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Endurance Assessment and Intervention

Pamela Bartlo, PT, DPT, CCS
Learning Outcomes

After this course, participants will be able to:

- Identify at least four endurance tests appropriate for any patient population.
- Describe at least two principles for performing interventions for endurance.
- Apply concepts of endurance testing to at least two patient case examples.
Introduction
Acknowledgments

- I’d like to acknowledge
  - Julie Skrzat, PT, DPT, PhD, CCS
  - Rachel Pata, PT, DPT, CCS
- We presented at CSM ‘18 and ‘19 on Endurance issues and some of the great background work these women did is reflected here.

Thank You!
Definitions

- **Endurance**: basic definition: the time limit of a person’s ability to sustain a particular level of physical effort. 

- **Fatigue**: basic definition: weariness or exhaustion from labor, exertion, or stress.
Aerobic Capacity/Endurance: The ability to perform work or participate in activities over time using the body's oxygen uptake, delivery, and energy release mechanisms.

Muscle Endurance: The ability of muscle to sustain forces repeatedly or to generate forces over a period of time.
Importance of Endurance Assessment

Who, What, Where, When, and Why?
Who should perform endurance assessments?

- PTs: can and should do baseline endurance assessment in their initial evaluation and then in subsequent re-evals.
- PTAs: can and should note endurance throughout sessions even though they are not performing the endurance assessment.
Who Cont’d

- OTs and COTAs: can and should do endurance assessment during ADLs and note endurance during OT sessions/tasks.

- Other health staff: should note endurance during tasks. PT can give them the guidelines/scales you would like them to use. Gives you more info on performance outside of PT session.
What endurance assessments should be used?

- Discussed more fully later in the presentation.
Where should endurance be assessed and treated?

- Clinic, gym, home care setting, long-term care facility, school, or other PT setting.
- Can also be tested in environments specific to that patient.
- Endurance interventions will occur anywhere the pt performs activity, but include those listed above.
When should endurance be assessed and treated?

- Assessment:
  - Initial evaluation period
  - Re-eval times
  - D/C from facility or PT care
  - Change in medical status occurs

- Intervention for endurance:
  - Should occur throughout the treatment sessions.
  - Great to do endurance specific interventions, but also incorporate it into other tasks/mobility
Why should endurance be assessed and treated?

- **COMPREHENSIVE CARE**
- Cardiovascular and respiratory systems contribute so much to function and QoL
- Skeletal muscle impact from conditions impacts demand on CVP systems too
- Metabolic costs – directly impacts functional life and quality of life$^{30}$
- Quantifiable
Factors Affecting Endurance
Factors Effecting Endurance

- Age
- Gender
- Heredity
  - Fiber type
    - Type 1 (slow twitch)
    - Type 2 (fast twitch)
- Elevation and environment
- Body composition
- Endurance training
Age

- Peak VO₂ typically between ages 18-25
- VO₂ max decreases about 0.5-1% per year or 5-10% per decade after age 25.¹⁰,²⁶,⁴⁴
- Primary reason for decline with Aging ⁵
  - Reduced CO
  - Reduced skeletal muscle oxidative capacity
Gender

- $\text{VO}_2\text{max}$ is approximately 200ml/kg/min > in boys than girls in throughout childhood

- An average difference between genders continues throughout the lifespan with males having a $\text{VO}_2\text{max}$ of about 15-30% greater than females.
  - % body fat
  - Heart and lung size
  - Hemoglobin
Fiber Type

- Type I fibers: slow twitch – typically better for endurance
- Type II fibers: fast twitch – typically better for power and strength
- As we age, we lose muscle mass including type I and type II fibers.
  - Can lose up to 10% muscle mass by age 50, and 50% loss by age 80 y/o.\textsuperscript{27}
- Some studies have shown greater loss of type II cells, but type I are also affected\textsuperscript{39}
Altitude

- Atmospheric pressure impacts oxygen in the blood stream and carried on hemoglobin.
- At higher altitudes: less O$_2$ in air and more O$_2$ dissociates off of Hgb.$^{47}$
- Max O$_2$ intake also decreased by about 8-10%.
- Compensate by increasing RR and HR.
  - As altitude increases or workload increases, RR and HR can’t keep up.
- Usually will compensate in about 2-5 days.
- So, not a long term issue for PTs usually.
Temperature

