2001 [A]; Jafar, 2001 [M]). ACE inhibitors have also been shown to provide symptomatic relief and prolong life for patients with heart failure and are the initial drug of choice for this condition. ACE inhibitors and angiotensin-receptor blockers have similar blood-pressure-lowering effects, but angiotensin-receptor blockers are less often associated with the side effect of cough (Matchar, 2008 [M]). Initial monotherapy with one of these agents is appropriate in these patient populations. A diuretic should be added if blood pressure response is not satisfactory. Evidence from a recent large trial suggests that ACE inhibitors may be less effective in African Americans than thiazide-type diuretics in controlling blood pressure and in preventing stroke and cardiovascular disease (Appel, 2002 [R]).

Based on meta-analyses of previous studies, beta-blockers may be less efficacious than other first-line alternatives in patients who are 60 years and older, especially for stroke prevention (Lindholm, 2005 [M]). Thus, use of these drugs as initial therapy in older patients probably should be restricted to situations where there is another indication for their use (e.g., heart failure, previous myocardial infarction, angina.) They still should be considered alternative first-line agents in younger patients, where they appear to lessen cardiovascular morbidity as well as other recommended drugs. Beta-blockers reduce the risk of sudden death and recurrent myocardial infarction for patients with an initial myocardial infarction. ACE inhibitors also reduce the risk of subsequent myocardial infarction and progression to heart failure for patients who experience a large myocardial infarction associated with impairment of left ventricular function. They also may reduce risk for patients with (or at high risk for) cardiovascular disease (Heart Outcomes Prevention Evaluation Study Investigators, The, 2000 [A]).

Long-acting dihydopyridine calcium antagonists have been shown to be effective for patients age 60 years or older with isolated systolic hypertension. Co-existing medical conditions may also justify the use of one of these classes of drugs. Evidence from a recent large study refutes concerns about increased risk of myocardial infarction, cancer or gastrointestinal bleeding from use of long-acting calcium antagonists. However, data does suggest that this class of drugs may be less effective in preventing heart failure (ALLHAT Officers, Coordinators for the ALLHAT Collaborative Research Group, The, 2000 [A]). The work group suggests these drugs be limited to those conditions listed in Appendix F, "Therapies." Data supporting potential dangers of calcium antagonists are limited to short-acting preparations (especially nifedipine) that are not approved for the treatment of hypertension.

A majority of patients will require more than one drug for blood pressure control. Combination therapies that include a diuretic are often effective, lessen the risk for side effects (by use of low doses of each component drug), and enhance adherence by simplification of the treatment program. For patients with chronic kidney disease, three or more drugs may be needed to achieve goal. Although limited scientific evidence supports the use of combination therapy as initial drug treatment for hypertension, several observations favor such an approach (Gradman, 2010 [R]). Hypertension results from the effects of multiple pressor mechanisms and drug monotherapy usually targets only one of these. Moreover, drug therapy targeted to only one mechanism often triggers counter-regulatory effects that limit overall response. Because combination therapy targets more than one pressor mechanism and limits counter-regulatory effects, blood pressure response is greater and control is achieved quicker than with drug monotherapy. In addition, many drugs have dose-related side effects. Lower doses of two drugs may be better tolerated than higher doses of a single agent. Studies also show that the blood pressure lowering effect of combining drugs is predicted on
the basis of additive effects and the overall response of using two drugs is five times greater than the effect of doubling the dose of a single agent (Wald, 2009 [M]). In addition, a correlation between time taken to achieve blood pressure control and clinical outcome has been observed. One study involving primary care clinics in Canada compared treatment using their current national guidelines with a treatment algorithm that directed initial therapy with a low-dose diuretic/ACE inhibitor or diuretic/ARB combination with subsequent up-titration of the combination as needed to control blood pressure (Feldman, 2009 [A]). After six months, control rates were significantly higher with the combination algorithm compared to the national guidelines approach, which directed treatment with drug monotherapy and subsequent dose up-titration of the initial drug. Current guidelines (Chobanian, 2003 [R]) suggest use of two drugs as initial therapy when BP is \( \geq 20/10 \) mmHg above the goal, which consists of all patients with Stage 2 hypertension. Most effective two-drug combinations include a diuretic paired with one of the other recommended first-line drugs. A recent study demonstrated superior efficacy of an ACE inhibitor/dihydropyridine calcium antagonist combination compared to a diuretic/ACE-inhibitor combination (Jamerson, 2008 [A]). More routine use of initial therapy with combinations of drugs may improve control rates and reduce morbidity and mortality from hypertension. Single pill combinations can be used initially or to simplify the drug program after titration of individual component drugs.


Cancer Risk of Angiotensin Receptor Blockers (ARBs)

In response to a meta-analysis by Sipahi, et al., the Food and Drug Administration has issued an ongoing safety review of ARBs and a potential risk of cancer.

Currently, the benefits of ARBs appear to outweigh their potential risks, and changes in their use are not advocated at this time. Until more information is available, ARBs should mainly be considered in patients with compelling indications for ACE-inhibitors but who are intolerant of them (Sipahi, 2010 [M]).

7. Blood Pressure at Goal?

Key Points:

- Isolated systolic hypertension is an important modifiable cardiovascular risk factor.
- Accurate home monitoring systems are an important tool for assessing blood pressure control.
- Review drugs, over-the-counter medications and herbal therapies that may interfere with blood pressure goal.

Goal office blood pressures should be less than 140/90 mmHg for adults with uncomplicated hypertension (in the absence of comorbidities). Goal blood pressures measured out of the office setting should be less than 135 mmHg systolic and less than 85 mmHg diastolic.

Special Populations

Existing guidelines recommend lower blood pressure goals for certain groups (see below). These lower targets are currently under review.
A recent review of seven trials (22,089 participants) comparing patients randomized to lower or to standard blood pressure targets (140-160/90-100 mmHg) found that lower targets did not reduce mortality, myocardial infarction, stroke, congestive heart failure, or end-stage renal disease (Arguedas, 2009 [M]). The results in subgroups with diabetes or chronic kidney disease were consistent with the overall results (i.e., no benefit). Subsequently, the results of the ACCORD trial in diabetic patients were published and will be detailed in the section related to blood pressure goals in diabetic patients (ACCORD Study Group, 2010 [A]). The discussion below weighs evidence from trials with other interventions that may have resulted in different blood pressure levels in the treatment arms (e.g., active drug versus placebo), observational studies and expert opinion.

**Chronic Kidney Disease (CKD)**

Hypertension is a major risk factor for as well as a consequence of CKD and end-stage renal disease (ESRD).

Current JNC 7 and NKF/DOQI recommendations call for treatment of blood pressure to < 130/80 in patients with CKD. However, no single, adequately powered intent-to-treat randomized control trial has shown a benefit of this blood pressure goal in CKD (Appel, 2010 [A]; Lewis, 2010 [M]; Arguedas, 2009 [M]) and meta-analysis of available trials shows a relative risk of ESRD of 1.01 for lower versus standard blood pressure goals (Lewis, 2010 [M]). Subgroup analysis from the Modification of Diet in Renal Disease (MDRD) of 156 patients with proteinuria > 1g/24 hours did show slower progression of renal disease with lower blood pressure; however, no benefit was seen in the proteinuric subgroup of the similarly designed African-American Study of Kidney Disease (AASK) during the trial phase (Wright, 2002 [A]; Peterson, 1995 [A]). In contrast, in the long-term cohort phase of this study that targeted a lower goal blood pressure of < 130/80 mmHg in all participants, those originally randomized to the lower blood pressure goal with albuminuria equivalent to > 300 mg/24 hours demonstrated slower progression of renal disease (Appel, 2010 [A]).

In the Modification of Diet in Renal Disease (MDRD) study, 585 individuals with chronic kidney disease (mean eGFR 39 ml/min/1.73 m²) were randomized to a low blood pressure (mean arterial pressure [MAP] 92 mmHg, corresponding to < 125/75 mmHg) or usual care condition (MAP 107 mmHg, corresponding to < 140/90 mmHg). At completion of the study (mean 2.2 years of follow-up), the rate of progression of kidney disease did not differ between blood pressure groups; however, the low blood pressure goal (achieved BP 126/77 versus 134/81 mmHg) slowed the decline in GFR in a subgroup of 156 patients with proteinuria (> 1 g/24 hours) (Klahr, 1994 [A]). A registry follow-up of all individuals in the MDRD study 6.2 years later suggested that individuals originally randomized to the low blood pressure target had a decreased incidence of end-stage kidney disease (62%), compared to those in the usual care group (70%) (Sarnak, 2005 [C]). In the African American Study of Kidney Disease and Hypertension (AASK), 1,094 African Americans with CKD (GFR 20-75 mL/min/1.73 m²) were randomized to a low MAP goal (< 92 mmHg) or to a usual MAP goal (< 107 mmHg). Those achieving a blood pressure of 128/78 experienced renal deterioration at the same rate as those achieving a blood pressure of 141/85 (Wright, 2002 [A]). There was no difference in cardiovascular events by blood pressure group (Norris, 2006 [A]). In a long-term follow-up of the cohort, a lower risk of renal deterioration was seen in participants with baseline proteinuria (equivalent to albuminuria > 300 mg/24 hours) initially assigned to the lower blood pressure goal, although no significant benefit of the lower blood pressure goal was seen overall (Appel, 2010 [A]).

Hence the recommendation for lower blood pressure goals in all patients with CKD is based on expert opinion and not fully supported by available prospective clinical trials.

Whether therapy should specifically be titrated to goals lower than < 140/90 mgHg for specific subgroups of CKD patients (e.g., those with moderate proteinuria) should be considered on an individual patient basis based on clinical judgment and patient preference.
Cardiovascular Disease

A reappraisal of evidence from randomized trials in patients with chronic heart disease or previous stroke does not show consistent evidence that cardiovascular disease risk is further reduced by more intensive lowering of blood pressure (Zanchetti, 2009 [R]). This evidence is not definitive, i.e., limitations include few trials designed to evaluate specific blood pressure goals, small differences in achieved blood pressure in many trials, and the use of active agents and corresponding placebo on top of multiple antihypertensive and other cardiovascular therapies. American Heart Association/American College of Cardiology guidelines published in 2007 called for goal office blood pressures less than 130/80 mmHg in patients with coronary disease, carotid disease, peripheral artery disease, abdominal aortic aneurysm, or a 10-year Framingham risk score of > 10% (Rosendorff, 2007 [R]). These recommendations are based on expert opinion and limited clinical evidence. A subgroup analysis of 6,400 participants of the International Verapamil SR-Trandolapril Study (INVEST) who had diabetes and coronary artery disease assessed the relationship between the degree of blood pressure control and adverse cardiovascular outcomes (Cooper-DeHoff, 2010 [M]). Tight control defined as systolic blood pressure to < 130 mmHg was not associated with fewer adverse cardiovascular outcomes compared to usual control (< 140-130 mmHg). Based on current evidence, pursuing blood pressure goals lower than < 140/90 should be considered on an individual patient basis based on clinical judgment and patient preference.

Coronary Artery Disease or Left Ventricular Hypertrophy

Concerns have been raised that excessive lowering of diastolic blood pressure increases the risk of coronary events in patients with established coronary artery disease or left ventricular hypertrophy by lowering diastolic perfusion pressure in the coronary circulation. This is known as the J-curve hypothesis. In a recently published secondary analysis of patients 80 years of age or older with hypertension and stable coronary artery disease and treated with either verapamil or atenolol-based therapy, a J-shaped phenomenon was observed in terms of increased risk of all-cause death, non-fatal myocardial infarction, or non-fatal stroke (Denardo, 2010 [M]). The systolic and diastolic blood pressure levels below which these event rates were increased were ≤ 140 or ≤ 70 mmHg, respectively. As a result, it would appear prudent to avoid lowering blood pressure to ≤ 140/70 mmHg in very elderly patients with coronary artery disease or left ventricular hypertrophy. In elderly patients with isolated systolic hypertension, some authors recommend against lowering the diastolic blood pressure below 55-60 mmHg (Fagard, 2007 [A]; Messerli, 2006 [M]). This may require compromise of the goal level of systolic blood pressure achieved.


