


# Cardiovascular Disease: Rehabilitation Considerations

Presented By  
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## Course Overview

- ▶ “Cardiovascular Disease: Rehabilitation Considerations” is a webinar for rehabilitation professionals that presents contemporary information about hypertension, atherosclerosis, atrial fibrillation, and heart failure. This course includes discussion of risk factors, pathogenesis, and therapeutic considerations for patients with these conditions.

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## Course Rationale

- ▶ The purpose of this course is to provide participants with contemporary information about the cardiovascular disease. Rehabilitation professionals can use this information when implementing their treatment programs to address the specific needs of individuals effected by these conditions.

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## Goals and Objectives

1. Identify the association between oral health, tobacco use, diet, physical activity, and cardiovascular disease.
2. Differentiate the clinical presentation and diagnostic criteria for the different types of hypertension.
3. Identify currently accepted standards and techniques used to measure blood pressure and monitor aerobic exercise intensity.
4. Identify components of metabolic syndrome and relationship to cardiovascular disease.
5. Define the role of chronic low-level inflammation in the pathogenesis of atherosclerosis.
6. Define atrial fibrillation and identify current strategies to manage anticoagulation bleeding risk factors.
7. Define the stages, pathogenesis, clinical presentation, and management of heart failure.
8. Identify biomarkers associated with specific cardiovascular diseases.
9. Identify considerations and parameters when developing exercise programs for patients with cardiovascular disease and indications for counter pressure maneuvers.
10. Identify the indications for use and mechanism of action of circulatory assist devices.


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## Disclaimer

- ▶ Application of concepts presented in this webinar is at the discretion of the individual participant in accordance with federal, state, and professional regulations.
- ▶ No conflict of interest exists for the presenter or provider of this course.

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### Course Outline and Schedule

| Topic  | Time       |
|--|------------|
| Contributors to Cardiovascular Health                  | 0:00-0:10  |
| Diet, Dental Health, Physical Activity                 | 0:11-0:20  |
| Blood Pressure Measurement                             | 0:21-0:25  |
| Equipment and Standard Technique                       | 0:26-0:30  |
| Hypertension   | 0:31-0:35  |
| Classifications  | 0:36-0:40  |
| Response to Exercise                                   | 0:41-0:50  |
| <b>Interactive Discussion of Clinical Applications</b> | 0:51-0:60  |
| Postural Hypotension Management Strategies             | 1:00-1:10  |
| Metabolic Syndrome                                     | 1:11-1:15  |
| Atherosclerosis Pathogenesis                           | 1:16-1:20  |
| Rehabilitation Considerations                          | 1:21-1:25  |
| Atrial Fibrillation                                    | 1:26-1:30  |
| Rehabilitation Considerations                          | 1:31-1:35  |
| Heart Failure Classifications                          | 1:36-1:40  |
| Pathogenesis   | 1:41-1:50  |
| <b>Interactive Discussion of Clinical Applications</b> | 1:51-2:00  |
| Rehabilitation Considerations                          | 2:01-2:10  |
| Cardiac Resynchronization                              | 2:11 -2:15 |
| Physical Activity Guidelines                           | 2:16-2:25  |
| Exercise Intensity Monitoring                          | 2:26-2:40  |
| Circulatory Assist Devices                             | 2:41-2:50  |
| <b>Interactive Discussion of Clinical Applications</b> | 2:51-3:00  |


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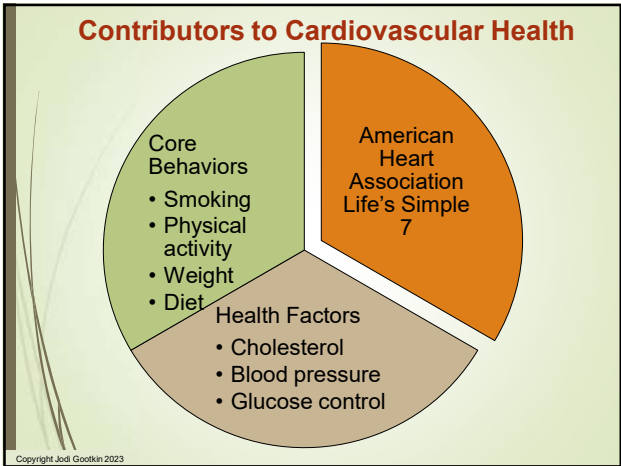
### Course Post Test

- Slides with "Consider This" icon in bottom right corner will be helpful in completing the post-test.



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### Behavioral Risk Factor Surveillance System (BRFSS)

- A continuous, state-based surveillance system that collects information about modifiable risk factors for chronic diseases and other leading causes of death.

| Core                            | Optional              |
|---------------------------------|-----------------------|
| Tobacco and alcohol use         | Anxiety               |
| Exercise                        | Oral Health           |
| Fruit and vegetable consumption | Cardiovascular Health |

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### Dietary Approaches to Stop Hypertension (DASH)

Fruits, vegetables, whole grain

Limit high fat dairy, meat and oils

Limit sugary beverages and food

Nutrition Goals

[https://ncsf.odc.gov/BRFSS/Prevalence/Report.aspx?rdReport=DPH\\_BRFSSExploreByTopic&LocationType=StatesAndMMSA&Class=CL\\_ABD10&rdTopic=TOPIC31&rdYear=2019&rdMetric=714](https://ncsf.odc.gov/BRFSS/Prevalence/Report.aspx?rdReport=DPH_BRFSSExploreByTopic&LocationType=StatesAndMMSA&Class=CL_ABD10&rdTopic=TOPIC31&rdYear=2019&rdMetric=714)  
Public domain: NIH, NHLBI. News: <https://www.nih.gov/news/2021/nih-supported-dash-diet-tops-rankings-heart-healthy-and-healthy-eating>

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### DASH Eating Goals

- Per Day
  - 6-8 Whole grains
  - Less than 6 Meat, fish, poultry
  - 4-5 Vegetables
  - 4-5 Fruits
  - 2-3 Low-fat dairy
  - 2-3 Fats and oils
- Per Week
  - Less than 5 sweets
  - 4-5 Nuts, seeds, legumes

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### DASH Outcomes

|                   |   |
|-------------------|---|
| DASH Trial        | <ul style="list-style-type: none"> <li>American Diet</li> <li>Lowered BP and LDL</li> </ul>   |
| DASH-Sodium Trial | <ul style="list-style-type: none"> <li>American Diet with sodium alterations</li> <li>Highest reduction in BP</li> </ul>                                      |
| OmniHeart Trial   | <ul style="list-style-type: none"> <li>DASH macronutrient alterations</li> <li>Weight constant, decreased BP and lipid levels with alterations</li> </ul>     |
| OmniCarb Trial    | <ul style="list-style-type: none"> <li>DASH carbohydrate alterations</li> <li>Weight constant, no change in BP, cholesterol or insulin resistance.</li> </ul> |
| PREMIER Trial     | <ul style="list-style-type: none"> <li>Advice vs. Counseling vs. Both &amp; DASH</li> <li>BP decreased in all</li> </ul>                                      |

National Institutes of Health, National Heart, Lung, and Blood Institute. DASH Eating Plan. <https://www.nhlbi.nih.gov/health-topics/dash-eating-plan>

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### Cigarette Smoking

- Promotes atherogenesis through several mechanisms.

