

High Blood Pressure

WHAT IS HIGH BLOOD PRESSURE?

High blood pressure, also called hypertension, is, simply, elevated pressure of the blood in the arteries. Hypertension results from two major factors, which can be present independently or together:

- The heart pumps blood with excessive force.
- The body's smaller blood vessels (known as the *arterioles*) narrow, so that blood flow exerts more pressure against the vessels' walls.

Although the body can tolerate increased blood pressure for months and even years, eventually the heart may enlarge (a condition called *hypertrophy*), which is a major factor in heart failure. Such pressure can also injure blood vessels in the heart, kidneys, the brain, and the eyes.

Two numbers are used to describe blood pressure: the *systolic pressure* (the higher and first number) and the *diastolic pressure* (the lower and second number). Health dangers from blood pressure may vary among different age groups and depending on whether systolic or diastolic pressure (or both) is elevated. A third measurement, *pulse pressure*, is becoming important as an indicator of severity.

Blood pressure is measured in millimeters of mercury (mm Hg). For example, excellent blood pressure would be less than 120/80 mm Hg (systolic/diastolic). Blood pressure is now categorized as optimal, normal, high normal, and hypertensive. The hypertensive category is further divided, according to severity. [See *Table Blood Pressure and Its Treatments*.]

American expert groups recommend that any blood pressure above normal should be treated. Some experts are concerned, however, that such guidelines may unnecessarily increase the use of anti-hypertensive drugs.

Systolic Blood Pressure. The systolic pressure (the first and higher number) is the force that blood exerts on the artery walls as the heart contracts to pump out the blood. High systolic pressure is now known to be a greater risk factor than diastolic pressure for heart, kidney, and circulatory complications and for death, particularly in middle-aged and elderly adults. The wider the spread between the systolic and diastolic measurements, the greater the danger.

In fact, elevated systolic pressure may pose a significant danger for heart events and stroke events even when diastolic is normal — a condition called *isolated systolic hypertension*. Isolated systolic hypertension is the most common form of hypertension in people older than fifty. In one study it comprised 87% of hypertension cases in people between ages 50 and 59.

Diastolic Blood Pressure. The diastolic pressure (the lower and second number) is the measurement of force as the heart relaxes to allow the blood to flow into the heart. High diastolic pressure (the second and lower number) is a strong predictor of heart attack and stroke in *young* adults. [See *Hypertension Categories, below*.]

Pulse Pressure. Pulse pressure is the difference between the systolic and the diastolic readings. It appears to be an indicator of stiffness and inflammation in the blood-vessel walls. The greater the difference between systolic and diastolic numbers, the stiffer and more injured the vessels are thought to be. Although not yet used by physicians to determine treatment, evidence is suggesting that it may prove to be a strong predictor of heart problems, particularly in older adults. Some studies suggest that in people over 45 years old, every 10-mm Hg increase in pulse pressure increases the risk for stroke increases by 11%, cardiovascular disease by 10%, and overall mortality by 16%. (In younger adults the risks are even higher.)

Hypertension Categories

Some experts categorize hypertension into the following types:

Essential Hypertension. Essential hypertension is also known as *primary* or *idiopathic hypertension*. About 90% of all high blood pressure cases are this type. The causes of essential hypertension are unknown but are certainly based on complex processes in all major organs and systems, including the heart, blood vessels, nerves, hormones, and the kidneys.

Secondary Hypertension. Secondary hypertension comprises about 5% of high blood pressure cases. In this condition, the cause has been identified.

Isolated Systolic Hypertension. This occurs when systolic hypertension is over 160 mm Hg but diastolic pressure is normal. It is related to arteriosclerosis (hardening of the arteries).

Pregnancy Induced Hypertension. This condition occurs during pregnancy if blood pressure increases by more than 15 mm Hg above normal.

White Coat Hypertension. This form of hypertension is elevated blood pressure that occurs only during a visit to the doctor's office, but not at home. It is a factor in about 20% of patients with mild hypertension. Although previously considered a relatively harmless condition, research is now suggesting that white-coat hypertension shares certain features with essential hypertension. In fact, studies have even suggested that white-coat hypertension actually may pose a risk for future heart problems, although the increased danger appears to be small compared with the risk in those with steady mild hypertension.

Blood Pressure Ranges And Actions Taken		
Blood Pressure Category	Ranges for Most Adults (systolic/diastolic)	Actions Taken after Initial Diagnosis
Optimal Blood Pressure (systolic/diastolic)	Systolic below 120 mm Hg Diastolic below 80 mm Hg	No action.
Normal Blood Pressure <i>(NOTE: This should be the minimum goal for everyone, particularly people with diabetes.)</i>	Systolic 120 to 130 mm Hg Diastolic 80 to 85 mm Hg	Rechecked every two years.
High Normal Blood Pressure	Systolic 130 to 139 mm Hg Diastolic 85 to 89 mm Hg	Blood pressure monitored at home. Patient should be evaluated for organ damage.
Hypertension (High Blood Pressure)	Systolic above 140 mm Hg Diastolic above 90 mm Hg <i>(In middle-aged and older people, systolic pressure above 140 mm Hg suggests higher health risks even when diastolic pressure is normal or low.)</i>	See below.
Mild Hypertension (Stage 1)	Systolic 140 to 159 mm Hg Diastolic 90 to 99 mm Hg	Same as high normal. If no organ damage, retesting at least twice a week for several weeks. If organ damage present, start drug therapy.
Moderate Hypertension (Stage 2)	Systolic 160 to 179 mm Hg Diastolic 100 to 109 mm Hg	Same as high normal. If no organ damage, retesting at least twice a week for several weeks. If organ damage present, start drug therapy.
Severe Hypertension (Stage 3)	Systolic 180 to 209 mm Hg Diastolic 110 to 119 mm Hg	Same as high normal. Consider immediate drug therapy regardless of organ damage evidence.
Very Severe Hypertension (Stage 4)	Systolic greater than 210 mm Hg Diastolic greater than 120 mm Hg	Same as high normal. Consider immediate drug therapy regardless of organ damage evidence.
<p>Note: If one measurement is normal and the other elevated, the higher category of either measurement is usually used to determine severity. For example, if systolic pressure is 165 (moderate) and diastolic is 92 (mild), the patient would still be diagnosed with moderate hypertension. It should be strongly noted that a high systolic pressure compared to a normal or low diastolic pressure should be a major focus of concern in most adults.</p>		

Blood Pressure in Children

A child's blood pressure is normally much lower than an adult's. Children are at risk for hypertension if they exceed the following levels:

- Ages three to five: 116/76 mm Hg
- Ages six to nine: 122/78 mm Hg
- Ages 10 to 12: 126/82 mm Hg
- Ages 13 to 15: 136/86 mm Hg

WHAT WILL CONFIRM THE DIAGNOSIS OF HIGH BLOOD PRESSURE?

It is a rare physical examination that does not include blood pressure measurement. The process is familiar to everyone. Before taking it, patients should not smoke or drink caffeinated beverages within 30 minutes of the measurement.

The Sphygmomanometer.

- The standard instrument used to measure blood pressure is called a mercury *sphygmomanometer*. Measurements are given as units of mercury, which has filled the central column in standard sphygmomanometers for years. (Of note, many people now view the mercury sphygmomanometer as an environmental health hazard, although modern devices are designed to prevent mercury spillage.)
- An inflatable cuff with a meter attached is placed around the patient's arm over the artery, while the patient is seated. The inflated cuff briefly interrupts the flow of blood in the artery, which then resumes as the cuff is slowly deflated.
- The person taking the blood pressure listens through a stethoscope for so-called *Korotkoff* sounds, which first appear as blood begins to flow through the artery and then change in tone and volume as the cuff is deflated.
- If a first blood pressure reading is above normal, the health professional may take two or more measurements separated by two minutes with the patient sitting or lying down. Then another measurement may be taken after the patient has been standing for two minutes.

Although this test has been used for more than 90 years, it is not completely accurate or sensitive. The following can bias the results.

The following can cause falsely low pressure reading:

- An arm cuff that is too wide.
- Recent exercise.
- Not smoking for a while after heavy, long-term smoking.

Falsely *high* pressure can result from the following:

- An arm cuff that is too small.
- Talking during the test.
- Having recently consumed foods or beverages (such as coffee) that raise blood pressure.