Chronic Heart Failure

There is a strong relationship between hypertension and developing heart failure, and numerous studies have demonstrated reduced incidence of heart failure with antihypertensive therapy (Hunt, 2009 [R]). American Heart Association/American College of Cardiology guidelines call for goal office blood pressures less than 120/80 mmHg for patients with a history of heart failure (Rosendorff, 2007 [R]). In heart failure with decreased systolic function in particular, many of the medications for which there is demonstrated benefit also lower blood pressure, and low normal or slightly hypotensive values are often seen during optimal therapy. However, there are no intent to treat randomized clinical trials to support lower blood pressure goals in patients with either systolic or diastolic chronic heart failure. Hence these recommendations are based on expert opinion and limited clinical evidence.

Systolic heart failure therapy should not be interrupted for low normal blood pressure readings. Whether therapy should specifically be titrated to a lower goal than < 140/90 mmHg should be considered on an individual patient basis based on clinical judgment, target drug dosing and patient preference.
Elderly – Over Age 60

Multiple randomized placebo controlled clinical trials have demonstrated benefit of the treatment of hypertension in people over 60 with systolic blood pressure > 160 mmHg (Beckett, 2008 [A]; Liu, 1998 [A]; MRC, 1992 [A]; Amery, 1985 [A]; Staessen, 1997 [A]; SHEP Cooperative Research Group, 1991 [A]). There does not appear to be an upper age limit to this benefit, extending well beyond 80 years of age (Beckett, 2008 [A]). However, no randomized control trial has recruited elderly patients with isolated Stage 1 systolic hypertension (140-159 mmHg), and therefore there is no direct evidence of the benefit or safety of initiating treatment or titrating therapy for systolic blood pressure levels below 160 mmHg. This lack of evidence for lower systolic blood pressure goals also applies to elderly patients with renal disease, heart disease and diabetes, where recommendations for systolic blood pressure < 130 have been advanced. On the other hand, in all other subgroups beside the elderly, the benefit of lowering systolic blood pressure < 140 mmHg has been demonstrated. Based on the achieved systolic blood pressure levels in placebo-controlled randomized trials of treatment for isolated systolic hypertension with initial systolic blood pressure > 160 mmHg, the evidence supports the safety and benefit of lowering systolic blood pressure into the 140s in patients over age 60 (Beckett, 2008 [A]; SHEP Cooperative Research Group, 1991 [A]). Treating to lower systolic goals should be considered on the basis of clinical judgment and patient preference. Only one randomized placebo-controlled trial that demonstrated benefit in the elderly had an explicit goal blood pressure, which was < 150/80 mmHg in the intervention group (Beckett, 2008 [A]).

Type 2 Diabetes Mellitus

The HOT, ADVANCE and ACCORD trials are all large randomized clinical trials that allow comparison of more-stringent versus less-stringent blood pressure levels on major cardiovascular outcomes in type 2 diabetes (ACCORD Study Group, The, 2010 [A]; ADVANCE Collaborative Group, 2008 [A]; Hansson, 1998 [A]). The ADVANCE trial found that those in the intensive group, with mean systolic blood pressure 135 mmHg, had lower total mortality and cardiovascular mortality, relative to those treated to higher systolic blood pressure levels. The ACCORD trial found no difference in major cardiovascular outcomes between a more-intensive blood pressure intervention targeting systolic blood pressure < 120 mmHg compared to a standard intervention targeting systolic blood pressure between 130 and 139 mmHg. The more-intensive blood pressure regimen was associated with no benefit on pre-specified composite outcome measures, but a small reduction in the rate of stroke was observed. However, those treated to systolic blood pressure < 120 mmHg had greater medication use and more serious adverse events (ACCORD Study Group, The, 2010 [A]).

The above studies support a systolic blood pressure goal < 140 mmHg for people with type 2 diabetes.

Only the HOT trial specifically targeted diastolic blood pressure. In the HOT trial, targeting a lower diastolic blood pressure was associated with fewer cardiovascular events in subjects with type 2 diabetes. The average achieved diastolic blood pressure values in the three HOT intervention arms ranged from 81 to 85 mmHg. Based on results from the ADVANCE and ACCORD trials, it appears likely that achieved systolic blood pressure values in the mid-130 range will usually be associated with diastolic blood pressure values well below 80 mmHg. Therefore, the work group recommends a diastolic blood pressure goal of < 85 mmHg.

Although more recent evidence supports raising the blood pressure goal above the previous goal of < 130/80 for those with type 2 diabetes, the work group acknowledges that the evidence is not definitive for any particular general blood pressure goal for patients with diabetes. The work group will continue to review the blood pressure goal to consider any new evidence and the recommendations of other national practice guidelines (e.g., ADA and JNC8) that are expected to announce revisions. The general recommendation of blood pressure < 140/85 does not preclude setting individual patient goals lower than that based on patient characteristics, comorbidities, risks or the preference of an informed patient.
8. Change Treatment

Once antihypertensive drug therapy is initiated, most patients should return for follow-up and medication adjustments at least at monthly intervals until blood pressure goal is reached.

Fewer than 50% of patients with hypertension will be controlled with a single drug.

If blood pressure goals are not met, the clinician has three options for subsequent therapy:

- Add a second drug from another class.
- Substitute an agent from another class.
- Increase the dose of the initial drug.

Individualized drug selection is based on several principles:

- If the initial response to one drug is adequate, continue the same drug.
- If the response is partial on one agent, increase the dose or add a second drug of a different class.
- If there is little response, substitute another single drug from a different class.
- Consider low-dose diuretic use early or as a first addition.
- Consider loop diuretic agents instead of thiazide or thiazide-like diuretics when creatinine is greater than 2.0 mg/dL or estimated glomerular filtration rate is less than 30 mL/min per 1.73m².
- Do not combine two drugs of the same class.
- The use of combination agents can be effective.

For most patients, two or more drugs in combination may be needed to reach hypertension goals. Systolic blood pressure control for adults with cardiovascular comorbidities is poor (Wong, 2007 [D]). The combination of a diuretic appropriate for level of renal function with an angiotensin-converting enzyme inhibitor or angiotensin receptor blocker is often an effective two-drug program. A diuretic ACE inhibitor combination has been shown to reduce both the macrovascular and microvascular complications of type 2 diabetes (ADVANCE Collaborative Group, 2007 [A]).

The combination of an ACE inhibitor with an angiotensin receptor blocker has little additional effect on blood pressure compared to either monotherapy and may be associated with increased risk of adverse effects including renal dysfunction and hyperkalemia (ONTARGET Investigators, The, 2008 [A]; however, this combination is more effective than either monotherapy alone in reducing proteinuria (Kunz, 2008 [M]).

The combination of a calcium channel antagonist with an ACE inhibitor is as effective or more effective than the traditional combination of a diuretic with a beta-blocker in lowering blood pressure and reducing cardiovascular events (Dahlöf, 2005 [A]; Chobanian, 2003 [R]; Bevan, 1993 [A]).

9. Blood Pressure at Goal?

Key Points:

- Carefully review potential barriers to long-term adherence to therapy, including the possible secondary diagnosis of depression.
- Systolic hypertension is an important modifiable cardiovascular risk factor.
• Accurate home monitoring systems are an important tool for assessing blood pressure control.

• Review drugs (prescription and over-the-counter) and herbal therapies that may interfere with blood pressure goal.

If at this point acceptable response has not been achieved, several issues should be addressed or revisited. These include adherence to appropriate lifestyle modifications, consistent use of prescribed drugs, and tolerance of treatment modalities. Non-adherence rates to prescribed medications are estimated at 50% and are slightly higher for both elderly and adolescent patients (Nichols-English, 2000 [R]). Since there is not a simple test to accurately measure adherence, there are some practical methods that can be used for all patients: asking the patient about missed doses, watching treatment response, tracking missed appointments, tracking prescription refills, asking about issues of cost, and monitoring side effects. Although patients will generally overestimate their adherence, simply asking the question will help identify up to 50% of low-adherence patients. Standardized instruction in self-blood-pressure measurement will allow assessment of "white-coat" syndrome. Interfering substances that can adversely affect treatment include non-steroidal anti-inflammatory drugs, oral contraceptives, sympathomimetics, antidepressants, glucocorticoids, nasal decongestants, licorice-containing substances (e.g., chewing tobacco), cocaine, cyclosporine and erythropoietin. Intermittent use of alcohol, particularly in alcoholics who are binge drinkers, may cause difficulties with widely fluctuating blood pressures.

Non-specific symptoms such as fatigue, lightheadedness or vaguely impaired cognition may be due to an acute decline in blood pressure level and may resolve within four to six weeks while continuing the drug. Other minor drug-related symptoms unrelated to blood pressure change may also resolve in time without discontinuing the drug. Non-office-standardized blood pressure measurement is desirable to monitor blood pressure control.

The factors that lead to non-adherence are multifactorial: misunderstanding of the treatment and the reason for it, adverse reactions (or fear of them), complex dosing regimens, financial constraints or simple forgetfulness. Depression has also been identified as a risk factor in noncompliance with treatment for acute or chronic conditions (DiMatteo, 2000 [M]). Asking open-ended/non-judgmental questions about treatment regimens can lead to a good discussion between the provider and patient about why the patient may have difficulty adhering. There are a number of recommendations that in various combinations may lead to better patient adherence. These suggestions are based on available evidence from randomized clinical trials that evaluated the usefulness of adherence interventions. To increase adherence on a long-term basis, provide education about the medication and how it fits with the treatment plan, simplify the regimen (e.g., less frequent dosing, [data shows compliance rates average 79% with once-daily dosing, 69% with twice-daily dosing, 65% with three-times-daily dosing and 51% with four-times-daily dosing] (Claxton, 2001 [M]) combination medications, controlled release dosage forms), use patient adherence aids (e.g., pillboxes, alarms), offer support group sessions, send reminders for medication refills and appointments, cue medications to daily events (e.g., breakfast, bedtime), offer positive reinforcement (acknowledge the patient's efforts to adhere), monitor with regular physician follow-up, and actively involve family members and significant others (Haynes, 2002 [R]). When choosing antihypertensive drugs, preference should be given to long-acting drugs that can be dosed once daily to enhance long-term compliance (Osterberg, 2005 [R]).

(McDonald, 2002 [M])

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10. Resistant Hypertension?

A patient has resistant hypertension when blood pressure goals are not met despite compliance with optimal doses of three antihypertensive drugs of different classes with one of the agents being a diuretic. Blood pressure remains uncontrolled most often because of elevated systolic blood pressure. Patient characteristics associated with resistant hypertension include older age, female gender, African American race, obesity and the presence of chronic kidney disease, diabetes, or left ventricular hypertrophy. Numerous reasons may exist for an inadequate or poor response (Calhoun, 2008 [R]; Taler, 2002 [A]; Yakovlevitch, 1991 [D]).

Consider causes of pseudo-resistant hypertension:

- Improper blood pressure measurement (overinflation of the cuff inducing a pain response, using a cuff that is too small for the arm, or measurement of blood pressure before letting the patient rest quietly in the sitting position) can lead to inaccurately high readings.

- Poor adherence to antihypertensive therapy. Lack of complete adherence to the drug program may be present in up to 40% of patients on multiple drug programs. Patients should be asked in a non-threatening way how successful they are in taking all of their medications in the doses prescribed. Questions should be directed to out-of-pocket costs, side effects and dosing inconvenience. Family members may provide useful information regarding compliance. Review of pharmacy records for timely prescription renewals may be helpful.

- Brachial arteries may be heavily calcified or arteriosclerotic and cannot be fully compressed (pseudo-hypertension), leading to inaccurately high cuff measurements.

- Clinic or white-coat hypertension.

Consider lifestyle factors:

- Obesity

- Excessive dietary sodium intake directly increases blood pressure and blunts the effectiveness of most antihypertensive drugs. Effects of salt are most pronounced in the elderly, African Americans and in patients with chronic kidney disease.

- Excessive alcohol intake

Consider drug-related causes:

- Several classes of drugs may directly increase blood pressure or interfere with the blood-pressure-lowering effect of antihypertensive therapies. These include non-steroidal anti-inflammatory agents, sympathomimetics (decongestants, diet pills, cocaine), stimulants (methylphenidate, dextroamphetamine, amphetamine, methamphetamine, modafinil), alcohol, oral contraceptives, cyclosporine, erythropoietin, corticosteroids, natural licorice and herbal compounds (ephedra, huang).

Consider secondary causes:

- Common causes include obesity, obstructive sleep apnea, chronic kidney disease, primary aldosteronism and renal artery stenosis. Uncommon causes include pheochromocytoma, Cushing’s syndrome and aortic coarctation.

