Review Last Lecture
- How do we reduce infection and prevent disease transmission?
- 3 modes of infection transmission
- 3 levels of cleanliness
- Universal Precautions
- Standard precautions (hand hygiene, PPE, respiratory hygiene, equipment/environment care)
- Sterile Field (creating, maintaining, gowning & gloving)

Why Learn Vital Signs?
- 1. It is an objective measurement of physiological function
- 2. Used to monitor a patient’s status prior to, during and after patient care
- 3. Vital Signs may indicate physiological responses to treatment
FOUR Vital Signs (& 3 extra)

- Heart rate
- Blood pressure
- Respiration rate
- Temperature
- Pain
- Pulse oximetry
- Rating of perceived exertion

Johansson, p108

Heart Rate

- There are **2 reasons** that we measure heart rate
  - **1.** to assess a patient’s cardiovascular (CV) health and response to PT treatment
  - **2.** to determine patency (the openness of the peripheral portion of the CV system)

Heart Rate

- **Pulse:** a measurement of heart rate
- Determining when to measure pulse rate during a PT session is dependent upon the patient’s condition
  - **Resting heart rate:** measured during rest, one indication of cardiovascular function
  - **During activity:** measuring CV system’s capacity to provide blood flow during physical stress
  - **After activity:** measuring the CV system’s ability to recover

Johansson, p110
Heart Rate & Patency

- **Patency**: the openness of the peripheral portion of the CV system
- We measure the presence or absence of a pulse at a chosen site
- **Chosen sites**:
  - Brachial, popliteal, posterior tibial, dorsal pedal, femoral, carotid, radial, apical
- Why would a pulse not be there?
  - May indicate arterial occlusion secondary to disease states (i.e., diabetes).
  - Edema may be a barrier to finding a peripheral pulse
  - If there is no pulse and you don’t have a medical explanation, it is a red flag. The PT must be notified so that an appropriate referral can be made.

Methods for Measuring Pulse

- **Manual palpation**
- **Use of a stethoscope**
- **Oximeter** (not responsible for)
- **Doppler** (not responsible for)

Manual Palpation of Pulses

- Do not use the pad of the thumb (due to presence of an artery in your thumb)
- Use the pads of the index and middle fingers of one hand over the site where the pulse is to be measured
- Do not press too hard
- Measured in beats per minute (bpm) – must be included in documentation
Heart Rate Measurement

- Use a watch or clock with a second hand
- Once a pulse is palpated, count beats within a specific interval of time
  - 60 seconds (no calculation needed) = most accurate
  - 30 seconds (multiply by 2)
  - 15 seconds (multiply by 4)
  - 10 seconds (multiply by 6)
  - Less than 10 seconds = less precise
- Using short cuts increases errors
  - Actual = 72 bpm
  - Miss 1 in 60 second count = 71 bpm (1.4% error)
  - Miss 1 in 10 second count = 66 bpm (8.3% error)

Heart Rate Measurement continued

- Start the time period of counting at a specific time on the watch, and the first heartbeat felt after the time period has begun is considered beat 1
- Resting Heart Rate
  - Adult norm: 60-100 bpm
  - Child (1-8yr): 80-100 bpm
  - Infant (1-12 mo): 100-120 bpm
  - Neonate (1-28 days): 120-160 bpm
  - Bradycardia: less than 60 bpm
  - Tachycardia: greater than 100 bpm

Maximal Heart Rate

- The highest heart rate a person should achieve upon exertion with respect to age.
- The following guidelines are based for patients without cardiovascular pathology
- 220 - patient’s age = maximal heart rate
- Ex. 47 year old: 220-47 = 173 bpm
Target Heart Rate

- The heart rate that an individual should achieve during cardiovascular conditioning with respect to age and medical condition.
- **For patients without contraindications**, target HR must fall between 60% & 80% of maximal heart rate
- 177(0.60) and 177(0.80)
- Between 106 bpm & 142 bpm

Factors Affecting Heart Rate

- Age
- Gender
- Activity
- Environment
- Drugs

Johansson, p115

Measurement Tools

- Stethoscope
  - An instrument used to transmit sounds produced by the body to the examiner’s ears.
Stethoscope

- Components
  - Ear pieces
    - For an individual’s use, potential for spread of disease with sharing of earpieces.
    - Use alcohol to clean the ear pieces
  - “Y” Tubing
    - Should be flexible and free of cracks