If a physician takes the blood pressure reading, it is more likely to be higher than if a nurse takes it or if it is measured at home. This so-called white coat hypertension requires additional readings by a nurse or by the patient. Home monitoring improves the accuracy of a simple office measurement. An average of all the measurements will be considered in the diagnosis of hypertension. If high normal or high blood pressure persists, further tests should be performed to determine if the organs are affected. [*For details see Box Blood Pressure Ranges and Actions Taken.*]

Other Blood-Pressure Monitors. Alternative pressure-measuring aneroid and electronic devices are also available. Aneroid instruments are round compass-like devices that use a metal spring to measure blood pressure and are often used by physicians. Electronic devices are typically used for home monitoring.

Home Monitoring

Monitoring Equipment. A number of home tests are available for checking blood pressure between doctor visits: A physician may loan a patient a portable unit that records blood pressure during a full day's activity. This test, known as ambulatory monitoring, is particularly useful for those who experience wide blood pressure swings, such as those who have white-coat hypertension or show resistance to drug therapy. In fact, according to one study, accurately measuring blood pressure at home over a full day was a significantly better predictor of cardiovascular risk than standard office-based measurements. To improve clinical outcomes, devices are now available that allow 24-hour ambulatory blood pressure monitoring and electronically store results for analysis by the physician. It is not clear if their added benefits justify their expense, however.

Cuffs and Stethoscopes. Manual cuffs and stethoscopes are fairly accurate, but they require practice to use. The cuff must be the right size (one size does not fit all). Devices that use a digital readout and a cuff that can be electronically inflated and deflated are proving to be as accurate as a stethoscope.

Blood Pressure Variations at Home. In general, everyone's blood pressure varies in the same way throughout a given day. In monitoring at home, it is important to note these changes:

- Blood pressure is usually highest at work.
- It drops slightly at home.
- It then normally dips to its lowest level during sleep. There are important exceptions. Certain people have a condition called *nondipper hypertension*, in which blood pressure does not fall at night. Postmenopausal women appear to be at particular risk for this phenomenon, and it may pose a special danger for heart disease

and stroke (particularly in older African American women). It has also been linked to salt–sensitivity and insulin resistance.

- Upon waking, pressure in most people typically increases suddenly. In people with severe high blood pressure, this is the highest risk period for heart attack and stroke.

Some studies have reported that when patients record and report their own blood pressure, they are unreliable and don't always tell the truth. Despite the difficulties and controversy surrounding this issue, home blood pressure monitoring has been shown to encourage patients to use measures that control their blood pressure and thereby reduce the risk of cardiovascular events.

Physical Examination for Complications of Hypertension

If blood pressure is elevated, the physician will check the patient's pulse rate, examine the neck for distended veins or an enlarged thyroid gland, check the heart for enlargement and murmurs, and examine the abdomen and the eyes.

Medical History

If hypertension is suspected, the physician should obtain the following information:

- A family and personal medical history, especially incidence of high blood pressure, stroke, heart problems, kidney disease, or diabetes.
- Risk factors of heart disease and stroke, including tobacco use, salt intake, obesity, physical inactivity, and unhealthy cholesterol levels.
- Any medications being taken.
- Any symptom that might indicate so–called *secondary hypertension* (that is, caused by another disorder). Such symptoms include headache, heart palpitations, excessive sweating, muscle cramps or weakness, or excessive urination.
- Any emotional or environmental factors that could affect blood pressure.

Laboratory and Other Tests

If a physical examination indicates hypertension, additional tests may help determine whether it is *secondary hypertension* or *essential hypertension* (no other disorder is present) and whether organ damage is present. They include the following:

- Blood tests and a urinalysis. (Performed to check for a number of factors, including potassium levels, cholesterol, blood sugar, infection, kidney function, and other possible problems. Measuring blood levels of the protein creatinine, for example, is important for all hypertensive patients in order to determine kidney damage. Higher concentrations may also be an indicator of heart disease.)
- An electrocardiogram (ECG).

An exercise stress test. This could be important for those with borderline hypertension. Stress–induced blood pressure in such patients has been associated with a risk for left ventricular hypertrophy, a serious complication in which the muscles on the left side of the heart become enlarged. Studies also suggest that an excessive rise in systolic pressure during exercise indicates a risk for coronary artery disease, and stroke.

WHAT CAUSES HIGH BLOOD PRESSURE?

Hypertension is referred to as essential, or primary, when the physician is unable to identify a specific cause. It is by far the most common type of high blood pressure. The causes of this type are unknown but are likely to be a complex combination of genetic, environmental, and other factors.

Genetic Factors. A number of genetic factors or interactions between genes play a major role in essential hypertension. Experts appear to have located the chromosomes (13 and 18) that house the genes responsible for blood pressure regulation, although pinning down the range of specific genes involved in hypertension is more difficult.

Abnormalities in the Angiotensin–Renin–Aldosterone System. Genes under intense study are those that regulate a group of hormones known collectively as the angiotensin–renin–aldosterone system. This system influences all aspects of blood pressure control, including blood vessel contraction, sodium and water balance, and cell development in the heart.

Experts believed that this system evolved millions of years ago to protect early humans during drought or stress by retaining salt and water and narrowing blood vessels to ensure adequate blood flow and repair injured tissue. With industrialization, however, this system wreaks havoc on modern humans by intensifying the effects of our high–salt diets and sedentary lifestyle. Of particular importance in these harmful responses are the hormone aldosterone and a peptide (which are components of proteins) called angiotensin II.

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Inherited Abnormalities in the Sympathetic Nervous System. Studies suggest that some people with essential hypertension may inherit abnormalities of the *sympathetic nervous system*. This is the part of the autonomic nervous system that controls heart rate, blood pressure, and the diameter of the blood vessels.

Insulin Resistance and Type 2 Diabetes. Hypertension is strongly associated with diabetes, both type 1 and both 2. Kidney damage is generally the cause of high blood pressure in type 1 diabetes. Obesity and insulin resistance are the factors associated with hypertension in type 2 diabetes, the more common type. People with type 2 diabetes generally have normal or high levels of insulin, a critical hormone in the metabolism of sugar. However, they are unable to use the insulin, the condition called *insulin resistance*. Without insulin, blood glucose (sugar) levels rise, the hallmark of diabetes.

Some research indicates that obesity is the one common element linking insulin, type 2 diabetes, and high blood pressure. Obesity is common in both type 2 diabetes and hypertension. Oddly, however, studies have found a stronger association between hypertension and insulin resistance in *thin* patients as well as overweight people with type 2 diabetes. Some research indicates that insulin resistance may cause sodium retention, a contributor to high blood pressure.

In any case, regardless of the causal connections, people who have both insulin resistance or full-blown diabetes plus hypertension have a significantly greater chance for heart attack, kidney disease, and stroke than people who have only high blood pressure.

Obesity. Obesity on its own has a number of possible effects that could lead to hypertension. It may blunt certain actions of insulin that open blood vessels, and it may cause structural changes in the kidney and abnormal handling of sodium. It is also associated with alterations in the systems that regulate blood flow.

Low Levels of Nitric Oxide. The gas nitric oxide can be produced in the body, where it affects the smooth muscles cells that line blood vessels; it helps keep them relaxed, flexible. It may also help prevent blood clotting. Low levels of nitric oxide have been observed in people with high blood pressure (particularly in African Americans) and may be an important factor in essential hypertension.

Secondary Hypertension

Secondary hypertension has recognizable causes, which are usually treatable or reversible.

Medical Conditions. A number of medical conditions can cause secondary high blood pressure:

- Kidney disease is the most common cause of secondary hypertension, particularly in older people.
- Sleep apnea, a disorder in which breathing halts briefly but repeatedly during sleep, is now highly associated with hypertension. A weak but still higher than normal association with high blood pressure has even been observed in those who snore or have mild sleep apnea. The relationship between sleep apnea and hypertension has been thought to be largely due to obesity, but major studies are finding a higher rate of hypertension in people with sleep apnea regardless of their weight. Treating sleep apnea with a device known as nasal continuous positive airway pressure (CPAP) may have modest benefits blood pressure as well.
- Other medical conditions that contribute to temporary hypertension are pregnancy, cirrhosis, and Cushing's disease.

