

The Future of Hypertension and the Optometrist

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Author's Bio

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Hypertension in the United States

The latest official data from the seventh Joint National Council (JNC VII) has reported that high blood pressure, or hypertension (HTN), is affecting more than 50 million Americans and about 1 billion patients worldwide.¹ More recent references from 2007 have reported that this figure is as high as 65 million in the United States.² Given that the US population *in 2011* was a little over 300 million, this means that about 1 in 6 people are currently diagnosed with high blood pressure. Since these figures were taken from studies over ten and five years ago respectively, it can be assumed that the numbers of those with hypertension have greatly increased now that we are in 2013. It is also assumed that these numbers do not account for the number of Americans living with *undiagnosed* hypertension. With the staggering number of people affected, hypertension has proven to be one of the most prevalent chronic diseases worldwide.

This is especially alarming to us, since we as optometrists know that hypertension can greatly affect the ocular health and vision of our patients. In the past, we have been very concerned about *diagnosing* ocular conditions related to hypertension, but it is time that we start thinking about this disease in the same manner as other diseases such as diabetes, and start talking about its *prevention*. With diabetes, it is common for us to ask about blood sugar numbers, ranges, A1cs, history, etc. We are great at educating patients about what diabetes can do to the eyes, but why don't the majority of us do the same for hypertension? Just as many patients enter the office with high blood pressure, if not more, than diabetes. When was the last time you asked the patient about their diagnosis, the last blood pressure reading, or how often are they checking their blood pressure? When did you last educate them on how they can control their blood pressure outside of the office to prevent any changes in their vision? These are the changes that need to be made today.

Hypertension and the Body

While waiting for the eighth Joint National Council (JNC VIII) to produce its report, we continue to utilize the guidelines that the JNC VII established in 2003. In that report they defined high blood pressure as a systolic blood pressure over 120 or a diastolic blood pressure over 80, with the systolic blood pressure being the maximum blood pressure found in the circulatory system, and the diastolic being the minimum. Yet, hypertension is not just a disease of the circulatory system alone. Left untreated, it can cause numerous disorders, including strokes, myocardial infarctions, renal failure, congestive heart failure, progressive atherosclerosis, and early death.

There are two types of hypertension, primary and secondary. Most patients with hypertension have what is known as primary or essential hypertension. Primary hypertension is caused by many factors, including genetic predisposition, increased body mass index, increased dietary salt, excess alcohol consumption, smoking, race (African Americans), and stress.³ Most of the time there are very few symptoms.³ The diagnosis is made when the patients visit a medical professional for some other problem. Symptoms such as severe headaches, nausea or vomiting, confusion, changes in vision, and nosebleeds, only manifest with a case of severe, acute hypertension. This makes hypertension known as the “silent killer.” While the patients are living their lives undiagnosed, they are slowly developing heart disease, kidney problems, and other systemic issues.

5% of patients have secondary hypertension, which is attributable to another cause, such as adrenal hyperplasia (Cushing’s syndrome), adrenal tumors (pheochromocytomas), thyroid disorders, obstructive sleep apnea, and certain drugs, including hormones, steroids, NSAIDs, decongestants, diet drugs and herbs, psychotic medications, and illicit drugs such as amphetamines and cocaine.⁴ These causes of secondary hypertension are seen more in younger patients with higher blood pressures and are all potentially preventable and curable.

Hypertension and the Eye

We learned in our clinical training that there are a number of changes that occur in the eyes secondary to increased systemic blood pressure. We look for these in every ocular fundus examination. Because patients may have these signs without a diagnosis of high blood pressure from a primary care physician, optometrists may be the first medical professionals to encounter and have a discussion about hypertension with the patient.

Hypertensive retinopathy is the most common ocular manifestation of hypertension. Studies have reported that hypertensive patients have a 50-80% chance of its development.⁵ Another study found that between 3-14% of the non-diabetic population over the age of 40 will have some signs of hypertensive retinopathy.⁶ So, it is important to pay attention to the blood vessels during all ocular fundus examinations. I explain to the patient that the blood vessels of the eye are the only blood vessels in the entire body that can be seen directly without cutting into the skin, so they are important to look at when diagnosing conditions of the entire body.