- **Cold temps (precaution with ex in <30°)**
  - Increase BP
  - Causes vasoconstriction
  - Some bronchoconstriction if breathing cold air without a buffer
  - More work on cardiopulm system = less endurance

- **Warm temps (precaution with ex in >80°)**
  - Increased metabolism by 5-15x that at rest
  - Higher internal body temp increases HR and BP
  - Thus higher CO and stress on the cardiopulm system = less endurance
Body Mass

- % body fat has direct impact on workload to cardiopulmonary system
- Also will see increased BP
- Possibly changes in pulmonary capacity
- Overall, increased body fat = decreased aerobic capacity so.... Decreased endurance\(^{36}\)
Standardized Assessments

Standardized Tools Used to Assess Endurance or Fatigue
Disclaimer

- This section is not meant to be an exhaustive list of tests that can be used.
- It is meant to provide you with the most common assessment tools used and a discussion of their validity and reliability.
Safety Considerations

- General safety recommendations
  - have emergency procedures in place
  - select appropriate exercise protocol
  - perform pre-exercise clinical assessment and testing
  - determine variables to be monitored
  - perform post-exercise eval and monitoring

- More specific indications to limit or stop ex discussed later.
Exercise Testing Measures

- Vitals
- RPE and Subjective Dyspnea Measurement
- VO$_2$ max
- METS
- Fatigue
Vital Signs

- HR
- BP
- $O_2$ Sats
- RR
- Signs of Endurance, NOT Strength/Power
RPE and Dyspnea

Borg RPE Scale

Dyspnea Scale

Borg Modified Dyspnea Scale

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<th>Dyspnea Scale</th>
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<td>0  No dyspnea</td>
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<td>7</td>
<td>1  Mild, noticeable</td>
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<td>10</td>
<td>4  Severe difficulty, cannot continue</td>
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<td>11</td>
<td>5  Severe</td>
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<td>12</td>
<td>6  Maximal</td>
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<td>13</td>
<td>7  Very Severe</td>
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<td>14</td>
<td>8  Extremely Severe</td>
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<td>15</td>
<td>9  Extremely Severe (almost maximal)</td>
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<td>16</td>
<td>10 Maximal</td>
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<td>17</td>
<td>11 Very, very hard</td>
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VO\textsubscript{2} Max

- VO\textsubscript{2} max: prescribe ex, measure endurance
- *We’re not really going to test that*
- Use research that equates test performance to VO\textsubscript{2} max…
- Or, train with intervals in aerobic rates to improve VO\textsubscript{2} max
- Think of oxygen consumption
METs

- Use measures from tests for METs
- Each type of exercise has its calculation to determine METs
- In general, uses power output (Watts or something like that) and pt’s weight to determine their METs
- Can use generic MET levels too\(^1\)
- Will discuss more later
Fatigue

- **COPD:**
  - Manchester COPD Fatigue Scale, FACIT-F Scale, MEMSI\textsuperscript{2,3,20}

- **MS:**
  - MFIS\textsuperscript{18,49} and FSS\textsuperscript{32}

- **PD:**
  - Fatigue Impact Scale for Daily Use (D-FIS)\textsuperscript{46}

- Many other scales specific to pathology
Standardized Tests

- GXT
- 2 MWT and 6 MWT
- 1 Mile walk
- Step test
- Sit to stand
- Recumbent stepper test
- Timed Up and Go (TUG)
- 6 Minute Arm Test
- Modified Shuttle Run Test
Maximal Graded Exercise Tests

- Strong reliability and validity in regards to endurance via aerobic capacity if pt reaches peak values\(^23\)
- Safe and feasible
  - Provided the pt has pre-test medical screening following ACSM inclusion/exclusion criteria
- **Disadvantage: Not very practical in clinic setting**
- Not actually able to even be done in a PT clinic
- Most patients won’t have a GXT (cardiac pt entering phase II rehab really only one.)
Modes of GXT

- Treadmill
- LE cycle ergometry
- UE cycle ergometry
- Recumbent Stepper – not very common
- Body weight supported treadmill
- For SCI, there is some research using w/c propulsion on treadmill\textsuperscript{31,21,40}
2 MWT

- Comparable to 6MWT. Same testing procedure, but pt only walks for 2 min.
- Significant correlations between the 2MWT and age, height, weight, and BMI.
2 MWT Cont’d

- Minimum detectable change: 42.5 m.
  - Meaning pt needs to improve 2MWT distance by at least 42.5 m (139.4”) to make a clinically significant difference.