Systemic inflammatory signaling

Procoagulant environment

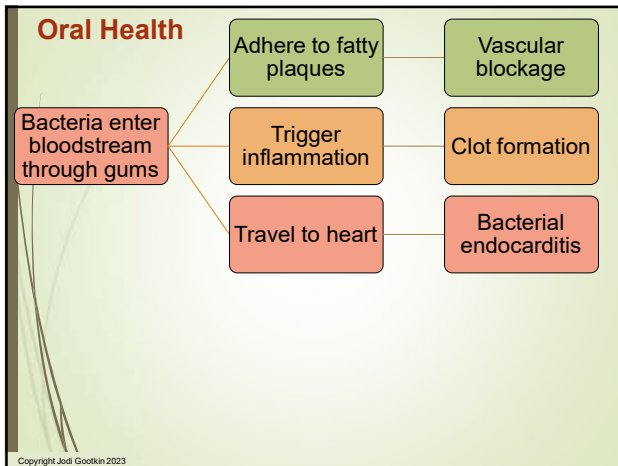
Prothrombotic processes

Endothelial damage

Periodontal disease

Messner, B., & Bernhard, D. (2014). Smoking and cardiovascular disease: mechanisms of endothelial dysfunction and early atherogenesis. *Arteriosclerosis, thrombosis, and vascular biology*, 34(3), 509-515.

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### Methods of Blood Pressure (BP) Measurement

- Manual auscultatory measurement is performed with an aneroid cuff and stethoscope using Korotkoff sounds.
- Automatic oscillometric devices incorporate automatic deflation and digital measurement

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### Equipment Accuracy

- Oscillometric devices should be clinically validated and manual cuffs should be calibrated.

| Aneroid cuff setting use | Outcome   |
|--------------------------|---|
| PT education programs    | High percentage of gauges not calibrated                              |
| Home healthcare          | Significant percent with gauge needles resting at zero not calibrated |

Arena, S. K., Simon, L., & Peterson, E. L. (2016). Aneroid blood pressure manometer calibration rates in physical therapy curricula: a descriptive study. *Cardiopulmonary Physical Therapy Journal*, 27(2), 56-61.

Arena, S. K., Bacynski, A., Simon, L., & Peterson, E. L. (2016). Aneroid blood pressure manometer calibration rates of devices used in home health. *Home healthcare now*, 34(1), 23-28.

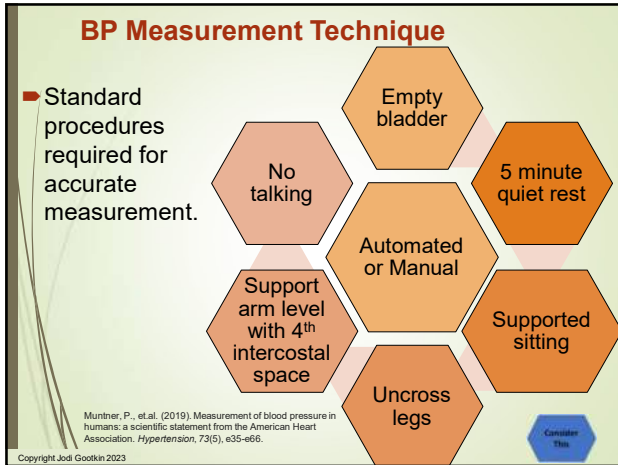
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### Accuracy of Manual Measurement

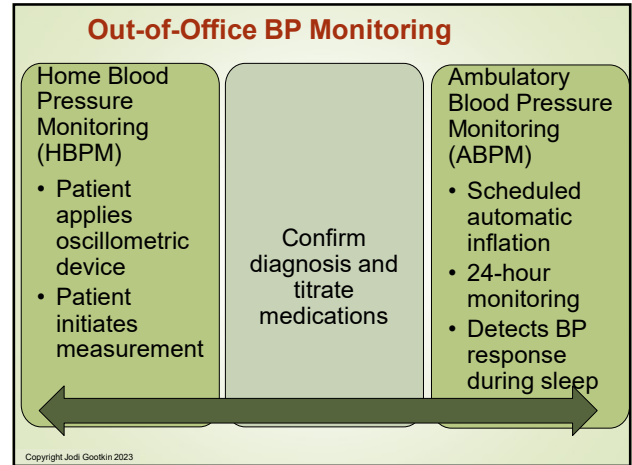
- Auscultatory gap is a period of diminished or absent Korotkoff sounds during manual measurement.
  - May not be detected with manual measurement
- Inflate cuff 30 mmHg higher than pressure value obtained with radial ablation technique.
- Deflate cuff at a rate of 2 mmHg per second.

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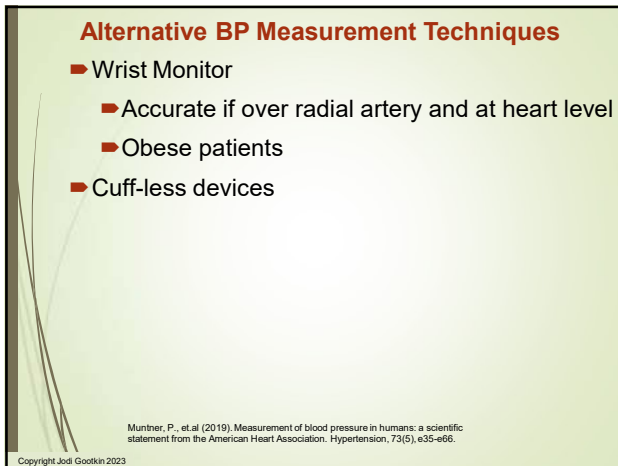
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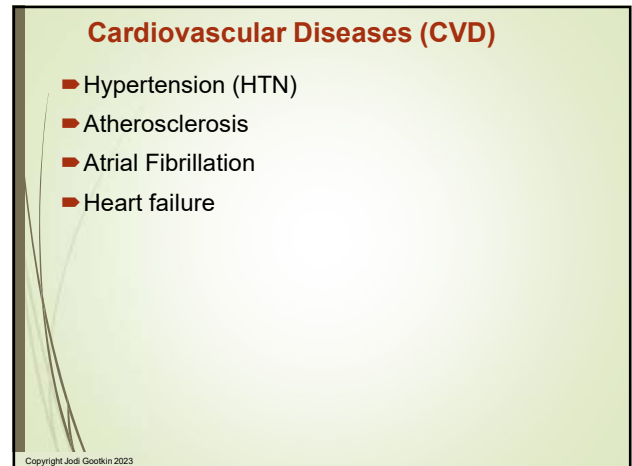
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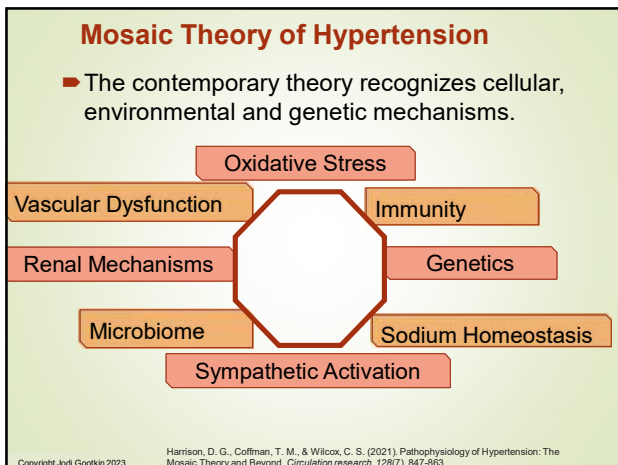
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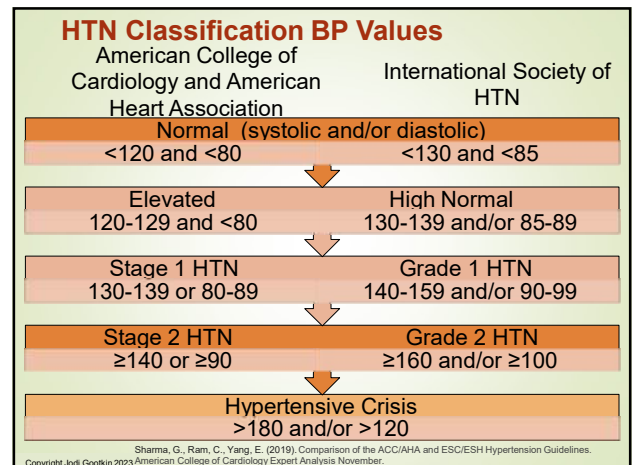
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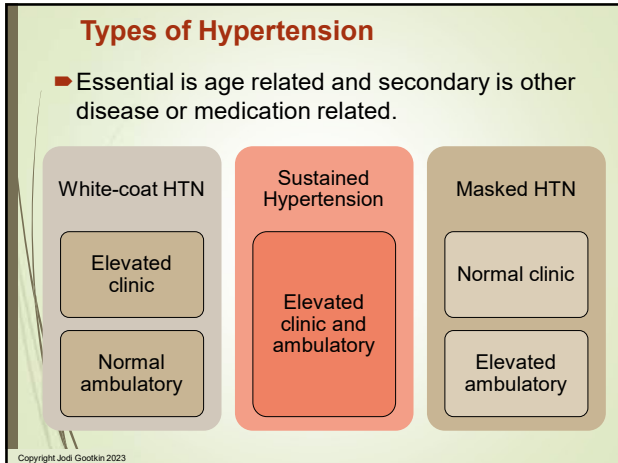