Stethoscope

- Bell/diaphragm
  - An enlarged metal or plastic attachment on the distal portion of the stethoscope to be applied to the skin of the patient
  - Amplifies the sounds being made by the body underneath it

Stethoscope

- Diaphragm/Bell
  - “active” position
    - Test for sound with a light tap to make sure that the side down is active
  - Bell
    - Smaller diameter
    - For hearing low frequency sounds (heart murmur)
    - For smaller areas of contact
  - Diaphragm
    - Larger diameter
    - Lung sounds, heart sounds
Blood Pressure

- Why do we measure blood pressure?
  - To determine vascular resistance to blood flow

- Two values make up blood pressure
  - **Systolic pressure**: how much pressure the blood is exerting against the arterial walls when the heart is contracting (top #); the first sound heard during reading
  - **Diastolic pressure**: how much pressure the arterial walls are exerting on blood when the heart is not contracting (bottom #); the last sound heard during reading

Methods for taking BP

- #1. Auscultation of an artery using a stethoscope while a sphygomanometer is applied over the same artery
  - Reported in mmHg (millimeters of mercury) b/c it was originally based on the pressure required to raise a column of mercury in a glass tube
  - Sounds you are listening for are called Korotkoff sounds

- #2. Sensor placed in artery (A-lines)

Monitoring Blood Pressure

- **Location**
  - Most commonly
    - The brachial artery in the cubital fossa

Johansson, p1019
Documentation of BP

- A systolic reading of 120 mmHg and a diastolic pressure of 80 mmHg is documented as 120/80 mmHg
- Verbally reported as “120 over 80”
- Documentation should include
  - The body part
  - The side (left or right)
  - Patient position
  - Reading

Contraindications to BP

- Do NOT measure BP
  - On arm with lymphedema
  - On arm of ipsilateral side of recent mastectomy
  - Over open wound
  - Dialysis shunt
  - IV or other inserted line
  - Abnormally high or low muscle tone (after a CVA)

What can affect BP readings?

- Arm side (left is higher)
- Patient position
- Medications
- Disease states
- Stress
- Physical activity
- Age
- Tobacco use & alcohol consumption
- Recent Food Consumption
- Exposure to heat or cold
- Pain
- Valsalva Maneuver

Johansson, p119
BP Norms & Red Flags

- **Norms**
  - Systolic less than 120 mmHg
  - Diastolic less than 80 mmHg

- **Red Flags** (an indication to stop PT and examine cardiac status)
  - Systolic does not rise with activity
  - Diastolic increase greater than 20 mmHg during activity
  - Diastolic decrease greater than 10 mmHg with activity
  - Resting Systolic greater than 200 mmHg
  - Resting Diastolic greater than 110 mmHg

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Sphygmomanometer

- **PRONUNCIATION**
  - Sphyg  sfig
  - Mo    mo
  - Man   man
  - Ometer ah meter

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Measurement Tools

- **Sphygmomanometer**
  - (blood pressure cuff)
  - An instrument used for determining arterial blood pressure indirectly.
**Sphygmomanometer**

- **Components**
  - Sleeve that contains an air bladder
  - Pressure gauge
  - Bulb and valve for adjustment of pressure

- **The Bladder**
  - Located in the sleeve, it should be positioned over the area to be occluded
    - Over the brachial artery in the cubital fossa
    - Over the popliteal artery if the UE is contraindicated bilaterally

- **The valve**
  - Tightened and loosened with the thumb and index finger
  - There is a definite open and closed position
  - Check the operation BEFORE applying the cuff to a patient
Sphygmomanometer

- **The Gauge**
  - Either Mercury or aneroid reading mmHg of pressure

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Monitoring Blood Pressure

- **Procedure**
  - Inspect the cuff for breaks and the location of the bladder
  - Inspect the valve
    - Practice opening and closing the valve
    - With one hand
  - Wrap the cuff around the UE with the bladder over the brachial artery

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Monitoring Blood Pressure

- Palpate the brachial pulse
- Check the diaphragm of the stethoscope for the active position
- Place the stethoscope's diaphragm over the brachial pulse
Monitoring Blood Pressure

