

Cardiovascular Disease: Rehabilitation Considerations

Goals and Objectives

Course Description

"Cardiovascular Disease: Rehabilitation Considerations" is an online recorded video of a previously presented live CE webinar for occupational therapists and occupational therapy assistants 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.

Course Rationale

The purpose of this course is to provide participants with contemporary information about cardiovascular disease. Occupational therapists and occupational therapy assistants can use this information to modify and implement rehabilitation programs specifically addressing the needs and limitations of individuals with compromised cardiovascular performance.

Course Goals and Objectives

Upon completion of this course, participants will be able to:

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 the stages, pathogenesis, clinical presentation, and management of heart failure.
7. Define atrial fibrillation and identify current strategies to manage anticoagulation bleeding risk factors.
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.

Course Provider – Innovative Educational Services

Provider Contact Information – information@cheapceus.com

Course Instructor – Jodi Gootkin, PT, Med, CEAS

Financial/Non-financial Disclosure – Neither the Provider nor the Instructor have any financial or non-financial conflict of interest related to the presentation of this CE program.

Target Audience – Occupational Therapists, Occupational Therapy Assistants

OT Scope of Practice – Foundational Knowledge

Course Educational Level – This course is applicable for introductory learners.

Course Prerequisites – None

Instructional Method – Distance Learning – Independent; Asynchronous online video-based home study

Location – Cheapceus.com

Date – Continuously available on-demand

PD Activity Completion Requirements / Criteria for Issuance of CE Credits – Completion of viewing of 3 hour recorded video, and a score of 70% correct or greater on the course post-test

Continuing Education Credits – Three (3) contact hours / .3 AOTA CEUs

Course Fee - \$34.95

Registration Information – No pre-registration required; available on-demand at Cheapceus.com

Special Needs Requests – Email: information@cheapceus.com or phone: 954-663-4101

Cancellation by the Learner – Learners may cancel their participation at any time and receive a full refund of all paid fees.

Cancellation by the Provider – Registrants for the cancelled activity will be contacted by an IES staff member via phone call or email within 12 hours of the cancellation decision. If the decision to cancel is made less than 14 hours prior to the event, each participant will be contacted no later than 2 hours prior to the scheduled start time of the activity. Registrants will receive a full refund if an activity is cancelled by the Provider. The refund will be processed back to the Registrant within 12 hours of the cancellation.

Complaint Resolution – Please call 954-663-4101 (24 hours/day, 7 days/week) to speak with a live customer service agent. Our goal is to work with our customers to resolve all issues to the customer's satisfaction with just one phone call whenever possible.

Refund Policy - Unrestricted 100% refund upon request. The request for a refund by the learner shall be honored in full without penalty or other consideration of any kind. The request for a refund may be made by the learner at any time without limitations before, during, or after course participation.



Innovative Educational Services is an AOTA Approved Provider of professional development. PD activity approval ID# 5471. This Distance Learning – Independent PD activity is offered at .3 CEUs; Introductory; OT Foundational Knowledge. The assignment of AOTA CEUs does not imply endorsement of specific course content, products, or clinical procedures by AOTA.

Innovative Educational Services

Cardiovascular Disease: Rehabilitation Considerations

Presented By

Jodi Gootkin, PT, MED, CEAS
jodiemail@comcast.net

Copyright Jodi Gootkin

1

Course Overview

- “Cardiovascular Disease: Rehabilitation Considerations” 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.

Copyright Jodi Gootkin

2

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.

Copyright Jodi Gootkin

3

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.

Copyright Jodi Gootkin

4

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.

Copyright Jodi Gootkin

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
Interactive Discussion of Clinical Applications	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
Interactive Discussion of Clinical Applications	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
Interactive Discussion of Clinical Applications	2:51-3:00

Copyright Jodi Gootkin


Cardiovascular Disease: Rehabilitation Considerations

Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.

Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited without prior written consent of both Innovative Educational Services and Jodi Gootkin.

How To Obtain CEUs For This Course


- Course review and summary for post test at the end of the webinar.
- After watching the video go to cheapceus.com
- Complete the post test with score of at least 70%
 - May be retaken multiple times
- Submit online payment for course
- Print certificate



Copyright Jodi Gootkin

Course Post Test

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



Copyright Jodi Goodkin

Contributors to Cardiovascular Health

Contributor	Details
American Heart Association Life's Simple 7	7
Core Behaviors	<ul style="list-style-type: none">• Smoking• Physical activity• Weight• Diet
Health Factors	<ul style="list-style-type: none">• Cholesterol• Blood pressure• Glucose control

Copyright Jodi Gootkin

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

Copyright Jodi Gootkin

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://flood.cdc.gov/BRFSS/Prevalence/#Page.aspx?rdrReport=DPH_BRFSS_ExploreByTopic&intLocationType=StatesAndMMSA&class=CL_A5B16&atTopic=TOPIC21&atYear=2018&ofFind=85794
Public domain: NCHS. News: <https://www.cdc.nih.gov/news/2021/hhs-supported-dash-diet-tops-ranking-heart-healthy-and-healthy-eating>

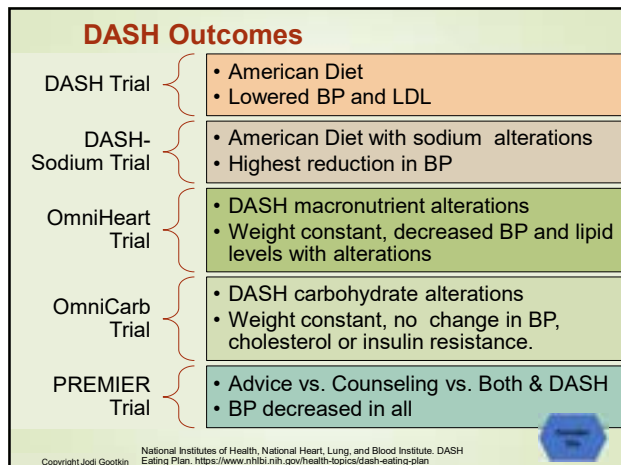
Copyright Jodi Goodkin

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

Copyright Jodi Goodkin

Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.
Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited
without prior written consent of both Innovative Educational Services and Jodi Gootkin.



13

Cigarette Smoking

- Promotes atherogenesis through several mechanisms.