Blood vessel changes include arteriolar/venule (AV) crossing changes, AV nicking, changes in the AV ratio, as well as changes in the arteriole light reflexes (ALR). Generally an elevated blood pressure only affects the diameter of the arteries and not the veins, causing them to become narrower and hence a smaller AV ratio.⁶ All of these signs can occur at different times in the life of the patient with hypertension. Arteriolar narrowing and nicking are more linked with a chronic hypertensive patient, while focal narrowing of the arteries, hemorrhages, microaneurysms, and cotton wool spots are linked with a more acute elevation in the blood pressure.⁶

When changes in the vasculature are noted, it is important to determine at which stage the patient is to diagnose the disease’s progression. Historically, the majority of us have been using Keith-Wagener-Barker’s Classification system, although there are many other systems out there. In this system developed in 1939, those with hypertensive changes are grouped into four classes as described in the table below.⁷

Group	Description
1	Mild to moderate narrowing and sclerosis of the arteries
2	Moderate to marked sclerosis of the retinal arterioles; exaggeration of the light reflex; arteriovenous compression changes or generalized or localized narrowing of the arterioles
3	Retinal arteriolar narrowing and focal constriction; retinal edema; cotton-wool spots; hemorrhage
4	Group 3 plus papilledema

In a newer system, proposed by Wong and Mitchell, hypertensive changes are divided into three groups classified as mild, moderate, or severe (which was once termed “malignant”).⁸ This is proving to be more useful to eye care professionals due to its ease of use. Their new classification is as follows:

Grade	Retinal Findings
Mild	Increased arteriole light reflex (ALR, formally known as copper and silver wiring effects), AV ratio changes, AV crossing changes, and focal narrowing
Moderate	Cotton-wool spots (CWS), hemorrhages, hard exudates, and aneurysms
Severe	Moderate findings in addition to optic nerve swelling

Besides hypertensive retinopathy and vasculature changes, those with hypertension are more prone to having other ocular manifestations, including anterior ischemic optic neuropathy, central or branch retinal artery occlusions, central or branch retinal vein occlusions, choroidal infarctions, cranial nerve palsies, progression of diabetic retinopathy, glaucoma, idiopathic polypoidal choroidal vasculopathy, macroaneurysms, ocular ischemic syndrome, subconjunctival hemorrhages, and transient visual obscurations. Because they all have various causes, we do not diagnose hypertension upon seeing these, but we use them along with other tests to help with a diagnosis.

Hopefully when any abnormal retinal finding is seen, we will either have the blood pressure reading already performed for us during pre-testing, or we can perform it ourselves at that time. Any retinal changes should be correlated with any abnormal blood pressure readings, past or present.

Hypertension Evaluation in the Office

All patients over 18 should have their blood pressure checked regularly.⁴ In my office, this is performed with every comprehensive examination. Many offices that measure blood pressure include it as part of the pre-testing that is performed. I personally like to do the testing myself during the course of my examination. For me, I feel it instills more confidence in patients that the doctor is actually performing the test, and it gives me time to educate the patients about the importance of blood pressure and how it can potentially affect their eyes.

Although not routinely taken in children, those with symptoms of high blood pressure will have the measurements taken in the office during their primary eye examinations. With higher readings, all younger patients will be referred to their primary care physicians to find the cause of the high blood pressure. More than likely it will be a secondary hypertension with an underlying cause that can be controlled or corrected.⁴

Typically the most common form of blood pressure measurement is the auscultatory method. This is a reliable method that has not changed in over 100 years.⁹ As the patient is seated, a cuff is placed on the upper arm with a stethoscope placed over the brachial artery. The cuff is inflated well above the systolic pressure so that the sound of the artery is quiet, noting that no blood is passing through. The cuff is then gradually deflated, allowing blood to once again flow through the artery. Five different sounds have been noted. The systolic pressure is recorded at the number that the first sound is heard. Although there is some discrepancy, it has been decided the diastolic pressure is recorded at the last audible sound.⁹

It is extremely important to measure the blood pressure properly to gain accurate recordings. Here are some important tips to remember when taking blood pressure measurements to get the most accurate reading:

1. Remove all clothing that the cuff would cover. Some practitioners try to get away with taking the measurement over “thin clothing.” To be more accurate, remove it, if possible.
2. Have the patient sit comfortably, with the legs uncrossed.
3. The patients should be as calm as possible and not talking.
4. Be sure to choose the most correct cuff size. This will greatly affect the measurement.