Medications. Certain prescription and over-the-counter drugs can cause temporary high blood pressure. Some include the following:

- Corticosteroids.
- Use of some common pain relievers, including non-aspirin nonsteroidal anti-inflammatory drugs (NSAIDs) and the newer COX-2 inhibitors, may be an important cause of secondary hypertension. Among the NSAIDs that may increase blood pressure are ibuprofen (Advil, Motrin, Rufen) and naproxen (Anaprox, Naprosyn, Aleve). In one important study, women who used an NSAID for five or more days a month had a significantly higher risk for hypertension. The more often they used them, the higher the risk. In another study of the COX-2 inhibitors, people who took celecoxib (Celebrex) or rofecoxib (Vioxx) experienced an increase in blood pressure, with rofecoxib having the greater effect. Most studies have found no significant increase in blood pressure with aspirin (which is the most commonly used NSAID) or acetaminophen (Tylenol).
- Cold medicines containing pseudoephedrine have also been found to increase blood pressure in hypertensive people, although they appear to pose no danger for those with normal blood pressure.
- Oral contraceptives ("the pill") increase the risk for high blood pressure, particularly in women who are older, obese, smokers, or some combination. Stopping the pill nearly always reduces blood pressure, although a recent study suggests that oral contraceptives may produce a small but significant increase in diastolic pressure that persists in some older women who have been off the pill for years.

Alcohol, Cigarettes, and Coffee

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- **Alcohol.** An estimated 10% of hypertension cases are caused by alcohol abuse (i.e., three alcohol drinks a day or more, with heavier drinkers having higher pressure). In one study, binge drinkers had even higher blood pressure than people who drank regularly. One study found alcohol abuse associated with low diastolic but high systolic pressure. Moderate drinking (one or two drinks a day) has benefits for the heart and may even protect against some types of stroke. (Of some concern was a study suggesting the even low or moderate drinking may increase the risk for hypertension in African Americans.) Red wine specifically may have chemicals that benefit blood pressure. (Red grape juice may have the same advantages) It is critical, in any case, for people who can't drink moderately to abstain from alcohol.
- **Smoking.** Smoking is a major risk factor. One study reported that smokers have blood pressures up to 10 points higher than nonsmokers.
- **Caffeine.** In healthy people with normal blood pressure, drinking a couple of cups of coffee a day is unlikely to do any harm. A high intake of coffee may be harmful in people with hypertension and may even increase their risk for stroke.

Other Causes of Secondary High Blood Pressure. Temporary high blood pressure can result from a number of other conditions or substances.

- Stress.
- Intense workouts (e.g., snow shoveling, jogging, speed walking, tennis, heavy lifting, heavy gardening).
- Long-term consumption of large amounts of licorice.
- Exposure to even low levels of lead also appears to cause hypertension in adults. More studies are needed to clarify this relationship.

WHO GETS HIGH BLOOD PRESSURE?

About 43 million Americans have high blood pressure. Less than half of these people are on medication, however, and, worse, only about half of this group have their blood pressure under good control with such agents. Older people are less likely to be treated adequately. The majority of people with high blood pressure have the mild type, but even this condition requires attention.

Age and Gender

Age is the major risk factor of hypertension. Blood pressure increases with age in both men and women, and in fact, the lifetime risk for hypertension is nearly 90%. More men than women have hypertension until age 55. After that the ratio reverses, and over time women gain on men and finally overtake them. In all, mortality rates from hypertension are higher in women than in men.

Ethnicity

Compared to Caucasians, they have 1.8 times the rate of fatal stroke, 1.5 times the risk for fatal heart disease, and 4.2 times the rates of end-stage kidney disease. In general, about 36% of African American men and women have hypertension; it may account for over 40% of all deaths in this group.

In fact, the prevalence of high blood pressure among African Americans is among the highest in the world. The rates of hypertension in Hispanic Americans, Caucasians, and Native Americans are about equivalent (ranging from 24% to 27%). (Individuals of Mexican descent, compared to Spanish descent, may have a lower risk.) The rate is much lower in Asian/ Pacific Islanders (9.7% in men and 8.4% in women). Of note, however, nearly three quarters of older Japanese American men are hypertensive.

A number of theories have addressed the reasons for this difference:

- Some studies have indicated that African Americans may have lower levels of nitric oxide and higher levels of a peptide called endothelin-1 (ET-1) than Caucasians. (Nitric oxide keeps blood vessels flexible and open and ET-1 narrows blood vessels.)
- African Americans have a higher risk for an impaired response to angiotensin (Ang II), which is a peptide important in regulating salt and water balances. (African Americans are more likely to be salt-sensitive than other groups.)
- Social and income disparities and dietary issues may explain many of the differences in blood pressure rates observed between ethnic groups. For example, while African Americans have a disproportionately high rate of hypertension, one study in rural African villages, where diets are rich in fish, reported only a 3% rate of high blood pressure among inhabitants. Another study reported that Caucasian as well as African Americans in the Southeast have a higher incidence of hypertension and stroke than people in other US regions. The Southeast also has a higher rate of obesity, stress, anxiety, and depression, and diets low in potassium and high in salt, all related to a lower socioeconomic level.

In any case, hypertension appears to be dangerously undertreated in major minority groups. Inadequately controlled hypertension is the major factor for the higher mortality rate from heart disease among African Americans.

Weight

Obesity. About one-third of patients with high blood pressure are overweight. Even moderately obese adults have double the risk of hypertension than people with normal weights. In fact, the increase in blood pressure in aging Americans may be due primarily to weight gain. (In other cultures old age does not necessarily coincide with weight gain or high blood pressure.) Children and adolescents who are obese are at greater risk for high blood pressure when they reach adulthood.

Thinness. Interestingly, thin people with hypertension are at higher risk for heart attacks and stroke than obese people with high blood pressure. Experts surmise that thin people with hypertension are likely to have conditions such as an enlarged heart or stiff arteries that cause the high blood pressure and also pose greater dangers to health.

Low Birth Weight. Low birth weight, particularly in girls, has been associated with high blood pressure in both childhood and adulthood. (One study suggested that breast-feeding these babies may help reduce this risk.) Another study reported high levels of stress hormones in babies with low birth weight, which could increase the risk for high blood pressure later on. Low birth weight is also associated with subsequent obesity, a major contributor to hypertension.

Diabetes

Up to 75% of cardiovascular problems in people with diabetes may be due to hypertension. There are strong biologic links between insulin resistance (with or without diabetes) and hypertension. And, it is not altogether clear which condition causes the other. Some experts believe angiotensin may be the common factor linking diabetes and high blood pressure. This natural chemical not only influences all aspects of blood pressure control but it also interferes with insulin's normal metabolic signaling. Studies are now suggesting the people with diabetes need to control their blood pressure to 130/85 mm Hg or lower to protect the heart and help prevent other complications common to both diseases. Lowering *systolic* pressure may be particularly important for diabetics.

Effects of Family

Spouses. Studies suggest that spouses of people with high blood pressure have a much higher risk for it as well. Such findings suggest that dietary and environmental factors play a role in this disease. Some evidence also indicates that higher risk in spouses may be due to the fact that many people mate with those who are similar to them.

Family History and Genetics. Some experts now believe that essential hypertension may be inherited in 30% to 60% of cases. According to one study, being a brother or sister of someone with premature coronary artery disease is a greater risk factor for hypertension than having a parent with the disease. A family history of heart disease is considered to be a major risk factor for high blood pressure in younger adults (under 65).

Emotional Factors

People who are anxious or depressed may have over twice the risk for high blood pressure than those without these problems.

Mental Stress. Recent evidence confirms the association between stress and hypertension (high blood pressure). In one 20-year study, for example, men who periodically measured highest on the stress scale were twice as likely to have high blood pressure as those with normal stress. The effects of stress on blood pressure in women were less clear. Job stress and lack of career success have been specifically linked to high blood pressure in both men and women.

Anxiety. Studies suggest that anxiety is risk factor for hypertension, particularly in women.

Depression. There is increasing evidence that depression has actual physiological effects that impair the heart, as well as contributing to destructive behaviors, such as weight gain, smoking, or alcohol abuse. In a 2000 study of young African Americans and Caucasians, those who scored highest on a depression test had about twice the risk of high blood pressure as those with the lowest score. This link was particularly strong in African Americans. In fact, depression was the strongest risk factor in this group.

Seasonal Factors

Seasonal changes may influence variations in blood pressure, with hypertension increasing during cold months and declining during the summer, particularly in smokers. While cold may narrow blood vessels, lack of light has also been associated with higher blood pressure.

HOW SERIOUS IS HIGH BLOOD PRESSURE?

Hypertension places stress on a number of organs (called target organs), including the kidney, eyes, and heart, causing them to deteriorate over time. High blood pressure was directly responsible for nearly 44,619 American deaths in 2000 and was listed as the primary or contributing cause of death in an estimated 118,000 cases. The death rate from high blood pressure is estimated to have increased by 21.3% between 1990 and 2000, with the actual numbers increasing by nearly 50%. High blood pressure contributes to 75% of all strokes and heart attacks. It is particularly deadly in African Americans.