Systemic inflammatory signaling

Procoagulant environment

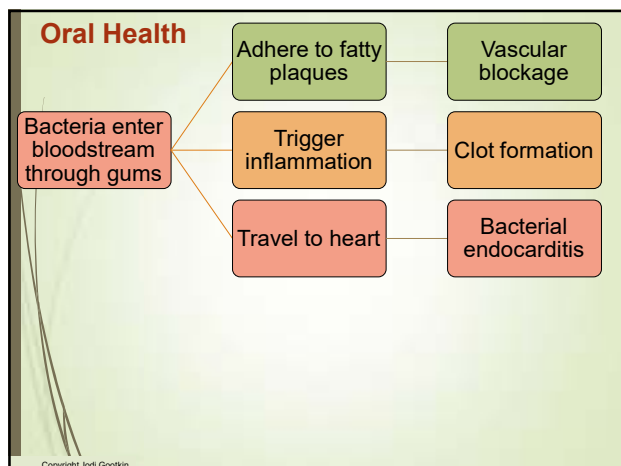
Prothrombotic processes

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.

14



15

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

Copyright Jodi Gootkin

16

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., Bacyinski, 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.

Copyright Jodi Gootkin

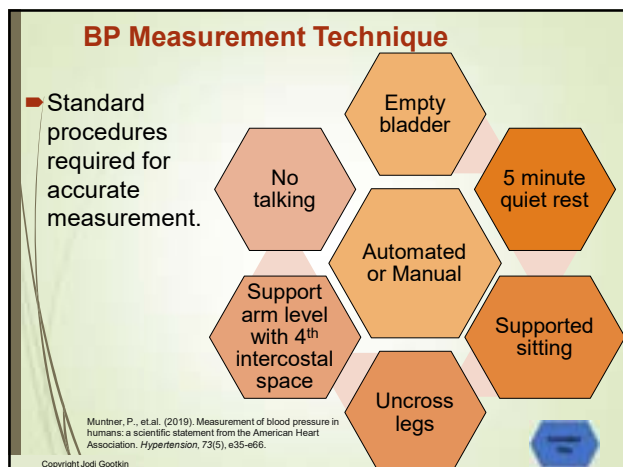
Accuracy of Manual Measurement

- 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.

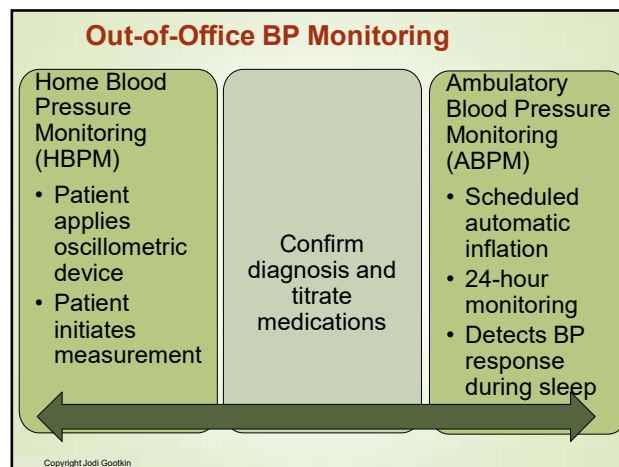
Copyright Jodi Gootkin

Cardiovascular Disease: Rehabilitation Considerations

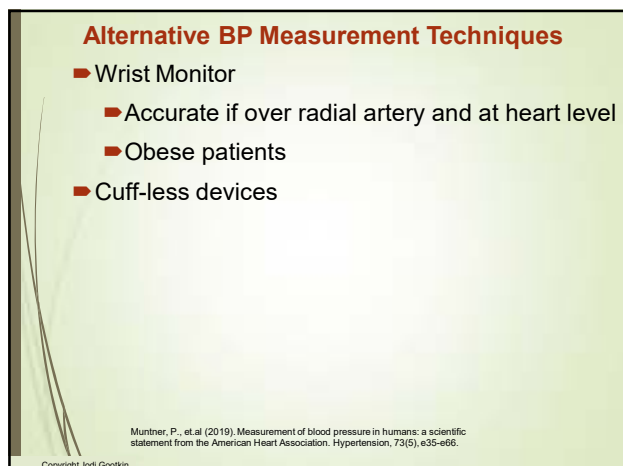
Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.
 Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited
 without prior written consent of both Innovative Educational Services and Jodi Gootkin.



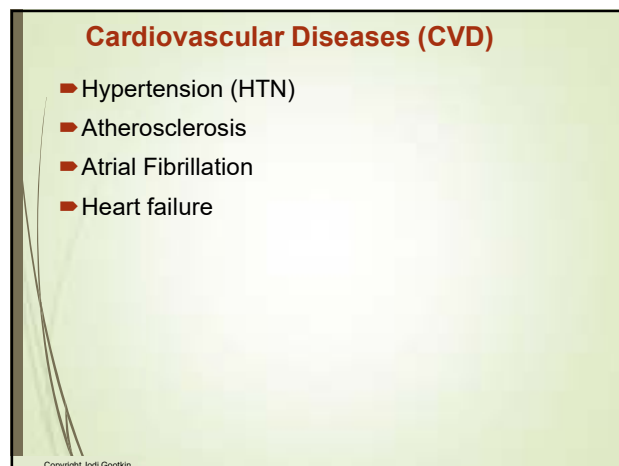
19



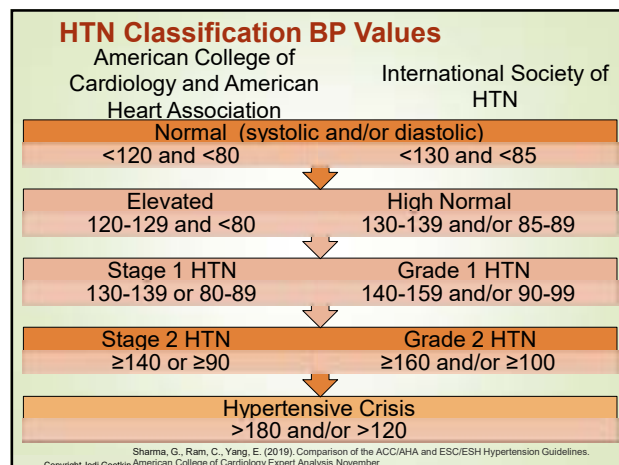
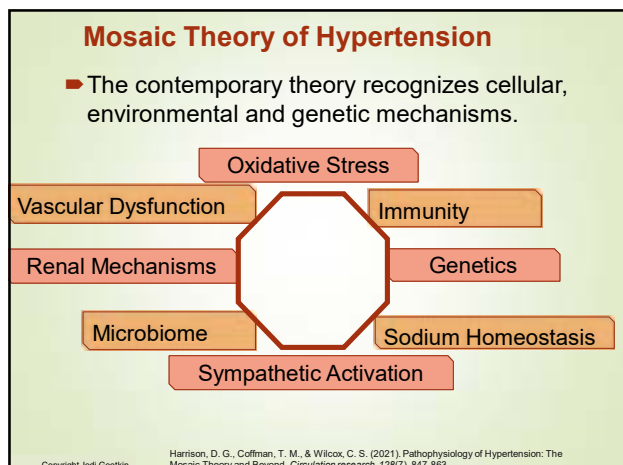
20



