PRE MED SUMMER COURSE
Session 1

Lead Faculty: Dr. Momina Salman, M.D.
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<tr>
<th>TIME</th>
<th>MONDAY</th>
<th>TUESDAY</th>
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<td>HOSPITAL TOUR</td>
<td>BASIC SKILLS</td>
<td>Dr. Agnes Kim</td>
<td>Dr. Rebecca Andrews</td>
<td>DR. MOMINA SALMAN AND BARBARA aBRON</td>
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The General Survey

The General Survey of the patient’s appearance, height, and weight begins with the opening moments of the patient encounter, but you will find that your observations of the patient’s appearance crystallize as you start the physical examination. The best clinicians continually sharpen their powers of observation and description. As you talk with and examine the patient, heighten your focus on the patient’s mood, build, and behavior. These details enrich and deepen your emerging clinical impression. A skilled observer describes the distinguishing features of the patient’s appearance so well that colleagues can spot the patient in a crowd of strangers.

Many factors contribute to the patient’s body habitus: socioeconomic status, nutrition, genetic makeup, degree of fitness, mood state, early illnesses, gender, geographic location, and age cohort. Recall that the patient’s nutritional status affects many of the characteristics you scrutinize during the General Survey: height and weight, blood pressure, posture, mood and alertness, facial coloration, dentition and condition of the tongue and gingiva, color of the nail beds, and muscle bulk, to name a few. Be sure to make the assessment of height, weight, BMI, and risk for obesity a routine part of your clinical practice.

Now is the time to recall the observations you have been making since the first moments of your interaction, refining them throughout your assessment. Does the patient hear you when greeted in the waiting room or examination room? Rise with ease? Walk easily or stiffly? If hospitalized when you first meet, what is the patient doing—sitting up and enjoying television?… or lying in bed?… What do you see on the bedside table—a magazine?… a flock of “get well” cards?… a Bible or a rosary?… an emesis basin?… or nothing at all? Each observation should raise questions or hypotheses for you to consider as your assessment unfolds.

GENERAL APPEARANCE

Apparent State of Health. Try to make a general judgment based on observations throughout the encounter. Support it with the significant details.

Level of Consciousness. Is the patient awake, alert, and responsive to you and others in the environment? If not, promptly assess the level of consciousness.

Signs of Distress. Does the patient show evidence of the problems listed below?

- Cardiac or respiratory distress

Is the patient acutely or chronically ill, frail, or fit and robust?

See Chapter 17, The Nervous System, Level of Consciousness, p. 735

Is there clutching of the chest, pallor, diaphoresis, or labored breathing, wheezing, and coughing?
**THE GENERAL SURVEY**

- Pain

- Anxiety or depression

**Skin Color and Obvious Lesions.** Assess any changes in skin color, scars, plaques, or nevi.

**Dress, Grooming, and Personal Hygiene.** How is the patient dressed? Is the clothing appropriate for the temperature and weather? Is it clean and appropriate to the setting?

Glance at the patient’s shoes. Are there cut-outs or holes? Are the shoes run-down?

Is the patient wearing unusual jewelry? Are there body piercings?

Note the patient’s hair, fingernails, and use of cosmetics. They may be clues to the patient’s personality, mood, lifestyle, and self-regard.

Do personal hygiene and grooming seem appropriate to the patient’s age, lifestyle, occupation, and stage of life?

**Facial Expression.** Observe the facial expression at rest, during conversation about specific topics, during the physical examination, and in interaction with others. Watch for eye contact. Is it natural? Sustained and unblinking? Averted quickly? Absent?

**EXAMPLES OF ABNORMALITIES**

Is there wincing, sweating, protectiveness of a painful area, facial grimacing, or an unusual posture favoring one limb or body area?

Are there anxious facial expressions, fidgety movements, cold and moist palms, inexpressive or flat affect, poor eye contact, or psychomotor slowing. See Chapter 5, Behavior and Mental Status, pp. 141–169.

Pallor, cyanosis, jaundice, rashes, bruises should be pursued. See Chapter 6, The Skin. Hair, and Nails, pp. 171–203.

Excess clothing may reflect the cold intolerance of hypothyroidism, hide skin rash or needle marks, mask anorexia, or signal personal lifestyle preferences.

Cut-out holes or slippers may indicate gout, bunions, edema, or other painful foot conditions. Run-down shoes can contribute to foot and back pain, calluses, falls, and infection.

Copper bracelets are sometimes worn for arthritis. Piercing may appear on any part of the body.

"Grown-out" hair and nail polish can help you estimate the length of an illness. Fingernails chewed to the quick may reflect stress.

Unkempt appearance may be seen in depression and dementia, but this appearance must be compared with the patient’s probable norm.

Watch for the stare of hyperthyroidism; the immobile face of parkinsonism; the flat or sad affect of depression. Decreased eye contact may be cultural or may suggest anxiety, fear, or sadness.
**THE GENERAL SURVEY**

**Odors of the Body and Breath.** Odors can be important diagnostic clues, like the fruity odor of diabetes or the scent of alcohol.

Never assume that alcohol on a patient’s breath explains changes in mental status or neurologic findings.

**Posture, Gait, and Motor Activity.** What is the patient’s preferred posture?

Is the patient restless or quiet? How often does the patient change position?

Is there any involuntary motor activity? Are some body parts immobile? Which ones?

Does the patient walk smoothly, with comfort, self-confidence, and balance, or is there a limp or discomfort, fear of falling, loss of balance, or any movement disorder?

**Height and Weight.** Measure the patient’s height in stocking feet and weigh the patient to determine the BMI.

Is the patient unusually short or tall? Is the build slender, muscular, or stocky? Is the body symmetric? Note the general body proportions.

Is the patient emaciated, slender, overweight, or obese? If the patient is obese, is the fat distributed evenly or concentrated over the upper torso, or around the hips?

**EXAMPLES OF ABNORMALITIES**

Breath odors can indicate the presence of alcohol, acetone (diabetes), pulmonary infections, uremia, or liver failure.

People with alcoholism may have other serious and potentially correctable problems such as hypoglycemia, subdural hematoma, or postictal state.

There is a preference for sitting upright in *left-sided heart failure* and for leaning forward with arms braced in *chronic obstructive pulmonary disease*.

Anxious patients appear agitated and restless. Patients in pain often avoid movement.

Look for tremors, other involuntary movements, or paralysis. See Table 17-5, Tremors and Involuntary Movements, pp. 752–753.

See Table 17-10, Abnormalities of Gait and Posture, p. 759. An impaired gait increases risk of falls.

Be aware of very short stature in *Turner’s syndrome*, childhood renal failure, and *achondroplastic* and *hypopituitary dwarfism*; long limbs in proportion to the trunk in hypogonadism and *Marfan’s syndrome*; height loss in osteoporosis and vertebral compression fractures.