Arm Circumference, in cm	Cuff Size
22-26	Small Adult, 12 x 22cm
27-34	Adult, 16 x 30cm
35-44	Large Adult, 16 x 36
45-52	Adult Thigh, 16 x 42cm

5. Generally there are no systemic differences between the blood pressures of the two arms. Only 20% of subjects have a difference of >10 mmHg.⁸
6. In women that have had a mastectomy, the blood pressure should be measured on the opposite side of the mastectomy.

Depending on the patient, I use various methods to check the blood pressure. For standard screenings, I generally use an automatic cuff that I purchased at a local pharmacy. I spoke with the pharmacist first, and he said that it was the one that he recommends to the majority of his patients. The first few recordings I took with it, I used it in conjunction with a stethoscope and sphygmomanometer. The numbers were surprisingly very close to each other, within 6 mmHg systolic and 4mmHg diastolic on average. Since we never rely on a single measurement for the diagnosis of high blood pressure, I decided that this was a fairly reliable instrument to use. Many of my patients are impressed with the “modern day technology” of the device, and it helps them understand that checking blood pressure is something that would be very easy for them to do on their own! If you are uncomfortable with taking blood pressures, practice on a friend or staff member. It is that important to perform the test correctly!

The Blood Pressure Results

Normal blood pressure readings are always noted, and the patient is told that everything is where it should be. With repeated higher readings or a single extremely high reading, I refer patients to their primary care physician for advanced care and possible medical treatment. A diagnosis of hypertension is never based on a single reading. Elevated blood pressures need to be verified on multiple occasions over time. When the blood pressure is only slightly elevated in the office, I advise for the patient to have their pressures checked either at a blood pressure machine found at pharmacies and malls, or they may purchase devices that can be used to measure their blood pressure in the comfort of their own home. After hearing of a high reading, the patient may express the reason, including extra coffee that morning or skipping their medications that night. This is the perfect opportunity to remind them about the importance of everyday compliance. About 15-20% of patients suffer from “white coat syndrome,” where the blood pressure reading is slightly elevated when a health care professional is taking the measurement.⁹ Although this can be common, do not discredit all slightly elevated blood pressures in your office as “white coat syndrome.” Use all readings of a patient over time to notate any general increase or decrease in the pressures. This can indicate whether a condition is getting worse or becoming more controlled.

An important factor to notate is regarding hypertensive crisis. This is defined as blood pressure greater than 180/120 mmHg.¹⁰ A patient with this reading would need to have their blood pressure controlled within 24-72 hours. I send these patients to their primary care physician with a note describing the urgency of the case. The cases that constitute

emergencies are those patients that have blood pressure over 180/120 mmHg with evidence of impending life-threatening or progressive target organ dysfunction seen as shortness of breath, headaches (which are often severe), and dizziness. The hallmark of a hypertensive emergency is the presence of bilateral optic disc edema with elevated blood pressure. These patients need to have their blood pressure controlled in a matter of minutes to hours.

Along with the higher blood pressure readings, it has been suggested that the variability in blood pressure may be a risk factor for morbidity, since our tissues are much more susceptible to varied changes than steady states.⁹ It is important to tell patients about the importance of not just lowering the blood pressure, but also stabilizing the readings as well. This is where a home monitor would come into play.

Treatment

It is important for optometrists to be knowledgeable about the treatment of high blood pressure to better help our patients. We can make simple recommendations that may reflect what they are being told by their primary care physicians. When patients hear the same information from more than one source, it reinforces its importance, and they may be more willing to listen and take our advice. It is important to remember that high blood pressure is completely controllable for the majority of patients.

I always begin with talking to patients with high blood pressure about a healthier lifestyle. This includes eating a more balanced diet, as well as becoming more active and exercising regularly. There is a specific diet called the DASH diet (Dietary Approaches to Stop Hypertension) that is very easy to follow. It focuses on foods rich in potassium and calcium, a decrease in the amount of sodium consumed, more physical activity, and less alcohol consumption.¹ Recently I have been listening to my own advice and have lost over 30 pounds. It is difficult for patients to listen to us if we are not listening to ourselves and being as healthy and active as we can be. Below is a table from the JNC VII with simple modifications that each patient can make in their lives that can lead to a reduction in blood pressure.