21

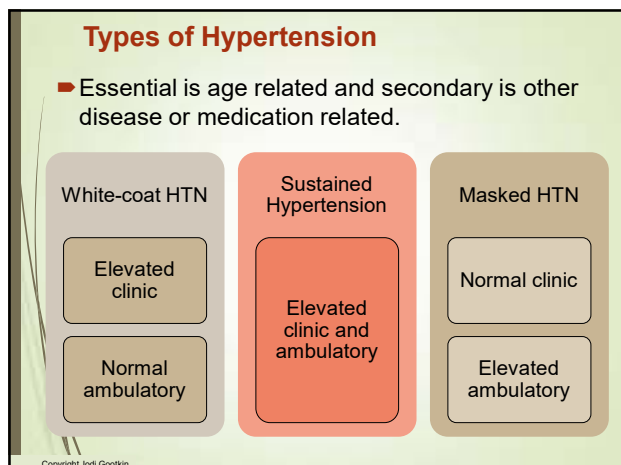


22

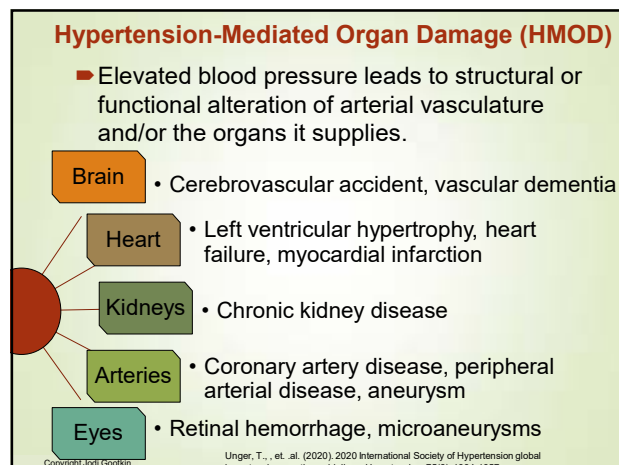


Cardiovascular Disease: Rehabilitation Considerations

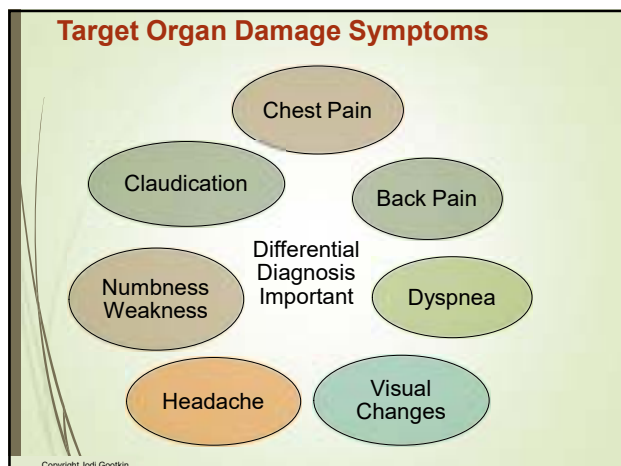
Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.
 Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited
 without prior written consent of both Innovative Educational Services and Jodi Gootkin.



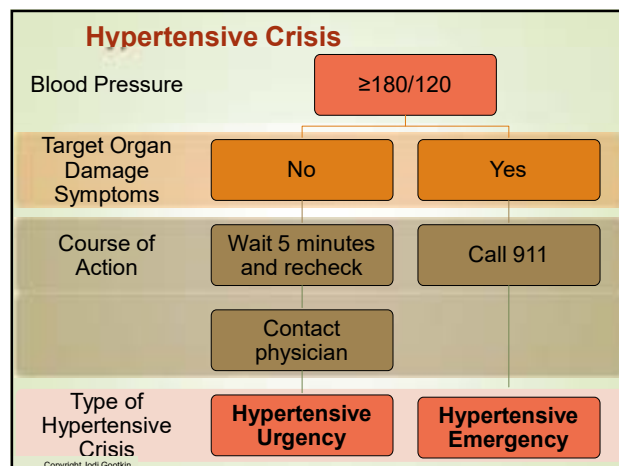
25



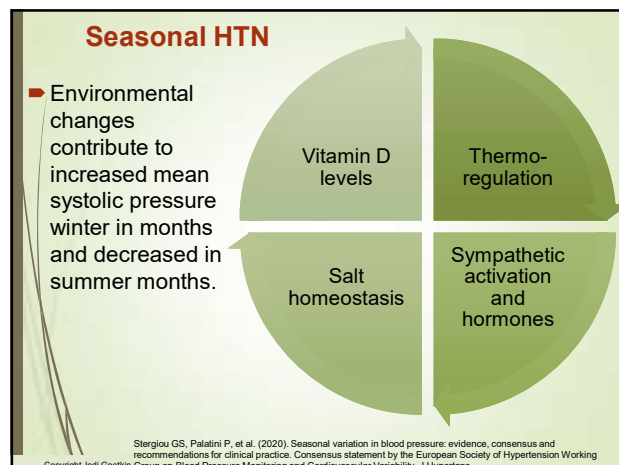
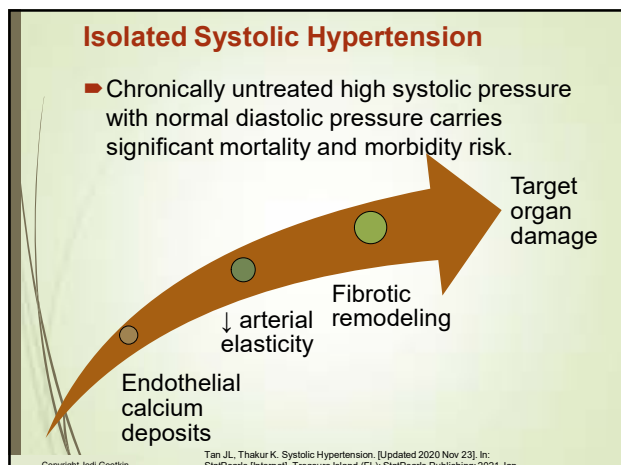
26



27



28



Cardiovascular Disease: Rehabilitation Considerations

Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.

Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited without prior written consent of both Innovative Educational Services and Jodi Gootkin.

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.

Inducers: Stress, Smoking, Alcohol, Activity

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

31

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

32

Hypertensive Response to Exercise (HRE)

- Abnormal response to exercise.

Peak BP -- Baseline BP

Category	Threshold
Peak BP	>60 mmHg men
Peak BP	>50 mmHg women
Peak BP	Masked HTN
Systolic BP	>220 mmHg men
Systolic BP	>190 mmHg women
Diastolic BP	>90 mmHg value
Diastolic BP	>10 mmHg increase

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

33

HTN Nontraditional Management

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

Pain, Anxiety, Sleep Quality

Hypertension

Copyright Jodi Gootkin 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.