- See Bohannon and Wang reference for age norms as they give them across the whole lifespan.⁹
6 MWT

- A sub-maximal test
- Done as a standard test with pulmonary patients, but can also be done with cardiac patients or any other medical patient
- Simple, easy, cheap test
- A good predictor of functional aerobic capacity
6 MWT Cont’d

- Can also correlate to max oxygen consumption (VO₂ max), exercise tolerance, and survival rates among cardiac and pulmonary patients.

- Validity and reliability of the 6-minute walk test in a cardiac rehabilitation population.²⁴

- Practical interpretation of 6-minute walk data using healthy adult reference equations.⁴⁵
6 MWT with Neuro Patients

- Pohl et al. showed that in stroke pts, the distance performed was influenced by: LE motor impairment and overall balance\(^{43}\)
- Kelly et al., showed that poor gait after stroke can be partially attributed to decreased endurance\(^{29}\)
- Van Hedel et al. showed good correlations between 6 MWT, TUG, and 10 meter walk test in pts with SCI\(^{50}\)
- Good validity for amb distance, and a physiologic cost index – PCI in pts with TBI
6 MWT Procedures

- Should have a walkway at least 30 meters (98’ 5”)
- Patient should walk at self-selected speed.
  - Can vary speed t/o test.
- Walk as far as they can in 6 minutes.
- Can use assistive device or oxygen.
- Can rest as needed either standing or sitting.
- Can use supervision or be independent.
- * If assistance is needed, you can provide it, but you are now doing a modified 6 MWT for individual performance only.

ATS Guidelines for Administration of 6 MWT, 2002
6 MWT Normal Values

- See Steffan et al. reference for age normative distances. Roughly average distances are:
  - Age 60-69 average 555 m (1800’)
  - Age 70-79 average 499 m (1622’)
  - Age 80-89 average 404 m (1315’)

- Also, Bittner et al. showed that
  - Ambulation distances of <300m (~1000ft) predicted poorer prognosis for long-term survival
  - Predicted increased likelihood of death in patients with significant heart and lung diseases.
6MWT using Treadmill

- Performance of 6MWT using treadmill\textsuperscript{33}
  - Good predictor of VO\textsubscript{2} max
  - As long as pt uses self selected speed, no significant difference from 6 MWT on floor
  - Has been used in a variety of pt populations now too (adults with ID, fibromyalgia, children, etc.)
1 Mile Walk Test

- Valid test to predict VO2 max and aerobic capacity.
- Been tested in various populations and ages with some different calculations for each so you may want to check them out before using on your population.11,35,12,42
1 Mile Walk Test Cont’d

- Need 1 mile course (track, treadmill, or other area).
  - Pt walks 1 mile as fast as they can.
  - At the end, takes HR
  - Calculations based on time to complete and HR. Some calculations use weight too.
1 Mile Walk Test Cont’d

- Pros: multiple pts can be tested at once, cheap, and simple.
- Cons: pacing is sometimes difficult for pts, performance can be affected by motivation, not good for less mobile populations.
Step Tests

- **Harvard Step Test** – original step test 30 steps/min at height 50.8 cm (1’ 7”)
  - Too tough for many patient populations

- **Height adjusted platform step test**
  - Height adjusted based on femur length in at a certain hip angle
  - 26 steps/min done at that height for 3 min
  - Immediately post exercise, the subject will remain standing and a pulse will be taken (15 second count)
Step Tests for Patients with Pulmonary Conditions

- **Astrand and Rhyming Step Test**
  - Step height: Females 33cm (13in), Males 40cm (15.7in)
  - Rate: 22.5 steps/min (90 total steps-“up, up, down, down”) for 6 min
  - Take HR at end of each minute (use pulse ox or HR monitor) and average the last two readings
Self paced step test\textsuperscript{41}

- Step height: 7"
- Rate: 20 steps at varying speeds: first pt instructed to go at slow speed, then at fast speed based on what the patient considered that to be
Step Test Cont’d