Modification	Recommendations	Approximate SBP Reduction (Range)
Weight Reduction	Maintain a normal body weight (BMI 18.5-24.9 kg/m ²)	5-20mmHg/ 10kg weight loss
Adopt the DASH eating plan	Consume a diet rich in fruits, vegetables, and lowfat dairy products with a reduced content of saturated and total fat.	8-14 mmHg
Dietary sodium reduction	Reduce dietary sodium intake to no more than 100mmol per day (2.4g sodium or 6g sodium chloride)	2-8 mmHg
Physical activity	Engage in regular aerobic physical activity such as brisk walking (at least 30 min per day, most days of the week).	4-9 mmHg
Moderation of alcohol consumption	Limit consumption to no more than 2 drinks (1oz or 30mL ethanol; e.g., 24oz beer, 10oz wine, or 3oz 80-proof whiskey) per day in most men and to no more than 1 drink per day in women and lighter weight persons	2-4 mmHg

Like the checking of blood sugar in patients with diabetes, patients should be checking their blood pressure at home on a regular basis as well. The American Heart Association strongly recommends home monitoring for all patients with high blood pressure.¹¹ This proves to be a very valuable aid for all health professionals trying to help the patient stabilize the

readings. Charting provides a way for patients to understand how their blood pressure is affected by various activities such as foods, activity levels, and times of day. This provides a clearer picture of the actual blood pressure of the patient. These machines are relatively inexpensive and available at pharmacies and other stores that carry medical equipment.

If the modifications listed above are not working as well as they should, then medication may be initiated by the primary care physician. These medications fall into many categories, each having a different mechanism to help lower the blood pressure. Below I have included a table from the JNC VII report of the major categories of hypertensive medications, along with a small sample of drugs that belong in each category.¹ By any means, do not memorize all of these, but a general knowledge of the classes and how they work, along with the most used high blood pressure medications, will definitely help you as an optometrist.

Diuretics

Working in the kidneys, the diuretics work to flush fluid out of the body, causing a decrease in blood pressure. This family includes many different types of diuretics, including loops diuretics, the thiazides, and potassium-sparing diuretics.

Class	Drug (Trade Name)	Usual Dosage Range, in mg/day	Usual Daily Frequency
Thiazide Diuretics	Chlorothiazide (Diuril)	125-500	1-2
	Chlorthalidone (generic)	12.5-25	1
	Hydrochlorothiazide (Microzide, HydroDIURIL)	12.5-25	1
	Polythiazide (Renese)	2-4	1
	Indapamide (Lozol)	1.25-2.5	1
	Metolazone (Mykrox)	0.5-1.0	1
	Matolazone (Zaroxolyn)	2.5-5	1
Loop Diuretics	Bumetanide (Bumex)	0.5-2	2
	Furosemide (Lasix)	20-80	2
	Torsemide (Demadex)	2.5-10	1
Potassium-Sparing Diuretics	Amiloride (Midamor)	5-10	1-2
	Triamterene (Dyrenium)	50-100	1-2

Beta Blockers

This type of medication slows the heart by reducing the nerve impulses that it receives, lowering the blood pressure.

Class	Drug (Trade Name)	Usual Dosage Range, in mg/day	Usual Daily Frequency
Beta Blockers	Atenolol (Tenormin)	25-100	1
	Betaxolol (Kerlone)	5-20	1
	Bisoprolol (Zebeta)	2.5-10	1
	Metoprolol (Lopressor)	50-100	1-2
	Metoprolol Extended Release (Toprol XL)	50-100	1
	Nadolol (Corgard)	40-120	1
	Propranolol (Inderal)	40-160	2
	Propranolol long-acting (Inderal LA)	60-180	1
	Timolol (Blocadren)	20-40	2

ACEIs (Angiotensin Converting Enzyme Inhibitors)

This medication family interferes with the formation of angiotensin II, the enzyme involved in blood vessel constriction. Without it, the vessels relax, causing a decrease in blood pressure.

Class	Drug (Trade Name)	Usual Dosage Range, in mg/day	Usual Daily Frequency
ACEIs	Benazepril (Lotensin)	10-40	1
	Captopril (Capoten)	25-100	2
	Enalapril (Vasotec)	5-40	1-2
	Fosinopril (Monopril)	10-40	1
	Lisinopril (Prinivil, Zestril)	10-40	1
	Moexipril (Univasc)	7.5-30	1
	Perindopril (Aceon)	4-8	1
	Quinapril (Accupril)	10-80	1
	Ramipril (Altace)	2.5-20	1
	Trandolapril (Mavik)	1-4	1

Angiotensin II Antagonists

These medications block AT1 receptors, preventing the action of angiotensin II, which would lead to vessel constriction. The vessels again relax, causing the blood pressure to decrease.