34

Neurogenic Orthostatic Hypotension (nOH)

- Can coexist with hypertension.

```

graph TD
    A[Stand up] --> B[↓ venous return, cardiac output, BP]
    B --> C[Baroreflex activation]
    C --> D[Autonomic system ↑HR, TPR]
    D --> E[Stabilize BP]
    C -- Inadequate --> F[SBP decreases ≥20 mmHg or DBP decreases ≥10 mmHg]
  
```

Copyright Jodi Gootkin

Orthostatic Hypotension Management

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

External compression devices

- Waist-high stockings or abdominal binder
- ↑ venous return

Counterpressure maneuvers

- Isometric contractions
- ↑ venous return

Elevate HOB when sleeping

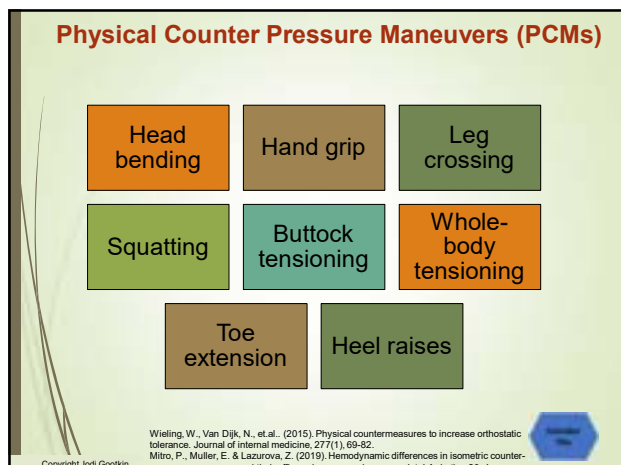
- Decrease supine BP and natriuresis

Copyright Jodi Gootkin 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.

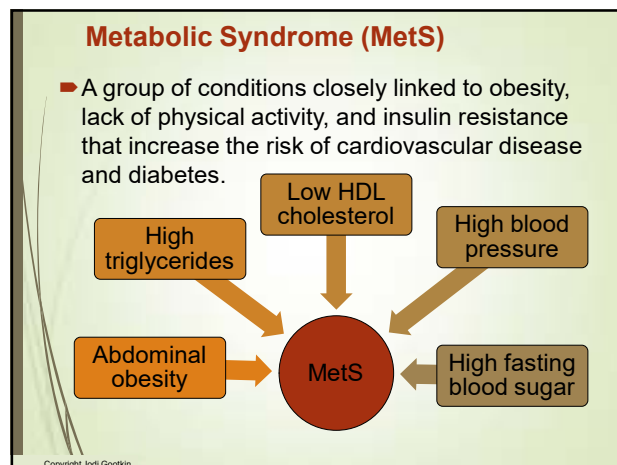
Cardiovascular Disease: Rehabilitation Considerations

Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.

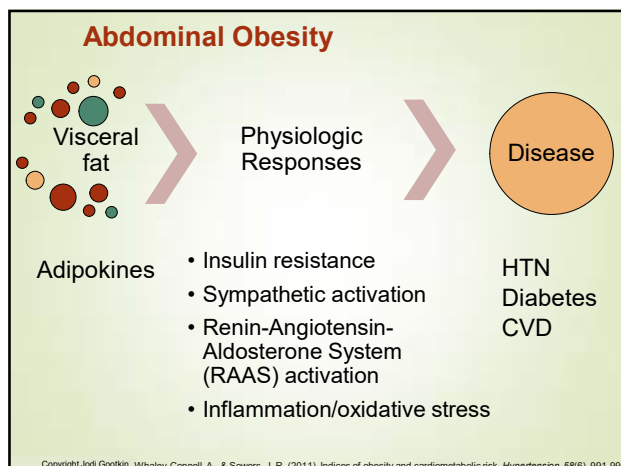
Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited without prior written consent of both Innovative Educational Services and Jodi Gootkin.