There is generalized fat in simple obesity; truncal fat with relatively thin limbs in *Cushing’s syndrome* and *metabolic syndrome*. 
The general survey

Weigh the patient with shoes off. Make note of any weight changes over time.

**Calculating the BMI.** Use your measurements of height and weight to calculate the body mass index, or BMI. Body fat consists primarily of adipose in the form of triglycerides and is stored in subcutaneous, inter-abdominal, and intramuscular fat depots that are difficult to measure directly. The BMI incorporates estimated but more accurate measures of body fat than weight alone. The National Institutes of Health caution that people who are very muscular can have a high BMI but still be healthy. Likewise, the BMI for older adults and those with low muscle mass may appear inappropriately “normal.”

There are several ways to calculate the BMI, as shown in the accompanying table. Choose the method best suited to your practice. The electronic medical record software may do this automatically.

**Waist Circumference.** If the BMI is 35 or greater, measure the patient’s waist circumference just above the hips. Risk for diabetes, hypertension, and cardiovascular disease increases significantly if the waist circumference is 35 inches or more in women and 40 inches or more in men.

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**Methods to Calculate Body Mass Index (BMI)**

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<th>Unit of Measure</th>
<th>Method of Calculation</th>
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<tr>
<td><strong>Weight in pounds, height in inches</strong></td>
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|                                         | (2) \[
|                                         | \[
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|                                         | \[
| **Weight in kilograms, height in meters squared** | (3) Weight (kg) / Height (m²)                           |
| **Either**                             | (4) “BMI Calculator” at Web site www.nhlbisupport.com/bmi |

*Several organizations use 704.5, but the variation in BMI is negligible. Conversion formulas:

2.2 lbs = 1 kg; 1 inch = 2.54 cm; 100 cm = 1 meter.


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Examples of abnormalities

Causes of weight loss include malignancy, diabetes mellitus, hyperthyroidism, chronic infection, depression, diuresis, and successful dieting.

The Vital Signs

Now you are ready to review or measure the Vital Signs: blood pressure, heart rate, respiratory rate, and temperature. The vital signs provide critical initial information that often influences the direction of your evaluation. Typically they are already recorded in the record by office staff. If they are abnormal, you will often retake them during the visit.

Begin by measuring the blood pressure and the heart rate. The heart rate can be assessed by counting the radial pulse with your fingers, or the apical pulse with your stethoscope at the cardiac apex. Continue either of these techniques as you count the respiratory rate without alerting the patient—breathing patterns can change if the patient knows breaths are being

See Table 9-3, Abnormalities of th Arterial Pulse and Pressure Waves p. 393. See Table 4-7, Abnormaliti in Rate and Rhythm of Breathing, p. 140.
counted. The temperature may be taken in various sites, depending on the patient and the equipment available. Learn the techniques for ensuring the accuracy of the vital signs described in the pages to follow.

**BLOOD PRESSURE**

*The Complexities of Measuring Blood Pressure.* Before turning to the recommended techniques for manual blood pressure measurements, it is important to review recent evidence about the correlation of office, home, and ambulatory blood pressure measurements with the "true blood pressure," the average blood pressure measured over days and weeks. Experts continue to raise concerns about the validity of routine office readings by physicians and other health professionals. Given the prevalence of hypertension, defined as blood pressure 140/90 or higher, errors in office diagnosis pose substantial threats to clinical decision making. Observer and measurement error, natural physiologic fluctuations in blood pressure, and anxiety and situational determinants can all alter the relationship of office measurements to "true" blood pressure.

Home and ambulatory blood pressure measurements are more accurate and predictive of cardiovascular disease and end-organ damage than conventional office measurements. *Ambulatory blood pressure monitoring* is fully automated and allows recording over an extended period of time. There are automated office blood pressure devices that sense the natural oscillations in the arterial pressure waves and estimate the systolic and diastolic pressure according to empirically derived algorithms. They can take five or more readings and display both individual and averaged measurements. These oscillometric devices hold promise for replacing manual auscultatory measurements in the office. They eliminate observer error, minimize the "white coat effect," increase the number of readings, and produce measurements that are comparable to mean ambulatory blood pressure, the current standard. The cut-off for normal home, ambulatory, and automated office measurements, 135/85, is lower than for office measurements. Currently there is no consensus on the setting, timing, or total number of blood pressure measurements needed for classifying patients or guiding treatment.

New insights based on office, home, and ambulatory blood pressure monitoring are briefly summarized here.

- Two types of hypertension based on manual office blood pressure measurements are especially important to understand: white coat hypertension and masked hypertension. In *white coat hypertension*, constituting roughly 15% to 20% of Stage 1 hypertensives, the office blood pressure is high but ambulatory pressures are normal, so cardiovascular risk is low. *Masked hypertension* is more problematic. In these patients, approximately 10% of the general population, the office blood pressure is normal but the ambulatory blood pressure is high, indicating high risk of cardiovascular disease.
THE VITAL SIGNS

- Poor measurement technique, including rounding of measurements to zero, anxiety at the time of measurement, the presence of a physician or nurse, and even the prior diagnosis of hypertension can substantially alter manual office blood pressure readings. Studies suggest that white coat hypertension may be a conditioned anxiety response because affected individuals do not appear to have generalized anxiety.23,29

- Averaging several blood pressure measurements is best, regardless of the setting. There are numerous short-term biological variations in blood pressure. The accuracy of clinic and home blood pressure measurements improves significantly when at least two measurements are taken, with additional gains in accuracy up to at least four readings.30 The variance between office and research systolic blood pressure reaches up to 15 mm Hg.

- Replacing manual office measurements with an automated office device has been shown to reduce blood pressure measurements by 5.4/2.1 mm Hg compared to ambulatory monitoring. It virtually eliminates the difference between manual and ambulatory measurements, substantially reducing the "white coat effect."31 The patient must be seated in a quiet room for several minutes while readings are being taken for this effect to occur.

Choosing the Correct Blood Pressure Cuff (Sphygmomanometer). More than 74.5 million Americans have elevated blood pressure.6 To detect blood pressure elevations, an accurate instrument is essential. Three types of blood pressure devices are currently used: aneroid, electronic, and "hybrid," which combines features of both electronic and ambulatory devices. In hybrid devices, the mercury column is replaced by an electronic pressure gauge; blood pressure can be displayed as a simulated mercury column, an aneroid reading, or a digital readout. All measuring instruments should be routinely tested for accuracy using international protocols.32,33

Mercury Blood Pressure Cuffs. Some offices continue to use mercury cuffs, although these are no longer available for sale. Experts recommend that mercury cuffs, properly maintained to avoid environmental spill, can still be used for routine office measurements and are important for evaluating the accuracy of any nonmercury device.27

Home Blood Pressure Monitoring. Many patients monitor their blood pressure at home. Be prepared to advise them about how to choose the best upper arm cuff for home use and have it recalibrated. Wrist and fingers monitors have become popular but introduce inaccuracies based on physiology and technique.27 Systolic pressure increases in more distal arteries, whereas diastolic pressure falls. When not used at heart level, wrist and finger monitors also introduce errors based on the hydrostatic effect of differences in position relative to the heart.