Class	Drug (Trade Name)	Usual Dosage Range, in mg/day	Usual Daily Frequency
Angiotensin II Antagonists	Candesartan (Atacand)	8-32	1
	Eprosartan (Teveten)	400-800	1-2
	Irbesartan (Avapro)	150-300	1
	Losartan (Cozaar)	25-100	1-2
	Olmesartan (Benicar)	20-40	1
	Telmisartan (Micardis)	20-80	1
	Valsartan (Diovan)	80-320	1-2

CCBs (Calcium Channel Blockers)

By blocking calcium entry into the vascular smooth muscle cells, vasoconstriction is again prevented. This allows the vessels to be relaxed, decreasing the blood pressure.

Class	Drug (Trade Name)	Usual Dosage Range, in mg/day	Usual Daily Frequency
CCB-Non-Dihydropyridines	Diltiazem extended release (Cardiazem CD, Dilacor XR, Tiazac)	180-240	1
	Diltiazem extended release (Cardiazem LA)	120-540	1
	Verapamil immediate release (Calan, Isoptin)	80-320	2
	Verapamil long acting (Calan SR, Isoptin SR)	120-480	1-2
	Verapamil (Coer, Covera HS, Verelan PM)	120-360	1
CCBs-Dihydropyridines	Amlopidine (Norvasc)	2.5-10	1
	Felodipine (Plendil)	2.5-20	1

	Isradipine (Dynacirc CR)	2.5-10	2
	Nicardipine sustained release (Cardene SR)	60-120	2
	Nifedipine long-acting (Adalat CC< Procardia XL)	30-60	1
	Nisoldipine (Sular)	10-40	1

Alpha-1 Blockers

By reducing the nerve impulses directly to the vessels, they relax, decreasing the blood pressure.

Class	Drug (Trade Name)	Usual Dosage Range, in mg/day	Usual Daily Frequency
Alpha-1 Blockers	Doxazosin (Cardura)	1-16	1
	Prazosin (Minipress)	2-20	2-3
	Terazosin (Hytrin)	1-20	1-2

Central Alpha-2 Agonists and other Centrally Acting Drugs

These drugs act by preventing your brain from sending signals to the heart to speed up and narrow the vessels, thus reducing the blood pressure.

There are also combination alpha agonists and beta blocking drugs that act in the CNS, at the ganglionic level or at the receptor level (alpha or beta blockers), reducing the blood pressure by reducing contractability, cardiac output, venous tone, and peripheral vascular resistance.

Class	Drug (Trade Name)	Usual Dosage Range, in mg/day	Usual Daily Frequency
Central Alpha-2 Agonists and other Centrally Acting Drugs	Clonidine (Catapres)	0.1-0.8	2
	Clonidine patch (Catapres-TTS)	0.1-0.3	1 weekly
	Methyldopa (Aldomet)	250-1000	2
	Reserpine (generic)	0.1-0.25	1
	Guanfacine (Tenex)	0.5-2	1
Combined Alpha and Beta	Carvedilol (Coreg)	12.5-50	2
	Labetalol (Normodyne, Trandate)	200-800	2

Direct Vasodilators

By acting on the smooth muscle vasculature walls, these medications open the walls, decreasing the blood pressure.

Class	Drug (Trade Name)	Usual Dosage Range, in mg/day	Usual Daily Frequency
Direct Vasodilators	Hydralazine (Apresoline)	25-100	2
	Minoxidil (Loniten)	2.5-80	1-2

Drugs may be used in combination. Sometimes only one drug may not work alone, and the prescribing doctor may want to include either another drug with a different mechanism of action or another drug in the same class. It is not always easy for compliance to add another pill to take, so a drug that is a combination of two is a good replacement to increase compliance with patients. Some examples from the JNC VII are seen in the following table.