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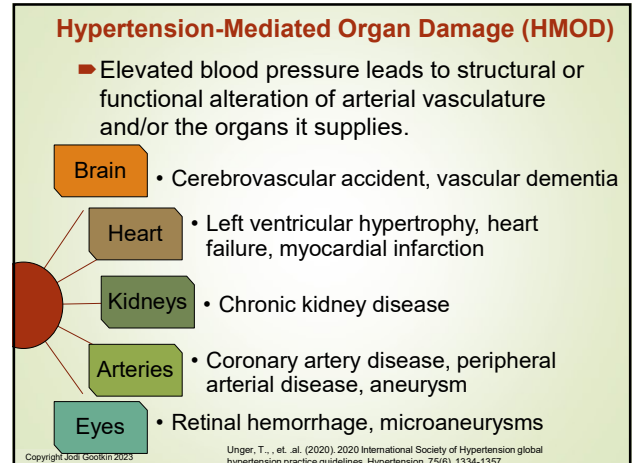


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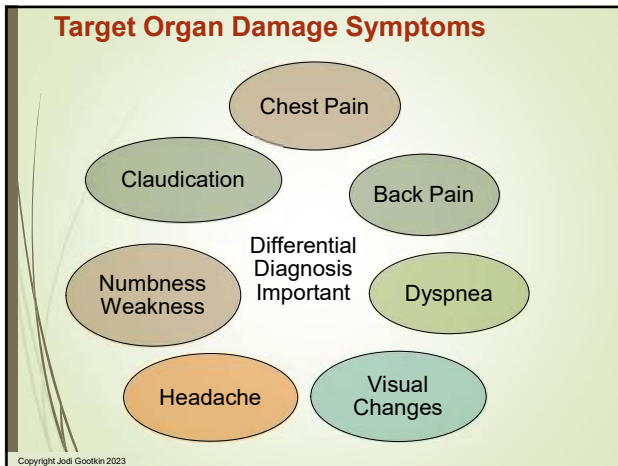
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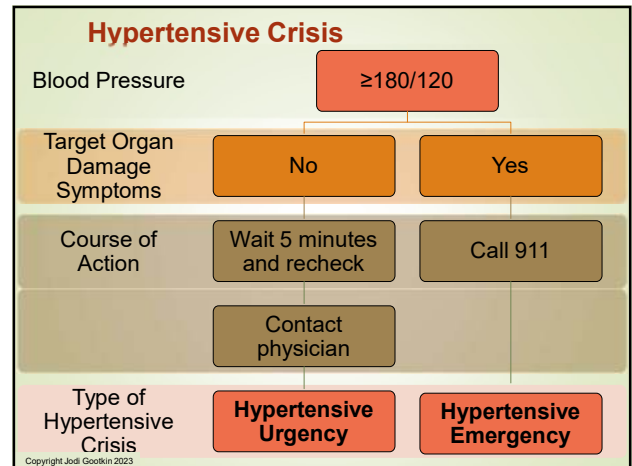
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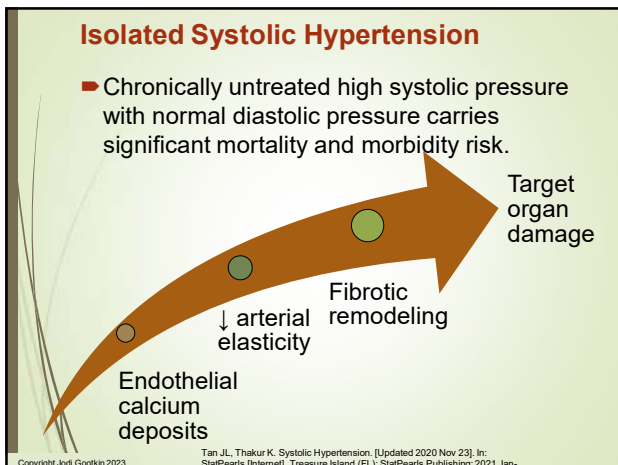
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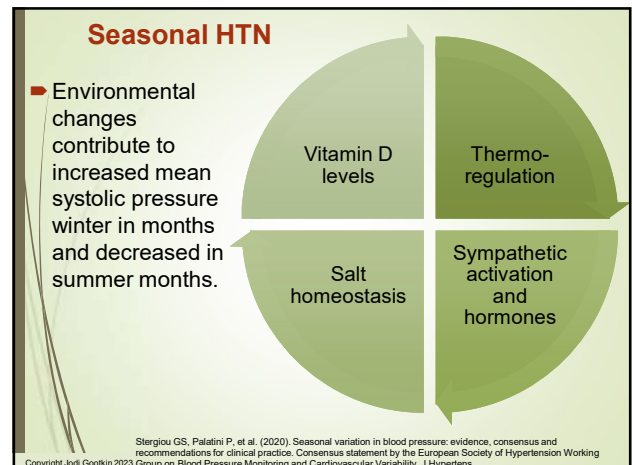
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### Masked Hypertension

- Normotensive or pre-hypertensive individuals at rest with elevated out of office blood pressure may not be identified to receive treatment.
- Exaggerated blood pressure response to low intensity exercise may be indicator.

Copyright Jodi Gootkin 2023 Franklin, S, et al. (2015). Masked hypertension: a phenomenon of measurement. *Hypertension*, 65(1), 16-20.

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### Normal Exercising Blood Pressure

- During Exercise**
  - Systolic BP:  $\uparrow$  10 mmHg per metabolic equivalent
  - Diastolic BP:  $\uparrow$   $\leq$  10 mmHg
- Post-exercise**
  - Decrease 10 mmHg per minute
  - At resting values by 5-6 minutes
- Post-exercise Hypotension (PEH)**
  - Systolic: 8 mmHg lower than baseline
  - Diastolic: 9 mmHg lower than baseline

Copyright Jodi Gootkin 2023 Severin, R., et al. (2020). Blood Pressure Screening by Outpatient Physical Therapists: A Call to Action and Clinical Recommendations.

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### Hypertensive Response to Exercise (HRE)

- Abnormal response to exercise.

Copyright Jodi Gootkin 2023 American Physical Therapy Association, Cardiovascular and Pulmonary Section. #VitalsAreVITAL. Exercising blood pressure.

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### HTN Nontraditional Management

- Massage, yoga, breathing and relaxation techniques may be beneficial adjuncts to pharmacologic management.

Copyright Jodi Gootkin 2023 Hamam, M., et al. (2020). Anxiety, Depression, and Pain: Considerations in the Treatment of Patients with Uncontrolled Hypertension. *Current hypertension reports*, 22(12), 1-7.

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### Neurogenic Orthostatic Hypotension (nOH)

- Can coexist with hypertension.