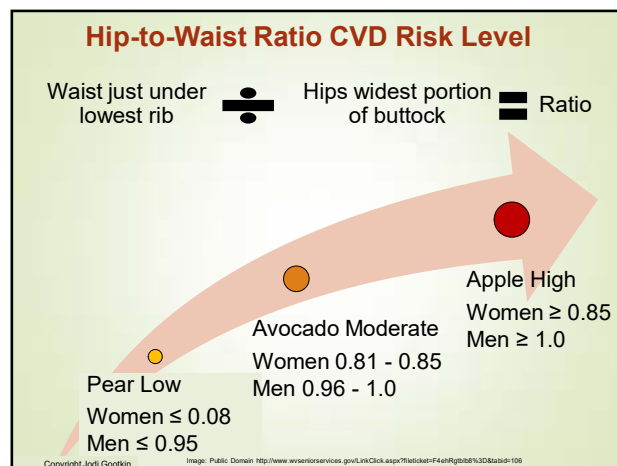
37



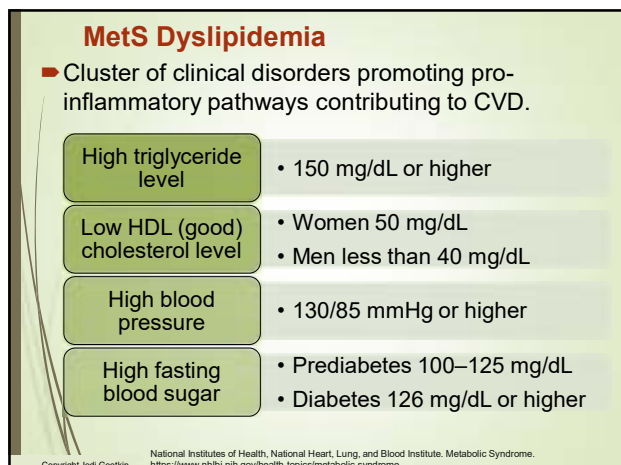
38



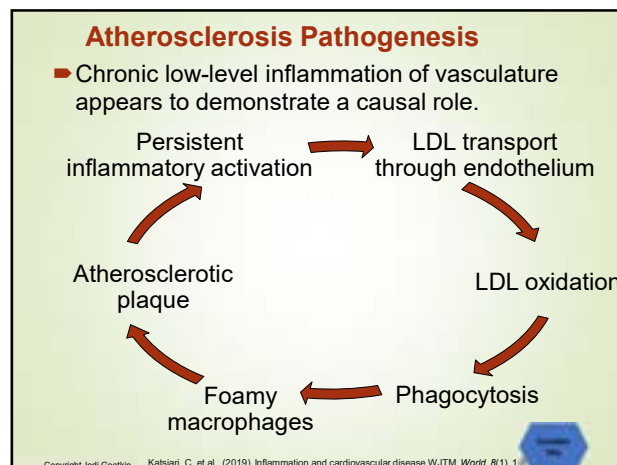
39



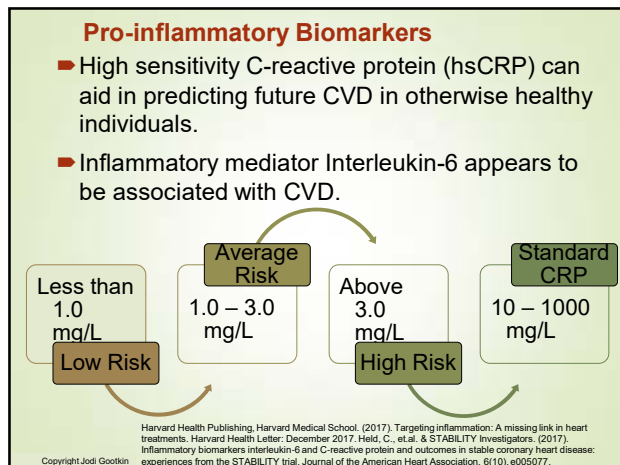
40



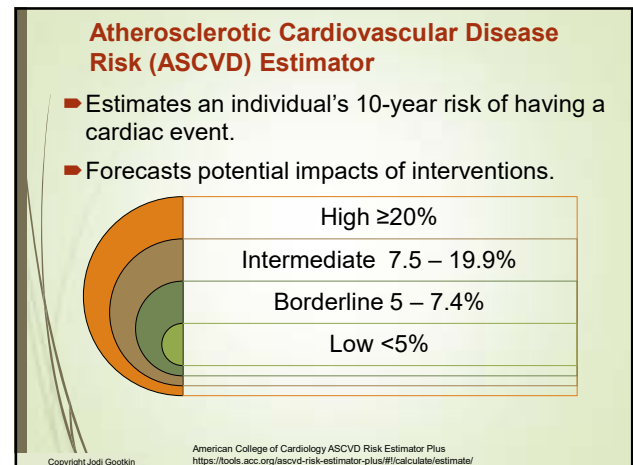
41



42



43



44

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.

Copyright Jodi Gootkin

45

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.

Copyright Jodi Gootkin

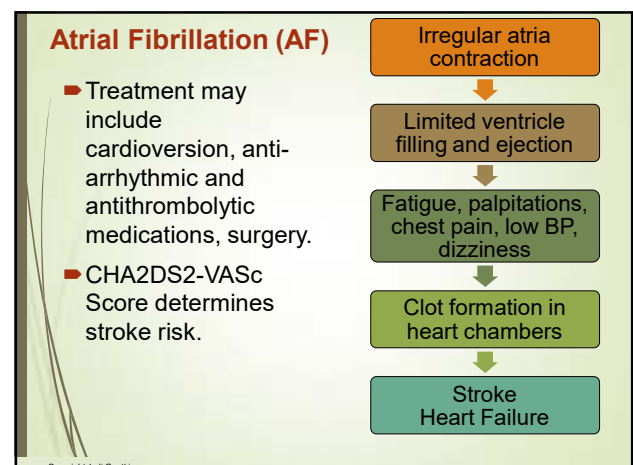
46

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).

Copyright Jodi Gootkin



Cardiovascular Disease: Rehabilitation Considerations

Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.
 Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited
 without prior written consent of both Innovative Educational Services and Jodi Gootkin.

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.

Copyright Jodi Gootkin

49

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), e005530.

Copyright Jodi Gootkin

50

AF Patient Education

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

Antithrombotics

Falls

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(3), e233-e241.

Copyright Jodi Gootkin

51

AF Smartphone Advances

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

Copyright Jodi Gootkin

52

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

Copyright Jodi Gootkin

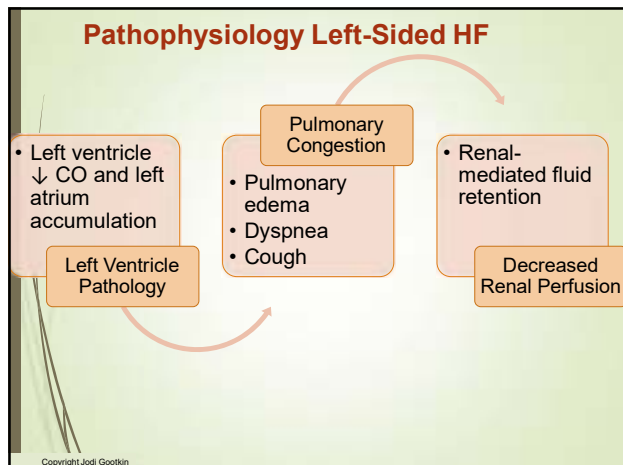
Types of Heart Failure

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

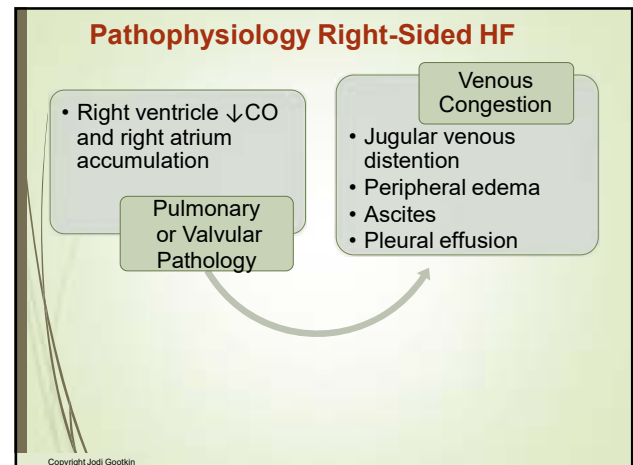
Copyright Jodi Gootkin

Cardiovascular Disease: Rehabilitation Considerations

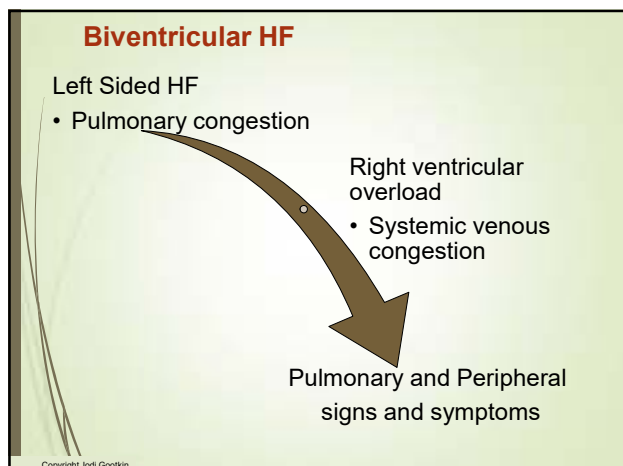
Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.
 Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited
 without prior written consent of both Innovative Educational Services and Jodi Gootkin.