Emergency Conditions

Malignant hypertension, an emergency condition resulting from untreated primary hypertension, can be lethal. [See What Are the Symptoms of High Blood Pressure?]

Stroke

About two-thirds of people who suffer a first stroke have moderate elevated blood pressure (160/95 mm Hg) or above. Hypertensive people have up to ten times the normal risk of stroke, depending on the severity of the blood pressure. Hypertension is also an important cause of so-called silent cerebral infarcts, which are blockages in the blood vessels in the brain that may predict major stroke or progression to dementia over time.

Mental Problems and Dementia

Uncontrolled chronic high blood pressure is also associated with reduced short-term memory and mental abilities. Isolated systolic hypertension may pose a particular risk for complications in the brain. Fortunately, controlling blood pressure with medications can reduce or even prevent memory loss and mental decline due to hypertension. (Anti-hypertensive drugs may even help protect against Alzheimer's disease in people with genetic susceptibility to this disease.)

Heart Disease

Among older patients, high blood pressure is the major risk factor for heart disease. Two studies in 2001 further reported that high blood pressure in young men poses a higher risk for heart disease later on, and in one of the studies, fewer years of life.

Heart Attack. About half of people who suffer their first heart attack have moderate hypertension (160/95 mm Hg) or greater. High blood pressure increases the risk for a heart attack by up to five times, depending on the severity of the hypertension.

Heart Failure. Hypertension precedes congestive heart failure in between 75% and 90% of heart failure cases. High blood pressure has various effects that cause the heart to fail, including the following:

- To compensate for increased blood pressure, the heart must work harder to pump blood, and so its muscles thicken (called hypertrophy), usually in the left side (called left-ventricle dysfunction). These thickened muscles pump inefficiently, and over time, the force of their contractions weakens. The heart muscles then have difficulty relaxing and filling the heart with blood. The heart begins to fail.
- The failing heart then triggers a number of hormonal and neurochemical mechanisms to correct imbalances in blood pressure and flow. This response, called *remodeling*, is helpful in the short run but very destructive and irreversible over time.
- As part of the remodeling process, the heart muscle cells elongate. The muscular walls of the heart dilate and become thinner and inefficient. The cells themselves undergo molecular changes that result in calcium loss, a mineral crucial for healthy heart contractions.
- The end-result of remodeling is that the volume of blood pumped to the kidneys falls, and the kidneys respond by retaining water and salt, which, in turn, increases fluid buildup in the body.
- To make matters worse, the body's arteries respond to a lower blood volume by constricting; this forces the heart to work even harder to pump blood through these narrowed vessels, thereby increasing blood pressure, and the cycle continues.

Kidney Disease

Diabetes and Nephropathy (Kidney Disease). High blood pressure is strongly associated with diabetic nephropathy. In fact, patients with type 2 diabetes who show early signs of nephropathy already have hypertension. When type 1 diabetes patients are diagnosed with early nephropathy, on the other hand, usually have normal blood pressure readings in the doctor's office. A 2002 study using home monitors, however, found that in type 1 patients, high systolic blood pressure during sleep often occurs before development of nephropathy. Home blood pressure monitoring, then, may help identify type 1 patients who are at risk for kidney damage because they have high systolic pressure.

End-Stage Kidney Disease. High blood pressure causes 30% of all cases of end-stage kidney disease (medically referred to as end-stage renal disease or ESRD). Only diabetes leads to more cases of kidney failure. In fact, although anti-hypertensive therapy has reduced the incidence of stroke and heart attack, the incidence in ESRD has almost doubled in the last decade.

Kidney Cancer. Men with high blood pressure may also have a higher risk of kidney cancer.

Effect on the Eyes

High blood pressure can injure the eyes, causing a condition called retinopathy.

Bone Loss

Hypertension also increases the elimination of calcium in urine that may lead to loss of bone mineral density, a significant risk factor for fractures, particularly in elderly women. In one study of Englishwomen, those with the highest blood pressure lost bone density at nearly twice the rate of those in the lowest range. It is not clear whether this effect occurs in men or in non-Caucasian women.

Sexual Dysfunction

Sexual dysfunction is more common and more severe in men with hypertension, and particularly in smokers, than it is in the general population. Many of the drugs used to treat hypertension are thought to cause impotence as a side effect; in these cases, it is reversible when the drugs are stopped. More recent evidence is suggesting, however, that the disease process that causes hypertension itself is the major cause of erectile dysfunction in these men. Newer anti-hypertensive agents, including angiotensin-converting enzyme (ACE) inhibitors and angiotensin-receptor blockers (ARBs), are less associated with erectile dysfunction. In fact, ARBs, such as losartan (Cozaar), may be particularly effective in restoring erectile function in men with high blood pressure who suffer from impotence. Sildenafil (Viagra) was reported to be successful in achieving erections in almost two-thirds of patients with controlled high blood pressure, but at this time its safety for men with uncontrolled hypertension is unclear. [*For more information see Well-Connected Report #15 Impotence (Erectile Dysfunction).*]

Pregnancy and Preeclampsia

Severe, sudden high blood pressure in pregnant women is one component of a condition called preeclampsia (commonly called toxemia) that can be very serious for both mother and child. Preeclampsia occurs in up to 10% of all pregnancies, usually in the third trimester of a first pregnancy, and resolves immediately after delivery. Other symptoms and signs of preeclampsia include protein in the urine, severe headaches, and swollen ankles.

This condition may be caused by a failure of the placenta to embed properly in the uterus, which causes it to misconnect with the mother's blood vessels. As a result, the fetus does not receive a sufficient blood supply and the mother's own blood pressure increases to replace it.

The reduced supply of blood to the placenta can cause low birth weight and eye or brain damage in the fetus. Severe cases of preeclampsia can cause kidney damage, convulsion, and coma in the mother and can be lethal to both mother and child.

Women at risk for preeclampsia (particularly those with existing hypertension) may benefit from having an ultrasound of uterine arteries at 20 to 24 weeks of pregnancy, followed (if abnormal) by 24-hour blood pressure monitoring.

Outlook for Children with Hypertension

Results of studies evaluating outcomes of children with hypertension suggest that early abnormalities, including enlarged heart and abnormalities in the kidney and eyes, may occur even in children with mild hypertension. Children and adolescents with hypertension should be monitored and evaluated for any early organ damage.

WHAT ARE THE SYMPTOMS OF HIGH BLOOD PRESSURE?

Hypertension has aptly been called the "silent killer" because it usually produces no symptoms. Untreated hypertension increases slowly over the years. It is important, therefore, for anyone with risk factors to have their blood pressure checked regularly and to make appropriate lifestyle changes. Such recommendations are urged for individuals who have overall high-normal blood pressure, mild or above systolic with normal diastolic pressure, or family histories of hypertension, or who are overweight or over age 40.

Symptoms of Malignant Hypertension

High Blood Pressure

In rare cases (fewer than 1% of all hypertensive patients), the blood pressure rises quickly (with diastolic pressure usually rising to 130 mm Hg or higher), resulting in malignant or accelerated hypertension. This is a life-threatening condition and must be treated immediately. People with uncontrolled hypertension or a history of heart failure are at increased risk for this crisis.

People should call a physician immediately if these symptoms occur:

- Drowsiness.
- Confusion.
- Headache.
- Nausea.
- Loss of vision.

WHAT ARE THE GENERAL GUIDELINES FOR CHOOSING THE APPROPRIATE TREATMENTS FOR HIGH BLOOD PRESSURE?

Perhaps the best initial approach for most patients with hypertension is to work with their physicians to set blood pressure goals based on their individual risk factors and to plan the optimal life-style and medication programs. Most people should strive for 140/90 mm Hg or below. People with diabetics should aim lower (130/85 mm Hg) to help reduce the chance for kidney complications.

Healthy life style changes are imperative for anyone, and are critical for people with even normal blood pressure and above. In appropriate patients, aggressive drug treatment of long-term high blood pressure can significantly reduce the incidence of mental decline and death from heart disease and other serious physical effects of hypertension. In people with diabetes, controlling both blood pressure and blood glucose levels prevents serious complications of that disease. Anti-hypertensive agents may even prevent mental decline, including in people genetically susceptible to Alzheimer's disease. Nevertheless, only slightly over half of patients with hypertension are treated at all and only a quarter has adequately controlled pressure.