- Biggest key is to pick the correct protocol for your pt and WATCH balance.
Sit to Stand Test

- Typically 5x sit to stand
- Standard height chair with a back
- Have pt fold arms across their chest and stand up and sit down 5x as quickly as they can. (Also have 1 min versions)
- You measure how long (in time) it takes them.
  - Stop timing when they stand the 5th time
Sit to Stand Test

- Interpretation:
  - Lower times = better scores = more function
  - Minimum detectable change needed is 2.3 sec

- Age-Matched Norms:\(^8\)
  - 60-69: 11.4 sec
  - 70-79: 12.6 sec
  - 80-89: 14.8 sec
5x Sit to Stand
Recumbent Stepper Exercise Test

- Reliability and Validity: strong to assess peak VO$_2$ in maximal testing$^{6,14}$

- Testing protocol:
  - Step at 100 steps/min.
  - Increase resistance level by 1 every min
  - Stopped upon fatigue or 85% HR max

- Good test to use as all extremity ex limits LE fatigue

- Good for neuro pts too including those with SCI$^{38}$
Timed Up and Go (TUG) Test

- **Benefits**
  - Simple, easy, cheap, quick
  - Functional activities
  - Fall risk assessment

- **Disadvantages**
  - Not really useful for endurance
TUG Cont’d

- **Procedure**
  - Begin timing
  - Rise from standard chair
  - Walk to a spot/line 3 meters (~10ft) away from the chair
  - Turn around and return to the chair
  - Sit in chair
  - End timing

- **Results**
  - **Low Risk**
    - Score of < 14 sec & < 3 RF
  - **Moderate Risk**
    - Score of < 14 sec & ≥ 3 RF or > 14 sec & < 3 RF
  - **High Risk**
    - Score of > 14 sec & ≥ 3 RF
TUG Cont’d

- Strong reliability and validity in relation to walking function\textsuperscript{48}
- No studies found to assess validity of TUG to endurance/physical fitness
- Not recommended as an endurance test at this time, but good with low level pts in to show overall improvement in functional endurance.
6 Minute Arm Test (6-MAT)

- Reliability and validity: Excellent reliability and validity\(^2\)
- Excellent correlation of 6-MAT to VO\(_2\) peak
- Gives a steady state ex test that is easy to use in clinic
- Hol et al. give a schematic to use to determine the power output setting for each person
Shuttle Run Test

- Symptom limited test with incremental work loads
  - The original protocol\textsuperscript{34}
  - The modified version\textsuperscript{51}
  - Hassett et al. gives an equation to determine VO2 peak from shuttle run result\textsuperscript{25}
Non-Standardized Endurance Assessments

Clinical Tools or Tests Used to Assess Endurance for Various Patient Populations
Clinical Methods to Evaluate Endurance

- **General Observation**
- **Positioning / Postural Control**
  - Is it requiring a lot of energy just to hold their head or trunk up?
- **Toleration to Therapy**
  - How many rest breaks do they require?
Clinical Endurance Cont’d

- Breathing Pattern
  - High effort
  - Could it be easier?

- Functional mobility skills
  - Bed Mobility, Transfers, Ambulation, Stairs, W/C Propulsion, ADL’s

- Adaptive devices & equipment utilization
  - Looking at the quality & efficiency of their movement

- Environmental accessibility
  - Is their current way the most energy efficient?
Endurance and Mobility
Endurance and Mobility Cont’d

- Too many studies to list.
- Basically
  - We need to improve endurance (muscle and aerobically)
    - That will improve mobility
  - As we work on mobility (balance, positioning, function, etc.)
    - Endurance will improve too
Interventions for Endurance
Parameters

- **Low level/Long duration**
  - Increases number of type I muscle fibers
  - Increases oxidative abilities of peripheral muscles
  - Will improve pulmonary function

- **HIIT (High Intensity Interval Training)**
  - Will improve cardiovascular and pulmonary abilities
  - Increase type II fibers and some type I fibers
  - Increase strength to make motions more efficient
Parameters Cont’d