Combination Type	Fixed Dose Combination	Trade Name
ACEIs and CCBs	Amlopidine-benazepril hydrochloride	Lotrel
	Enalapril-felodipine	Lexxel
	Trandolapril-verapamil	Tarka
ACEIs and Diuretics	Benazepril-hydrochlorothiazide	Lotensin HCT
	Captopril-hydrochlorothiazide	Capozide
	Enalapril-hydrochlorothiazide	Vaseretic
	Fosinopril-hydrochlorothiazide	Monopril HCT
	Lisinopril-hydrochlorothiazide	Prinzide, Zestoretic
	Moexipril-hydrochlorothiazide	Uniretic
	Quinapril-hydrochlorothiazide	Accuretic
ARBs and Diuretics	Candesartan-hydrochlorothiazide	Atacand HCT
	Eprosartan-hydrochlorothiazide	Teveten HCT
	Irbesartan-hydrochlorothiazide	Avalide
	Losartan-hydrochlorothiazide	Hyzaar
	Olmesartan medoxomil-hydrochlorothiazide	Benicar HCT
	Telmisartan-hydrochlorothiazide	Micardis HCT
	Valsartan-hydrochlorothiazide	Diovan HCT
BBs and Diuretics	Atenolol-chlorothiazide	Tenoretic
	Bisoprolol-hydrochlorothiazide	Ziac
	Metoprolol-hydrochlorothiazide	Lopressor HCT
	Nadolol-bendroflumethiazide	Corzide
	Propranolol LA-hydrochlorothiazide	Inderide LA
	Timolol-hydrochlorothiazide	Timolide
Centrally acting drug and diuretic	Methyldopa-hydrochlorothiazide	Aldoril
	Reserpine-chlothalidone	Demi-Regroton, Regroton
	Reserpine-chlorothiazide	Diupres
	Reserpine-hydrochlorothiazide	Hydropres
Diuretic and Diuretic	Amiloride-hydrochlorothiazide	Moduretic
	Spironolactone-hydrochlorothiazide	Aldactazide
	Triamterene-hydrochlorothiazide	Dyazide, Maxzide

Conclusion

Hopefully after reading this, you will agree that there is much more that can be done in an optometric setting to help manage our patients with or at risk of systemic hypertension. Please check your patient's blood pressure at every comprehensive examination. Also spend a few more moments discussing what the patient can do to improve the overall health of their body, not just the eyes. As long as the body remains healthy, the eyes will follow. This extra step will not only allow your patients to see that you care and allow them to increase their trust in you, but it may also save their life in the long-run. I once heard a quote from John C. Maxwell that I try to follow every day. He said that "[the patients] will not care about how much you know until they know about how much you care."

References

1. Chobanian AV, Bakris, Black HR, et al. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension. 2003;42:1206-1252

2. Ong KL, Cheung BMY, Man YB, et al. Prevalence, Awareness, Treatment, and Control of Hypertension Among United States Adults 1999-2004. *Hypertension*. 2007;49:69-75.
3. Dugdale DC, Zieve D. Hypertension. June 2011. Available at: www.ncbi.nlm.gov/pubmedhealth/PMH0001502. (Accessed January 14, 2013).
4. Viera AJ, Neutze DM. Diagnosis of Secondary Hypertension: An Age-Based Approach. *Am Fam Physician*. 2010 Dec 15;82(12):1471-1478.
5. Klein R, Klein BE, Moss SE, et al. Hypertension and Retinopathy Arteriolar Narrowing, and Arteriovenous Nicking in a Population. *Arch Ophthalmol* 1994 Jan;112(1):92-8.
6. Wong TY. Hypertensive Retinopathy- A Journey From Fundoscopy to Digital Imaging. *Clinical and Experimental Ophthalmology*. 2006;34:397-400.
7. Walsh JB. Hypertensive Retinopathy: Description, Classification, and Prognosis. *Ophthalmology*. 1982;89:1127.
8. Wong TY, Mitchell P. Hypertensive Retinopathy. *N Engl J Med*. 2004;351:2310-7.
9. Pickering TG, Hall JE, Appel LJ, et al. Recommendations for Blood Pressure Measurement in Humans and Experimental Animals. *Hypertension*. 2005;45:142-161.
10. Meetz RE, Harris TA. The Optometrist's Role in the Management of Hypertensive Crisis. *Optometry*. 2011;82:108-116.
11. http://www.heart.org/HEARTORG/Conditions/HighBloodPressure/SymptomsDiagnosisMonitoringofHighBloodPressure/Home-Blood-Pressure-Monitoring_UCM_301874_Article.jsp. (Accessed January 14, 2013).