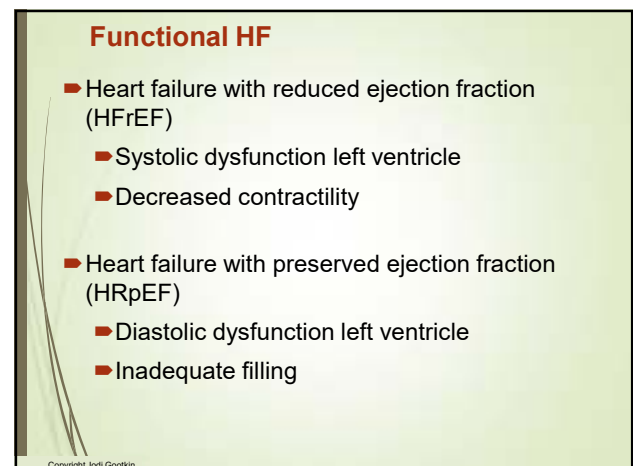
55



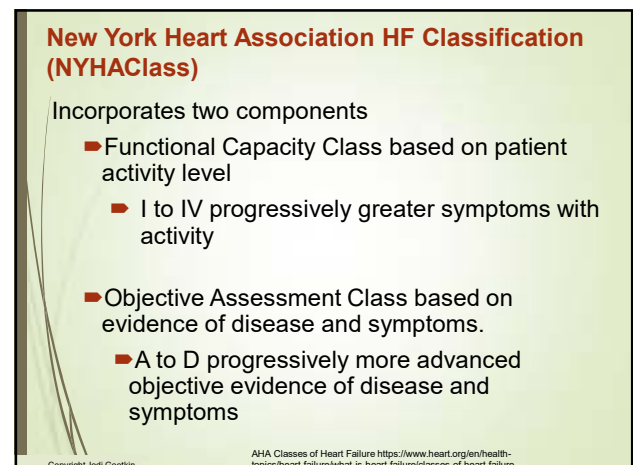
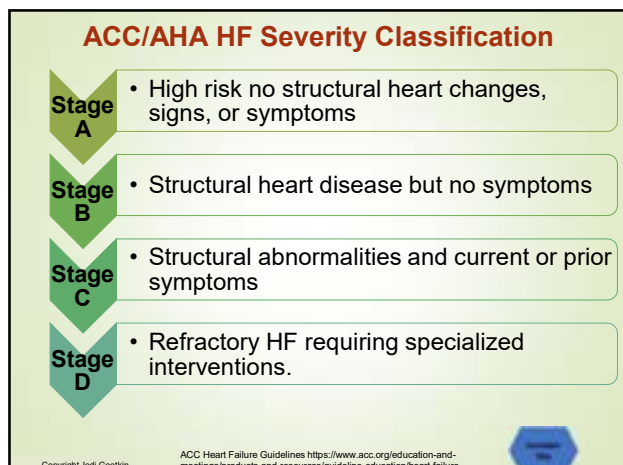
56



57



58



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.

61

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.

62

HF Management Strategies

Stage A Modify risk factors	Stage B Treat structural heart disease Pharmacologic management	Stages C and D Reduce morbidity and mortality Cardiac resynchronization therapy (CRT) Mechanical Circulatory Support (MCS)
---------------------------------------	--	--

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.

63

Patient Education – HF Zones of Management

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

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

64

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.

Cardiovascular Disease: Rehabilitation Considerations

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.

66

Exercise Based Cardiac Rehab (ExCR) for HF Outcomes

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

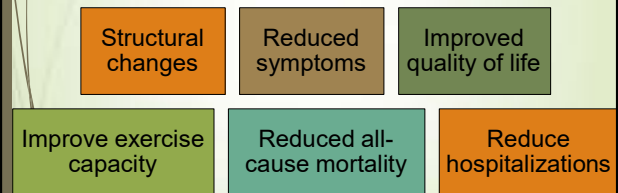
Kitzman, D. et al. (2021). Physical Rehabilitation for Older Patients Hospitalized for Heart Failure. *New England Journal of Medicine*. May 2021
 Taylor, R. et al. (2019). Exercise-based rehabilitation for heart failure: Cochrane systematic review, meta-analysis, and trial sequential analysis. *JACC: 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.

Copyright Jodi Gootkin

67

Cardiac Resynchronization Therapy (CRT)

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



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.

Copyright Jodi Gootkin

68

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.
 Tedjasukmana, D., et al. (2020). Aerobic exercise prescription in heart failure patients with cardiac resynchronization therapy. *Journal of arrhythmia*, 37(1), 165-172.

Copyright Jodi Gootkin

69

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

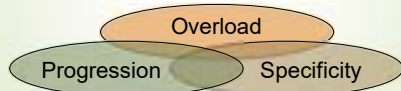
Million Hearts-Cardiac Rehabilitation Change Package. <https://millionhearts.hhs.gov/tools-protocols/action-guides/cardiac-change-package/index.html>

Copyright Jodi Gootkin

70

CV Benefits Physical Activity

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



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.

Copyright Jodi Gootkin

Physical Activity Intensity

Sedentary	Light	Moderate	Vigorous
≤ 1.5 METs While awake sitting, reclining, lying	<3.0 METs Slow walking, cooking, light chores	3.0 – 5.9 METs Brisk walking, doubles tennis, yard work	≥ 6.0 METs 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.

Copyright Jodi Gootkin

Cardiovascular Disease: Rehabilitation Considerations

Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.

Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited without prior written consent of both Innovative Educational Services and Jodi Gootkin.

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

73

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 Typical breathing	Moderate Intensity Somewhat harder breathing	Vigorous Intensity Much harder breathing
--------------------------------------	---	---

Copyright Jodi Gootkin

74

Daily Step Count

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

Copyright Jodi Gootkin 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.

75

Motion Sensor Exercise Intensity

► What cadence achieves sufficient activity intensity?

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

Stratification of Risk of Exercise Events

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

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

Cardiovascular Disease: Rehabilitation Considerations

Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.
Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited without prior written consent of both Innovative Educational Services and Jodi Gootkin.

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

Copyright Jodi Gootkin

79

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

Copyright Jodi Gootkin

80

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.

Copyright Jodi Gootkin

81

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 – age) x %HRmax

Copyright Jodi Gootkin

82

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

Copyright Jodi Gootkin

Cardiovascular Disease: Rehabilitation Considerations

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:

Copyright Jodi Gootkin

84

Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.

Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited without prior written consent of both Innovative Educational Services and Jodi Gootkin.