- Increase duration first, then intensity
- Rarely increase both on the same day
- Research shows increasing volume of moderate intensity exercise greater improvement in cardiovascular health
- Vigorous intensity will cause greater reduction of CAD risk, but not significant
- Take Home: vigorous ex is great if tolerated, but moderate intensity is all that is needed\textsuperscript{15}
ACSM Standard Ex Guidelines

- “…accumulate 30 minutes or more of moderate-intensity physical activity on most, and preferably all, days of the week.” (ACSM, 2006)
- Really need to get our patients active.
- Overload principle:
Exercise Prescription:

- Frequency: 3x / wk
- Intensity: 60% - 85% maximal value or age-estimated maximal value
- Time: 30 – 40 minutes / session
- Type: Exercises that use large muscle groups

**TAKE HOME:** The largest risk reductions occur when patients exercise 3–7 METs-h/wk and less benefit in patients exercising >7 METs-h/wk.

- Many of our pts may not get that high, so we just maximize what they can get

---

Eijsvogels et al., 2016; Keteyian et al., 2012.
METs

- Review: the metabolic equivalent of a task
- It’s how much energy a person burns relative to their mass
- At rest, that’s about 3.5 ml of $O_2$/kg/min or 1 MET
- Measure number of METs to complete an activity and then use that for your exercise prescription.
  - Pt does basic ADLs now at 2.5-3 METs
  - 4 weeks from now, they’ll perform bike and treadmill at 4 METs
METs Cont’d

- **1-2 METs**
  - Rest
  - Eating
  - Rolling in bed
  - Reaching for 1 item

- **2 METs**
  - Sit to stand
  - Standing
  - Basic supine or sitting ex

- **3 METs**
  - ADLs
  - Slow amb (3.0 mph)
  - Carrying small child
  - Light weight lifting or ex
  - Vacuuming (3.5 METs)

- **4 METs**
  - Amb (3.5 mph)
  - Household chores at vigorous level
  - Snowblowing
  - Golf w/pull cart
  - Mod level ex

- **>5 METs**
  - Amb/jogging (4.0 mph or more)
  - Mod to vigorous level ex
  - House repair
  - Hiking
Subjective scales

- Use subjective scales with METs and other parameters for exercise prescription

- General rule of thumb
  - Acute care:
    - RPE 6-10 overall. Up to 11-13 for specific task with rest afterwards
    - Dyspnea: 0-2 overall, 3 for specific task with rest
  - Sub-Acute/Home Health:
    - RPE: 9-11 overall. Up to 13-14 for specific task with rest
    - Dyspnea: 0-2 overall, 3 for specific task with rest
  - Outpt/SNF/School:
    - RPE: initially 11-13, then 12-14 later on outpt as able. SNF and peds may always stay 11-13.
    - Dyspnea: 0-2 overall, 3 for specific task with rest
RPE and Dyspnea – Review

Borg RPE Scale

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<th>Description</th>
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<td>1</td>
<td>Very, very light</td>
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<tr>
<td>2</td>
<td>Very light</td>
</tr>
<tr>
<td>3</td>
<td>Light</td>
</tr>
<tr>
<td>4</td>
<td>Somewhat hard</td>
</tr>
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<td>5</td>
<td>Hard</td>
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<td>6</td>
<td>Very hard</td>
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Dyspnea Scale

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<td>No dyspnea</td>
</tr>
<tr>
<td>1</td>
<td>Mild, noticeable</td>
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<tr>
<td>2</td>
<td>Mild, some difficulty</td>
</tr>
<tr>
<td>3</td>
<td>Moderate difficulty, but can continue</td>
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<td>4</td>
<td>Severe difficulty, cannot continue</td>
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Borg Modified Dyspnea Scale

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<td>0.5</td>
<td>Extremely Slight (just noticeable)</td>
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<tr>
<td>1</td>
<td>Very Slight</td>
</tr>
<tr>
<td>2</td>
<td>Slight</td>
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<tr>
<td>3</td>
<td>Moderate</td>
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<tr>
<td>4</td>
<td>Somewhat Severe</td>
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<td>Severe</td>
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<td>6</td>
<td>Very Severe</td>
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<tr>
<td>7</td>
<td>Extremely Severe (almost maximal)</td>
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<td>8</td>
<td>Maximal</td>
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Intervention Strategies

- Depending on the level of your patients, you may have to start very basic and progress as needed