It is not altogether clear when drugs should be started, particularly for people with high-normal or mild high blood pressure. To help make basic treatment choices, the National Heart, Lung, and Blood Institute has created categories (denoted as groups A, B, and C) according to a patient's risk factors for heart disease. Applying these categories to the severity of hypertension helps determine whether lifestyle changes alone or medications are needed. [See Table Treatment Recommendations by Stage and Risk Groups.]

Treatment Recommendations By Stage And Risk Groups				
Risk Groups	Blood Pressure Stages (Systolic/Diastolic)			
(Everyone should aim for 130/85 or below.)	High Normal Blood pressure (130–139/85–89)	Mild (Stage 1) Blood Pressure (140–159/90–99)	Moderate (Stage 2) Blood Pressure (160–179/100–109)	Severe Blood Pressure (Stage 3 and 4) (over 180/110)
Risk Group A Have no risk factors for heart disease.* Note: only women are in this group.	Life style changes only. (Exercise and dietary program with regular monitoring.) It should be noted that high normal still poses a risk for heart disease even in people with Group A.	Year trial of lifestyle changes only. If blood pressure is not lower at one year, add drug treatments.	Lifestyle changes and medications.	Lifestyle changes and medications.
Risk Group B Have at least one risk factor for heart disease* (excluding diabetes) but have no target organ damage (such as in the kidney, eyes, or heart or existing heart disease).	Lifestyle changes only.	Six month trial of lifestyle changes only. If blood pressure is not lower at six months, add drug treatments. (Medications considered for patients with multiple risk factors.)	Lifestyle changes and medications.	Lifestyle changes and medications.
Risk Group C	Lifestyle changes and medications.	Lifestyle changes and medications.	Lifestyle changes and medications.	Lifestyle changes and medications.

Have diabetes with or without target organ damage and existing heart disease (with or without risk factors for heart disease).				
* Risk factors for heart disease include smoking, unhealthy cholesterol and lipid levels, diabetes, being over 60 years old, being a man or a postmenopausal woman, and women under 65 and men under 55 with a family history of heart disease.				

WHAT LIFESTYLE CHANGES ARE NEEDED TO CONTROL HIGH BLOOD PRESSURE?

In 2002 the National High Blood Pressure Education Program Coordinating Committee published its first recommendations for preventing high blood pressure since 1993. They emphasize the following steps:

- Engage in at least moderate exercise.
- Maintain normal weight.
- Limit alcohol consumption.
- Reduce salt intake and maintain adequate potassium intake.
- Consume a diet rich in fruits, vegetables, and low-fat dairy products while reducing total and saturated fat intake. (The DASH diet is one way of achieving such a dietary plan.)

Important studies have reported that such healthy lifestyle change can lower blood pressure as well as improve other risk factors for heart disease and poor health, including in people on anti-hypertensive medications.

DASH Diet.

The DASH diet (Dietary Approaches to Stop Hypertension) is proving to help lower blood pressure after eight weeks. Restricting sodium improves results. The diet appears to have antioxidant effects and may even prove to be a good diet for lowering LDL cholesterol levels — although the beneficial HDL levels also decline.

This diet is not only rich in important nutrients and fiber but also includes foods that contain far more electrolytes, potassium, calcium, and magnesium, than are found in the average American diet. The dietary recommendations are as follows:

- Avoid saturated fat (although include calcium-rich dairy products that are no- or low-fat).
- When choosing fats, select monounsaturated oils, such as olive or canola oils. (One study reported a reduced need for anti-hypertension medication in people with a high intake of virgin olive oil, but not sunflower oil, a polyunsaturated fat.)
- Choose whole grains over white flour or pasta products.
- Choose fresh fruits and vegetables every day. In one 2002 study people who increased their intake of fruits and vegetables experienced a drop in blood pressure after six months. Many of these foods are rich in potassium, fiber, or both which may help lower blood pressure. [*For a list of foods containing potassium, see Potassium, below.*]
- Include nuts, seeds, or legumes (dried beans or peas) daily.

Choose modest amounts of protein (preferably fish, poultry, or soy products). Soy in combination with fiber-rich foods or supplements may have specific benefits. Oily fish may also be particularly beneficial. They contain omega-3 fatty acids, which have been associated with heart and nerve protection .

Salt Restriction

A combination of the DASH diet and salt restriction is extremely effective in reducing blood pressure. (Each approach has positive benefits, but the combination is best.) Reducing sodium may also help protect against heart failure. Everyone, regardless of their blood pressure, should consume less than 2,400 milligrams (about one teaspoon) of sodium each day. It should be noted, however, that many experts disagree on the overall benefits of salt restriction for everyone. Still, the following specific groups should take particular measures to restrict salt:

- *People at Risk for Salt-Sensitivity (African Americans, Diabetics, the Elderly).* About half of people with hypertension have blood pressure that reacts significantly to salt. Such people are known to be *salt-sensitive*. High-salt diets in anyone who is salt-sensitive may harm the heart, kidney, and brain and increase the risk for death, regardless of their blood pressure. (Even people with normal blood pressure can be salt-sensitive.) Among those at highest risk for salt sensitivity are African Americans, people with diabetes, and elderly people. A 2001 study, for example, reported that reducing sodium intake in older people, including African Americans, was very effective in controlling their hypertension. Still because testing for salt-sensitivity is not easy, experts recommend that *everyone* proactively restrict their daily salt-intake.

- *Overweight People.* Overweight individuals may absorb and retain sodium differently from people with normal weights. In fact, one 1999 study reported that high sodium intake was associated with an increased risk of heart disease and all-cause mortality in overweight, but not in normal weight, people. Reducing sodium can also help reduce the risk of stroke in people who are overweight. Unfortunately, because overweight people generally consume more calories, they are also likely to take in more sodium.
- *People on Anti-Hypertensive Drugs.* Restricting salt also enhances the benefits of many standard anti-hypertensive drugs by reducing potassium loss, and may help protect against kidney disease in patients who are also taking calcium-blocker drugs. A low-salt diet can also increase the chances for being able to stop such medications.

Simply eliminating table and cooking salt can be beneficial. Salt substitutes, such as Cardia, containing mixtures of potassium, sodium, and magnesium are available, but they are expensive. It should be noted, in any case, that about 75% of the salt in the typical American diet comes from processed or commercial foods, not from food cooked at home, so the benefits of table-salt substitutes are likely to be very modest. Some sodium is essential to protect the heart, but most experts agree that the amount is significantly less than that found in the average American diet. If people cannot significantly reduce the amount of salt in their diets, adding potassium-rich foods might help to restore a healthy balance.

Potassium

Evidence now strongly indicates that a potassium-rich diet can help achieve healthy blood pressure levels, and that potassium supplements can lower systolic blood pressure by 1.8 mm Hg and diastolic blood pressure by 1 mm Hg. In fact, there is some evidence that a potassium-rich diet can reduce the risk of stroke by 22% to 40%. Current expert guidelines now support the use of potassium supplements or enough dietary potassium to achieve 3,500 mg per day for people with normal or high blood pressure (who have no risk factors for excess potassium levels). This goal is particularly important in people who have high sodium intake.

The best source of potassium is from the fruits and vegetables that contain them. Some potassium-rich foods include bananas, oranges, pears, prunes, cantaloupes, tomatoes, dried peas and beans, nuts, potatoes, and avocados. Some patients, such as those taking certain diuretics that do not spare potassium, may require supplements.

It should be noted, that excess potassium can cause abdominal distress, muscle weakness, and, in rare cases, dangerous heart events. Some people should be particularly cautious about excess potassium, including those with conditions, such as diabetes or kidney disease, that increase potassium levels or people who are taking medications, such as ACE inhibitors or potassium-sparing diuretics, that limit the kidney's ability to excrete potassium.

Caffeine, Alcohol, and Smoking

Smoking. Everyone should quit smoking.

Alcohol. People who drink alcohol should do so in moderation. Men with hypertension should limit their intake to an average of no more than one or two drinks a day and women and lighter people should drink less.

Caffeine Drinks. Coffee drinking is associated with small increases in blood pressure, but the risk it poses is very small in people with normal blood pressure. (Such individuals would make a healthier choice, however, if they drank tea, which may have beneficial nutrients.) People with existing hypertension should avoid caffeine altogether.

Other Dietary Considerations

Fish Oil and Omega 3 Fatty Acids. Omega 3 fatty acids (docosahexaenoic and eicosapentaenoic acids) are found in oily fish. Studies are indicating that they may have specific benefits for many medical conditions, including hypertension. They appear to help keep blood vessels flexible and may also help protect the nervous system. The fatty acids are also available in supplements, although over-the-counter supplements are not regulated and their effects on health are not known. The long-term effects on blood pressure are not known.