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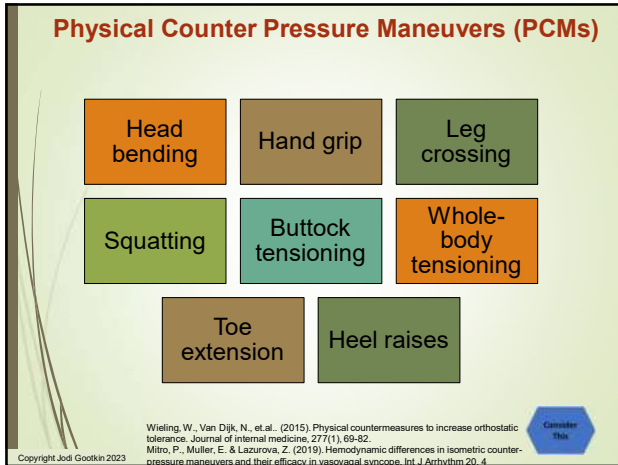
### Orthostatic Hypotension Management

- Management of conditions and medications, diet, fall prevention, volume expansion, and mechanical increase of vascular return.

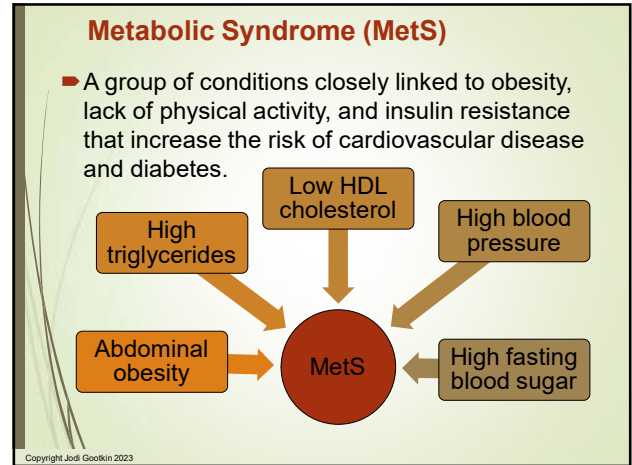
Copyright Jodi Gootkin 2023 Isaacson, S., et al. (2021). Management Strategies for Comorbid Supine Hypertension in Patients with Neurogenic Orthostatic Hypotension. *Current Neurology and Neuroscience Reports*, 21(4), 1-13.

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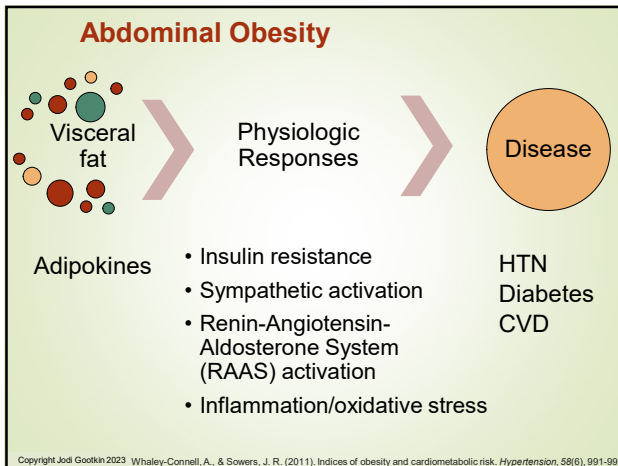
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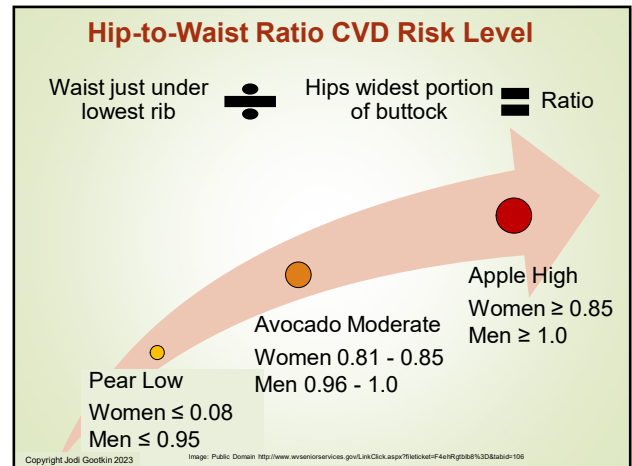
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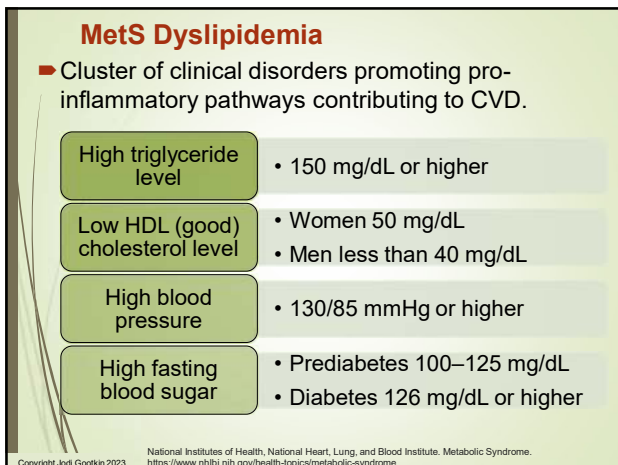
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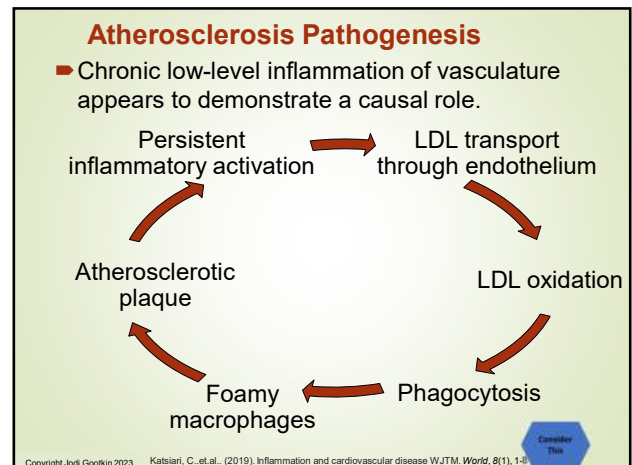
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### Pro-inflammatory Biomarkers

- High sensitivity C-reactive protein (hsCRP) can aid in predicting future CVD in otherwise healthy individuals.
- Inflammatory mediator Interleukin-6 appears to be associated with CVD.

Harvard Health Publishing, Harvard Medical School. (2017). Targeting inflammation: A missing link in heart treatments. Harvard Health Letter: December 2017. Held, C., et al. & STABILITY Investigators. (2017). Inflammatory biomarkers interleukin-6 and C-reactive protein and outcomes in stable coronary heart disease: experiences from the STABILITY trial. Journal of the American Heart Association, 6(10), e005077.

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### Atherosclerotic Cardiovascular Disease Risk (ASCVD) Estimator

- Estimates an individual's 10-year risk of having a cardiac event.
- Forecasts potential impacts of interventions.

American College of Cardiology ASCVD Risk Estimator Plus  
<https://tools.acc.org/ascvd-risk-estimator-plus/#/calculate/estimate/>

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### Exercise-based Cardiac Rehab (ExCR) for CAD Outcomes

| Cohort                      | Outcome                            |
|-----------------------------|------------------------------------|
| Post-revascularization      | Some benefit short-term QoL        |
| Stable angina               | Possible increase in fitness level |
| Acute myocardial infarction | Decreased anxiety and depression   |

McGregor, G., et al. (2020). Does contemporary exercise-based cardiac rehabilitation improve quality of life for people with coronary artery disease? A systematic review and meta-analysis. *BMJ Open*, 10(6).

Long, L., et al. (2018). Exercise-based cardiac rehabilitation for adults with stable angina. *The Cochrane database of systematic reviews*, 2(2).

Zheng, X., et al. (2019). Effect of exercise-based cardiac rehabilitation on anxiety and depression in patients with myocardial infarction: a systematic review and meta-analysis. *Heart & Lung*, 48(1), 1-7.