It is important to for clinicians and patients to choose a cuff that fits the patient’s arm. Follow the guidelines outlined here for selecting the correct size.

Self-monitoring of blood pressure by well-instructed patients using approved devices improves blood pressure control, especially when it is done two times daily at the upper arm with automatic readouts.36-38
**Selecting the Correct Blood Pressure Cuff**

- Width of the inflatable bladder of the cuff should be about 40% of upper arm circumference (about 12–14 cm in the average adult).
- Length of the inflatable bladder should be about 30% of upper arm circumference (almost long enough to encircle the arm).
- The standard cuff is 12 x 23 cm, appropriate for arm circumferences up to 28 cm.

**Making Accurate Blood Pressure Measurements.** Before assessing the blood pressure, take several steps to make sure your measurement will be accurate. Proper technique is important and reduces the inherent variability arising from the patient or examiner, the equipment, and the procedure itself.³⁷

**Steps to Ensure Accurate Blood Pressure Measurement**

- In ideal situations, instruct the patient to avoid smoking or drinking caffeinated beverages for 30 minutes before the blood pressure is measured.
- Check to make sure the examining room is quiet and comfortably warm.
- Ask the patient to sit quietly for at least 5 minutes in a chair with feet on the floor, rather than on the examining table.
- Make sure the arm selected is free of clothing. There should be no arteriovenous fistulas for dialysis, scarring from prior brachial artery cutdowns, or signs of lymphedema (seen after axillary node dissection or radiation therapy).
- Palpate the brachial artery to confirm that it has a viable pulse.
- Position the arm so that the brachial artery, at the antecubital crease, is at heart level—roughly level with the 4th interspace at its junction with the sternum.
- If the patient is seated, rest the arm on a table a little above the patient’s waist; if standing, try to support the patient’s arm at the midchest level.

If the cuff is too small (narrow), the blood pressure will read high; if the cuff is too large (wide), the blood pressure will read low on a small arm and high on a large arm.

If the brachial artery is 7 to 8 cm below heart level, the blood pressure will read approximately 6 cm higher; if the brachial artery is 6 to 7 cm higher, the blood pressure will read 5 cm lower.³⁸,³⁹
Now you are ready to measure the blood pressure.

- With the arm at heart level, center the inflatable bladder over the brachial artery. The lower border of the cuff should be about 2.5 cm above the antecubital crease. Secure the cuff snugly. Position the patient’s arm so that it is slightly flexed at the elbow.

- To determine how high to raise the cuff pressure, first estimate the systolic pressure by palpation. As you feel the radial artery with the fingers of one hand, rapidly inflate the cuff until the radial pulse disappears. Read this pressure on the manometer and add 30 mm Hg to it. Use of this sum as the target for subsequent inflations prevents discomfort from unnecessarily high cuff pressures. It also avoids the occasional error caused by an auscultatory gap—a silent interval that may be present between the systolic and the diastolic pressures.

- Deflate the cuff promptly and completely and wait 15 to 30 seconds.

- Now place the bell of a stethoscope lightly over the brachial artery, taking care to make an air seal with its full rim. Because the sounds to be heard, the Korotkoff sounds, are relatively low in pitch, they are generally better heard with the bell.

A loose cuff or a bladder that balloons outside the cuff leads to falsely high readings.

An unrecognized auscultatory gap may lead to serious underestimation of systolic pressure (150/98 in the example below) or overestimation of diastolic pressure.

If you find an auscultatory gap, record your findings completely (e.g., 200/98 with an auscultatory gap from 170–150).

An auscultatory gap is associated with arterial stiffness and atherosclerotic disease.
Inflate the cuff rapidly again to the level just determined, and then deflate it slowly at a rate of about 2 to 3 mm Hg per second. Note the level at which you hear the sounds of at least two consecutive beats. This is the systolic pressure.

In some people, the muffling point and the disappearance point are farther apart. Occasionally, as in aortic regurgitation, the sounds never disappear. If the difference is 10 mm Hg or greater, record both figures (e.g., 154/80/68).

Continue to lower the pressure slowly until the sounds become muffled and then disappear. To confirm the disappearance of sounds, listen as the pressure falls another 10 to 20 mm Hg. Then deflate the cuff rapidly to zero. The disappearance point, which is usually only a few mm Hg below the muffling point, provides the best estimate of true diastolic pressure in adults.

Read both the systolic and the diastolic levels to the nearest 2 mm Hg. Wait 2 or more minutes and repeat. Average your readings. If the first two readings differ by more than 5 mm Hg, take additional readings.

When using an aneroid instrument, hold the dial so that it faces you directly. Avoid slow or repetitive inflations of the cuff, because the resulting venous congestion can cause false readings.

Blood pressure should be taken in both arms at least once. Normally, there may be a difference in pressure of 5 mm Hg and sometimes up to 10 mm Hg. Subsequent readings should be made on the arm with the higher pressure.

By making the sounds less audible, venous congestion may produce artificially low systolic and high diastolic pressures.

Pressure difference of more than 10–15 mm Hg occurs in subclavian steal syndrome, aortic dissection.
**Classification of Normal and Abnormal Blood Pressure.** In its seventh report in 2003, the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure recommended using the mean of two or more properly measured seated blood pressure readings, taken on two or more office visits, for diagnosis of hypertension.\(^{41}\) Blood pressure measurement should be verified in the contralateral arm.

The Joint National Committee has identified four levels of systolic and diastolic hypertension. Note that either component may be high.

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<tr>
<th>Category</th>
<th>Systolic (mm Hg)</th>
<th>Diastolic (mm Hg)</th>
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<td>Normal</td>
<td>&lt;120</td>
<td>&lt;80</td>
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<tr>
<td>Prehypertension</td>
<td>120–139</td>
<td>80–89</td>
</tr>
<tr>
<td>Stage 1 Hypertension</td>
<td>140–159</td>
<td>90–99</td>
</tr>
<tr>
<td>Stage 2 Hypertension</td>
<td>≥160</td>
<td>≥100</td>
</tr>
<tr>
<td>If Diabetes or Renal Disease</td>
<td>&lt;130</td>
<td>&lt;80</td>
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When the systolic and diastolic levels fall in different categories, use the higher category. For example, 170/92 mm Hg is Stage 2 hypertension; 135/100 mm Hg is Stage 1 hypertension. In isolated systolic hypertension, systolic blood pressure is ≥140 mm Hg, and diastolic blood pressure is <90 mm Hg.