Calcium. Calcium regulates the tone of the smooth muscles lining blood vessels, and population studies have found that people who have sufficient dietary calcium have lower blood pressure than those who do not. Hypertension itself increases calcium loss from the body. The effects of extra calcium on blood pressure, however, are mixed with some even showing higher pressure.

Magnesium. Some studies reported that magnesium supplements may induce small but significant reductions in blood pressure. No major studies, however, have been done on long-term benefits or risks of magnesium supplements. A major 2001 study on diet found no effect on blood pressure from magnesium intake from foods.

Antioxidant Supplements. Antioxidants are any substances that help the body eliminate oxidants, or oxygen free radicals, which are damaging particles produced as part of the body's chemical processes. Some antioxidant supplements, including vitamins C and E and alpha-lipoic acid, are being studied for possible benefits in protecting

against hypertension by preventing injury in the blood vessels. Alpha-lipoic acid for example prevented elevated blood pressure in rats. Vitamin C apparently also has specific benefits for hypertension by preventing dangerous effects on nitric acid, the substance that keeps arteries flexible.

Weight Loss

In people who are overweight, even modest reductions in weight, particularly in the abdominal area, can immediately reduce blood pressure and help reduce heart size. Weight loss, particularly accompanied by salt restriction, may allow patients with mild hypertension, even older people, to safely reduce or go off medications. The benefits of weight loss on blood pressure appear to be durable. [*For more information, see Well-Connected Report #53 Weight Control and Diet.*]

Exercise

Positive Effects on Blood Pressure. Regular exercise helps keep arteries elastic, even in older people, which in turn ensures blood flow and normal blood pressure. Sedentary people have a 35% greater risk of developing hypertension than athletes do.

Experts recommend at least 30 minutes of exercise on most — if not all—days. In one study, moderate exercise (jogging two miles per day) controlled hypertension so well that more than half the patients who had been taking drugs for high blood pressure were able to discontinue their medication.

Studies have also indicated that yoga and Tai Chi, an ancient Chinese exercise involving slow, relaxing movements, may lower blood pressure almost as well as moderate-intensity aerobic exercises.

High-intensity exercise may not lower blood pressure as effectively as moderate intensity exercise and may be dangerous in people with hypertension.

Negative Effects. Each year an estimated 75,000 heart attacks (or 5% of all heart attacks) occur after heavy exertion, leading to 25,000 deaths. Older people and those with uncontrolled hypertension or other serious medical conditions should be very cautious. Studies report that older people who begin vigorous exercise are at a slightly higher than average risk for a heart attack during the first year, but over time, regular exercise is likely to be protective.

The following activities may pose particular dangers for high-risk individuals.

- Intense workouts (snow shoveling, slow jogging, speed walking, tennis, heavy lifting, heavy gardening). They tend to stress the heart, raise blood pressure for a brief period, and may cause spasms in the arteries leading to the heart.
- Competitive sports, which couple intense activity with aggressive emotions.

Effects of Anti-Hypertensive Drugs on Exercise. Certain anti-hypertensive medications, including diuretics and beta-blockers, can interfere with exercise capacity. ACE inhibitors or calcium-channel blockers are the best drugs for active individuals. However, patients who must take drugs that interfere somewhat with exercise capability should still adhere to an exercise program and consult a physician on how best to balance medications with exercise.

Good Sleep Habits

Certain sleep disorder, especially sleep apnea, is associated with hypertension. Even chronic, insufficient sleep may raise blood pressure in patients with hypertension, placing them at increased risk of cardiovascular morbidity and mortality. According to a 1999 Italian study, blood pressure and heart rate were higher the morning after a sleep-deprived night compared with the morning after a full night of sleep. Stress hormone levels increase with sleeplessness, which can activate the sympathetic nervous system, a strong player in hypertension. Patients who have chronic insomnia or other severe sleep disturbances, particularly sleep apnea, should consider consulting sleep experts. Physicians whose hypertensive patients are habitually poor sleepers should consider long-acting blood pressure medications to help counteract the increase in blood pressure that occurs in the early morning hours. People with hypertension and sleep apnea should consider aggressive treatments for the sleep disorder. [*See Well-Connected Report #27 Insomnia or Report #65 Sleep Apnea.*]

Stress Reduction and Psychologic Considerations

Improving mood or relieving stress may be helpful. The following are some studies suggesting possible benefits:

- Stress reduction programs that use cognitive-behavioral therapy may reduce blood pressure.
- Active religious faith was associated with healthy blood pressure levels, possibly indicating the combined benefits of a strong social network and reduced stress from spiritual activities.
- A simple relaxation technique called transcendental meditation (TM), which involves silent repetition of a single sound, was associated with lower blood pressure.

It should be strongly noted that treating stress cannot cure medical problems. Any stress management program is not a substitute for standard medical treatments, but it can be a very important component in a medical regimen.

WHAT ARE THE GENERAL GUIDELINES FOR DRUG THERAPY FOR HIGH BLOOD PRESSURE?

Dozens of anti-hypertensive drugs are available. Most fall into the following categories:

- Diuretics, which cause the body to excrete water and salt. This is the standard agent for most people with hypertension.
- Beta-blockers, which block the effects of adrenaline, thus easing the heart's pumping action and widening blood vessels.
- Angiotensin converting enzyme (ACE) inhibitors, which reduce the production of angiotensin, a chemical that causes arteries to constrict.
- Vasodilators, which expand blood vessels.
- Calcium-channel blockers, which help decrease the contractions of the heart and widen blood vessels.
- Angiotensin-receptor blockers (ARBs), which are newer agents that act on angiotensin.

In about half of patients a single-drug regimen can control mild to moderate hypertension. More severe hypertension often requires a combination of two or more drugs. Each may have specific benefits depending, but their effects vary depending on the individual patient. [See Table Effects of Specific Anti-Hypertensives in Various Patient Populations.]

Effects of Specific Anti-Hypertensives in Various Patient Populations*					
Patient Groups	Diuretics	ACE Inhibitors	Beta Blockers	Angiotensin-receptor blockers (ARBs)	Calcium Channel Blockers (CCBs)
<i>Most Patients without Complicating Conditions</i>	Drug of choice for most patients. Inexpensive and effective. May be more effective in general than other drugs for lowering rates of heart failure stroke, angina. (2002 studies)	Drug of choice in patients with diabetes or congestive heart failure. In some studies, better than diuretics for protection of blood vessels.	Also good general first choice. Reduces risk of heart disease, stroke, and over all deaths from heart disease. (Use cautiously in people with lung disease or congestive heart failure).	Evidence accumulating that they offer many of the same advantages as ACE inhibitors for patients who cannot tolerate ACE inhibitors.	No better than other drugs in preventing heart attack or death from heart disease, except possibly for stroke (although this is not clear). Less effective than others for reducing risk of heart disease, heart failure or overall mortality.
<i>For Elderly Adults</i>	Drug of choice for most elderly patients. May protect against dementia and fractures. Lower their risk for heart attack, stroke, and heart failure compared to other drugs.	Comparative studies with diuretics are mixed. May achieve fewer heart attacks in elderly Caucasian male. (2003 study) May also improve muscle strength in older individuals.	Less effective and has more side effects than diuretics in this group.	Not enough evidence.	See comments above. Of note, however some of the newer CCBs may prove to be effective, safe, and have nerve-protecting properties that may be particularly useful in older people.
<i>African Americans</i>	Best choice.	Not usually recommended, although may be effective in higher doses and when salt is restricted.		Not enough evidence.	Although often prescribed because of lower stroke risk, they do not prevent heart or kidney complication. May even worsen kidney disease in this group.
<i>History of Heart Attack</i>		Lowers risk for progression to heart failure, second heart	Prevents second heart attack and death in these patients.		

		attack and death.			
Diabetes	Has effects on blood sugar that might make this a worse choice than others.	First choice. Protects against kidney disease. May not prevent progression of existing kidney disease in type 2 patients, although they do in type 1 diabetes.		Very effective (although expensive.) May help prevent kidney disease and progression in both type 1 and 2 diabetes. May be first choice for preventing kidney failure in type 2 diabetics with kidney disease.	
Heart Failure	Useful in these patients.	First choice. May improve heart and lung muscle function	Useful in these patients.		

* It should be noted that many people with hypertension require more than one kind of drug.