- Your patients may be a starting low level: ICU early AROM and mobility... all the way up to outpatient older person with balance deficits due to endurance. (Crazy to think that person is considered high level)

- We have to be prepared to evaluate and treat endurance at various levels
Along the Continuum of Care

ICU/Acute Care
- Positioning upright
- Breathing ex:
  - Diaphragmatic
  - Deep breathing
  - IMT as able
- Early Mobility OOB
- General conditioning ex
- Standing, amb, as able

Sub-Acute/Home Health
- Functional training: transfers, bed mobility, standing posture
- Ambulation
- General conditioning ex
- Weights and aerobic ex equipment
- Specific muscle targeted ex

Outpatient/Peds School/SNF
- Functional training still: individualized
- Ambulation
- General conditioning ex
- Weights and aerobic ex equipment
- Balance training
- Specific muscle targeted ex
Intervention Strategies: early

- Tolerating Upright
  - May have to begin in the bed and move into the chair
  - Monitor the length of time the pt is able to sit up in their chair without having to be tilted etc

- Tolerating therapy
  - Being able to tolerate the time they are supposed to be in therapy
Intervention Strategies: trunk

- Positioning / Postural Control
  - Using whatever equipment needed to keep the pt in the best position (i.e. lap trays, headrests) so they aren’t getting tired trying to hold themselves up before they even begin therapy.

- Breathing Techniques
  - Teaching the pt to breath correctly
  - Incentive Spirometer
  - Inspiratory muscle trainer (P-Flex or Threshold IMT)
Intervention Strategies: functional

- Functional Mobility Skills
  - Breaking down the whole task to parts of the task

- Adaptive Equipment & Equipment utilization
  - Teaching our patients to use equipment the most efficient way & to allow them to utilize equipment to be more independent and to exercise.

- Environmental Accessibility
  - Teaching them independence, efficiency and strength
Intervention Strategies: aerobic

- Gait Training: Basic to high level (treadmill)
- Bike or airdyne
- UE Ergometry (arm bike)
- Recumbent stepper (Nu-Step)
- W/C Propulsion
- For very low level pt - standing program (Stander)
- Circuit Training (weight lifting & aerobic)
  - Cybex or Uppertone
  - The Wii – Endurance games
  - Free weights
Take Home of Intervention Strategies

- There is no perfect answer I can tell you
- Any ex the pt can do, is an ex to have them do
- Any ex the pt will do, is an ex to have them do
- May need to focus on specific component
  - Just on amb OR specific muscle(s) strengthening OR balance OR aerobic capacity
- May need to do a several pronged approach
  - Work on amb AND muscle strengthening AND balance AND aerobic capacity
Importance of Documentation
As clinicians, documentation is very important, now more than ever. Insurances dictate the length of stay of our patients. Insurances rely heavy on the progress shown in our documentation.

We are good about making our main goals functional, measurable, and attainable.

For Endurance:
- Describe the time, weight/resistance, repetition, amount of rests needed, etc.
Use the **SMART** system

- **S**mart – clear, concise, who/what/when…
- **M**easurable – time, amount, distance…
- **A**chievable – functional and good for time set and pt’s ability levels
- **R**elevant – consistent with LTGs of pt and other health care disciplines
- **T**ime-bound – set for appropriate length of time
Documentation Examples: Low Level

- While in short sit, patient will be able to hold proper posture for 30 seconds independently
  - Progress it by upping the time or put it to a functional task

- Pt will be able to speak 5 syllables/letters per breath.
  - Eventually up the number of syllables/letters etc.

- Pt will be able to perform the IMT (inspiratory muscle trainer) for 5 minutes on resistance 1 three times a day.
  - Work up to 15 minutes on each level 4-5 times a day and then increase the resistance
Documentation Examples: Mid Level

- Pt will be able to use the recumbent stepper (or other aerobic ex equipment i.e. bike, AE, etc.) for 10 minutes at ___ resistance without a rest.
  - Then up the time and resistance to progress pt

- Pt will tolerate 15 min of amb prior to rest needed. (Or other specific activity)
  - Up the time or decrease the time of rest needed
Documentation Examples: High Level