A common cause of resistant hypertension is lack of control of extra-cellular volume due to inadequate diuretic therapy. Full doses of a diuretic appropriate for level of renal function should be used. In patients with chronic kidney disease who have an estimated glomerular filtration rate less than 30 mL/minute, loop diuretics are necessary for effective volume control. Furosemide is short acting and should be given twice
daily. Longer acting loop diuretics can be used once daily (torsemide). The drug regimen should also include near maximal doses of two of the following additional classes of drugs:

- ACE inhibitor
- Calcium channel blocker
- Angiotensin receptor blocker
- Beta-adrenergic-blocker or other anti-adrenergic agent
- Direct vasodilator

11. Hypertension Consultation
Consider hypertension consultation if a patient's blood pressure is not controlled on three to four medications, including a diuretic, or if secondary hypertension is suspected.

12. Hypertension at Goal
Key Points:

- On follow-up visits, history and physical examination should be directed toward detection of hypertensive target organ damage.
- In patients with office blood pressure at goal who demonstrate progressive target organ disease, home monitoring may be beneficial.

Once blood pressure is at goal and stable, the patient should be seen usually at three- to six-month intervals by the provider to assess patient adherence, patient satisfaction and any changes in target organ status. Patients' comorbidities such as heart failure, associated diseases such as diabetes, and need for laboratory tests influence the frequency of visits (Chobanian, 2003 [R]). Lifestyle modifications should be reviewed, reemphasized and documented annually. Patients should monitor blood pressure more frequently by home monitoring or by other allied health professionals.

Ongoing care can be facilitated by physicians or specially trained allied health care professionals who provide education, reinforcement, realistic short- and long-term goal-setting and adjustment of medications according to the individual clinical situation. Intervention strategies that seek to involve the patient in decision-making can improve long-term adherence to therapy and thus improve blood pressure control. Additionally, such an ongoing relationship might better identify those patients who are suitable candidates for a reduction or withdrawal from antihypertensive drug therapy following a prolonged interval of excellent blood pressure control (Nelson, 2001 [M]).

On follow-up visits, history and physical examination should be directed toward detection of hypertensive target organ damage.

One may consider decreasing the dosage or number of antihypertensive drugs while maintaining lifestyle modification if:

- patient has uncomplicated hypertension that is well controlled; and
- blood pressure has been maintained and documented for at least one year.
This section provides resources, strategies and measurement for use in closing the gap between current clinical practice and the recommendations set forth in the guideline.

The subdivisions of this section are:

• Aims and Measures
  - Measurement Specifications
• Implementation Recommendations
• Resources
• Resources Table
Aims and Measures

Refer to Appendix H, "Accountability Measures for Hypertension Treatment in Adults," for additional measurement information.

1. Increase the percentage of hypertensive patients, age 18 and older, whose blood pressure is in control. (Annotation #7)

Measures for accomplishing this aim:

a. Percentage of hypertensive patients with a blood pressure reading at provider visit.

b. Percentage of uncomplicated hypertensive adult patients, age 18 to 60 years, with a blood pressure reading of less than 140/90 mmHg.

c. Percentage of patients over age 60 years with isolated systolic hypertension on drug therapy with a blood pressure reading of less than 150 mmHg systolic.

d. Percentage of type 2 diabetes patients with a blood pressure reading of less than 140/85 mmHg.

2. Improve the assessment of hypertensive patients, age 18 and older. (Annotation #2)

Measure for accomplishing this aim:

a. Percentage of hypertensive patients with a home blood pressure monitoring device who have been educated in the correct technique for blood pressure measurement and monitoring.

3. Increase the percentage of hypertensive patients, age 18 and older, who receive patient education, with a focus on the use of non-pharmacological treatments. (Appendix C)

Measure for accomplishing this aim:

a. Percentage of hypertensive patients who receive education on the usage of non-pharmacological treatments.

4. Increase the percentage of patients, age 18 and older, with uncontrolled hypertension who have a care plan. (Annotations #3, 6, 7)

Measures for accomplishing these aims:

a. Percentage of uncomplicated hypertensive patients, age 18 through 60 years, with a blood pressure reading of greater than 140/90 mmHg who have a care plan.

b. Percentage of type 2 diabetes patients with a blood pressure reading of greater than 140/85 mmHg who have a care plan.

c. Percentage of patients over age 60 years with isolated systolic hypertension on drug therapy with a blood pressure reading greater than 150 mmHg who have a care plan.

5. Increase the percentage of hypertensive patients, age 18 and older, not at a blood pressure goal, who have a change in subsequent pharmacological therapy. (Annotation #8)

Measure for accomplishing this aim:

a. Percentage of uncomplicated hypertensive patients, age 18 through 60 years, with blood pressure greater than 140/90 mmHg and on medication who have a change in pharmacological therapy (e.g., increase in dose of initial drug, change to a drug from another class or addition of a second drug from another class).

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Measurement Specifications

Measurement #1a
Percentage of hypertensive patients, age 18 and older, with a blood pressure reading at provider visit.

Population Definition
Patients, age 18 and older, with an office visit within the previous 12 months and with any of the following hypertension ICD-9 diagnosis codes: 401.0, 401.1 and/or 401.9.

Data of Interest

\[
\frac{\text{# of patients who had a blood pressure reading at provider visit}}{\text{# of patients who have hypertension}}
\]

Numerator/Denominator Definitions

Numerator: Number of patients, age 18 and older and with hypertension, who have a blood pressure reading at provider visit.

Denominator: Number of patients, age 18 and older, and with hypertension. Hypertension ICD-9 Codes: 401.0, 401.1 and/or 401.9.

Method/Source of Data Collection
Medical groups may generate a list of patients meeting the inclusion criteria: age 18 and older and hypertension ICD-9 Codes: 401.0, 401.1 and/or 401.9. Data may be collected by medical record review. Identify whether the blood pressure reading was done at the most recent provider visit.

Note: Groups can generate either the full list of patients or randomly select a sample of patients' charts.

Time Frame Pertaining to Data Collection
Monthly.

Notes
This is a process measure, and improvement is associated with a higher score.

Return to Table of Contents
Measurement #1b
Percentage of uncomplicated hypertensive adult patients age 18 to 60 years with a blood pressure reading of less than 140/90 mmHg.

Population Definition
Adult patients, age 18 to 60 years who have had an office visit within the previous 12 months and with any of the following hypertension ICD-9 codes: 401.0, 401.1 and/or 401.9.

Data of Interest
\[
\frac{\text{# of patients with a blood pressure reading of less than 140/90 mmHg}}{\text{# of patients with hypertension}}
\]

Numerator/Denominator Definitions
Numerator: Number of adult patients age 18 to 60 years with uncomplicated hypertension, who had a blood pressure reading of less than 140/90 mmHg.
Denominator: Number of adult patients age 18 to 60 years with uncomplicated hypertension.
Hypertension ICD-9 Codes: 401.0, 401.1 and/or 401.9.

Method/Source of Data Collection
Medical groups may generate a list of patients meeting the inclusion criteria; adult age 18 to 60 years and hypertension ICD-9 codes: 401.0, 401.1 and/or 401.9. Data may be collected by medical record review. Identify the blood pressure at the most recent office visit. Groups can generate either the full list of patients or randomly select a sample of patient charts. Of those adult patients meeting the inclusion criteria, identify those that had a blood pressure reading of 140/90 mmHg at the most recent office visit.

Notes:
- Identify the blood pressure at the most recent office visit.
- If more than one reading was performed at the most recent office visit, calculate the average of two or more systolic blood pressure and diastolic blood pressure readings taken at the most recent office visit to determine level of control.
- Refer to the previous office visit if the most recent office visit was for sigmoidoscopy, injuries or a visit at which local anesthesia such as lidocaine was given for a procedure.
- The mean of two or more systolic and the mean of two or more diastolic readings taken at the selected visit would be calculated. The mean systolic blood pressure and mean diastolic blood pressure may then be used to determine whether the patient has a blood pressure less than 140/90 mmHg.

Time Frame for Data Collection
Monthly.

Notes
This is an outcome measure, and improvement is associated with a higher score.
Measurement #1c

Percentage of patients over age 60 years with isolated systolic hypertension on drug therapy with a blood pressure reading of less than 150 mmHg systolic.

Population Definition

Patients, over age 60 years who have had an office visit within the previous 12 months and diagnosed with isolated hypertension and on drug therapy.

Data of Interest

\[
\frac{\text{# of patients with a blood pressure reading of less than 150 mmHg systolic}}{\text{# of patients isolated hypertension and on drug therapy}}
\]

Numerator/Denominator Definitions

Numerator: Number of patients over age 60 years with isolated systolic hypertension on drug therapy with a blood pressure reading of less than 150 mmHg systolic.

Denominator: Number of patients over age 60 years with isolated systolic hypertension on drug therapy.

Method/Source of Data Collection

Medical groups may generate a list of patients over age 60 years meeting population definition criteria. Data may be collected by medical record review. Groups can generate either the full list of patients or randomly select a sample of patients' charts. Of those patients meeting the population definition criteria, identify those that had a blood pressure reading of 150 mmHg systolic at the most recent office visit.

Notes:

- Identify the systolic blood pressure at the most recent office visit.
- If more than one reading was performed at the most recent office visit, calculate the average of two or more systolic blood pressure readings taken at the most recent office visit to determine level of control.
- Refer to the previous office visit if the most recent office visit was for sigmoidoscopy, injuries or a visit at which local anesthesia such as lidocaine was given for a procedure.
- The mean of two or more systolic taken at the selected visit would be calculated. The mean systolic blood pressure may then be used to determine whether the patient has a blood pressure less than 150 mmHg systolic.

Time Frame for Data Collection

Monthly.

Notes

This is an outcome measure, and improvement is associated with a higher score.

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**Measurement #1d**

Percentage of type 2 diabetes patients with a blood pressure reading of less than 140/85 mmHg.

**Population Definition**

Patients, age 18 and older, who have had an office visit within the previous 12 months and type 2 diabetes diagnosis.

**Data of Interest**

\[
\frac{\text{# of patients with a blood pressure reading of less than 140/85 mmHg}}{\text{# of patients with type 2 diabetes}}
\]

**Numerator/Denominator Definitions**

**Numerator:**  Number of patients, age 18 and older and with diagnosis of type 2 diabetes, who had a blood pressure reading of less than 140/85 mmHg.

**Denominator:**  Number of patients, age 18 and older, with type 2 diabetes.

**Method/Source of Data Collection**

Medical groups may generate a list of patients meeting the inclusion criteria: age 18 and older, and type 2 diabetes diagnosis. Data may be collected by medical record review. Groups can generate either the full list of patients or randomly select a sample of patients' charts. Of those patients meeting the inclusion criteria, identify those who had a blood pressure reading of 140/85 mmHg at the most recent office visit.

**Notes:**

- Identify the blood pressure at the most recent office visit.
- If more than one reading was performed at the most recent office visit, calculate the average of two or more systolic blood pressure and diastolic blood pressure readings taken at the most recent office visit to determine level of control.
- Refer to the previous office visit if the most recent office visit was for sigmoidoscopy, injuries or a visit at which local anesthesia such as lidocaine was given for a procedure.
- The mean of two or more systolic and the mean of two or more diastolic readings taken at the selected visit would be calculated. The mean systolic blood pressure and mean diastolic blood pressure may then be used to determine whether the patient has a blood pressure less than 140/85 mmHg.

**Time Frame Pertaining to Data Collection**

Monthly.

**Notes**

This is an outcome measure, and improvement is associated with a higher score.
Measurement #2a
Percentage of hypertensive patients with a home blood pressure monitoring device who have been educated in the correct technique for blood pressure measurement and monitoring.

Population Definition
Patients, age 18 and older, who have had an office visit within the previous 12 months and hypertension diagnosis with any of the following ICD-9 codes: 401.0, 401.1 and/or 401.9.

Data of Interest
\[
\frac{\text{# of patients who have been educated in the correct technique}}{\text{# of patients with a home blood pressure monitoring device}}
\]

Numerator/Denominator Definitions
Numerator: Number of patients, age 18 and older, and with hypertension, who have been educated in the correct technique for blood pressure measurement and monitoring.
Denominator: Number of patients, age 18 and older, and hypertension who have a home blood pressure monitoring device.