Side Effects and Problems in Compliance

One of the most difficult issues that hypertensive patients face, particularly those with primary hypertension, is that the treatment may make them feel worse than the disease, which is almost always without symptoms. Patients face a life-long prospect of taking drugs with unpleasant side effects, reducing their salt intake, exercising, and watching their diet. Whatever the difficulties, compliance with a drug and lifestyle program is worth the effort and the cost. It is very important, in any case, to rigorously maintain a drug regimen.

Withdrawal from Anti-Hypertensive Medications

Patients whose blood pressure has been well-controlled and who are able to maintain a healthy life style may choose to withdraw from hypertensive medications. They should do so in a step-down manner (gradual reduction) and be monitored regularly. Stopping too quickly can have adverse effects, including serious effects on the heart. The highest success rates are more likely in those who lose weight and reduce sodium intake, in patients who have been treated with a single drug, and in those who have maintained lower systolic blood pressure during treatment. People over 75 years old may have more trouble than younger adults in maintaining normal blood pressure after withdrawal.

WHAT ARE THE SPECIFIC DRUG TREATMENTS USED FOR HIGH BLOOD PRESSURE?

There are several classes of drugs used to treat hypertension.

Diuretics

For decades, diuretics, which cause reduction of water and sodium, have been the mainstays of anti-hypertensive therapy. Diuretics are inexpensive and are the drug of choice for most people with hypertension. They are especially helpful for treating the elderly and African-American patients. (African Americans are more likely to be salt-sensitive and so respond well to these drugs.) A landmark 2002 study reported that patients who take them have a lower incidence of heart failure, heart disease, and stroke after five to six years compared to those who took calcium-channel blocker and an ACE inhibitor. Beta-blockers, which are also often used as first-line therapy, were not studied in this trial. One previous analysis of many studies reported that diuretics were better than beta-blockers on all important points, including reducing heart attacks, strokes, and mortality rates. Of concern, in fact, are studies reporting an increase in the development of type 2 diabetes among people who take beta-blockers.

Diuretics continue to be the best choice for most older adults. A 1999 study reported, in fact, that diuretics may protect against dementia. Combinations may be needed. Because of a concern for drug interactions, some physicians are reluctant to give anti-hypertensive drugs to elderly patients with other risk factors for heart disease. Studies in 2001 reported, however, that the use of diuretics or beta blockers in this population, including those with isolated systolic hypertension, lowered their risks for heart attack, stroke, and heart failure.

Benefits of Diuretics. Some of the benefits reported on diuretics include the following:

- Diuretics significantly reduce the risk for stroke; they may in fact be the most important anti-hypertensive agent for preventing this brain attack. They also appear to protect against stroke in people without hypertension.
- They are associated with lower risk for heart attack (although this is not as significant as their protection against stroke).
- They may protect against blood clots.

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- Diuretics may help reduce the risk for dementia and the rate of fractures in elderly people who have taken them for a long time.

Diuretic Types. Diuretics come in many brands and are generally inexpensive. Some need to be taken once a day, others twice a day.

Three primary types of diuretics exist:

- **Thiazides.** Thiazides often serve as the basis for high blood pressure treatment, either taken alone for mild to moderate hypertension or used in combination with other types of drugs. There are many thiazides and thiazide-related drugs; some common ones are chlorothiazide (Diuril), chlorthalidone (Hygroton), indapamide (Lozol), and hydrochlorothiazide (Esidrix, HydroDiuril).
- **Loop diuretics.** Loop diuretics block sodium transport in parts of the kidney; they act faster than thiazides and have a great diuretic effect. It is important therefore to control the medication and avoid dehydration and potassium loss. Loop diuretics include bumetanide (Bumex), furosemide (Lasix), and ethacrynic acid (Edecrin).
- **Potassium sparing agents.** Some potassium-sparing diuretics include amiloride (Midamor), spironolactone (Aldactone), and triamterene (Dyrenium).

Problems with Diuretics. The loop and thiazide diuretics deplete the body's supply of potassium, which, if left untreated, increases the risk for arrhythmias. Arrhythmias are heart rhythm disturbances that can, in rare instances, lead to cardiac arrest. In such cases, physicians will either prescribe lower doses of the current diuretic, recommend potassium supplements, or use potassium-sparing diuretics either alone or in combination with a thiazide. Potassium-sparing drugs have their own risks, which include dangerously high levels of potassium in people with existing elevated levels of potassium or in those with damaged kidneys. It should be noted, however, that, in general, all diuretics are more beneficial than harmful.

Common Side Effects. Common side effects of diuretics are fatigue, depression, irritability, urinary incontinence, loss of sexual drive, breast swelling in men, and allergic reactions. Diuretics can trigger attacks of gout. They may also increase the risk of gastrointestinal (GI) bleeding. Diuretics may raise cholesterol level and, used alone, they have no effect on enlarged heart size (hypertrophy). Arrhythmias can also occur as an interaction between diuretics and certain drugs, including some antidepressants, anti-arrhythmic drugs themselves, and digitalis.

Beta-Blockers

Benefits of Beta-blockers. Beta-blockers have the following benefits for people with high blood pressure:

- They affect the force and frequency of heartbeats.
- They slow certain metabolic processes.
- They ease the workload of the heart.

They are very effective in reducing blood pressure and have been associated with the following positive effects on the heart:

- They are now well known for reducing deaths from heart disease.
- In one study, the beta-blocker atenolol (Tenormin) reduced left ventricular hypertrophy and, when used with the diuretic chlorthalidone, was found to significantly reduce the risk for heart failure, particularly in patients at high risk for it.
- Studies are now finding that certain beta-blockers called nonselective beta-blockers (such as carvedilol) may improve heart function, symptoms, and survival in patients with mild to moderate heart failure.

Beta-Blocker Brands. Many beta-blockers are now available, including propranolol (Inderal), acebutolol (Sectral), atenolol (Tenormin), betaxolol (Kerlone), carteolol (Cartrol), metoprolol (Lopressor), nadolol (Corgard), penbutolol (Levitol), pindolol (Visken), carvedilol (Coreg), and timolol (Blocadren). The drugs may differ in their effects and benefits.

Problems with Beta-Blockers. On the downside, studies are reporting that, when used alone, they may reduce blood pressure, but they do not reduce mortality rates. And, of concern are studies reporting an increase in the incidence of type 2 diabetes in people who take beta blockers. Because they can narrow bronchial airways and constrict blood vessels, patients with asthma, emphysema, and chronic bronchitis should avoid them whenever possible. Some beta-blockers tend to lower HDL cholesterol (the beneficial cholesterol) by about 10%; the effect is most marked in smokers.

Common Side Effects. Fatigue and lethargy are the most common psychologic side effects. Some people experience vivid dreams and nightmares, depression, and memory loss. Dizziness and lightheadedness may occur upon standing. Exercise capacity may be reduced. Other side effects may include coldness in the extremities (that is, legs and toes; arms and hands), asthma, decreased heart function, and gastrointestinal problems. Sexual dysfunction was a problem with older beta-blockers but does not appear to be significant at all in newer agents.

If side effects become very distressing, the patient should call a physician, but it is extremely important not to stop the drug abruptly. Angina, heart attack, and even sudden death have occurred in patients who discontinued treatment without gradual withdrawal.

Angiotensin Converting Enzyme Inhibitors

Angiotensin converting enzyme (ACE) inhibitors block the effects of the angiotensin–renin–aldosterone system, which is thought to have many harmful effects on the heart and blood vessels. ACE inhibitors are expensive, however. In an important 2003 study diuretics, achieved a lower risk for heart failure—and also stroke and angina — than an ACE inhibitor. However, another 2003 comparison study reported fewer heart attacks and lower risk for death with ACE inhibitors than with diuretics, particularly in elderly Caucasian men. More research is needed to confirm the specific benefits of each agent.

ACE inhibitors are particularly important, in any case, for patients with diabetes. A large study, for example, reported that diabetic patients who took these drugs had fewer heart attacks and lower all–cause mortality rates compared to those who took other anti–hypertensive agents. ACE inhibitors also may help slow progression of kidney disease, independently of their effect on blood pressure. (Some experts believe, in fact, that angiotensin may be the common factor linking diabetes and high blood pressure. This natural chemical not only influences all aspects of blood pressure control but it also interferes with insulin's normal metabolic signaling.)

Some research has also suggested that ACE inhibitors improved heart and lung muscle function, which should be very helpful for patients with existing heart failure. (A 2002 study also indicated that these agents may help preserve general muscle strength in older individuals.) Nevertheless, an important 2003 study suggested that ACE inhibitors might provide less protection against congestive heart failure than diuretics. Other studies have suggested that taking aspirin (or other so–called NSAIDs) may reduce the heart protection of ACE inhibitors. Aspirin is commonly used by patients with heart disease to prevent heart attacks. Studies are needed to clarify all these issues.