**Low Blood Pressure.** Relatively low levels of blood pressure should always be interpreted in the light of past readings and the patient's present clinical state.

**Orthostatic Hypotension.** If indicated, assess orthostatic hypotension, common in older adults. Measure blood pressure and heart rate in two positions—supine after the patient is resting from 3 to 10 minutes, then within 3 minutes after the patient stands up. Normally, as the patient rises from the horizontal to the standing position, systolic pressure drops slightly or remains unchanged, while diastolic pressure rises slightly. Orthostatic hypotension is a drop in systolic blood pressure of 20 mm Hg or greater or in diastolic blood pressure of 10 mm Hg or greater within 3 minutes of standing.\(^{43,44}\)

**Special Situations**

**Weak or Inaudible Korotkov Sounds.** Consider technical problems such as erroneous placement of your stethoscope, failure to make full skin contact with the bell, and venous engorgement of the patient's arm from repeated inflations of the cuff. Also consider the possibility of shock.

When you cannot hear Korotkov sounds at all, you may be able to estimate the systolic pressure by palpation. Alternative methods such as Doppler techniques or direct arterial pressure tracings may be necessary.

Assessment of hypertension also includes its effects on target "end organs"—the eyes, heart, brain, and kidneys. Look for hypertensive retinopathy, left ventricular hypertrophy, and neurologic deficits suggesting stroke. Renal assessment requires urinalysis and blood tests of renal function.

Treatment of isolated systolic hypertension in patients 60 years or older reduces total mortality and both mortality and complications from cardiovascular disease.\(^{41,42}\) A pressure of 110/70 mm Hg would usually be normal but could also indicate significant hypotension if past pressures have been high.

A fall in systolic pressure of 20 mm Hg or more, especially when accompanied by symptoms and tachycardia, indicates orthostatic (postural) hypotension. Causes include drugs, moderate or severe blood loss, prolonged bed rest, and diseases of the autonomic nervous system.

See Chapter 20, Assessing the Older Adult, p. 945.

In rare cases, patients are pulseless due to occlusive disease in the arteries of all the limbs from Takayasu arteritis, giant cell arteritis, or atherosclerosis.
To intensify Korotkoff sounds, one of the following methods may be helpful:

- Raise the patient’s arm before and while you inflate the cuff. Then lower the arm and determine the blood pressure.
- Inflate the cuff. Ask the patient to make a fist several times, and then determine the blood pressure.

**White Coat Hypertension.** Try to relax the patient and remeasure the blood pressure later in the encounter. Consider automated office readings or ambulatory recordings.

**The Obese or Very Thin Patient.** For the *obese arm*, use a cuff 15 cm in width. If the upper arm is short despite a large circumference, use a thigh cuff or a very long cuff. If the arm circumference is >50 cm and not amenable to use of a thigh cuff, wrap an appropriately sized cuff around the forearm, hold the forearm at heart level and feel for the radial pulse. Other options include using a Doppler probe at the radial artery or an oscillometric device. For the *very thin arm*, consider using a pediatric cuff.

**Arrhythmias.** Irregular rhythms produce variations in pressure and therefore unreliable measurements. Ignore the effects of an occasional premature contraction. With frequent premature contractions or atrial fibrillation, determine the average of several observations and note that your measurements are approximate. Ambulatory monitoring for 2 to 24 hours is recommended.²⁷

**The Hypertensive Patient With Unequal Blood Pressures in the Arms and Legs.** To detect coarctation of the aorta, make two further blood pressure measurements at least once in every hypertensive patient:

- Compare blood pressures in the arms and legs. In normal patients, the systolic blood pressure should be 5 to 10 mm higher in the arms.
- Compare the volume and timing of the radial or brachial and femoral pulses. Normally, volume is equal and the pulses occur simultaneously.

To determine blood pressure in the leg, use a wide, long thigh cuff that has a bladder size of 18 × 42 cm, and apply it to the midthigh. Center the bladder over the posterior surface, wrap it securely, and listen over the popliteal artery. If possible, the patient should be prone. Alternatively, ask the supine patient to flex one leg slightly, with the heel resting on the bed.

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**Examples of Abnormalities**

See definition of white coat hypertension on p. 119.

Using a small cuff overestimates systolic blood pressure in obese patients.⁴⁶

Palpation of an irregularly irregular rhythm indicates atrial fibrillation. For all irregular patterns, an ECG is needed to identify the type of rhythm.

Coarctation of the aorta results from narrowing of the thoracic aorta, usually proximal but sometimes distal to the left subclavian artery.

Coarctation of the aorta and occlusive aortic disease are distinguished by hypertension in the upper extremities and low blood pressure in the legs, and by diminished or delayed femoral pulses.⁴⁷
**THE VITAL SIGNS**

## HEART RATE AND RHYTHM

Examine the arterial pulses, the heart rate and rhythm, and the amplitude and contour of the pulse wave.

**Heart Rate.** The radial pulse is commonly used to assess the heart rate. With the pads of your index and middle fingers, compress the radial artery until a maximal pulsation is detected. If the rhythm is regular and the rate seems normal, count the rate for 30 seconds and multiply by 2. If the rate is unusually fast or slow count for 60 seconds. The range of normal is 50–90 beats per minute.\(^4^8\)

**Rhythm.** To begin your assessment of rhythm, feel the radial pulse. If there are any irregularities, check the rhythm again by listening with your stethoscope at the cardiac apex. Premature beats may not be detected peripherally, and the heart rate can be seriously underestimated. Is the rhythm regular or irregular? If irregular, try to identify a pattern: (1) Do early beats appear in a basically regular rhythm? (2) Does the irregularity vary consistently with respiration? (3) Is the rhythm totally irregular?

## RESPIRATORY RATE AND RHYTHM

Observe the rate, rhythm, depth, and effort of breathing. Count the number of respirations in 1 minute either by visual inspection or by subtly listening over the patient’s trachea with your stethoscope during your examination of the head and neck or chest. Normally, adults take approximately 20 breaths per minute in a quiet, regular pattern. An occasional sigh is normal. Check to see if expiration is prolonged.

## TEMPERATURE

The average oral temperature, usually quoted at 37°C (98.6°F), fluctuates considerably. In the early morning hours, it may fall as low as 35.8°C (96.4°F), and in the late afternoon or evening, it may rise as high as 37.3°C (99.1°F). Rectal temperatures are higher than oral temperatures by an average of 0.4 to 0.5°C (0.7 to 0.9°F), but this difference is also quite variable. In contrast, axillary temperatures are lower than oral temperatures by approximately 1°, but take 5 to 10 minutes to register and are generally considered less accurate than other measurements.

Most patients prefer oral to rectal temperature measurements. However, taking oral temperatures is not recommended when patients are unconscious,

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### Examples of Abnormalities

See Table 9-1, Selected Heart Rates and Rhythms, p. 391, and Table 9-2, Selected Irregular Rhythms, p. 392.