Method/Source of Data Collection
Medical groups may generate a list of patients meeting the inclusion criteria: age 18 and older and hypertension diagnosis with any of the following ICD-9 Codes: 401.0, 401.1 and/or 401.9. Data may be collected by medical record review. Groups can generate either the full list of patients or randomly select a sample of patients' charts. Of those patients meeting the inclusion criteria, identify those that have a home blood pressure monitoring device and whether education was provided on the correct technique for blood pressure measurement and monitoring.

Time Frame Pertaining to Data Collection
Monthly.

Notes
This is a process measure, and improvement is associated with a higher score.

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Measurement #3a

Percentage of hypertensive patients who receive education on the usage of non-pharmacological treatments.

Population Definition

Patients, age 18 and older, who have had an office visit within the previous 12 months and hypertension diagnosis with any of the following ICD-9 codes: 401.0, 401.1 and/or 401.9.

Data of Interest

# of patients who have received education on the use of non-pharmacological treatments
# of patients with hypertension

Numerator/Denominator Definitions

Numerator: Number of patients, age 18 and older, and with hypertension, who have received education on the use of non-pharmacological treatments.

Denominator: Number of patients, age 18 and older, and with hypertension.

Method/Source of Data Collection

Medical groups may generate a list of patients meeting the inclusion criteria: age 18 and older and hypertension diagnosis with any of the following ICD-9 Codes: 401.0, 401.1 and/or 401.9. Data may be collected by medical record review. Groups can generate either the full list of patients or randomly select a sample of patients’ charts. Of those patients meeting the inclusion criteria, identify those who have received education on the use of non-pharmacological treatments.

Time Frame Pertaining to Data Collection

Monthly.

Notes

This is a process measure, and improvement is associated with a higher score.
Measurement #4a

Percentage of uncomplicated hypertensive patients, age 18 through 60, with a blood pressure reading of greater than 140/90 mmHg who have a care plan.

Population Definition

Patients, age 18 through 60, who have had an office visit within the previous 12 months and hypertension diagnosis with any of the following ICD-9 codes: 401.0, 401.1 and/or 401.9.

Data of Interest

<table>
<thead>
<tr>
<th># of patients who have a care plan</th>
<th># of patients with hypertension and blood pressure greater than 140/90 mmHg</th>
</tr>
</thead>
</table>

Numerator/Denominator Definitions

Numerator: Number of patients, age 18 through 60, and with uncomplicated hypertension, and blood pressure greater than 140/90 mmHg who have a care plan.

Denominator: Number of uncomplicated hypertension patients, age 18 through 60, and blood pressure greater than 140/90 mmHg.

Method/Source of Data Collection

Medical groups may generate a list of patients meeting the inclusion criteria: age 18 and older and hypertension diagnosis with any of the following ICD-9 codes: 401.0, 401.1 and/or 401.9 and blood pressure greater than 140/90 mmHg. Data may be collected by medical record review. Groups can generate either the full list of patients or randomly select a sample of patients’ charts. Of those patients meeting the inclusion criteria, identify those who have a care plan.

Time Frame Pertaining to Data Collection

Monthly.

Notes

This is a process measure, and improvement is associated with a higher score.

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Measurement #4b

Percentage of type 2 diabetes patients with a blood pressure reading of greater than 140/85 mmHg who have a care plan.

Population Definition

Patients, age 18 and older, who have had an office visit within the previous 12 months and type 2 diabetes diagnosis.

Data of Interest

| # of patients who have a care plan | # of patients with type 2 diabetes and blood pressure greater than 140/85 mmHg |

Numerator/Denominator Definitions

Numerator: Number of patients, age 18 and older, and with type 2 diabetes, and blood pressure greater than 140/85 mmHg who have a care plan.

Denominator: Number of type 2 diabetes patients, age 18 and older, and blood pressure greater than 140/85 mmHg.

Method/Source of Data Collection

Medical groups may generate a list of patients meeting the inclusion criteria: age 18 and older and type 2 diabetes diagnosis and blood pressure greater than 140/85 mmHg. Data may be collected by medical record review. Groups can generate either the full list of patients or randomly select a sample of patients’ charts. Of those patients meeting the inclusion criteria, identify those who have a care plan.

Time Frame Pertaining to Data Collection

Monthly.

Notes

This is a process measure, and improvement is associated with a higher score.

Return to Table of Contents
Measurement #4c
Percentage of patients over age 60 years, with isolated systolic hypertension on drug therapy with a blood pressure reading greater than 150 mmHg systolic who have a care plan.

Population Definition
Patients, over age 60 years, who have had an office visit within the previous 12 months and diagnosed with isolated systolic hypertension on drug therapy and blood pressure reading greater than 150 mmHg systolic.

Data of Interest
\[
\text{# of patients who have a care plan} \quad \text{# of patients with isolated systolic hypertension on drug therapy and a blood pressure reading greater than 150 mmHg systolic}
\]

Numerator/Denominator Definitions
Numerator: Number of patients, over age 60 years, with isolated systolic hypertension on drug therapy with a blood pressure reading greater than 150 mmHg systolic who have a care plan.

Denominator: Number of patients, over age 60 years, with isolated systolic hypertension on drug therapy with a blood pressure reading greater than 150 mmHg systolic.

Method/Source of Data Collection
Medical groups may generate a list of patients, over age 60 years, meeting population definition criteria. Data may be collected by medical record review. Groups can generate either the full list of patients or randomly select a sample of patients' charts. Of those patients meeting the population definition criteria, identify those that had a care plan.

Time Frame Pertaining to Data Collection
Monthly.

Notes
This is a process measure, and improvement is associated with a higher score.
Measurement #5a

Percentage of uncomplicated hypertensive patients, age 18 through 60, with blood pressure greater than 140/90 mmHg and on medication, who have a change in pharmacological therapy (e.g., increase in dose of initial drug, change to a drug from another class or addition of a second drug from another class).

Population Definition

Patients age 18 through 60, and hypertensive diagnosis ICD-9 codes 401.0, 401.1 and/or 401.9 who have had a clinic visit within the past month.

Data of Interest

\[
\frac{\text{# of patients who have a change in pharmacological therapy}}{\text{# of hypertension patients with blood pressure greater than 140/90 mmHg and on medication}}
\]

Numerator/Denominator Definitions

Numerator: Number of uncomplicated hypertensive patients, age 18 through 60, and blood pressure greater than 140/90 mmHg and on hypertension medication who have a change in pharmacological therapy. Change in pharmacological therapy may include: increase in dose of initial drug, change to a drug from another class or addition of a second drug from another class.

Denominator: Number of uncomplicated hypertensive patients with blood pressure greater than 140/90 mmHg and on hypertension medication. Hypertension ICD-9 codes of 401.0, 401.1 and/or 401.9.

Method of Data Collection

Medical groups may generate a list of patients meeting the inclusion criteria: age 18 through 60, and any of the following hypertension ICD-9 diagnoses: 401.0, 401.1 and/or 401.9, and blood pressure greater than 140/90 mmHg and on hypertension medication. Data may be collected by medical record review. From the review, determine if the patients meeting the criteria had a change in pharmacological therapy. Change in pharmacological therapy may include: increase in dose of initial drug, change to a drug from another class or addition of a second drug from another class.

Time Frame for Data Collection

Monthly.

Notes

This is a process measure, and improvement is associated with a higher score.

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Implementation Recommendations

Prior to implementation, it is important to consider current organizational infrastructure that address the following:

- System and process design
- Training and education
- Culture and the need to shift values, beliefs and behaviors of the organization

The following system changes were identified by the guideline work group as key strategies for health care systems to incorporate in support of implementation of this guideline.

1. Develop systems that provide for staff education on proper blood pressure measurement. (See Appendix A, "Standards for Blood Pressure Measurement.") Based on surveys that show the variability of blood pressure measurement, training sessions should be arranged by your medical facility (review the steps in Appendix A and the rationale that accompanies the document). Accurate, reproducible blood pressure measurement is important to correctly classify blood pressure. Inconsistencies may result from using defective equipment and not standardizing the technique. The education and training standards found in Appendix A are consistent with American Heart Association and National Heart, Lung, and Blood Institute recommendations.

2. Develop systems for providing patient education on hypertension management. (See Appendix C, "Recommended Education Messages.") The appendix contains educational messages that will support goals of patient education and self-involvement in ongoing hypertension management. Major components of the education message are:
   - basic information about "What is blood pressure?", what the blood pressure numbers mean, and how high blood pressure affects your life;
   - lifestyle modifications;
   - pharmacologic therapy; and
   - ongoing management.

3. Consider the use of motivational interviewing as a method for addressing behavior change. Motivational interviewing is defined as a client-centered, directive counseling style for eliciting behavior change by helping patients to explore and resolve ambivalence. Rather than telling a client what changes to make, the interviewer elicits "change talk" from them, taking into account an individual's priorities and values.

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Resources

Criteria for Selecting Resources

The following resources were selected by the guideline work group as additional resources for providers and/or patients. The following criteria were considered in selecting these resources.

- The site contains information specific to the topic of the guideline.
- The content is supported by evidence-based research.
- The content includes the source/author and contact information.
- The content clearly states revision dates or the date the information was published.
- The content is clear about potential biases, noting conflict of interest and/or disclaimers as appropriate.

Resources Available to ICSI Members Only

ICSI has a wide variety of knowledge resources that are only available to ICSI members (these are indicated with an asterisk in far left-hand column of the Resources table). In addition to the resources listed in the table, ICSI members have access to a broad range of materials including tool kits on CQI processes and Rapid Cycling that can be helpful. To obtain copies of these or other Resources, go to http://www.icsi.org/improvement_resources. To access these materials on the Web site, you must be logged in as an ICSI member.

The resources in the table on the next page that are not reserved for ICSI members are available to the public free-of-charge.

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# Resources Table

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<th>Web sites/Order Information</th>
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<td></td>
<td>Allina Press</td>
<td>What You Should Know about High Blood Pressure (hypertension brochure) #31483</td>
<td>Patients and Families</td>
<td>To order, call 612-775-9614</td>
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<td></td>
<td>American Heart Association (AHA)</td>
<td>Web site with excellent resources for patient education and general heart health resources. Understanding and Controlling Your High Blood Pressure and Exercise and Your Heart.</td>
<td>Patients and Families</td>
<td><a href="http://www.americanheart.org">http://www.americanheart.org</a></td>
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<td>Mayo Clinic</td>
<td>Blood pressure monitor information</td>
<td>Patients and Families</td>
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<td></td>
<td>Mayo Health Oasis</td>
<td>Web site with excellent resources for patient education resources, particularly using search terms &quot;hypertension,&quot; &quot;blood pressure&quot; and &quot;home monitoring.&quot;</td>
<td>Patients and Families</td>
<td><a href="http://www.mayoclinic.com/health/how-to-measure-blood-pressure/MM00785">http://www.mayoclinic.com/health/how-to-measure-blood-pressure/MM00785</a></td>
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<td>National Kidney Foundation</td>
<td>The National Kidney Foundation, Inc. (NKF) is a major voluntary health organization dedicated to preventing kidney disease, improving the health and well-being of individuals and families affected by kidney disease.</td>
<td>Health Care Professionals</td>
<td><a href="http://www.kidney.org/kidney-disease/">http://www.kidney.org/kidney-disease/</a></td>
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<td>* Park Nicollet Health Services</td>
<td>Patient Education: Hypertension, Understanding brochure</td>
<td>Patients and Families</td>
<td><a href="http://www.americanheart.org">http://www.americanheart.org</a></td>
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</tbody>
</table>

* Available to ICSI members only.

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The subdivisions of this section are:

- References
- Appendices
References

Links are provided for those new references added to this edition (author name is highlighted in blue).