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### Exercise Prior to Major Adverse Cardiac Event (MACE)

| Cohort       | Intervention                    | Outcome                                     |
|--------------|---------------------------------|---|
| HTN          | Moderate intensity aerobic      | Improved endothelium-dependent vasodilation |
| Pre-HTN      | Vigorous aerobic intervals      | Vascular health benefits                    |
| Both cohorts | Isometric or dynamic resistance | May improved localized vascular function    |

Waclawovsky, G., et al. (2021). Effects of different types of exercise training on endothelial function in prehypertensive and hypertensive individuals: a systematic review. *Arquivos Brasileiros de Cardiologia*, 116, 938-947.

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### Exercise and Lipid Profile

| Intervention                           | Outcome             |
|--|---------------------|
| Long duration moderate exercise volume | ↑ HDL               |
| Combination aerobic and resistance     | ↓ Triglyceride      |
| Short duration high exercise volume    | ↓ LDL               |
| Combination aerobic and resistance     |                     |
| Moderate exercise volume               | ↓ Total cholesterol |

Javaherian, M., et al. (2020). The characteristics of exercise-based cardiac rehabilitation program are important in the improvement of lipid profiles level: A systematic review and meta-analysis. *ARYA Atherosclerosis*, 16(4).

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### Atrial Fibrillation (AF)

- Treatment may include cardioversion, anti-arrhythmic and antithrombotic medications, surgery.
- CHA2DS2-VASc Score determines stroke risk.

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### Antithrombotic Medications

- Anticoagulant**  
Vitamin K Antagonist (VKA) - Example Warfarin  
Non-vitamin K Oral Anticoagulant (NOAC) “-xaban”
- Antiplatelet**  
Aspirin  
P2Y12 Inhibitor - Example Clopidrel
- Combination Therapy**  
“Double” 1-Anticoagulant and 1-Antiplatelet  
“Triple” 1-Anticoagulant plus 2- Antiplatelet

January, C. T., et.al. (2019). 2019 AHA/ACC/HRS focused update of the 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Rhythm Society. *Journal of the American College of Cardiology*, 74(1), 104-132.

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### Bleeding Risk Factors

**Non-modifiable**

- Age
- Heart failure
- Vascular disease
- Stroke history
- Major bleed history
- Labile INR

**Modifiable**

- Uncontrolled HTN
- Excess alcohol use
- Antiplatelet drugs, NSAIDs or Paracetamol
- Fall risk
- Renal disease
- Liver disease

Kirchhof, P., et.al. & XANTUS Investigators\*. (2020). Impact of Modifiable Bleeding Risk Factors on Major Bleeding in Patients With Atrial Fibrillation Anticoagulated With Rivaroxaban. *Journal of the American Heart Association*, 9(5), e009530.

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### AF Patient Education

- Address emotional concerns regarding quality of life, fear of falling and complications.

```

graph LR
    A[Antithrombotics] --> B[Falls]
    B --> C[Intracranial hemorrhage]
    
```

McCabe, P. et al. (2020). Exploring Patients' Values and Preferences for Initial Atrial Fibrillation Education. *The Journal of Cardiovascular Nursing*, 35(5), 445-455.

Lane, D. A., et al., (2018). Patients' Perceptions of Atrial Fibrillation, Stroke Risk, and Oral Anticoagulation Treatment: An International Survey. *TH open - companion journal to thrombosis and haemostasis*, 2(1), e243-e244.

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### AF Smartphone Advances

| Technology   | Outcome   |
|--|---|
| Photoplethysmography (PPG) -based camera application | False positives in healthy asymptomatic individuals<br>Detect post-operative AF |
| Portable single-lead electrocardiograph device       | AF symptom validation<br>Detect post-operative AF                               |

O'Sullivan, J. W., et al. (2020). Accuracy of smartphone camera applications for detecting atrial fibrillation: a systematic review and meta-analysis. *JAMA network open*, 3(4).

Lamberigts, M., et al. (2021). Remote Heart Rhythm Monitoring by Photoplethysmography-Based Smartphone Technology After Cardiac Surgery: Prospective Observational Study. *JMIR mHealth and uHealth*, 9(4), e26519.

Ding, E. Y., et al. (2020). Emerging technologies for identifying atrial fibrillation. *Circulation Research*, 127(1), 128-142.

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### Heart Failure (HF)

- Chronic progressive condition with reduced cardiac output unable to meet metabolic demands of the body.

**Etiology**

- HTN, CAD, MetS, DM
- Cardiomyopathy
- Metabolic disorders
- Toxins
- Valvular heart disease
- Left ventricle dysfunction
- Pulmonary disease

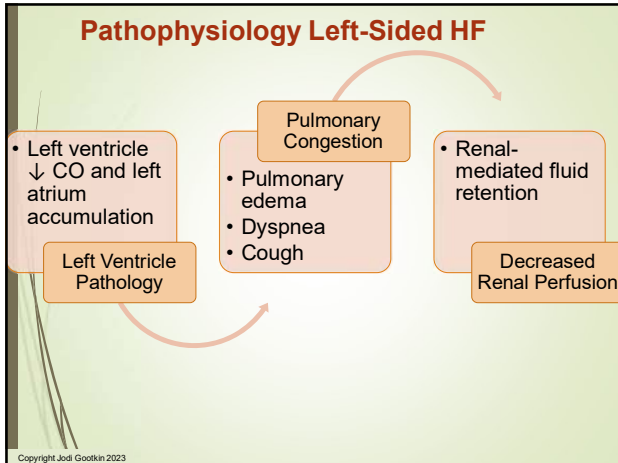
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### Types of Heart Failure

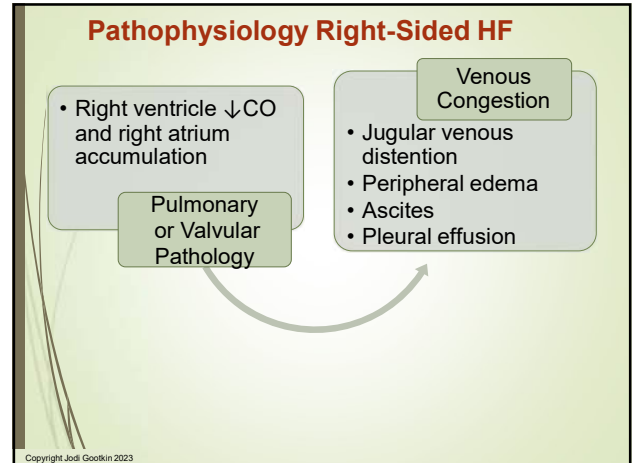
- Structural HF**
  - Left-sided
  - Right-sided
  - Biventricular dysfunction
- Functional HF**
  - Heart failure with reduced ejection fraction (HFrEF)
  - Heart failure with preserved ejection fraction (HRpEF)