- Close the valve & inflate the cuff 30 mmHg higher then when the pulse is no longer audible or when the radial pulse can no longer be felt
- Slightly open the valve, allowing the cuff to slowly deflate
- Watch the gauge
  - Systolic BP occurs when the pulse first becomes audible (sounds like a tapping)
  - Diastolic BP occurs when the last audible pulse is heard

- Continue to deflate the cuff (at a more rapid rate at this point)
- Record the readings indicating mmHg for systolic/diastolic pressures

Blood Pressure

- **Normal** is considered 120/80 mmHg
- **Abnormal**
  - **Hypertension**
    - Systolic consistently greater than 140 mmHg
    - Diastolic consistently greater than 90 mmHg
  - **Hypotension**
    - Systolic consistently less than 100 mmHg
    - Diastolic consistently less than 60 mmHg
Blood Pressure

- **Systolic Abnormality in response to activity**
  - Flat response
  - Decreased systolic pressure
  - Normal response followed by systolic BP drop at increased workload
  - Excessive increase
    - Patients with severe ischemia
    - Poor ventricular function
    - Inability of the ventricles to increase stroke volume

Blood Pressure

- **Diastolic Abnormality with regards to activity**
  - Persistent rise in diastolic pressure with activity
    - Greater than 15-20 mm Hg
    - May indicate severe cardiac arterial disease

Blood Pressure

- **Orthostatic hypotension**
  - **Definition**: A fall in blood pressure associated with dizziness, syncope, and blurred vision that appears with sitting or standing up.
  - **Results from**:
    - Prolonged bed rest
    - Poor ventricular function
    - Medications
  - **Treatment**:
    - Lie back down if severe
    - Slowly raise the head of the bed
    - Have patient stay in seated position before standing
    - Ankle pumps
What is considered orthostatic hypotension?

- Drop in systolic greater than 20 mmHg
- Systolic less than 100 mmHg while standing

Respiration

- "the act of breathing"
  - Inhaling and exhaling
    - The lungs are provided with air through inhaling
    - Carbon dioxide is removed through exhaling

Respiratory Rate (RR)

- Measures the rate of breathing
- Each cycle includes one inspiration and the subsequent exhalation
- Methods:
  - Auscultation: listening with stethoscope
  - Observation: visual, auditory, or palpation
  - Visual and auditory measurements are unobtrusive and can be made without the patient knowing, just prior to or after taking a pulse
When the patient is breathing too shallow or quietly to easily measure using auditory or visual observations, then you can either use a stethoscope to listen, or place your hand on the patient’s thorax or use the dorsum of your hand close to but not touching the mouth/nose to feel the air flow.

Measured as the number of breathing cycles per minute
Same process as testing heart rate
Count only full cycles (inhalation & exhalation)
Reported without the use of units
Documented as 12 RR (not 12 cycles per minute)

Exhalation is usually longer than inhalation
Can also document:
- Depth of inspiration (shallow, normal)
- Use of accessory muscles of respiration

Normal resting respiratory rates:
- Adults = 12 RR
- Children = 20 RR
- Abnormal = less than 10 or greater than 20 RR
Respiratory Rate

- A patient will often alter their rate if they are aware that they are being monitored.
  - Be discreet!!!
  - Observe the following for expansion:
    - Rib cage
    - Nostrils
    - Chest

Respiratory Rate

- **Influencing Factors**
  - Pulmonary Pathology
  - Cardiac Pathology
  - De-conditioning
  - Pain/anxiety
  - Medications

Measurement Tools

- **Clock** (with a second hand)
  - 60 seconds is a fairly long period of time to count the number of respirations, yet it is the most accurate amount of time when irregularities are present.
Temperature

- Gives us info regarding (1) potential presence of infection and (2) metabolic response to exercise
- You may not routinely measure temp, but you need to know the methods and norms
  - Method = thermometer
  - Norms = 98.6° F or 36.6° C
  - Temps fluctuate a few degrees during the day

Temperature continued

- PTs and PTAs frequently measure skin temperature
- Skin temperature provides information concerning:
  - Circulatory status (cold extremity?)
  - Potential peripheral nerve injury (CRPS)
  - Local inflammatory responses

Skin Temperature Method

- Use the dorsum of your hand lightly on the skin, moving it slowly distal to proximal, noting any temp changes
- Helpful to do this on both left and right to compare
- Not objective
Pain