Always check an ECG to determine the type of rhythm.

See Table 4-7, Abnormalities in Rate and Rhythm of Breathing, p. 140.

Prolonged expiration is common in COPD.

**Fever** or pyrexia refers to an elevated body temperature. Hyperpyrexia refers to extreme elevation in temperature, above 41.1°C (106°F), while hypothermia refers to an abnormally low temperature, below 35°C (95°F) rectally.
restless, or unable to close their mouths. Temperature readings may be inaccurate and thermometers broken by unexpected movements of the patient’s jaws.

**Oral Temperatures.** For *oral temperatures*, choose a glass or an electronic thermometer. When using a *glass thermometer*, shake the thermometer down to 35°C (96°F) or below, insert it under the tongue, instruct the patient to close both lips, and wait 3 to 5 minutes. Then read the thermometer, reinsert it for a minute, and read it again. If the temperature is still rising, repeat this procedure until the reading remains stable. Note that hot or cold liquids, and even smoking, can alter the temperature reading. In these situations, it is best to delay measuring the temperature for 10 to 15 minutes. Due to breakage and mercury exposure, glass thermometers are being replaced by electronic thermometers.

If using an *electronic thermometer*, carefully place the disposable cover over the probe and insert the thermometer under the tongue. Ask the patient to close both lips, and then watch closely for the digital readout. An accurate temperature recording usually takes about 10 seconds.

**Rectal Temperatures.** For a *rectal temperature*, ask the patient to lie on one side with the hip flexed. Select a rectal thermometer with a stubby tip, lubricate it, and insert it about 3 cm to 4 cm (1½ inches) into the anal canal, in a direction pointing to the umbilicus. Remove it after 3 minutes, then read. Alternatively, use an electronic thermometer after lubricating the probe cover. Wait about 10 seconds for the digital temperature recording to appear.

**Tympanic Membrane Temperatures.** Taking the *tympanic membrane temperature* is an increasingly common practice and is quick, safe, and reliable if performed properly. Make sure the external auditory canal is free of cerumen, which lowers temperature readings. Position the probe in the canal so that the infrared beam is aimed at the tympanic membrane (otherwise the measurement will be invalid). Wait 2 to 3 seconds until the digital temperature reading appears. This method measures core body temperature, which is higher than the normal oral temperature by approximately 0.8°C (1.4°F). Tympanic measurements are more variable than oral or rectal measurements, including right and left comparisons in the same person.

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**Acute and Chronic Pain**

**Understanding Acute and Chronic Pain.** The International Association for the Study of Pain defines *pain* as “an unpleasant sensory and emotional experience” associated with tissue damage. The experience of pain is complex and multifactorial. Pain involves sensory, emotional, and cognitive processing but may lack a specific physical etiology.

Chronic pain may be a spectrum disorder related to mental health and somatic conditions. See Chapter 5, Behavior and Mental Status, Symptoms and Behavior, pp. 142–146.
Techniques of Examination

Because abnormalities covered by the hair are easily missed, ask if the patient has noticed anything wrong with the scalp or hair. If you detect a hairpiece or wig, ask the patient to remove it.

Examine:

The Hair. Note its quantity, distribution, texture, and any pattern of loss. You may see loose flakes of dandruff.

The Scalp. Part the hair in several places and look for scaliness, lumps, nevi, or other lesions.

The Skull. Observe the general size and contour of the skull. Note any deformities, depressions, lumps, or tenderness. Learn to recognize the irregularities in a normal skull, such as those near the suture lines between the parietal and occipital bones.

The Face. Note the patient’s facial expression and contours. Observe for asymmetry, involuntary movements, edema, and masses.

The Skin. Observe the skin, noting its color, pigmentation, texture, thickness, hair distribution, and any lesions.

Examples of Abnormalities

Fine hair is seen in hyperthyroidism; coarse hair in hypothyroidism. Tiny white ovoid granules that adhere to hairs may be nits (lice eggs).

Look for redness and scaling that may indicate seborrheic dermatitis or psoriasis; soft lumps that may be pilar cysts (wens); pigmented nevi.

An enlarged skull may signify hydrocephalus or Paget’s disease of bone. Palpable tenderness or step-offs may be present after head trauma.

See Table 7-5, Selected Facies, p. 264.

Acne is found in many adolescents. Hirsutism (excessive facial hair) occurs in some women with polycystic ovary syndrome.

THE EYES

Anatomy and Physiology

Identify the structures illustrated at the right. Note that the upper eyelid covers a portion of the iris but does not normally overlay the pupil. The opening between the eyelids is called the palpebral fissure. The white sclera may look somewhat buff-colored at its periphery. Do not mistake this color for jaundice, which is a deeper yellow.
The **conjunctiva** is a clear mucous membrane with two easily visible components. The **bulbar conjunctiva** covers most of the anterior eyeball, adhering loosely to the underlying tissue. It meets the cornea at the **limbus**. The **palpebral conjunctiva** lines the eyelids. The two parts of the conjunctiva merge in a folded recess that permits movement of the eyeball.

Within the eyelids lie firm strips of connective tissue called **tarsal plates**. Each plate contains a parallel row of **meibomian glands**, which open on the lid margin. The **levator palpebrae**, the muscle that raises the upper eyelid, is innervated by the oculomotor nerve, CN III. Smooth muscle, innervated by the sympathetic nervous system, also contributes to lid elevation.

A film of tear fluid protects the conjunctiva and cornea from drying, inhibits microbial growth, and gives a smooth optical surface to the cornea. This fluid comes from the meibomian glands, conjunctival glands, and lacrimal gland. The **lacrimal gland** lies mostly within the bony orbit, above and lateral to the eyeball. The tear fluid spreads across the eye and drains medially through two tiny holes called **lacrimal puncta**. The tears then pass into the **lacrimal sac** and on into the nose through the **nasolacrimal duct**. You can easily find a **punctum** atop the small elevation of the lower lid medially. The lacrimal sac rests in a small depression inside the bony orbit and is not visible.
The eyeball is a spherical structure that focuses light on the neurosensory elements within the retina. The muscles of the iris control pupillary size. Muscles of the ciliary body control the thickness of the lens, allowing the eye to focus on near or distant objects.

A clear liquid called aqueous humor fills the anterior and posterior chambers of the eye. Aqueous humor is produced by the ciliary body, circulates from the posterior chamber through the pupil into the anterior chamber, and drains out through the canal of Schlemm. This circulatory system helps to control the pressure inside the eye.