Mechanical Circulatory Support Devices (MCS)

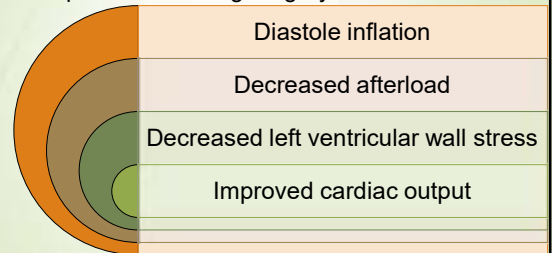
- Circulatory assist devices provide hemodynamic support to restore, aid or maintain blood flow in patients with cardiac compromise.
- Intra-aortic Balloon Pump (IABP)
- Extracorporeal Membrane Oxygenation (ECMO)
- Ventricular Assist Device (VAD)

Copyright Jodi Gootkin

85

Intra-aortic Balloon Pump (IABP)

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



Copyright Jodi Gootkin

86

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.

Copyright Jodi Gootkin

87

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.

Copyright Jodi Gootkin

88

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.

Copyright Jodi Gootkin

1. _____ is a research-based diet plan proven to lower blood pressure and LDL cholesterol.

- A. CANTOS
- B. DASH
- C. BRFSS
- D. MetS

Copyright Jodi Gootkin

Cardiovascular Disease: Rehabilitation Considerations

Copyright Innovative Educational Services and Jodi Gootkin. All rights reserved.

Reproduction, reuse, or republication of all or any part of this presentation is strictly prohibited without prior written consent of both Innovative Educational Services and Jodi Gootkin.

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

91

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

92

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

93

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

94

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

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

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

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

Copyright Jodi Gootkin

97

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

Copyright Jodi Gootkin

98

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

Copyright Jodi Gootkin

99

Cardiovascular Disease: Rehabilitation Considerations

References

- American Physical Therapy Association, Cardiovascular and Pulmonary Section. #VitalsAreVITAL: Exercising blood pressure interpretation. Accessed July 5, 2025 <https://www.cardiopt.org/vitalsarevital/>
- American Physical Therapy Association, Cardiovascular and Pulmonary Section. #VitalsAreVITAL. Accessed July 5, 2025 <https://www.cardiopt.org/vitalsarevital/>
- Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Health Disease and Stroke Prevention (DHDSP), National Cardiovascular Disease Surveillance System. BRFSS National Cardiovascular Disease Surveillance Data: Heart Disease and Stroke Prevention. Accessed July 5, 2025 [https://chronicdata.cdc.gov/Heart-Disease-Stroke-Prevention/Behavioral-Risk-Factor-Surveillance-System-BRFSS-N/ikwk-8git#:~:text=BRFSS%20is%20a%20continuous%2C%20state,and%20Stroke%20Prevention%20\(DHDSP\).](https://chronicdata.cdc.gov/Heart-Disease-Stroke-Prevention/Behavioral-Risk-Factor-Surveillance-System-BRFSS-N/ikwk-8git#:~:text=BRFSS%20is%20a%20continuous%2C%20state,and%20Stroke%20Prevention%20(DHDSP).)
- Centers for Disease Control and Prevention. Behavioral Risk Factor Surveillance System. Accessed July 5, 2025 <https://www.cdc.gov/brfss/questionnaires/index.htm>
- Centers for Disease Control and Prevention. Data User's Guide to the BRFSS Fruit and Vegetable Module. Accessed July 5, 2025 <https://www.cdc.gov/nutrition/data-statistics/data-users-guide.html>
- Chou, R., Cantor, A., Dana, T., Wagner, J., Ahmed, A. Y., Fu, R., & Ferencik, M. (2022). Statin use for the primary prevention of cardiovascular disease in adults: updated evidence report and systematic review for the US Preventive Services Task Force. *Jama*, 328(8), 754-771.
- Centers for Disease Control and Prevention. Public Health Surveillance of Fruit and Vegetable Intake Using the Behavioral Risk Factor Surveillance System Accessed July 5, 2025 https://www.cdc.gov/brfss/data_documentation/pdf/fruits_vegetables.pdf
- de Bont, J., Jaganathan, S., Dahlquist, M., Persson, Å., Stafoggia, M., & Ljungman, P. (2022). Ambient air pollution and cardiovascular diseases: An umbrella review of systematic reviews and meta-analyses. *Journal of internal medicine*, 291(6), 779-800.
- Diab, A., Dastmalchi, L. N., Gulati, M., & Michos, E. D. (2023). A heart-healthy diet for cardiovascular disease prevention: where are we now?. *Vascular health and risk management*, 237-253.
- Dibben, G. O., Faulkner, J., Oldridge, N., Rees, K., Thompson, D. R., Zwisler, A. D., & Taylor, R. S. (2023). Exercise-based cardiac rehabilitation for coronary heart disease: a meta-analysis. *European heart journal*, 44(6), 452-469.
- Faletra, A., Bellin, G., Dunning, J., Fernández-de-Las-Peñas, C., Pellicciari, L., Brindisino, F., ... & Mourad, F. (2022). Assessing cardiovascular parameters and risk factors in physical therapy practice: findings from a cross-sectional national survey and implication for clinical practice. *BMC Musculoskeletal Disorders*, 23(1), 749.
- Goldsborough, E., Osuji, N., & Blaha, M. J. (2022). Assessment of cardiovascular disease risk: a 2022 update. *Endocrinology and Metabolism Clinics*, 51(3), 483-509.
- Henein, M. Y., Vancheri, S., Longo, G., & Vancheri, F. (2022). The role of inflammation in cardiovascular disease. *International journal of molecular sciences*, 23(21), 12906.
- Kaminsky, L. A., German, C., Imboden, M., Ozemek, C., Peterman, J. E., & Brubaker, P. H. (2022). The importance of healthy lifestyle behaviors in the prevention of cardiovascular disease. *Progress in cardiovascular diseases*, 70, 8-15.
- Kosmas, C. E., Bousvarou, M. D., Kostara, C. E., Papakonstantinou, E. J., Salamou, E., & Guzman, E. (2023). Insulin resistance and cardiovascular disease. *Journal of International Medical Research*, 51(3), 03000605231164548.
- Kuan, P. X., Chan, W. K., Ying, D. K. F., Rahman, M. A. A., Peariasamy, K. M., Lai, N. M., ... & Anand, A. (2022). Efficacy of telemedicine for the management of cardiovascular disease: a systematic review and meta-analysis. *The Lancet Digital Health*, 4(9), e676-e691.
- Little, M. P., Azizova, T. V., Richardson, D. B., Tapio, S., Bernier, M. O., Kreuzer, M., ... & Hamada, N. (2023). Ionising radiation and cardiovascular disease: systematic review and meta-analysis. *bmj*, 380.
- Lopez, E. O., Ballard, B. D., & Jan, A. (2023). Cardiovascular disease. In *StatPearls [Internet]*. StatPearls Publishing.
- Makita, S., Yasu, T., Akashi, Y. J., Adachi, H., Izawa, H., Ishihara, S., ... & Hirata, K. I. (2022). JCS/JACR 2021 guideline on rehabilitation in patients with cardiovascular disease. *Circulation Journal*, 87(1), 155-235.
- Mangione, C. M., Barry, M. J., Nicholson, W. K., Cabana, M., Coker, T. R., Davidson, K. W., ... & US Preventive Services Task Force. (2022). Behavioral counseling interventions to promote a healthy diet and physical activity for cardiovascular disease prevention in adults without cardiovascular disease risk factors: US preventive services task force recommendation statement. *Jama*, 328(4), 367-374.
- Maryland Department of Health and Mental Hygiene. Heart Disease and Your Oral Health Heart Disease and Your Oral Health Heart Disease and Your Oral Health. Accessed July 5, 2025 <https://phpa.health.maryland.gov/oralhealth/Documents/HeartDisease.pdf>