ADVANCE Collaborative Group. Effects of a fixed combination of perindopril and indapamide on macrovascular and microvascular outcomes in patients with type 2 diabetes mellitus (the ADVANCE trial): a randomised controlled trial. *Lancet* 2007;370:829-40. (Class A)


ALLHAT Officers, Coordinators for the ALLHAT Collaborative Research Group, The. Major cardiovascular events in hypertensive patients randomized to doxazosin vs chlorthalidone: the Antihypertensive and Lipid-lowering Treatment to Prevent Heart Attack Trial (ALLHAT). *JAMA* 2000;283:1967-75. (Class A)

ALLHAT Officers, Coordinators for the ALLHAT Collaborative Research Group, The. Major outcomes in high-risk hypertensive patients randomized to angiotensin-converting enzyme inhibitor or calcium channel blocker vs diuretic: the antihypertensive and lipid-lowering treatment to prevent heart attack trial (ALLHAT). *JAMA* 2002;288:2981-97. (Class A)


Appel LJ. ASH position paper: dietary approaches to lower blood pressure. *J Clin Hypertens* 2009;11:358-68. (Class R)

Appel LJ. The verdict from ALLHAT – thiazide diuretics are the preferred initial therapy for hypertension. *JAMA* 2002;288:3039-42. (Class R)


Arguedas JA, Perez MI, Wright JM. Treatment blood pressure targets for hypertension (review). *The Cochrane Library* 2009, Issue 3. (Class M)

Aw T, Haas SJ, Liew D, Krum H. Meta-analysis of cyclooxygenase-2 inhibitors and their effects on blood pressure. *Arch Intern Med* 2005;165:490-96. (Class M)


Return to Table of Contents


Borhani NO, Mercuri M, Borhani PA, et al. Final outcome results of the multicenter isradipine diuretic atherosclerosis study (MIDAS): a randomized controlled trial. *JAMA* 1996;276:785-91. (Class A)


Cooper-DeHoff RM, Gong Y, Handberg EM, et al. Tight blood pressure control and cardiovascular outcomes among hypertensive patients with diabetes and coronary artery disease. *JAMA* 2010;304:61-68. (Class M)


*Return to Table of Contents*


DiMatteo MR, Lepper HS, Croghan TW. Depression is a risk factor for noncompliance with medical treatment: meta-analysis of the effects of anxiety and depression on patient adherence. *Arch Intern Med* 2000;160:2101-07. (Class M)


Fotherby MD, Potter JF. Potassium supplementation reduces clinic and ambulatory blood pressure in elderly hypertensive patients. *J Hypertens* 1992;10:1403-08. (Class A)


Haynes RB, McDonald HP, Garg AX. Helping patients follow prescribed treatment: clinical applications. JAMA 2002;288:2880-83. (Class R)


Hypertension Detection Follow-Up Program Cooperative Group. Five-year findings of the hypertension detection and follow-up program: I. reduction in mortality of persons with high blood pressure, including mild hypertension. JAMA 1979;242:2562-71. (Class A)


Kahn N, McAlister FA. Re-examining the efficacy of beta-blockers for the treatment of hypertension: a meta-analysis. CMAJ 2006;174:1737-42. (Class M)


McDonald HP, Garg AX, Haynes RB. Interventions to enhance patient adherence to medication prescriptions: scientific review. *JAMA* 2002;288:2868-79. (Class M)


Priya D, Kochar MS. Herbs and hypertension. *VHSJ* 60-64, July 2000. (Class R)

PROGRESS Collaborative Group, The. Effects of blood pressure lowering with perindopril and indapamide therapy in dementia and cognitive decline in patients with cerebrovascular disease. *Arch Intern Med* 2003;163:1069-75. (Class A)


Rahman M, Pressel S, Davis BR, et al. Renal outcomes in high-risk hypertensive patients treated with an angiotensin-converting enzyme inhibitor or a calcium channel blocker vs a diuretic: a report from the antihypertensive and lipid-lowering treatment to prevent heart attack trial (ALLHAT). *Arch Intern Med* 2005;165:936-46. (Class A)


SHEP Cooperative Research Group. Prevention of stroke by anti hypertensive drug treatment in older persons with isolated systolic hypertension: final results of the systolic hypertension in the elderly program (SHEP). *JAMA* 1991;265:3255-64. (Class A)


Trials of Hypertension Prevention Collaborative Research Group, The. The effects of nonpharmacologic interventions on blood pressure of persons with high-normal levels: results of the trials of hypertension prevention, phase I. *JAMA* 1992;267:1213-20. (Class A)


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Wright JM, Musini VM. First-line drugs for hypertension (review). *The Cochrane Library* 2009, Issue 3. (Class M)


Zanchetti A, Grassi G, Mancia G. When should antihypertensive drug treatment be initiated and to what levels should systolic blood pressure be lowered? A critical reappraisal. *J Hypertension* 2009;27:923-34. (Class R)
Appendix A – Standards for Blood Pressure Measurement

Accurate, reproducible blood pressure measurement is important to correctly classify blood pressure. Inconsistencies may result from using defective equipment and not standardizing the technique. Review the following steps and the accompanying rationale. Based on surveys that show the variability of blood pressure measurement, training sessions should be arranged by your medical facility.

These standards are consistent with American Heart Association and National Heart, Lung, and Blood Institute recommendations.

**SELECTING EQUIPMENT:**

**RATIONALE:**

- Use mercury manometer or a recently calibrated aneroid manometer with the center of the mercury column or aneroid dial at eye level.

- If the meniscus of the Hg or aneroid gauge is not level with your vision, a reading may be read as too high or too low.

- Select appropriate cuff size. The width of the bladder should be 40% of the arm circumference, and the length of the bladder should encircle at least 80% of the arm.

- A too-small cuff will give falsely high readings. A too-large cuff may rarely give a false low reading but with less clinical significance.

- Use the bell of the stethoscope. Ideally, the bell should be placed above the medial epicondyle and medial to the biceps tendon (brachial artery).

- The stethoscope bell is designed to listen to low-pitched sounds. The early and late blood pressure sounds are low pitched.

**PREPARING THE PATIENT:**

**RATIONALE:**

- The patient should avoid eating, smoking, caffeine, exercise, and drinking alcohol one-half to one hour before blood pressure measurement.

- Readings will vary after exercise, eating, smoking, drinking alcohol or having caffeine (e.g. differences of 5-15 mmHg with 150 mg caffeine within 15 minutes).

- Have the patient sit quietly for a period at rest with both feet flat on the floor and back supported prior to measurement.

- Any change in posture or activity causes blood pressure to change. Some patients may experience an alerting reaction initially.

- No clothing should be between the blood pressure cuff and the arm. Place the center of the cuff's bladder over the brachial artery on the upper arm.

- Extra noise from the bell of the stethoscope rubbing against clothing could cause a false blood pressure reading. Failure to center the cuff can result in a falsely high reading.

- Use the patient's same arm for blood pressure readings and record arm and cuff size used.

- This allows for consistency and better comparison.

- The patient's arm should be supported or allowed to rest on a solid surface so the inner aspect of the bend of the elbow is level with the heart.

- The difference between lower and higher positions of the arm can cause differences in measurements of as much as 10 mmHg systolic and diastolic. For every cm the cuff sits above or below heart level, the blood pressure varies by 0.8 mmHg. If the patient's arm is tense, measurement can vary by up to 15 mmHg (systolic more than diastolic.)
Appendix A – Standards for Blood Pressure Measurement

These standards are consistent with American Heart Association and National Heart, Lung, and Blood Institute recommendations.

**TAKING AN INITIAL MEASUREMENT:**

Secure the blood pressure cuff evenly and snugly around the arm, 1 to 1-1/2 inches above the antecubital space (at the elbow). Center the bladder (inflatable bag) over the brachial artery.

Initially perform a palpatory estimate of systolic pressure. Wait 15-30 seconds before taking the auscultatory reading.

Inflate the cuff quickly to 30 mmHg above the palpatory blood pressure.

Deflate bladder at 2-3 mmHg per second.

Record the first of at least two consecutive sounds as the systolic. Diastolic is identified by the last sound heard. If blood pressure is normal (systolic less than 140 and diastolic less than 90), inform the patient.

Helpful hint: If the tones are difficult to hear, confirm brachial artery location by palpitation, then elevate arm for 15 seconds to drain the veins. With arm still overhead, inflate the cuff to 60 mmHg above palpatory blood pressure. Then lower arm and repeat auscultation.

**CONFIRMING INITIAL ELEVATION:**

If blood pressure is elevated and the patient had initially waited quietly for five minutes, repeat blood pressure in one-two minutes. Record both measurements and inform the patient.

If blood pressure is elevated but the patient had not initially waited quietly for five minutes, now allow for a five-minute rest. Remeasure blood pressure and record it as the first reading. If this blood pressure is still elevated, repeat the measurement in one-two minutes, record it as the second measurement, and inform the patient.

This form was developed by Park Nicollet Health Services.

**RATIONALE:**

A loose blood pressure cuff may balloon in the center, decreasing the effective width of the cuff. Since pressure transmitted through larger tissue bulk requires more external pressure to compress the underlying artery, a falsely higher lever of systolic and diastolic pressure may be heard.

This step provides knowledge of the range of the systolic pressure. An auscultatory gap (absence of sound for 20-40 mmHg) occurs in 5% of hypertensives. The estimate will help to avoid incorrectly recording the systolic below the gap.

Inflating the cuff too high can cause pain and result in a falsely high reading.

If the pressure is released too quickly, you could record the systolic blood pressure falsely low as the first systolic tap is missed and the diastolic is falsely high. If you deflate too slowly, you could record the diastolic falsely high.

The last sound heard is easier than muffling for observers to accurately record. In some patients (for example, children or pregnant women), sounds are heard to near 0. In these cases, record both muffling and 0, e.g., 150/80/0. The muffling value is then considered the diastolic pressure.

Because blood pressure normally varies up to 10 mmHg, it is necessary to take two readings to obtain the most accurate present blood pressure.

A time interval of one-two minutes between cuff inflations is necessary to reduce forearm engorgement.
## Appendix B – 10-Year Cardiovascular Disease Risk Calculator (Risk Assessment)

### Table 1.

<table>
<thead>
<tr>
<th>Age</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-39</td>
<td>0</td>
</tr>
<tr>
<td>40-49</td>
<td>0</td>
</tr>
<tr>
<td>50-59</td>
<td>0</td>
</tr>
<tr>
<td>60-69</td>
<td>0</td>
</tr>
<tr>
<td>70-79</td>
<td>0</td>
</tr>
<tr>
<td>Non-smoker</td>
<td>0</td>
</tr>
<tr>
<td>Smoker-Male</td>
<td>8</td>
</tr>
<tr>
<td>Smoker-Female</td>
<td>9</td>
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</table>

### Table 2.

<table>
<thead>
<tr>
<th>Systolic BP</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 120</td>
<td>0</td>
</tr>
<tr>
<td>120-129</td>
<td>1</td>
</tr>
<tr>
<td>130-139</td>
<td>2</td>
</tr>
<tr>
<td>140-159</td>
<td>3</td>
</tr>
<tr>
<td>&gt; 160</td>
<td>4</td>
</tr>
<tr>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### Table 3.

<table>
<thead>
<tr>
<th>HDL Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 60</td>
</tr>
<tr>
<td>50-59</td>
</tr>
<tr>
<td>40-49</td>
</tr>
<tr>
<td>&lt; 40</td>
</tr>
</tbody>
</table>

### Table 4.

<table>
<thead>
<tr>
<th>Age</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-34</td>
<td>-9</td>
</tr>
<tr>
<td>35-39</td>
<td>-4</td>
</tr>
<tr>
<td>40-44</td>
<td>0</td>
</tr>
<tr>
<td>45-49</td>
<td>3</td>
</tr>
<tr>
<td>50-54</td>
<td>6</td>
</tr>
<tr>
<td>55-59</td>
<td>8</td>
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<tr>
<td>60-64</td>
<td>10</td>
</tr>
<tr>
<td>65-69</td>
<td>11</td>
</tr>
<tr>
<td>70-74</td>
<td>12</td>
</tr>
<tr>
<td>75-79</td>
<td>13</td>
</tr>
<tr>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>-9</td>
<td>-7</td>
</tr>
<tr>
<td>-4</td>
<td>-3</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### Table 5.

<table>
<thead>
<tr>
<th>Total Cholesterol</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 160</td>
<td>0</td>
</tr>
<tr>
<td>160-199</td>
<td>4</td>
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<tr>
<td>200-239</td>
<td>7</td>
</tr>
<tr>
<td>240-279</td>
<td>9</td>
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<tr>
<td>&gt; 280</td>
<td>11</td>
</tr>
<tr>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>13</td>
<td>8</td>
</tr>
</tbody>
</table>

There is an online downloadable CV risk calculator that is used in assessing 10-year risk of CV disease. The link is [http://hin.nhlbi.nih.gov/atpiii/calculator.asp?usertype=prof](http://hin.nhlbi.nih.gov/atpiii/calculator.asp?usertype=prof)

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Appendix C – Recommended Education Messages

Purpose
The following educational messages will support the goals of patient education and self-involvement in ongoing hypertension management:

Health Care Provider Visits

Basic Information
• Discuss:
  - What is blood pressure?
  - What do the numbers mean?
  - Factors affecting blood pressure, e.g., OTC medications
  - How high blood pressure affects health

Lifestyle Modification
• Recommend appropriate lifestyle modification:
  - Weight reduction and maintenance
  - Moderation of dietary sodium
  - Moderation of alcohol intake
  - Adequate physical activity
  - Incorporation of DASH diet
• Recommend interventions for cardiovascular risk factors (e.g., smoking, hyperlipidemia, diabetes).