The posterior part of the eye that is seen through an ophthalmoscope is often called the fundus of the eye. Structures here include the retina, choroid, fovea, macula, optic disc, and retinal vessels. The optic nerve with its retinal vessels enters the eyeball posteriorly. You can find it with an ophthalmoscope at the optic disc. Lateral and slightly inferior to the disc, there is a small depression in the retinal surface that marks the point of central vision. Around it is a darkened circular area called the fovea. The roughly circular macula (named for a microscopic yellow spot) surrounds the fovea but has no discernible margins. You do not usually see the normal vitreous body, a transparent mass of gelatinous material that fills the eyeball behind the lens. It helps to maintain the shape of the eye.
Visual Fields. A visual field is the entire area seen by an eye when it looks at a central point. Fields are conventionally diagrammed on circles from the patient's point of view. The center of the circle represents the focus of gaze. The circumference is 90 degrees from the line of gaze. Each visual field, shown by the white areas below, is divided into quadrants. Note that the fields extend farthest on the temporal sides. Visual fields are normally limited by the brows above, the cheeks below, and the nose medially. A lack of retinal receptors at the optic disc produces an oval blind spot in the normal field of each eye, 15 degrees temporal to the line of gaze.

When a person is using both eyes, the two visual fields overlap in an area of binocular vision. Laterally, vision is monocular.

Visual Pathways. To see an image, light reflected from the image must pass through the pupil and be focused on sensory neurons in the retina. The image projected there is upside down and reversed right to left. An image from the upper nasal visual field thus strikes the lower temporal quadrant of the retina.
Nerve impulses, stimulated by light, are conducted through the retina, optic nerve, and optic tract on each side, then on through a curving tract called the **optic radiation**. This ends in the visual cortex, a part of the occipital lobe.

**Pupillary Reactions.** Pupillary size changes in response to light and to the effort of focusing on a near object.

**The Light Reaction.** A light beam shining onto one retina causes pupillary constriction in both that eye, termed the **direct reaction** to light, and in the opposite eye, the **consensual reaction**. The initial sensory pathways are similar to those described for vision: retina, optic nerve, and optic tract. The pathways diverge in the midbrain, however, and impulses are transmitted through the oculomotor nerve, CN III, to the constrictor muscles of the iris of each eye.
The Near Reaction. When a person shifts gaze from a far object to a near one, the pupils constrict. This response, like the light reaction, is mediated by the oculomotor nerve (CN III). Coincident with this pupillary constriction, but not part of it, are (1) convergence of the eyes, an extraocular movement; and (2) accommodation, an increased convexity of the lenses caused by contraction of the ciliary muscles. This change in shape of the lenses brings near objects into focus but is not visible to the examiner.

Autonomic Nerve Supply to the Eyes. Fibers travelling in the oculomotor nerve (CN III) and producing pupillary constriction are part of the parasympathetic nervous system. The iris is also supplied by sympathetic fibers. When these are stimulated, the pupil dilates, and the upper eyelid rises a little, as if from fear. The sympathetic pathway starts in the hypothalamus and passes down through the brainstem and cervical cord into the neck. From there, it follows the carotid artery or its branches into the orbit. A lesion anywhere along this pathway may impair sympathetic effects that dilate the pupil.
Extraocular Movements. The coordinated action of six muscles, the four rectus and two oblique, control the eye. You can test the function of each muscle and the cranial nerve that supplies it by asking the patient to move the eye in the direction controlled by that muscle. There are six such cardinal directions, indicated by the lines on the figure below. When a person looks down and to the right, for example, the right inferior rectus (CN III) is principally responsible for moving the right eye, whereas the left superior oblique (CN IV) is principally responsible for moving the left eye. If one of these muscles is paralyzed, the eye will deviate from its normal position in that direction of gaze and the eyes will no longer appear conjugate, or parallel.

Techniques of Examination

Important Areas of Examination

- Visual acuity
- Visual fields
- Conjunctiva and sclera
- Cornea, lens, and pupils
- Extraocular movements

Visual Acuity. To test the acuity of central vision, use a well-lit Snellen eye chart, if possible. Position the patient 20 feet from the chart. Patients who use glasses other than for reading should wear them. Ask the patient to cover one eye with a card (to prevent peeking through the fingers) and to read the smallest line of print possible. Coaxing to attempt the next line may improve performance. A patient who cannot read the largest letter should be positioned closer to the chart; note the intervening distance. Determine the smallest line of print from which the patient can identify more than half the letters. Record the visual acuity designated at the side of this line, along with use of glasses, if any. Visual acuity is expressed as two numbers (e.g., 20/30): the first indicates the distance of the patient from the chart, and the second, the distance at which a normal eye can read the line of letters.

Vision of 20/200 means that at 20 feet the patient can read print that a person with normal vision could read at 200 feet. The larger the second number, the worse the vision. “20/40 corrected” means the patient could read the 40 line with glasses (a correction).

Myopia is impaired far vision.
Finally, test for *convergence*. Ask the patient to follow your finger or pencil as you move it in toward the bridge of the nose. The converging eyes normally follow the object to within 5 cm to 8 cm of the nose.

**Convergence**

*Ophthalmoscopic Examination.* In general health care, examine your patients’ eyes *without dilating their pupils*. Your view is, therefore, limited to the posterior structures of the retina. To see more peripheral structures, to evaluate the macula well, or to investigate unexplained visual loss, ophthalmologists dilate the pupils with mydriatic drops unless this is contraindicated.

At first, using the ophthalmoscope may seem awkward, and it may be difficult to visualize the fundus. With patience and practice of proper technique, the fundus will come into view, and you will be able to assess important structures such as the optic disc and the retinal vessels. Remove your glasses unless you have marked nearsightedness or severe astigmatism. (If the patient’s refractive errors make it difficult to focus on the fundi, however, it may be easier to keep your glasses on.)

Review the components of the ophthalmoscope pictured above. Then follow the steps for using the ophthalmoscope, and your examination skills will improve over time.

**Steps for Using the Ophthalmoscope**

- Darken the room. Switch on the ophthalmoscope light and turn the lens disc until you see the large round beam of white light. *Shine the light on the back of your hand to check the type of light, its desired brightness, and the electrical charge of the ophthalmoscope.*
- Turn the lens disc to the 0 diopter. (A diopter is a unit that measures the power of a lens to converge or diverge light.) At this diopter, the lens either

(continued)
Steps for Using the Ophthalmoscope (continued)

- Converges nor diverges light. Keep your finger on the edge of the lens disc so you can turn the disc to focus the lens when you examine the fundus.
- Hold the ophthalmoscope in your right hand and use your right eye to examine the patient's right eye; hold it in your left hand and use your left eye to examine the patient's left eye. This keeps you from bumping the patient's nose and gives you more mobility and closer range for visualizing the fundus. At first, you may have difficulty using your nondominant eye, but this will abate with practice.
- Hold the ophthalmoscope firmly braced against the medial aspect of your bony orbit, with the handle tilted laterally at about a 20-degree slant from the vertical. Check to make sure you can see clearly through the aperture. Instruct the patient to look slightly up and over your shoulder at a point directly ahead on the wall.
- Place yourself about 15 inches away from the patient and at an angle 15 degrees lateral to the patient's line of vision. Shine the light beam on the pupil and look for the orange glow in the pupil—the red reflex. Note any opacities interrupting the red reflex.