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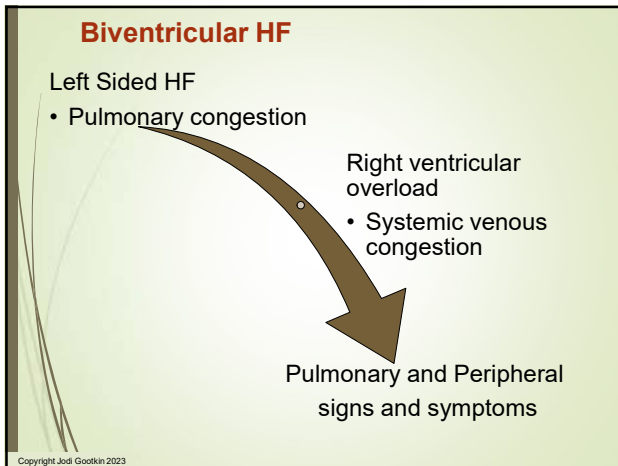
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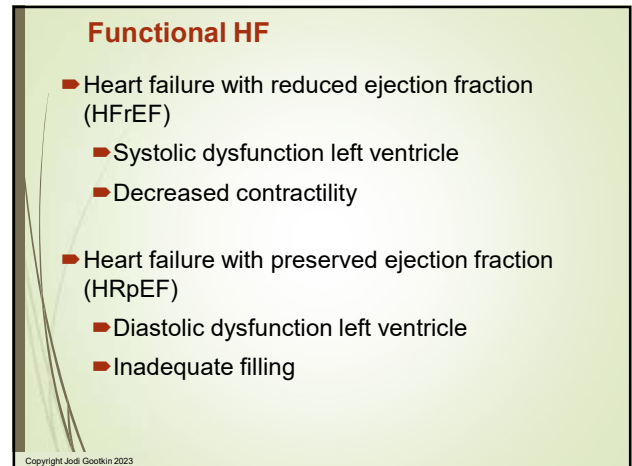
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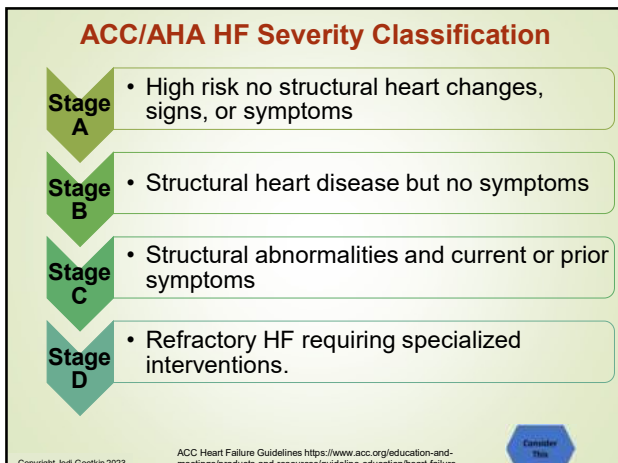
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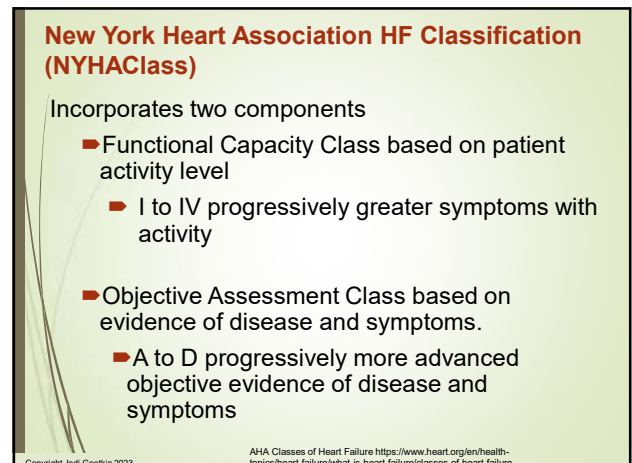
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## Cardiovascular Disease: Rehabilitation Considerations

### Biomarker - Brain Natriuretic Peptide (BNP)

- Determines if HF is origin of dyspnea in ambulatory patients, disease progression, and response to intervention.

| Level           | Interpretation        |
|-----------------|-----------------------|
| <100 pg/ml      | Rules out HF          |
| 100 - 400 pg/ml | Additional assessment |
| >400 pg/ml      | Potential HF          |
| >900 pg/ml      | High probability HF   |

Yancy, C. W., et al. (2017). 2017 ACC/AHA/HFSA focused update of the 2013 ACCF/AHA guideline for the management of heart failure: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines and the Heart Failure Society of America. Journal of the American College of Cardiology, 70(6), 776-803.

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### HF Exercise Intolerance

- Altered skeletal muscle structure and metabolism contributes to fatigability.
- Respiratory muscle myopathy decreases inspiratory muscle strength and endurance contributing to dyspnea.

Piepoli, M., Coats, A. (2013). The 'skeletal muscle hypothesis in heart failure' revised. European Heart Journal, 34(7), 486-488.  
Laoutaris, I. (2018). The 'aerobic/resistance/inspiratory muscle training hypothesis in heart failure'. European journal of preventive cardiology, 25(12), 1257-1262.

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### HF Management Strategies

|   |  |  |
|---|--|--|
| <p><b>Stage A</b></p> <ul style="list-style-type: none"> <li>Modify risk factors</li> </ul> | <p><b>Stage B</b></p> <ul style="list-style-type: none"> <li>Treat structural heart disease</li> <li>Pharmacologic management</li> </ul> | <p><b>Stages C and D</b></p> <ul style="list-style-type: none"> <li>Reduce morbidity and mortality</li> <li>Cardiac resynchronization therapy (CRT)</li> <li>Mechanical Circulatory Support (MCS)</li> </ul> |
|---|--|--|

**All Stages**

- Exercise
- Patient education
- Monitor weight
- Restrict sodium
- Physical Activity
- Social support

Yancy, C. et al (2013). 2013 ACCF/AHA guideline for the management of heart failure: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on practice guidelines. Circulation, 128(16), 1810-1852.

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### Patient Education – HF Zones of Management

|               |   |
|---------------|---|
| <b>Green</b>  | <ul style="list-style-type: none"> <li>No new or worsening SOB, swelling, chest pain</li> <li>No change to physical activity level</li> <li>Weight stable</li> </ul>  |
| <b>Yellow</b> | <ul style="list-style-type: none"> <li>Dry cough</li> <li>Worsening SOB with activity</li> <li>Weight gain &gt;2 to 3 pounds in 24 hours</li> <li>Peripheral edema, ascites, orthopnea</li> </ul>   |
| <b>Red</b>    | <ul style="list-style-type: none"> <li>Frequent dry, hacking cough</li> <li>SOB at rest</li> <li>Increased peripheral edema or ascites</li> <li>Weight gain &gt;2 to 3 pounds in 24 hours</li> <li>Cognitive changes</li> <li>Loss of appetite</li> <li>Paroxysmal nocturnal dyspnea</li> </ul> |

AHA Self-check plan for HF Management. <https://www.heart.org/-/media/files/health-topics/heart-failure/heart-failure-symptom-tracker.pdf?e=en>

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### HF Rehabilitation Interventions

- Advocate for increased total daily physical activity.
- Educate on and facilitate chronic disease management behaviors.
- Based on HF classification and pre-exercise assessment develop program.
  - Aerobic exercise training
  - High Intensity interval training (HIIT)
  - Upper and lower body resistance training
  - Inspiratory muscle training
  - Neuromuscular Electrical Stimulation
- Minnesota Living with Heart Failure Questionnaire (MLHFQ)

Shoemaker, M. et al. (2020). Physical therapist clinical practice guideline for the management of individuals with heart failure. Physical Therapy, 100(1), 14-43.

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### HF Exercise Adherence

- Exercise is safe and effective for patients who are able to participate.
- Emphasize patient self-assessment of Heart Failure Zones.
- Increasing exercise capacity should translate to improved overall daily physical activity to break the negative cycle of deconditioning.
- Include psychosocial components.

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## Cardiovascular Disease: Rehabilitation Considerations

### Exercise Based Cardiac Rehab (ExCR) for HF Outcomes

| Cohort                    | Outcome   |
|---------------------------|---|
| Older acute decompensated | Improved physical function<br>Equal rehospitalization rate                      |
| Reduced and preserved EF  | No difference in mortality<br>↓ hospitalization and Improved HRQoL              |
| HFrEF                     | No difference mortality/hospitalization<br>↑ exercise capacity and improved QoL |

Kitzman, D. et al. (2021). Physical Rehabilitation for Older Patients Hospitalized for Heart Failure. *New England Journal of Medicine*. May 2021  
Taylor, R. et al. (2019). Exercise-based rehabilitation for heart failure: Cochrane systematic review, meta-analysis, and trial sequential analysis. *JACC: Heart Failure*, 7(8), 691-705.  
Bjarnason-Wehrens, B. et al. & German Society of Cardiovascular Prevention and Rehabilitation (DGPR). (2020). Exercise-based cardiac rehabilitation in patients with reduced left ventricular ejection fraction: the Cardiac Rehabilitation Outcome Study in Heart Failure (CROS-HF): a systematic review and meta-analysis. *European journal of preventive cardiology*, 27(9), 929-952.