- Patient will be able to amb 200’ in less than 3 min without rest needed.
- Patient will perform 2 sets of 10 reps of 8 UE and LE resistance exercises with 5# wts.
- Patient will perform cycle ergometer for 12 min at > 80 rpms and resistance level 4.
Documentation Using Time

- Use time in 2 ways:
  - Time pt can perform activity for: pt will perform amb x 200’
  - Efficiency based on performing a task in a certain amount of time: pt will amb x 200’ in less than 3 min
Outcomes

- We do expect endurance to improve based on our interventions and progress of their functional mobility.
- Like other tests and measures, it is important that we re-perform standardized endurance tests after several sessions/weeks of PT.
- When endurance doesn’t improve:
  - Why is that?
  - What do we need to change?
Contraindications to Start Ex

- Unstable angina
- Resting HR >120
- Resting SBP>200, DBP >100 or DPB <60
- Atrial or ventricular tachycardia, frequent PVCs, multi-focal PVCs, PVCs which increase with ex or resting S-T segment depression of >2mm, 3° heart block
- Blood glucose >400
- Significant medical problems
- Unstable blood glucose levels

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Relative Indications to Stop Ex

- Drop in SBP > 20 mmHg
- Rapid rise in SBP >180 mmHg, DBP >100 mmHg
- ST or QRS changes such as excessive ST depression
- Arrhythmias including multifocal PVCs, triplets of PVCs, development of new bundle-branch block, supraventricular tachycardia (SVT), heart block, bradycardia [NOT VT]
- Fatigue, SOB, diaphoresis, wheezing, leg cramps or signs of vascular claudication
- Increasing chest pain

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Indications to Stop Ex

- Onset of angina or angina-like sx
- Drop in SBP ≥10 mmHg
- Excessive rise in BP: SBP > 250 mmHg and/or DBP > 115 mmHg
- SOB, wheezing, leg cramps, signs of claudication causing pt to want to stop ex
- Signs of poor perfusion: light headedness, confusion, ataxia, pallor, cyanosis, nausea, or cold and clammy skin
- Failure of HR to increase with increased ex intensity
- Noticeable change in heart rhythm by palpation or auscultation

ACSM, 2018
Case Study
Case Study – Roy G. Biv

- Roy is a 72 y/o man who underwent abdominal surgery 2 days ago s/p lower bowel obstruction.
- PMH: Prostate Ca 6 years ago, HTN, MI 4 years ago, COPD, cataract surgery 2018.
- Meds: Colace 100 mg bid, Atenolol 12.5 mg bid, Avapro 150 mg QD, Albuterol 2 puffs Q6 hrs, Percocet 5 mg Q4 hrs.
- Social Hx: retired police officer. Lives with his wife in a 2 story cape and was independent PTA.
Roy Initial Evaluation: Acute Care

- Upon entering room you find Roy supine with HOB elevated to about 45°, 1L O₂ NC, IV, PCA pump, catheter, and abdominal drain in place.
- Pt with c/o 5/10 at incision and increases with movement.
- Vitals: HR – 77, BP – 146/85, RR – 15, O₂ sats – 92%
Roy Eval Cont’d

- Do you general AROM and functional strength tests.

- What endurance test(s) would you like to do?
Roy Treatment: Acute

- What is your plan of treatment intervention for the first PT session?

- How will you progress plan and how will you show endurance improvement?
Roy G. Biv goes to Sub-Acute Rehab

- Day 5 after surgery, Roy is transferred to your sub-acute rehab facility.
- Initial eval: Roy is brought to your PT gym in a wheelchair on RA and no lines in place.
- Pain is 5/10 at abdomen and is fairly constant. He reports that it does increase with amb.
- Vitals: HR – 75, BP – 148/82, RR – 12, O₂ sats – 88%
Roy’s Subacute Eval

- Do your full PT sub-acute eval.
- Then, what endurance test(s) would you like to do?
Roy’s Treatment: Sub-Acute

- How will you treat Roy’s endurance impairments?

- How will you show endurance improvement?
Roy to Outpatient PT

- How would the interventions and assessments used in sub-acute change in outpatient?
Summary

- Describe importance of endurance assessment and intervention
- List factors that impact Endurance
- Explain endurance tests and their administration
- Detail endurance intervention strategies and parameters
- Apply knowledge
Thank You and Questions
References


References Cont’d


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