![Examiner at 15-degree angle from patient's line of vision, eliciting red reflex](image)

Now, place the thumb of your other hand across the patient's eyebrow. (This technique helps keep you steady but is not essential.) Keeping the light beam focused on the red reflex, move in with the ophthalmoscope on the 15-degree angle toward the pupil until you are very close to it, almost touching the patient's eyelashes.

Try to keep both eyes open and relaxed, as if gazing into the distance, to help minimize any fluctuating blurriness as your eyes attempt to accommodate.

You may need to lower the brightness of the light beam to make the examination more comfortable for the patient, avoid hippus (spasm of the pupil), and improve your observations.

*Some clinicians like to use the large round beam for large pupils, and the small round beam for small pupils. The other beams are rarely helpful. The slitlike beam is sometimes used to assess elevations or concavities in the retina, the green (or red-free) beam to detect small red lesions, and the grid to make measurements. Ignore the last three lights and practice with the large or small round white beam.*

Absence of a red reflex suggests an opacity of the lens (cataract) or possibly of the vitreous. Less commonly, a detached retina or, in children, a retinoblastoma may obscure this reflex. Do not be fooled by an artificial eye, which has no red reflex.
Now you are ready to inspect the *optic disc* and the *retina*. You should be seeing the optic disc—a yellowish orange to creamy pink oval or round structure that may fill your field of gaze. The ophthalmoscope magnifies the normal retina about 15 times and the normal iris about 4 times. The optic disc actually measures about 1.5 mm. Follow the next steps for this important segment of the physical examination.

**Steps for Examining the Optic Disc and the Retina**

**The Optic Disc**

- **First. locate the optic disc.** Look for the round yellowish-orange structure described above. If you do not see it at first, follow a blood vessel centrally until you do. You can tell which direction is central by noting the angles at which vessels branch—the vessel size becomes progressively larger at each junction as you approach the disc.

- **Now, bring the optic disc into sharp focus** by adjusting the lens of your ophthalmoscope. If both you and the patient have no refractive errors, the retina should be in focus at 0 diopters. If structures are blurred, rotate the lens disc until you find the sharpest focus.

  For example, if the patient is myopic (nearsighted), rotate the lens disc counterclockwise to the minus diopters; in a hyperopic (farsighted) patient, move the disc clockwise to the plus diopters. You can correct your own refractive error in the same way.

- **Inspect the optic disc.** Note the following features:
  - *The sharpness or clarity of the disc outline.* The nasal portion of the disc margin may be somewhat blurred, a normal finding.
  - *The color of the disc,* normally yellowish orange to creamy pink. White or pigmented crescents may ring the disc, a normal finding.
  - *The size of the central physiologic cup,* if present. It is usually yellowish white. The horizontal diameter is usually less than half the horizontal diameter of the disc.
  - *The comparative symmetry* of the eyes and findings in the fundi.

**Detecting Papilledema.** *Papilledema* describes swelling of the optic disc and anterior bulging of the physiologic cup. Increased intracranial pressure is transmitted to the optic nerve, causing stasis of axoplasmic flow, intra-axonal (continued)
edema, and swelling of the optic nerve head. Papilledema often signals serious disorders of the brain, such as meningitis, subarachnoid hemorrhage, trauma, and mass lesions, so searching for this important disorder is a priority during all your funduscopic examinations.

Inspect the fundus for spontaneous venous pulsations (SVPs), rhythmic variations in the caliber of the retinal veins as they cross the fundus (narrower in systole; wider in diastole), present in 90% of normal patients.

The Retina—Arteries, Veins, Fovea, and Macula

- **Inspect the retina**, including arteries and veins as they extend to the periphery, arteriovenous crossings, the fovea, and the macula. Distinguish arteries from veins based on the features listed below.

<table>
<thead>
<tr>
<th>Arteries</th>
<th>Veins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color</td>
<td>Light red</td>
</tr>
<tr>
<td>Size</td>
<td>Smaller (1/4 to 1/3 the diameter of veins)</td>
</tr>
<tr>
<td>Light Reflex (reflection)</td>
<td>Bright</td>
</tr>
<tr>
<td></td>
<td>Larger</td>
</tr>
<tr>
<td></td>
<td>Inconspicuous or absent</td>
</tr>
</tbody>
</table>

- **Follow the vessels peripherally in each of four directions**, noting their relative sizes and the character of the arteriovenous crossings.

- Identify any lesions of the surrounding retina and note their size, shape, color, and distribution. As you search the retina, move your head and instrument as a unit, using the patient's pupil as an imaginary fulcrum. At first, you may lose your view of the retina because your light falls out of the pupil. You will improve with practice.

- Lesions of the retina can be measured in terms of "disc diameters" from the optic disc.

Loss of SVPs occurs with high intracranial pressures (above 190 mm H₂O) that change the pressure gradient between cerebral spinal fluid pressure and intraocular pulse pressure in the optic disc.⁴²,⁴³

See Table 7-14, Retinal Arteries and Arteriovenous Crossings: Normal and Hypertensive, p. 273; Table 7-15, Red Spots and Streaks in the Fundi, p. 274; Table 7-16, Ocular Fundi: Normal and Hypertensive Retinopathy, p. 275; Table 7-17, Ocular Fundi: Diabetic Retinopathy, p. 276; Table 7-18, Light-Colored Spots in the Fundi, p. 277.

Note the irregular patches between 11 and 12 o'clock, 1 to 2 disc diameters from the disc. Each measures about one-half by one-half disc diameters.
Steps for Examining the Optic Disc and the Retina (continued)

- Inspect the fovea and surrounding macula. Direct your light beam laterally or by asking the patient to look directly into the light. In younger people, the tiny bright reflection at the center of the fovea helps to orient you; shimmering light reflections in the macular area are common.

- Inspect the anterior structures. Look for opacities in the vitreous or lens. Rotate the lens disc progressively to diopters of around +10 or +12, so you can focus on the more anterior structures in the eye.

Macular degeneration is an important cause of poor central vision in older adults. Types include dry atrophic (more common but less severe) and wet exudative, or neovascular. Undigested cellular debris, called drusen, may be hard and sharply defined, as seen below, or soft and confluent with altered pigmentation (see p. 277).

Vitreous floaters may be seen as dark specks or strands between the fundus and the lens. Cataracts are densities in the lens (see p. 268).

THE EAR

Anatomy and Physiology

The ear has three compartments: the external ear, the middle ear, and the inner ear.