- A subjective perception described by patients
- These perceptions are unique to each individual and may depend on:
  - Previous experience
  - Type of injury or disease
  - Body part affected
  - Age
  - Time since onset
  - Ethnic background

Pain continued

- Why document pain levels?
  - To help the PT determine diagnosis & prognosis
  - To help determine appropriate interventions
  - To measure the patient’s response to interventions

Pain

- **Method of Measurement**
  - **Visual Analog Scale (VAS)** – marking their pain level on a visual line from 0 to 10
  - We use a common adaptation called the NPS (numeric pain scale), which is to ask patients to provide a number between 0 and 10 that represents where they rank their current perception of pain
  - Children = faces
  - Body Diagrams
Rate of Perceived Exertion

- Patients are asked to choose a # that corresponds to how hard they feel they are working
- Often used with patients who are taking medications that mask pulse and blood pressure changes with activity

Johansson, p135

Self Selected Gait Speed

- Assesses physiological and functional status
- Is reliable and valid
- Is a predictor of falls, mortality, hospitalization, and location of residence after discharge
- Easy to measure

Johansson, p135
Self Selected Gait Speed continued

- The patient ambulates 20 feet.
- You measure the middle 10 feet with a timing device.
- Norms are in Johansson, page 136.

Johansson, p136

Pulse Oximetry

- Non-invasive, applied to finger or ear.
- Measures % of hemoglobin that is saturated with oxygen.
- Has light emitting diode, a photodiode signal detector and a microprocessor.
- It is a warning system.
- Be aware that the results can be misinterpreted (did the patient have a cigarette within the hour, nail polish, anemia, dye injection).
- Hold treatment if less than 90%.

Effects of Exercise on Vital Signs

<table>
<thead>
<tr>
<th></th>
<th>During Exercise</th>
<th>Long Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>Increases &amp; then plateaus</td>
<td>Decreases by 5-25 bpm</td>
</tr>
<tr>
<td>BP – systolic</td>
<td>Increases &amp; then plateaus</td>
<td>Decreases</td>
</tr>
<tr>
<td>BP – diastolic</td>
<td>Stays the same or slight decrease</td>
<td>Decreases</td>
</tr>
<tr>
<td>RR</td>
<td>Increases and then plateaus</td>
<td>Decreases</td>
</tr>
<tr>
<td>Temp</td>
<td>Increases</td>
<td>No affect</td>
</tr>
<tr>
<td>Pain</td>
<td>Dependent on many factors...goal?</td>
<td>depends</td>
</tr>
</tbody>
</table>
Measuring Vitals During Exercise

- How?

Safety during Emergency Episodes

- First make sure patient is in a safe position and environment
- Contact the PT, or nurse, and then PT depending on setting
- Continue to assess vital signs, signs and symptoms
- Possibly need to call 911

Cyanosis

- **Definition:** a dark bluish or purplish coloration of the skin, nail beds, lips, or mucous membranes due to deficient oxygenation of the blood
Responding to edema, pain, dyspnea

<table>
<thead>
<tr>
<th>Aggravating Activities</th>
<th>Edema</th>
<th>Pain</th>
<th>Dyspnea</th>
</tr>
</thead>
<tbody>
<tr>
<td>-dependent positions</td>
<td></td>
<td>-Unique to each patient</td>
<td>-Intense physical exertion</td>
</tr>
<tr>
<td>-exercise</td>
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</tbody>
</table>

| Relieving Activities   | -RICE | -Modalities -Rest -Movement (gentle) | -Rest -Meds if asthma -breathing techniques |
|                        |       |                                |                                           |

Documenting Vital Signs

- **Heart Rate**
  - Ex. Resting HR 78 bpm
  - Ex. HR after 10 min walk 100 bpm

- **Blood Pressure**
  - Ex. BP a rx 120/80mmHg left upper arm seated
  - Ex. BP p rx 130/75mmHg left upper arm supine

Documenting Vital Signs

- **Respiratory Rate**
  - Ex. RR 12 at rest

- **Temperature**
  - Ex. Left knee displays warmth to the touch in 5 inch radius surrounding incision site

- **Pain**
  - Ex. Left shoulder pain reported at 3/10 prior to rx.
Why do you think these are named “vital” signs?
Why do you think these are termed “signs”?
What is pain?

References