Pharmacologic Therapy
• Reinforce lifestyle modification and cardiovascular risk factor interventions.
• Provide medication information (e.g., what, when and why taking medication, possible side effects).
• Advise when to call with problems.

Ongoing Management
• Advise on necessity for follow-up.
• Set realistic goals in partnership with the patient.
• Reinforce educational messages.
• Adopt an attitude of concern along with hope and interest in the patient's future.
• Provide positive feedback for BP and behavioral improvement.

* Resource: "Hypertension = High Blood Pressure," a patient education brochure developed by Hypertension Screening guideline team (see educational resource list)

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## Appendix D – Clinical Evaluation of Confirmed Hypertension

This table is used to help define etiology, to define target organ damage and to identify cardiovascular risk factors.

<table>
<thead>
<tr>
<th>Medical History</th>
<th>Pertinent Medical History in the Initial Evaluation of Hypertension:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Symptoms suggesting secondary hypertension</td>
</tr>
<tr>
<td></td>
<td>• History of high blood pressure, including duration and levels</td>
</tr>
<tr>
<td></td>
<td>• Results and side effects of previous antihypertensive therapy</td>
</tr>
<tr>
<td></td>
<td>• Use of oral contraceptives, steroids, NSAIDs, nasal decongestants, appetite suppressants, tricyclic/tetracyclic antidepressants, MAO inhibitors, cocaine and other illicit drugs, alcohol, and/or herbal supplements</td>
</tr>
<tr>
<td></td>
<td>• History of tobacco use, diabetes, hyperlipidemia</td>
</tr>
<tr>
<td></td>
<td>• History of weight gain, exercise, sodium and fat intake</td>
</tr>
<tr>
<td></td>
<td>• History or symptoms of stroke, transient ischemic attack, angina, previous myocardial infarction, coronary revascularization procedure, heart failure, claudication, renal disease</td>
</tr>
<tr>
<td></td>
<td>• Family history of coronary artery disease, stroke, renal disease and hypertension</td>
</tr>
<tr>
<td></td>
<td>• Psychosocial and environmental factors that may influence blood pressure</td>
</tr>
<tr>
<td></td>
<td>• Snoring, daytime somnolence</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical Examination</th>
<th>Pertinent Features on Physical Examination:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Tachycardia</td>
</tr>
<tr>
<td></td>
<td>• Unequal blood pressures in arms (more than 10 mmHg)</td>
</tr>
<tr>
<td></td>
<td>• Cushingoid appearance</td>
</tr>
<tr>
<td></td>
<td>• Obesity</td>
</tr>
<tr>
<td></td>
<td>• Orthostatic drop after standing for two minutes</td>
</tr>
<tr>
<td></td>
<td>• Arteriolar narrowing, arterio-venous nicking, papilloedema, hemorrhages or exudates in the fundi</td>
</tr>
<tr>
<td></td>
<td>• Thyromegaly or thyroid nodules</td>
</tr>
<tr>
<td></td>
<td>• Carotid bruits or diminished upstroke</td>
</tr>
<tr>
<td></td>
<td>• Cardiomegaly</td>
</tr>
<tr>
<td></td>
<td>• Murmurs, gallops or arrhythmias</td>
</tr>
<tr>
<td></td>
<td>• Signs of heart failure</td>
</tr>
<tr>
<td></td>
<td>• Abdominal bruits or masses</td>
</tr>
<tr>
<td></td>
<td>• Delayed or diminished peripheral pulses</td>
</tr>
<tr>
<td></td>
<td>• Aneurysms</td>
</tr>
<tr>
<td></td>
<td>• Peripheral edema</td>
</tr>
<tr>
<td></td>
<td>• Neurological deficits on exam</td>
</tr>
<tr>
<td></td>
<td>• Radial/femoral pulse delay</td>
</tr>
<tr>
<td></td>
<td>• Café au lait spots</td>
</tr>
<tr>
<td></td>
<td>• Oral facial neuromas</td>
</tr>
<tr>
<td></td>
<td>• Neurofibromas</td>
</tr>
<tr>
<td></td>
<td>• Marfinoid habitus</td>
</tr>
<tr>
<td>Initial Pertinent Labs</td>
<td>Routine Labs:</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Order tests as necessary, especially if not done within past year.</td>
<td>• 12-lead ECG</td>
</tr>
<tr>
<td>(Each institution's lab profiles may vary as to which are most cost effective and efficient.)</td>
<td>• Urinalysis</td>
</tr>
<tr>
<td></td>
<td>• Fasting blood glucose or A1c</td>
</tr>
<tr>
<td></td>
<td>• Hematocrit</td>
</tr>
<tr>
<td></td>
<td>• Serum sodium</td>
</tr>
<tr>
<td></td>
<td>• Potassium</td>
</tr>
<tr>
<td></td>
<td>• Creatinine (estimate GFR*)</td>
</tr>
<tr>
<td></td>
<td>• Calcium</td>
</tr>
<tr>
<td></td>
<td>• Lipid profile (total cholesterol, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol and triglycerides)</td>
</tr>
</tbody>
</table>

*Estimate of glomerular filtration rate = (140 - age in years) x (weight in kilograms) x (0.85 if patient female)/72 x (serum creatinine).

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# Appendix E – Suspicion of Secondary Hypertension

Early discussion or consultation with an appropriate subspecialist may lead to the most accurate and cost-effective workup.

## Clinical Findings:

<table>
<thead>
<tr>
<th>Clinical Findings:</th>
<th>Recommended Test/Referral:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elevated serum creatinine, abnormal urine sediment, hematuria on two occasions, or structural renal abnormality</td>
<td>Consider referral to nephrology.</td>
</tr>
<tr>
<td>Isolated proteinuria on two occasions</td>
<td>Quantify proteinuria and refer if appropriate.</td>
</tr>
</tbody>
</table>

## Features of renovascular hypertension:

- Initial onset before age 30 or after age 50 years
- Blood pressure over 180/110
- Hemorrhages and exudates in the fundi
- Presence of abdominal bruit over renal arteries
- Diminishing blood pressure control
- Women of childbearing age
- Sudden worsening of previously controlled hypertension
- Unexplained episodes of pulmonary edema
- Acute decline in renal function with ACE inhibitor or angiotension receptor blocker
- Unexplained decline in renal function

Hypertensive intravenous pyleograms are not recommended.

There is no single test for renovascular hypertension. If you suspect renovascular hypertension, consult experts in your institution.

## Low serum potassium in absence of diuretics on two occasions

Consider primary aldosteronism and referral to nephrology or endocrinology.

## Cushingoid features

24-hour urine for cortisol

## Features of pheochromocytoma:

- Spells
  - Headaches
  - Palpitations
  - Perspiration
  - Pallor
- Extremely labile blood pressure

Plasma metanephrines or 24-hour urine metanephrines if plasma results not available
<table>
<thead>
<tr>
<th>Drug</th>
<th>Associated Conditions Where Indicated</th>
<th>Associated Conditions Where Useful</th>
<th>Associated Conditions Requiring Caution</th>
<th>Contraindications</th>
<th>Drug Interactions*</th>
<th>Potential Side Effects*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thiazide Diuretics</td>
<td>- preferred initial therapy for most patients with uncomplicated hypertension - especially effective in African Americans</td>
<td>- ISH in elderly - heart failure - diabetes - high coronary risk</td>
<td>- edema states - renal insufficiency (loop agents for CR &gt; 2.0 mg/dl)</td>
<td>- cardiac arrhythmias - glucose intolerance - elevated triglycerides - gout - hypertrophic cardiomyopathy</td>
<td>- sensitivity to thiazides</td>
<td>- hypokalemia - hyperuricemia - hyponatremia - hypertension - dry mouth - nausea - constipation - orthostatic hypotension - rash</td>
</tr>
<tr>
<td>Beta-Blockers</td>
<td>- previous MI (non-ISA)* - heart failure - diabetes - high coronary risk</td>
<td>- angina pectoris - supraventricular arrhythmias - suppression of PVCs - prophylaxis for migraines - hypertrophic cardiomyopathy - anxiety - essential tremor - glaucoma</td>
<td>- COPD with mild bronchospasm** - asthma (moderate or severe) - COPD with significant bronchospasm - sinus bradycardia (non-ISA) - 2nd or 3rd degree heart block - sensitivity to beta-blockers - hypoglycemia-prone IDDM</td>
<td>- cimetidine and nicotine reduce bioavailability of liver-metabolized drugs - liver-metabolized beta-blockers may increase warfarin activity - additive negative inotropic effect with verapamil - addition of reserpine - bradycardia and syncope - combined with verapamil may cause complete heart block</td>
<td>- erectile dysfunction - fatigue - lightheadedness - dizziness - dyspnea - wheezing - cold extremities - claudication - confusion - vivid dreams - insomnia - depression - diarrhea - bradycardia</td>
<td></td>
</tr>
</tbody>
</table>

* ISA = intrinsic sympathomimetic activity (acebutolol, penbutolol, pindolol)
** Use cardioselective agents
### Hypertension Diagnosis and Treatment

**Appendix F – Therapies**

*Thirteenth Edition/November 2010*

---

**Drug Interactions**

- angioedema
- tachycardia
- increase in serum potassium
- nausea
- diuretic failure
- agranulocytosis
- peripheral edema
- headache
- constipation
- flushing
- hypokalemia
- hyperkalemia
- anemia
- rash
- abnormal liver enzymes
- hypertension

---

**Potential Side Effects**

- dizziness
- beta-blockers
- increases in diastolic blood levels
- decreases in systolic blood levels

---

**Contraindications**

- pregnancy
- sensitivity to ACE inhibitors

---

**Associated Conditions Where Indicated**

- type 1 diabetes with renal disease
- congestive heart failure
- previous MI with impaired LV function
- non-diabetic renal diseases associated with proteinuria
- high coronary risk
- nephrotic syndrome
- unilateral renovascular hypertension
- type 2 diabetes with renal disease
- renal insufficiency (renal function and hyperkalemia)
- bilateral renal artery stenosis
- renal artery stenosis in solitary kidney
- hypertrophic cardiomyopathy
- less effective for monotherapy in African Americans

---

**Associated Conditions Where Useful**

- hypertension in elderly patients
- variant angina
- prophylaxis (verapamil)
- Raynaud’s disease (nifedipine)
- esophageal spasm - hypertrophic cardiomyopathy without obstruction (verapamil, diltiazem)
- supraventricular tachycardia (verapamil, diltiazem)
- pulmonary hypertension (milrinone)

---

**Associated Conditions Requiring Caution**

- renal insufficiency and hyperkalemia
- bilateral renal artery stenosis
- renal artery stenosis in solitary kidney
- high-risk for heart failure
- liver disease
- sensitivity to calcium channel blockers

---

**Drug**

- ACE Inhibitors
- Calcium Channel Blockers

---

*For a complete listing of side effects and drug interactions for any particular drug, consult the PDR or academic pharmacology texts.*

Cooper, 2006

---

Return to Table of Contents
<table>
<thead>
<tr>
<th>Drug</th>
<th>Associated Conditions Where Indicated</th>
<th>Associated Conditions Where Useful</th>
<th>Associated Conditions Requiring Caution</th>
<th>Contraindications</th>
<th>Drug Interactions*</th>
<th>Potential Side Effects*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angiotensin Receptor Blockers</td>
<td>- type 2 diabetes with renal disease - non-diabetic renal disease with proteinuria - heart failure - left ventricular hypertrophy</td>
<td>- congestive heart failure - type 1 diabetes with renal involvement - nephrotic syndrome - unilateral renovascular hypertension</td>
<td>- renal insufficiency (renal function and hyperkalemia) - bilateral renal artery stenosis - renal artery stenosis in solitary kidney - hypertrophic cardiomyopathy</td>
<td>- pregnancy - sensitivity to angiotensin receptor blockers</td>
<td>- antihypertensive effect blocked by NSAIDs - NSAIDs (hyperkalemia) - potassium supplements (hyperkalemia) - potassium sparing diuretics (less hypokalemia or hyperkalemia)</td>
<td>- angioedema - tachycardia - increase in serum creatinine - increase in serum potassium - hypotension - fatigue</td>
</tr>
</tbody>
</table>

* For a complete listing of side effects and drug, interactions for any particular drug, consult the PDR or academic pharmacology texts.