The External Ear. The external ear comprises the auricle and ear canal. The auricle consists chiefly of cartilage covered by skin and has a firm elastic consistency. Its prominent curved outer ridge is the helix. Parallel and anterior to the helix is another curved prominence, the antihelix. Inferiorly is the fleshy projection of the earlobe, or lobule. The ear canal opens behind the tragus, a nodular protuberance that points backward over the entrance to the canal.

The ear canal curves inward and is approximately 24 mm long. Cartilage surrounds its outer portion. The skin in this portion is
hairy and contains glands that produce cerumen (wax). The inner portion of the canal is surrounded by bone and lined by thin, hairless skin. Pressure on this latter area causes pain—a point to remember when you when you examine the ear. At the end of the ear canal lies the lateral tympanic membrane, or eardrum, marking the lateral limit of the external ear. The external ear captures sound waves for transmission into the middle and inner ear.

Behind and below the ear canal is the mastoid portion of the temporal bone. The lowest portion of this bone, the mastoid process, is palpable behind the lobule.

**The Middle Ear.** In the air-filled middle ear, the ossicles—the malleus, the incus, and the stapes—transform sound vibrations into mechanical waves for the inner ear. The proximal end of the eustachian tube connects the middle ear to the nasopharynx.

Two of the ossicles are visible through the tympanic membrane, and are angled obliquely and held inward at its center by the malleus. Find the handle and the short process of the malleus, the two chief landmarks. From the umbo, where the eardrum meets the tip of the malleus, a light reflection called the cone of light fans downward and anteriorly. Above the short process lies a small portion of the eardrum called the pars flaccida. The remainder of the drum is the pars tensa. Anterior and posterior malleolar folds, which extend obliquely upward from the short process, separate the pars flaccida from the pars tensa but
are usually invisible unless the eardrum is retracted. A second ossicle, the *incus*, can sometimes be seen through the drum.

**The Inner Ear.** The inner ear includes the *cochlea*, the *semicircular canals*, and the distal end of the *auditory nerve (CN VIII)*. Movements of the stapes vibrate the perilymph in the labyrinth of the semicircular canals and the hair cells and endolymph in the ducts of the cochlea, producing electrical nerve impulses transmitted by the auditory nerve to the brain.

Much of the middle ear and all of the inner ear are inaccessible to direct examination. Assess their condition by testing auditory function.

**Hearing Pathways.** The first part of the hearing pathway, from the external ear through the middle ear, is known as the *conductive phase*. The second part of the pathway, involving the cochlea and cochlear nerve, is the *sensorineural phase*.

Hearing disorders of the external and middle ear cause *conductive hearing loss*. External ear causes include infection (*otitis externa*), trauma, squamous cell carcinoma, and benign bony growths such as *exostoses* or *osteomas*. Middle ear disorders include congenital conditions, benign cholesteatomas and otosclerosis, tumors, and perforation of the tympanic membrane.

Disorders of the inner ear cause *sensorineural hearing loss* from congenital and hereditary conditions, *presbycusis*, viral infections such as *rubella* and *cytomegalovirus*, Ménière's disease, noise exposure, and *acoustic neuroma*.

*Air conduction* describes the normal first phase in the hearing pathway. An alternate pathway, known as *bone conduction*, bypasses the external and middle ear and is used for testing purposes. A vibrating tuning fork, placed on the head, sets the bone of the skull into vibration and stimulates the cochlea directly. In a normal person, air conduction is more sensitive than bone conduction.

**Equilibrium.** The labyrinth of three semicircular canals in the inner ear senses the position and movements of the head and helps to maintain balance.
Techniques of Examination

The Auricle. Inspect the auricle and surrounding tissue for deformities, lumps, or skin lesions.

If ear pain, discharge, or inflammation is present, move the auricle up and down, press the tragus, and press firmly just behind the ear.

Ear Canal and Drum. To see the ear canal and drum, use an otoscope with the largest ear speculum that the canal will accommodate. Position the patient’s head so that you can see comfortably through the instrument. To straighten the ear canal, grasp the auricle firmly but gently and pull it upward, backward, and slightly away from the head.

Holding the otoscope handle between your thumb and fingers, brace your hand against the patient’s face. Your hand and instrument can then follow unexpected movements by the patient. (If you are uncomfortable switching hands for the left ear, as shown below, you may reach over that ear to pull it up and back with your left hand and rest your otoscope-holding right hand on the head behind the ear.)

Insert the speculum gently into the ear canal, directing it somewhat down and forward and through the hairs, if any.

See Table 7-19, Lumps on or Near the Ear, p. 278.

Movement of the auricle and tragus (the “tug test”) is painful in acute otitis externa (inflammation of the ear canal), but not in otitis media (inflammation of the middle ear). Tenderness behind the ear may be present in otitis media.

Nontender nodular swellings covered by normal skin deep in the ear canals suggest exostoses. These are nonmalignant overgrowths which may obscure the drum.
ANATOMY AND PHYSIOLOGY AND TECHNIQUES OF EXAMINATION

*Inspect the ear canal,* noting any discharge, foreign bodies, redness of the skin, or swelling. Cerumen, which varies in color and consistency from yellow and flaky to brown and sticky or even to dark and hard, may wholly or partly obscure your view.

![Diagram of the Eardrum]

*Inspect the eardrum,* noting its color and contour. The cone of light—usually easy to see—helps to orient you.

Identify the *handle of the malleus,* noting its position, and inspect the *short process of the malleus.*

Gently move the speculum so that you can see as much of the drum as possible, including the *pars flaccida* superiorly and the margins of the *pars tensa.* Look for any perforations. The anterior and inferior margins of the drum may be obscured by the curving wall of the ear canal.

Mobility of the eardrum can be evaluated with a pneumatic otoscope.

**Testing Auditory Acuity—Whispered Voice Test.** To begin screening, ask the patient “Do you feel you have a hearing loss or difficulty hearing?” If the patient reports hearing loss, proceed to the whispered voice test.

The *whispered voice test* is a reliable screening test for hearing loss if examiners use a standard method of testing and exhales before whispering. For best results, follow the steps on the next page.

Examples of Abnormalities

In acute *otitis externa,* shown below, the canal is often swollen, narrowed, moist, pale, and tender. It may be reddened.

![Image of acute otitis externa]

In *chronic otitis externa,* the skin of the canal is often thickened, red, and itchy.

Look for the red bulging drum of acute purulent *otitis media*; the amber drum of a serous effusion. See Table 7-20, Abnormalities of the Eardrum, p. 279.

An unusually prominent short process and a prominent handle that looks more horizontal suggest a retracted drum.

A serous effusion, a thickened drum, or purulent *otitis media* may decrease mobility.

Patients who answer “yes” are twice as likely to have a hearing deficit; for patients who report normal hearing the likelihood of moderate to severe hearing impairment is only 0.13. Sensitivity is 90% to 100% and specificity 70% to 87%. This test detects significant hearing loss of greater than 30 decibels.