- Marx, N., Federici, M., Schütt, K., Müller-Wieland, D., Ajjan, R. A., Antunes, M. J., ... & Sattar, N. (2023). 2023 ESC Guidelines for the management of cardiovascular disease in patients with diabetes: Developed by the task force on the management of cardiovascular disease in patients with diabetes of the European Society of Cardiology (ESC). *European heart journal*, 44(39), 4043-4140.
- Münzel, T., Hahad, O., Sørensen, M., Lelieveld, J., Duerr, G. D., Nieuwenhuijsen, M., & Daiber, A. (2022). Environmental risk factors and cardiovascular diseases: a comprehensive expert review. *Cardiovascular research*, 118(14), 2880-2902.
- National Institutes of Health, National Heart, Lung, and Blood Institute. Cardiogenic shock. Accessed July 5, 2025 <https://www.nhlbi.nih.gov/health-topics/cardiogenic-shock>
- National Institutes of Health, National Heart, Lung, and Blood Institute. Heart Failure. Accessed July 5, 2025 <https://www.nhlbi.nih.gov/health-topics/heart-failure>
- National Institutes of Health, National Heart, Lung, and Blood Institute. Metabolic Syndrome. July 5, 2025 <https://www.nhlbi.nih.gov/health-topics/metabolic-syndrome>
- National Institutes of Health, National Heart, Lung, and Blood Institute. DASH Eating Plan. July 5, 2025 <https://www.nhlbi.nih.gov/health-topics/dash-eating-plan>
- Pedretti, R. F., Hansen, D., Ambrosetti, M., Back, M., Berger, T., Ferreira, M. C., ... & Abreu, A. (2023). How to optimize the adherence to a guideline-directed medical therapy in the secondary prevention of cardiovascular diseases: a clinical consensus statement from the European Association of Preventive Cardiology. *European journal of preventive cardiology*, 30(2), 149-166.
- Perna, M., & Hewlings, S. (2022). Saturated fatty acid chain length and risk of cardiovascular disease: a systematic review. *Nutrients*, 15(1), 30.
- Popovic, D., Bjelobrck, M., Tesic, M., Seman, S., Jayasinghe, S., Hills, A. P., ... & behalf of the HL-PIVOT, O. (2022). Defining the importance of stress reduction in managing cardiovascular disease-the role of exercise. *Progress in cardiovascular diseases*, 70, 84-93.
- Ramachandran, H. J., Jiang, Y., Tam, W. W. S., Yeo, T. J., & Wang, W. (2022). Effectiveness of home-based cardiac telerehabilitation as an alternative to Phase 2 cardiac rehabilitation of coronary heart disease: a systematic review and meta-analysis. *European Journal of Preventive Cardiology*, 29(7), 1017-1043.
- Reynolds, A. N., Akerman, A., Kumar, S., Diep Pham, H. T., Coffey, S., & Mann, J. (2022). Dietary fibre in hypertension and cardiovascular disease management: systematic review and meta-analyses. *BMC medicine*, 20(1), 139.
- Saiz, L. C., Gorricho, J., Garjon, J., Celaya, M. C., Erviti, J., & Leache, L. (2022). Blood pressure targets for the treatment of people with hypertension and cardiovascular disease. *Cochrane Database of Systematic Reviews*, (11).
- Salari, N., Khazaie, H., Abolfathi, M., Ghasemi, H., Shabani, S., Rasoulpoor, S., ... & Khaledi-Paveh, B. (2022). The effect of obstructive sleep apnea on the increased risk of cardiovascular disease: a systematic review and meta-analysis. *Neurological Sciences*, 43(1), 219-231.
- Sanchis-Gomar, F., Lavie, C. J., Marín, J., Perez-Quilis, C., Eijvogels, T. M., O'Keefe, J. H., ... & Blair, S. N. (2022). Exercise effects on cardiovascular disease: from basic aspects to clinical evidence. *Cardiovascular research*, 118(10), 2253-2266.
- Tucker, W. J., Fegers-Wustrow, I., Halle, M., Haykowsky, M. J., Chung, E. H., & Kovacic, J. C. (2022). Exercise for primary and secondary prevention of cardiovascular disease: JACC focus seminar 1/4. *Journal of the American College of Cardiology*, 80(11), 1091-1106.
- Savarese, G., von Haehling, S., Butler, J., Cleland, J. G., Ponikowski, P., & Anker, S. D. (2023). Iron deficiency and cardiovascular disease. *European heart journal*, 44(1), 14-27.
- Taylor, R. S., Dalal, H. M., & McDonagh, S. T. (2022). The role of cardiac rehabilitation in improving cardiovascular outcomes. *Nature Reviews Cardiology*, 19(3), 180-194.
- Vaduganathan, M., Mensah, G. A., Turco, J. V., Fuster, V., & Roth, G. A. (2022). The global burden of cardiovascular diseases and risk: a compass for future health. *Journal of the American College of Cardiology*, 80(25), 2361-2371.
- Valenzuela, P. L., Ruilope, L. M., Santos-Lozano, A., Wilhelm, M., Kränkel, N., Fiuza-Luces, C., & Lucia, A. (2023). Exercise benefits in cardiovascular diseases: from mechanisms to clinical implementation. *European Heart Journal*, 44(21), 1874-1889.
- Van Veldhuisen, S. L., Gorter, T. M., van Woerden, G., de Boer, R. A., Rienstra, M., Hazebroek, E. J., & Van Veldhuisen, D. J. (2022). Bariatric surgery and cardiovascular disease: a systematic review and meta-analysis. *European heart journal*, 43(20), 1955-1969.
- Yan, Q., Liu, S., Sun, Y., Chen, C., Yang, S., Lin, M., ... & Yang, Y. (2023). Targeting oxidative stress as a preventive and therapeutic approach for cardiovascular disease. *Journal of translational medicine*, 21(1), 519.