Appendix G – Cost of Antihypertensive Drugs

Approximate cash price (based on Average Wholesale Price) for a 30-day supply of medication. Based on individual patient’s insurance formularies and pharmacy programs (i.e., $4 generic lists), these costs may vary.

<table>
<thead>
<tr>
<th>Diuretics</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thiazide Type</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorthalidone</td>
<td>12.5-25 mg daily</td>
<td>$</td>
</tr>
<tr>
<td>Chlorothiazide</td>
<td>0.5-1g once or twice daily</td>
<td>$$</td>
</tr>
<tr>
<td>Hydrochlorothiazide</td>
<td>12.5-25 mg daily</td>
<td>$</td>
</tr>
<tr>
<td>Indapamide</td>
<td>1.25 mg daily</td>
<td>$</td>
</tr>
<tr>
<td>Metolazone</td>
<td>2.5-5 mg daily</td>
<td>$$$</td>
</tr>
<tr>
<td><strong>Loop</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bumetanide*</td>
<td>0.5-1 mg daily</td>
<td>$</td>
</tr>
<tr>
<td>Ethacrynic Acid*</td>
<td>50-100 mg daily</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Furosemide</td>
<td>40 mg twice daily</td>
<td>$</td>
</tr>
<tr>
<td>Torsemide</td>
<td>5 mg daily</td>
<td>$$</td>
</tr>
<tr>
<td><strong>Potassium-Sparing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amiloride</td>
<td>5 mg daily</td>
<td>$$$</td>
</tr>
<tr>
<td>Eplerenone</td>
<td>50 mg daily</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Spironolactone</td>
<td>50-100 mg daily</td>
<td>$$</td>
</tr>
<tr>
<td>Triamterene</td>
<td>50-100 mg daily</td>
<td>$$</td>
</tr>
<tr>
<td><strong>Angiotensin-Converting Enzyme Inhibitors</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benazepril</td>
<td>10 mg daily</td>
<td>$$</td>
</tr>
<tr>
<td>Captopril</td>
<td>25 mg two to three times daily</td>
<td>$$</td>
</tr>
<tr>
<td>Enalapril</td>
<td>5 mg daily</td>
<td>$</td>
</tr>
<tr>
<td>Fosinopril</td>
<td>10 mg daily</td>
<td>$$$</td>
</tr>
<tr>
<td>Lisinopril</td>
<td>10 mg daily</td>
<td>$</td>
</tr>
<tr>
<td>Moexipril</td>
<td>7.5 mg daily</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Perindopril</td>
<td>4 mg daily</td>
<td>$</td>
</tr>
<tr>
<td>Quinapril</td>
<td>10-20 mg daily</td>
<td>$$</td>
</tr>
<tr>
<td>Ramipril</td>
<td>2.5 mg daily</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Trandolapril</td>
<td>1-2 mg daily</td>
<td>$$</td>
</tr>
</tbody>
</table>

* Not approved for hypertension

$0-10 = $
$11-30 = $$
$31-50 = $$$
$51-70 = $$$$$
Greater than $71 = $$$$$

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Institute for Clinical Systems Improvement
<table>
<thead>
<tr>
<th>Angiotensin Receptor Blockers (ARBs)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drug</strong></td>
</tr>
<tr>
<td>Candesartan</td>
</tr>
<tr>
<td>Eprosartan</td>
</tr>
<tr>
<td>Irbesartan</td>
</tr>
<tr>
<td>Losartan</td>
</tr>
<tr>
<td>Olmesartan</td>
</tr>
<tr>
<td>Telmisartan</td>
</tr>
<tr>
<td>Valsartan</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beta-Adrenergic Blockers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Without Intrinsic Sympathomimetic Activity</strong></td>
</tr>
<tr>
<td>Atenolol</td>
</tr>
<tr>
<td>Betaxolol</td>
</tr>
<tr>
<td>Bisoprolol</td>
</tr>
<tr>
<td>Metoprolol Succinate</td>
</tr>
<tr>
<td>Metoprolol Tartrate</td>
</tr>
<tr>
<td>Nadolol</td>
</tr>
<tr>
<td>Nebivolol</td>
</tr>
<tr>
<td>Propranolol</td>
</tr>
<tr>
<td>Propranolol Extended-release</td>
</tr>
<tr>
<td>Timolol</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>With Intrisistic Sympathomimetic Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acebutolol</td>
</tr>
<tr>
<td>Penbutolol</td>
</tr>
<tr>
<td>Pindolol</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>With Alpha-Blocking Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carvedilol</td>
</tr>
<tr>
<td>Carvedilol Extended-release</td>
</tr>
<tr>
<td>Labetalol</td>
</tr>
</tbody>
</table>

$0-10 = $
$11-30 = $$
$31-50 = $$$
$51-70 = $$$$$
Greater than $71 = $$$$$$
## Hypertension Diagnosis and Treatment

### Cost of Antihypertensive Drugs

**Calcium Channel Blockers**

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-dihydropyridines</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diltiazem ER (24 hour)</td>
<td>120 daily</td>
<td>$$</td>
</tr>
<tr>
<td>Verapamil ER (24 hour)</td>
<td>180 daily</td>
<td>$$</td>
</tr>
<tr>
<td><strong>Dihydropyridines</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amlodipine</td>
<td>5 mg daily</td>
<td>$</td>
</tr>
<tr>
<td>Felodipine</td>
<td>5 mg daily</td>
<td>$$$</td>
</tr>
<tr>
<td>Isradipine</td>
<td>2.5 mg twice daily</td>
<td>$$$</td>
</tr>
<tr>
<td>Isradipine ER</td>
<td>5 mg daily</td>
<td>$$$</td>
</tr>
<tr>
<td>Nicardipine</td>
<td>20 mg three times daily</td>
<td></td>
</tr>
<tr>
<td>Nicardipine Extended-release</td>
<td>30 mg twice daily</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Nifedipine</td>
<td>30 mg twice daily</td>
<td>$$$</td>
</tr>
<tr>
<td>Nifedipine ER</td>
<td>30 mg daily</td>
<td>$$$</td>
</tr>
<tr>
<td>Nisoldipine ER</td>
<td>17 mg daily</td>
<td>$$$$$</td>
</tr>
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**Alpha-Adrenergic Blockers**

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doxazosin</td>
<td>1 mg daily</td>
<td>$</td>
</tr>
<tr>
<td>Prazosin</td>
<td>1 mg daily</td>
<td>$</td>
</tr>
<tr>
<td>Terazosin</td>
<td>1 mg daily</td>
<td>$</td>
</tr>
</tbody>
</table>

**Other Antihypertensives**

**Central Alpha-Andrenertic Agonists**

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clonidine</td>
<td>0.1 mg twice daily</td>
<td>$$</td>
</tr>
<tr>
<td>Clonidine TTS</td>
<td>0.1 mg patch applied weekly</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Guanabenz</td>
<td>4 mg twice daily</td>
<td>$$$$$</td>
</tr>
<tr>
<td>Guanfacine</td>
<td>1 mg daily</td>
<td>$</td>
</tr>
<tr>
<td>Methylldopa</td>
<td>250 mg twice daily</td>
<td>$$</td>
</tr>
</tbody>
</table>

**Direct Vasodilators**

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydralazine</td>
<td>10 mg four times daily</td>
<td>$$</td>
</tr>
<tr>
<td>Minoxidil</td>
<td>5 mg daily</td>
<td>$$</td>
</tr>
</tbody>
</table>

**Renin Inhibitors**

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aliskiren</td>
<td>150 mg daily</td>
<td>$$$$$</td>
</tr>
</tbody>
</table>

$0-10 = $
$11-30 = $$
$31-50 = $$$
$51-70 = $$$$$
Greater than $71 = $$$$$$
### Available Drug Combination

<table>
<thead>
<tr>
<th>Drug*</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ace Inhibitor/Diuretic</strong></td>
<td></td>
</tr>
<tr>
<td>Benazepril/Hydrochlorothiazide</td>
<td>$</td>
</tr>
<tr>
<td>Captopril/Hydrochlorothiazide</td>
<td>$</td>
</tr>
<tr>
<td>Enalapril/Hydrochlorothiazide</td>
<td>$</td>
</tr>
<tr>
<td>Fosinopril/Hydrochlorothiazide</td>
<td>$$</td>
</tr>
<tr>
<td>Lisinopril/Hydrochlorothiazide</td>
<td>$</td>
</tr>
<tr>
<td>Moexipril/Hydrochlorothiazide</td>
<td>$$</td>
</tr>
<tr>
<td>Quinapril/Hydrochlorothiazide</td>
<td>$$</td>
</tr>
<tr>
<td><strong>Angiotensin Receptor Blockers/Diuretic</strong></td>
<td></td>
</tr>
<tr>
<td>Candesartan/Hydrochlorothiazide</td>
<td>$$$$</td>
</tr>
<tr>
<td>Eprosartan/Hydrochlorothiazide</td>
<td>$$$$</td>
</tr>
<tr>
<td>Irbesartan/Hydrochlorothiazide</td>
<td>$$$$</td>
</tr>
<tr>
<td>Losartan/Hydrochlorothiazide</td>
<td>$$</td>
</tr>
<tr>
<td>Olmesartan/Hydrochlorothiazide</td>
<td>$$$$</td>
</tr>
<tr>
<td>Telmisartan/Hydrochlorothiazide</td>
<td>$$$$</td>
</tr>
<tr>
<td>Valsartan/Hydrochlorothiazide</td>
<td>$$$$</td>
</tr>
<tr>
<td><strong>Beta-Adrenergic Blockers/Diuretics</strong></td>
<td></td>
</tr>
<tr>
<td>Atenolol/Chlorthalidone</td>
<td>$</td>
</tr>
<tr>
<td>Bisoprolol/Hydrochlorothiazide</td>
<td>$$</td>
</tr>
<tr>
<td>Metoprolol tartrate/Hydrochlorothiazide</td>
<td>$$</td>
</tr>
<tr>
<td>Propranolol/Hydrochlorothiazide IR</td>
<td>$</td>
</tr>
<tr>
<td>Propranolol/Hydrochlorothiazide ER</td>
<td>$</td>
</tr>
<tr>
<td><strong>Diuretic Combinations</strong></td>
<td></td>
</tr>
<tr>
<td>Hydrochlorothiazide/Spironolactone</td>
<td>$$</td>
</tr>
<tr>
<td>Triamterene/Hydrochlorothiazide</td>
<td>$</td>
</tr>
<tr>
<td>Hydrochlorothiazide/Amiloride</td>
<td>$</td>
</tr>
</tbody>
</table>

* Refer to individual drugs for starting doses

$0-10 = $
$11-30 = $$
$31-50 = $$$
$51-70 = $$$$$
Greater than $71 = $$$$$

**Return to Table of Contents**
## Hypertension Diagnosis and Treatment

### Cost of Antihypertensive Drugs

#### Direct Vasodilators/Diuretics

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydralazine/Hydrochlorothiazide</td>
<td>25/25 mg twice daily</td>
<td>$$</td>
</tr>
</tbody>
</table>

#### Central Alpha/Andrenergic Agonist/Diuretic

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyldopa/Hydrochlorothiazide</td>
<td>250/15 mg two or three times daily</td>
<td>$$</td>
</tr>
</tbody>
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#### Calcium Channel Blocker/Ace Inhibitor

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amlodipine/Benazepril</td>
<td>2.5/10 mg daily</td>
<td>$$$</td>
</tr>
<tr>
<td>Felodipine/Enalapril</td>
<td>2.5/5 mg daily</td>
<td>$$$</td>
</tr>
<tr>
<td>Verapamil/Trandolapril</td>
<td>180/2 mg daily</td>
<td>$$$$</td>
</tr>
</tbody>
</table>