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### Cardiac Resynchronization Therapy (CRT)

- ▶ CRT-Pacemaker (CRT-P) uses pacing leads to coordinate myocardial contraction.
- ▶ May include a defibrillator (CRT-D)

Structural changes

Reduced symptoms

Improved quality of life

Improve exercise capacity

Reduced all-cause mortality

Reduce hospitalizations

Michaels HJ. et al. (2019). Use of Cardiac Resynchronization Therapy. (Prepared by the Johns Hopkins University Evidence based Practice Center under Contract No. HHS290201500006L) Rockville, MD: Agency for Healthcare Research and Quality.

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### CRT Devices Rehabilitation Considerations

- ▶ Avoid upper extremity activities post-surgery.
- ▶ Important to know device settings.
- ▶ Patient education on safety with activities.
- ▶ Exercise improves exercise capacity, heart function, and health related quality of life.

Ye, L., et al. (2020). Efficacy and Safety of Exercise Rehabilitation for Heart Failure Patients With Cardiac Resynchronization Therapy: A Systematic Review and Meta-Analysis. *Frontiers in physiology*, 11, 980.  
Tedjasumana, D., et al. (2020). Aerobic exercise prescription in heart failure patients with cardiac resynchronization therapy. *Journal of arrhythmia*, 37(1), 165-172.

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### Cardiac Rehabilitation (CR)

- ▶ Multidisciplinary medically supervised program for individuals recovering from cardiac events, surgery, or with stable chronic conditions.
- ▶ CR is significantly underutilized despite strong evidence to support its benefits.
  - ▶ Reduce mortality and hospital readmission
  - ▶ Improve functional status, quality of life, and mood

Million Hearts-Cardiac Rehabilitation Change Package. <https://millionhearts.hhs.gov/tools-protocols/action-guides/cardiac-change-package/index.html>

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### CV Benefits Physical Activity

| Research Summary                         | Outcome   |
|--|---|
| Accelerometry measured physical activity | all intensities ↓ mortality<br>sedentary time ↑ mortality |
| Follow-up on 12-week pedometer walking   | ↑ weekly physical activity<br>↓ new CV events             |

Overload, Progression, Specificity

Ekelund, U., et al. (2019). Dose-response associations between accelerometry measured physical activity and sedentary time and all cause mortality: systematic review and harmonised meta-analysis. *bmj*, 366, H4570.  
Harris T., et al. (2019). Effect of pedometer-based walking interventions on long-term health outcomes: Prospective 4-year follow-up of two randomised controlled trials using routine primary care data. *PLoS Med* 16(6): e1002836.

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### Physical Activity Intensity

| Sedentary   | Light   | Moderate   | Vigorous   |
|---|---|--|--|
| ≤ 1.5 METs<br>While awake sitting, reclining, lying | <3.0 METs<br>Slow waking, cooking, light chores | 3.0 – 5.9 METs<br>Brisk walking, doubles tennis, yard work | ≥ 6.0 METs<br>Jogging, carrying heavy loads upstairs, shoveling snow |

U.S. Department of Health and Human Services. *Physical Activity Guidelines for Americans*, 2nd edition. Washington, DC: U.S. Department of Health and Human Services; 2018.

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## Cardiovascular Disease: Rehabilitation Considerations

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### Physical Activity Recommendations

|                           |  |
|---------------------------|--|
| Preschool-age             | Physically active throughout the day   |
| School-age and Adolescent | ≥60 minutes moderate/vigorous daily  |
| Adult                     | At least 150 – 300 minutes moderate OR 75 – 150 minutes vigorous per week AND muscle strengthening 2 days a week |
| Older adult               | As physically active as possible based on their abilities and conditions   |

Copyright Jodi Gootkin 2023 Piercy, K. et al. (2018). The physical activity guidelines for Americans. JAMA, 320(19), 2020-2028.

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### Global Physical Activity Questionnaire (GPAQ)

Self-report measure of physical activity intensity, duration, and frequency in the domains of work, travel, recreation, and sedentary behavior.

|                                      |   |   |
|--------------------------------------|---|---|
| Normal Activity<br>Typical breathing | Moderate Intensity<br>Somewhat harder breathing | Vigorous Intensity<br>Much harder breathing |
|--------------------------------------|---|---|

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### Daily Step Count

An inverse relationship exists between steps per day and multiple CVD outcome risks.

Copyright Jodi Gootkin 2023 Saint-Maurice, P. F., et al. (2020). Association of daily step count and step intensity with mortality among US adults. JAMA, 323(12), 1151-1160.

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### Motion Sensor Exercise Intensity

What cadence achieves sufficient activity intensity?

Copyright Jodi Gootkin 2023 Zuhl, M. (2020). Tips for Monitoring Aerobic Exercise Intensity. American College of Sports Medicine Infographic.

76

### Sample Endurance Exercise Program

Warm-up and cool-down 5-10 minutes each  
Cardiorespiratory Fitness

**Intensity:**  
HR + 20 - 30 bpm over resting HR  
2 METs  
RPE 11 to 14

**Duration:** 20 - 30 minutes

**Frequency:** 3 days/week

**Type:** Treadmill, leg or arm ergometer

Copyright Jodi Gootkin 2023 American Association of Cardiovascular & Pulmonary Rehabilitation. (2021). Guidelines for cardiac rehabilitation programs. 6th ed. Human Kinetics.

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### Stratification of Risk of Exercise Events

|                 |  |
|-----------------|--|
| <b>High</b>     | Complex ventricular arrhythmias, silent ischemia, abnormal hemodynamics<br>Functional capacity ≤3 METs Rest EF <35%<br>Angina/symptoms at exertion <5METs<br>HF, ICD, MI, depression |
| <b>Moderate</b> | Mild to moderate silent ischemia<br>Functional capacity <5 METs Rest EF=35% - 49%<br>Angina/symptoms at exertion ≥7METs  |
| <b>Low</b>      | Functional capacity ≥7METs Rest EF ≥50%<br>No HF, depression, symptoms on exercise testing   |

Copyright Jodi Gootkin 2023 American Association of Cardiovascular & Pulmonary Rehabilitation. (2021). Guidelines for cardiac rehabilitation programs. 6th ed. Human Kinetics.

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## Cardiovascular Disease: Rehabilitation Considerations

### Monitoring Exercise Intensity

- ▶ In addition to use during supervised sessions, patients must learn how to monitor their own response to exercise.
- ▶ Talk Test
- ▶ Heart Rate
- ▶ Rate of Perceived Exertion

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### Talk Test Physiology

Ventilatory Threshold VT1

Blood lactate increases  
Breathing increases to release CO2

Respiratory Compensation Threshold RCT or VT2

CO2 trapping and lactic acid accumulation  
Out of breath

VO2 Max

Less oxygen available  
Suppression of speech

Rodriguez-Marroyo, J. A., et al. (2013). Relationship between the talk test and ventilatory thresholds in well-trained cyclists. *The Journal of Strength & Conditioning Research*, 27(7), 1942-1949.  
Foster, C. and Porcari, J. ACE-Sponsored research: Validating the talk test as a measure of exercise intensity. American Council on Exercise: CertifiedNews

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### Talk Test Assessment

- ▶ As exercise intensity increases toward VT, the demand for speech is overridden to meet oxygen demands for activity.