Brands. ACE inhibitors include captopril (Capoten), enalapril (Vasotec), quinapril (Accupril), benazepril (Lotensin), ramipril (Altace), perindopril (Aceon), and lisinopril (Prinivil, Zestril).

Side Effects. Side effects include an irritating cough, excessive drops in blood pressure, and allergic reactions. (In some people, the cough is intolerable. Iron supplements or the drug picotamide may prove to help reduce the frequency of coughs.) One rare but severe side effect, granulocytopenia, which is an extreme reduction in white blood cells, has been observed. In rare cases (0.3%), patients suffer a sudden and severe allergic reaction called angioedema that causes swelling in the eyes and mouth and may close off the throat.

Although ACE inhibitors can protect against kidney disease, they also increase potassium retention in the kidneys. This increases the risk for cardiac arrest if levels become too high. Because of this action, they are not generally given with potassium–sparing diuretics or potassium supplements.

They can harm a developing fetus and should not be used during pregnancy, particularly in the second and third trimester.

Calcium–Channel Blockers (CCBs)

Calcium–channel blockers (CCBs), or calcium antagonists, have an immediate effect on reducing blood pressure. Despite this, studies continue to report that they are inferior to the other anti–hypertensive agents in preventing heart events, stroke, or kidney complications. They are also more expensive than diuretics or beta–blockers. A major study also reported that they were not as effective as a diuretic in preventing heart failure. In fact, the drugs may slightly increase the risk. And in another 2002 study, African Americans with hypertensive kidney disease who took them experienced a worsening of their kidney condition. Some experts now believe they should be used only as a last resort. Nevertheless, CCBs have nerve–protecting properties and some of the newer agents may prove to have specific and unique benefits, including helping to reduce the risk for dementia in the elderly.

Calcium–Channel Blocker Brands. CCBs vary widely in their effects and calcium channel blockers used in the US may be categorized into different groups based upon different chemical structures. Those used for hypertension are called dihydropyridines and include diltiazem (Cardizem, Dilacor), amlodipine (Norvasc), felodipine (Plendil), isradipine (DynaCirc), verapamil (Calan, Isoptin, Verelan), nisoldipine (Sular), nicardipine (Cardene), and nifedipine (Adalat, Procardia). Newer CCBs include lercanidipine (Zanidip), lacidipine (Motens) and nitrendipine (Nitrepin). Lercanidipine, for example, is a unique CCP that may be effective and safe for a wider range of patients than with other CCBs.

Side Effects. Side effects vary among different preparations. Most drugs can cause fluid accumulation in the feet, along with constipation, fatigue, impotence, gingivitis, flushing, and allergic symptoms. Interactions with foods and drugs also differ depending on the drug. For example, verapamil interacts with digoxin, but diltiazem does not. Overdose on many of these agents can cause a severe drop in blood pressure.

Note: Grapefruit and Seville oranges boost the effects of calcium-channel blocking drugs, which are often used for hypertension. Seville oranges are often used in marmalade or other condiments. (Regular oranges do not appear to pose any hazard.)

Angiotensin–Receptor Blockers

Angiotensin–receptor blockers (ARBs), also known as angiotensin II receptor antagonists, are similar to ACE inhibitors in their ability to lower blood pressure. ARBs may have fewer or less severe side effects, including cough. Comparison studies with the beta blocker atenolol ACE inhibitor have suggested that it was superior in protection against stroke and in reducing both overall mortality and mortality from heart disease, including in patients with systolic hypertension. In one of the studies, ARBs also appeared to reduce the rate of new-onset diabetes. Other studies have also reported protection against kidney disease even in people with normal blood pressure, making them particularly beneficial for people with diabetes. They may even improve quality of life when added to a drug regimen — a finding also found with no other anti-hypertensive drugs. In fact, evidence suggests they may improve sexual function in men. These drugs are expensive, however, and additional comparison studies are needed, particularly with diuretics and ACE inhibitors.

Brands. Brands include losartan (Cozaar, Hyzaar), olmesartan (Benicar) candesartan (Atacand), telmisartan (Micardis), eprosartan (Teveten), irbesartan (Avapro), and valsartan (Diovan). A combination medication containing ARBs and the diuretic hydrochlorothiazide (Diovan HCT, Atacand HCT) is also available. Newer agents are proving to be more effective for lowering blood pressure than losartan, but more comparison studies are needed to determine long term benefits.

Side Effects. Side effects may include headache, dizziness, nasal congestion, elevated potassium blood levels, and abnormal kidney function. Sudden hypotension (a drop in blood pressure) can occur. As with ACE inhibitors, these agents can harm a developing fetus and should be not be used during pregnancy.

Alpha Blockers

Alpha blockers, such as doxazosin (Cardura) and prazosin (Minipress), widen arterioles and veins and thereby reduce blood pressure. However, a major study on doxazosin was stopped when it was associated with a higher risk of chest pain, stroke, and congestive heart failure compared with a diuretic. At this time, until more is known, they are still recommended for reducing blood pressure if no other agents are effective.

Vasodilators

Vasodilators, which widen blood vessels, are often used in combination with a diuretic or a beta-blocker. They are almost never used by themselves. Representative vasodilators include hydralazine (Apresoline), clonidine (Catapres, available in tablets or as a skin patch), and Minoxidil (Loniten). Some of these drugs should be used with caution or not at all in people with angina or who have had a heart attack.

Newer Agents that Block Chemicals Involved in Hypertension

Aldosterone Blockers. Aldosterone is a hormone that is critical in regulating the body's balance of salt and water. Excessive levels may play important roles in hypertension and heart failure. Additional agents that block this hormone are being developed. Eplerenone (Inspra) is the first to be approved. Its actions are similar to potassium-sparing diuretics, and like these agents, it poses some risk for high potassium levels, which in some cases can be dangerous.

Neutral Endopeptidase Inhibitors (NEPs). Neutral endopeptidase inhibitors (NEPs) are similar to ACE inhibitors. Their primary action is to produce higher levels of an enzyme called atrial natriuretic peptide, which has the following effects:

- It opens blood vessels.
- Induces fluid elimination.
- Opposes the actions of the compensating systems responsible for ongoing damage of the failing heart.

Agents under investigation include omapatrilat (Vanlev), candoxatril, and ecadotril. Important studies of omapatrilat, however, are reporting little advantages compared to ACE inhibitors, although may have some benefits in patients with heart failure. Unfortunately, in patients with hypertension, the drug poses a risk (0.7%) for angioedema, a sudden and severe allergic reaction that causes swelling in the eyes, mouth, and may close off the throat. (ACE inhibitors also can cause this reaction but the risk is lower.) Other side effects are very similar to those of ACE inhibitors, including coughing.

Statins

Statins are common drugs used to lower cholesterol that are proving to have many other health benefits as well. They include lovastatin (Mevacor), pravastatin (Pravachol), simvastatin (Zocor), luvastatin (Lescol) and atorvastatin

(Lipitor). An important 2002 study, patients with high blood pressure but normal or slightly high cholesterol levels had fewer heart attacks and strokes when they took the statin atorvastatin. The study was stopped so all subjects could take statins. An earlier study had shown similar benefits with the statin simvastatin.

WHERE ELSE CAN HELP BE FOUND FOR HIGH BLOOD PRESSURE?

National Heart, Lung, and Blood Institute (www.nhlbi.nih.gov/hbp). Call (301-496-4000).

For latest expert guidelines on high blood pressure visit: (www.nhlbi.nih.gov/health/prof/heart/index.htm#hbp).

American College of Cardiology (www.acc.org). Call (800-253-4636).

American Heart Association (www.americanheart.org). Call (800-242-8721). This is the primary source of information about heart problems. They will send free pamphlets and reading material, including useful diet information and locations of local representatives.

The American Society of Hypertension (www.ash-us.org). Call (212-644-0650).

This site offers information on the heart (www.heartinfo.org).

For information on the DASH diet visit: (www.nhlbi.nih.gov/health/public/heart/hbp/dash/).

This site offers a useful heart risk evaluation test (www.heartriskevaluations.com).

This site addresses health issues for African Americans (<http://blackhealthcare.com>).

FIND A HEART SPECIALIST: www.ama-assn.org/aps/amahg.htm.

FIND A DIETICIAN: www.eatright.org.

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