#### Calcium Channel Blocker/Angiotensin Receptor Blocker

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amlodipine/Telmisartan</td>
<td>5/40 mg daily</td>
<td>$$$$</td>
</tr>
<tr>
<td>Amlodipine/Olmesartan</td>
<td>5/20 mg daily</td>
<td>$$$$</td>
</tr>
<tr>
<td>Amlodipine/Valsartan</td>
<td>5/160 mg daily</td>
<td>$$$$</td>
</tr>
</tbody>
</table>

#### Calcium Channel Blocker/Angiotensin Receptor Blocker/Diuretic

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amlodipine/Valsartan/Hydrochlorothiazide</td>
<td>5/160/12.5 mg daily</td>
<td>$$$$</td>
</tr>
<tr>
<td>Amlodipine/Olmesartan/Hydrochlorothiazide</td>
<td>5/20/12.5 mg daily</td>
<td>$$$$</td>
</tr>
</tbody>
</table>

#### Renin Inhibitor/Diuretic

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aliskiren/Hydrochlorothiazide</td>
<td>150/12.5 mg daily</td>
<td>$$$$</td>
</tr>
</tbody>
</table>

#### Renin Inhibitor/Angiotensin Receptor Blocker

<table>
<thead>
<tr>
<th>Drug</th>
<th>HTN Starting Dose</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aliskiren/Valsartan</td>
<td>150/160 mg daily</td>
<td>$$$$</td>
</tr>
</tbody>
</table>

$0-10 = $  
$11-30 = $$  
$31-50 = $$$  
$51-70 = $$$$  
Greater than $71 = $$$$$

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Appendix H – Accountability Measures for Hypertension Treatment in Adults

BACKGROUND

Several organizations (e.g., NCQA, NQF and CMS) now use or are considering the use of accountability measures related to the care of adults with hypertension. Use of such measures is expected to encourage timely use of evidence-based care recommendations to better control hypertension and ultimately reduce the likelihood of major complications such as congestive heart failure, renal disease, stroke and myocardial infarctions (Chassin, 2010 [X]).

USES OF ACCOUNTABILITY MEASURES

Measurement for accountability is conceptually different from measurement for improvement or measurement for research (Solberg, 1997 [R]). Most accountability measures are used for the following purposes: (a) public reporting of medical group, clinic or provider performance to patients or to payers, with the goal of providing positive publicity (and ultimately more patients) and remuneration to those whose patients have better hypertension control; and/or (b) pay-for-performance programs that increase the income of providers whose patients have better hypertension control.

BENEFITS OF USING HYPERTENSION ACCOUNTABILITY MEASURES

Over 20% of United States adults have hypertension, which if uncontrolled increases risk of major cardiovascular events. A moderate amount of evidence (none from randomized studies) suggests that use of accountability measures may lead to higher rates of hypertension control. No studies have carefully assessed possible untoward unintended consequences related to use of accountability measures such as over treatment of some patients, hospitalizations related to greater use of antihypertensive agents, or loss of providers from care systems that serve patients whose hypertension is more difficult to control due to low health literacy, social disadvantage or non-adherence.

CONSTRAINTS ON THE USE OF HYPERTENSION ACCOUNTABILITY MEASURES

Several factors constrain the assumption that accountability measures accurately reflect the quality of care provided. These factors include:

- Hypertension control depends in part upon changes in lifestyle, including reduction of sodium intake, weight loss, regular exercise, reduction of alcohol use, and stress reduction. Adopting these lifestyles is often beyond the control of clinical providers. Providers who serve patients with lower health literacy or educational levels, or those with higher rates of alcohol use, mental illness, obesity or stress may, as a group, be less able to achieve hypertension control than providers who serve more educated, less socially disadvantaged populations of patients. Use of unadjusted accountability measures linked to economic incentives may have the unintended consequence of driving competent providers out of care settings that serve more socially disadvantaged patients. A technical response to this problem is to adjust ratings for the proportion of socially disadvantaged patients at a given care delivery setting.

- Most chronic disease clinical guidelines recommend individualizing therapy, based on the balance of the benefits and the risks of therapy for a given patient. Although hypertension medications are generally regarded as safe, diuretics and ACE/ARB agents are among the five leading causes of drug-related hospitalization in the United States.

- When a patient has multiple chronic conditions, or has a severe or life-threatening condition that circumscribes life expectancy, the benefits of hypertension control may diminish, while the risks of
hypothesis control may increase. Deviation from recommended BP targets is often appropriate under these circumstances.

- All evidence-based recommendations are not of equal benefit to all patients. For example, the benefits related to hypertension control are greatest, on average, for those with Stage 2 hypertension, and the incremental benefits of blood pressure lowering diminish as blood pressure levels approach recommended goals. Accountability measures that specify a threshold (such as blood pressure < 140/90 mmHg) may tempt clinical providers to focus on those closest to goal, rather than on those furthest from goal who may never achieve goal but may still benefit the most from lowering blood pressure.

TECHNICAL CONSIDERATIONS IN SELECTING BLOOD PRESSURE CONTROL LEVELS FOR ACCOUNTABILITY MEASURES

1. Because accountability measures, especially when linked to financial incentives, may have substantial effects on provider behavior, it is important to select accountability measures that are very well supported by strong, consistent evidence of benefit across wide groups of patients based on multiple well-designed randomized clinical trials. In essence, accountability measures should be based only on the strongest levels of evidence, and not be based on controversial or inconsistent data, epidemiological data alone or expert opinion.

2. When accountability measures are based on clinical trial results, the mean or median achieved blood pressure level in the group with superior results is NOT an appropriate threshold clinical goal for an accountability measure. Half the subjects in any group are at or above the median value for that group. Thus, if an intervention group with median systolic blood pressure of 135 mmHg did better than a comparison group that achieved a mean systolic blood pressure of 145 mmHg, the recommended threshold value for an accountability measure would most appropriately be around < 140 mmHg, not < 135 mmHg. It is not defensible to recommend as a community standard of care a clinical metric that could only be achieved by half of the eligible and consented patients receiving free, highly structured care from expert providers within clinical trial clinics.

3. A technical response to heterogeneity of distribution of socially disadvantaged patients across care settings is to statistically adjust accountability measures for the proportion of socially disadvantaged patients at a given care delivery setting.

SUMMARY: POLICY CONSIDERATIONS

Accountability measures that are linked to public reporting or financial incentives for providers may be an effective method for influencing clinical decision-making and improving chronic disease care. For this reason, it is critically important to select accountability measures that are consistently and strongly supported by randomized clinical trial data, and to apply these measures only to the subsets of patients most likely to achieve benefits. Even with such carefully considered constraints, there is a real danger that overly stringent accountability measures could lead to over treatment of hypertension in some patients, or other unintended consequences. To minimize the risks, while retaining the potential benefits of accountability measurement, conservative thresholds are indicated, and adjustment of accountability measures for social disadvantage is strongly encouraged.

The consensus recommendation of the guideline group for use of accountability measures for hypertension treatment is summarized below:

1. In general, it would not be appropriate to recommend blood pressure accountability targets lower than a standard of < 140/90 mmHg for adults with hypertension. This level of control is supported by numerous randomized clinical trials. Use of this level for accountability measures would still allow providers to treat individual patients to lower goals whenever it is determined to be appropriate,
while minimizing the risks of incentivizing providers to over treat those who are frail, elderly, or have multiple chronic diseases.

2. Whether classification of blood pressure control in an individual patient should be adjusted for the number of antihypertensive drugs being used in attempting to achieve control is a matter to consider for accountability measures. For example, if a patient is on three or four antihypertensive medications but has blood pressure somewhat over 140/90 mmHg, the quality of care is not likely to be deficient—the lack of control may be more related to severity of disease, or to non-adherence. Thus, an alternative accountability measure might be this: (a) blood pressure < 140/90 mmHg, OR ELSE (b) treatment in the last year with two or more blood pressure medications. Use of this accountability measure would allow clinical providers to treat individual patients to lower goals whenever this might be appropriate, while minimizing the risks of incentivizing providers to over treat those who are frail, elderly, or have multiple chronic diseases. In addition, this accountability measure would not penalize physicians caring for a disproportionate share of patients who are non-adherent, or who express a strong personal preference for less-intensive hypertension treatment than providers may recommend. We do not, at this time, recommend that accountability measures apply to those age 65 and over.

3. Statistical adjustment of accountability measures for the proportion of socially disadvantaged patients at a given care setting is recommended, to avoid the erroneous conclusion that providers serving socially disadvantaged patient populations provide uniformly poorer care than providers serving less disadvantaged patient populations.
Document History, Development and Acknowledgements:
Hypertension Diagnosis and Treatment

Original Work Group Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>David Colville, MD</td>
<td>Work Group Leader, Internal Medicine/Hypertension</td>
<td>Mayo Clinic</td>
</tr>
<tr>
<td>Steven D. Hagedorn, MD</td>
<td>Facilitator</td>
<td>Mayo Clinic</td>
</tr>
<tr>
<td>Kathy Halvorson, RN</td>
<td></td>
<td>Honeywell, Inc.</td>
</tr>
<tr>
<td>Donald Lum, MD</td>
<td></td>
<td>Family Medicine</td>
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<tr>
<td>Gary Schwartz, MD</td>
<td></td>
<td>Mayo Clinic</td>
</tr>
<tr>
<td>Pam Pearson, RN</td>
<td></td>
<td>Group Health, Inc.</td>
</tr>
<tr>
<td>Linda Pietz, RN</td>
<td></td>
<td>Park Nicollet Medical Center</td>
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<tr>
<td>Steve Thomas, PA</td>
<td></td>
<td>Ramsey Medical Center</td>
</tr>
<tr>
<td>Patrick O'Connor, MD, MPH</td>
<td>Measurement Advisor</td>
<td>Group Health Foundation</td>
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<td>Measurement Advisor</td>
<td>Group Health Foundation</td>
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<tr>
<td>N. Tracy Wolf, MD</td>
<td></td>
<td>Park Nicollet Medical Center</td>
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<tr>
<td>Lori Utech, MD</td>
<td></td>
<td>Family Medicine</td>
</tr>
<tr>
<td>Patrick O'Connor, MD, MPH</td>
<td>Measurement Advisor</td>
<td>Group Health Foundation</td>
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</tbody>
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Released in October 2010 for Thirteenth Edition.
The next scheduled revision will occur within 24 months.

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ICSI Document Development and Revision Process

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Since 1993, the Institute for Clinical Systems Improvement (ICSI) has developed more than 60 evidence-based health care documents that support best practices for the prevention, diagnosis, treatment or management of a given symptom, disease or condition for patients.

Document Development and Revision Process

The development process is based on a number of long-proven approaches. ICSI staff first conducts a literature search to identify pertinent clinical trials, meta-analysis, systematic reviews, regulatory statements and other professional guidelines. The literature is reviewed and graded based on the ICSI Evidence Grading System.

ICSI facilitators identify gaps between current and optimal practices. The work group uses this information to develop or revise the clinical flow and algorithm, drafting of annotations and identification of the literature citations. ICSI staff reviews existing regulatory and standard measures and drafts outcome and process measures for work group consideration. The work group gives consideration to the importance of changing systems and physician behavior so that outcomes such as health status, patient and provider satisfaction, and cost/utilization are maximized.

Medical groups, who are members of ICSI, review each guideline as part of the revision process. The medical groups provide feedback on new literature, identify areas needing clarification, offer recommended changes, outline successful implementation strategies and list barriers to implementation. A summary of the feedback from all medical groups is provided to the guideline work group for use in the revision of the guideline.

Implementation Recommendations and Measures

Each guideline includes implementation strategies related to key clinical recommendations. In addition, ICSI offers guideline-derived measures. Assisted by measurement consultants on the guideline development work group, ICSI's measures flow from each guideline's clinical recommendations and implementation strategies. Most regulatory and publicly reported measures are included but, more importantly, measures are recommended to assist medical groups with implementation; thus, both process and outcomes measures are offered.

Document Revision Cycle

Scientific documents are revised every 12-24 months as indicated by changes in clinical practice and literature. Each ICSI staff monitors major peer-reviewed journals every month for the guidelines for which they are responsible. Work group members are also asked to provide any pertinent literature through check-ins with the work group mid-cycle and annually to determine if there have been changes in the evidence significant enough to warrant document revision earlier than scheduled. This process complements the exhaustive literature search that is done on the subject prior to development of the first version of a guideline.

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