Below Ventilatory Threshold  
Able to speak comfortably

Moderate intensity  
Steady conversation but unable to sing

Vigorous intensity  
Only a few words are sustainable

Zuhl, M. (2020). Tips for Monitoring Aerobic Exercise Intensity. American College of Sports Medicine Infographic.  
Giddings, P. (2018). The Talk Test as a measure of exercise intensity in children (Doctoral dissertation). University of Wisconsin.

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### Heart Rate

- ▶ If formal exercise testing is completed, percentage of maximum heart rate is used.
- ▶ Alternative:
  - ▶ RHR + (20-30 bpm) Initial session
  - ▶ Percentage above resting HR
  - ▶ Target HR =  $(220 - \text{age}) \times \%HR_{\text{max}}$

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### Rate of Perceived Exertion (RPE)

- ▶ Subjective measurement method of how hard exercise feels.

No exertion at all  
6

Moderate intensity  
12 - 14

Maximal exertion  
20

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### High-Intensity Interval Training (HIIT)

- ▶ A form of interval training that consists of alternating short periods of maximal-effort exercise with less intense recovery periods.
- ▶ Adults with overweight or obesity and those at higher risk of cardiovascular disease and type 2 diabetes tend to have greater cardiovascular benefits compared to normal-weight or healthy adults.

U.S. Department of Health and Human Services. (2018) Physical Activity Guidelines for Americans, 2nd edition. Washington, DC:

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## Cardiovascular Disease: Rehabilitation Considerations

### Mechanical Circulatory Support Devices (MCS)

- Circulatory assist devices provide hemodynamic support to restore, aid or maintain blood flow in patients with cardiac compromise.
- Intra-aortic Balloon Pump (IABP)
- Extracorporeal Membrane Oxygenation (ECMO)
- Ventricular Assist Device (VAD)

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### Intra-aortic Balloon Pump (IABP)

- Balloon placed in aorta supports patients in cardiogenic shock or at risk of hemodynamic decompensation during surgery.

|  |
|--|
| Diastole inflation                     |
| Decreased afterload                    |
| Decreased left ventricular wall stress |
| Improved cardiac output                |

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### Extracorporeal Membrane Oxygenation (ECMO)

- A form of life support providing cardiopulmonary assistance outside the body.
- The pump circulates blood through an artificial lung back into the bloodstream providing external gas exchange.
- Indicated to support lung function for severe respiratory failure or heart function for severe cardiac failure.

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### Ventricular Assist Device (VAD)

- Mechanical device designed to assist the native heart by providing hemodynamic support to under perfused organs.
- The device is implanted in parallel with the heart, taking over the majority of its circulatory function.
- Indicated as bridge to recovery, bridge to transplant, or destination therapy.

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### Conclusion

- Understanding the pathogenesis of cardiovascular conditions and contemporary research outcomes allows the clinician to monitor patients for safe exercise prescription and develop programs to improve their quality of life.

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1. \_\_\_\_\_ is a research-based diet plan proven to lower blood pressure and LDL cholesterol.
  - A. CANTOS
  - B. DASH
  - C. BRFSS
  - D. MetS

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## Cardiovascular Disease: Rehabilitation Considerations

2. It is recommended that the patient do which of the following to ensure an accurate blood pressure measurement?

- A. Sit unsupported during the measurement
- B. Empty their urinary bladder immediately prior to the measurement
- C. Lay supine for 7 minutes of quiet rest first
- D. Position the arm level with the 5th intercostal space

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3. A middle-aged female is normotensive at rest. After exercising, she exhibits a blood pressure difference between peak and baseline of 55 mmHg. This may be indicative of what condition?

- A. Sustained HTN
- B. White-coat HTN
- C. Pre-hypertension
- D. Masked HTN

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4. Which of the following is NOT one of the recommended counter pressure maneuvers used to address postural hypotension?

- A. Leg crossing
- B. Whole-body clenching
- C. Bicep curls
- D. Toe extension

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5. The currently accepted pathogenesis of atherosclerosis does NOT include which mechanism?

- A. Elevated HDL
- B. Foamy macrophages
- C. Chronic low-level inflammation
- D. LDL oxidation

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6. Which heart failure classification would be assigned to an individual with structural heart disease who has not yet developed symptoms of heart failure?

- A. Stage A
- B. Stage B
- C. Stage C
- D. Stage D

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7. What brain natriuretic peptide (BNP) level in an ambulatory patient with dyspnea would rule out heart failure as the cause?

- A. < 100 pg/ml
- B. 100 - 400 pg/ml
- C. > 400 pg/ml
- D. > 900 pg/ml

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## Cardiovascular Disease: Rehabilitation Considerations



8. Which of the following is NOT a domain of the Global Physical Activity Questionnaire?

- A. Work
- B. Travel
- C. Sleep
- D. Recreation

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9. Using the Talk Test to gauge exertion, what level of speaking should an individual be able to maintain during exercise at moderate intensity?

- A. Be able to talk, but not sing
- B. Speak comfortably without any difficulty
- C. Unable to talk or sing
- D. Need to pause for a breath after a few words

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10. What device is inflated in the aorta during diastole to decrease left ventricular wall stress and improve cardiac output perfusion to the peripheral circulation?

- A. Extracorporeal membrane oxygen valve
- B. Ventricular assist device
- C. Percutaneous circulatory assist device
- D. Intra-aortic balloon pump

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## Cardiovascular Disease: Rehabilitation Considerations Resources

American Heart Association – Life’s Simple 7

<https://www.heart.org/en/professional/workplace-health/lifes-simple-7>

Centers for Disease Control - BRFSS Prevalence & Trends Data

<https://www.cdc.gov/brfss/brfssprevalence/>

DASH Diet

<https://www.nhlbi.nih.gov/health-topics/dash-eating-plan>

APTA Academy of Cardiovascular & Pulmonary Physical Therapy #VitalsareVITAL -  
Blood Pressure Measurement

<https://www.aptacvp.org/-vitals-are-vital>

American Medical Association - US Blood Pressure Validated Device Listing

<https://www.validatebp.org/>

National Institutes of Health - Clinical Trials Searchable Database

<https://clinicaltrials.gov/ct2/home>

American College of Cardiology - ASCVD Risk Estimator

<https://tools.acc.org/ascvd-risk-estimator-plus/#!/calculate/estimate/>

CHA<sub>2</sub>DS<sub>2</sub>-VASc - Score for Atrial Fibrillation Stroke Risk Calculator

<https://www.mdcalc.com/cha2ds2-vasc-score-atrial-fibrillation-stroke-risk>

American College of Cardiology - AnticoagEvaluator

<https://tools.acc.org/anticoag/#!/content/calculator/>

New York Heart Association - Heart Failure Classification

<https://www.heart.org/en/health-topics/heart-failure/what-is-heart-failure/classes-of-heart-failure>

APTA and Academy of Cardiovascular & Pulmonary Physical Therapy -

Clinical Practice Guideline for the Management of Individuals with Heart Failure

<https://academic.oup.com/ptj/article/100/1/14/5714224>

American Heart Association - Heart Failure Zones Sheet for Patients

<https://www.heart.org/en/health-topics/heart-failure/heart-failure-tools-resources>

Million Hearts® 2022 - Clinician and Patient Resources

<https://millionhearts.hhs.gov/>

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Move Your Way – Public Health Resources

<https://health.gov/moveyourway>

TAKEheart Initiative – Clinician and Patient Resources

<https://takeheart.ahrq.gov/>

Global Physical Activity Questionnaire

[https://www.who.int/ncds/surveillance/steps/resources/GPAQ\\_Analysis\\_Guide.pdf](https://www.who.int/ncds/surveillance/steps/resources/GPAQ_Analysis_Guide.pdf)

U.S. Department of Health and Human Services. Physical Activity Guidelines for Americans, 2nd edition. [https://health.gov/sites/default/files/2019-09/Physical\\_Activity\\_Guidelines\\_2nd\\_edition.pdf](https://health.gov/sites/default/files/2019-09/Physical_Activity_Guidelines_2nd_edition.pdf)