REHABILITATION FOR SOLID ORGAN TRANSPLANTATION: PHYSICAL THERAPY CONSIDERATIONS

Types of Patients Who May Benefit from Physical Therapy Involvement

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Duke University
APTA—Combined Sections Meeting
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Organ Transplantation

• Solid Organ Transplants performed in the U.S.
  – Liver
  – Intestine
  – Kidney
  – Pancreas
  – Kidney/Pancreas
  – Heart
  – Lung
  – Heart/Lung

Based on OPTN (Organ Procurement and Transplant Network) as of November 18, 2012
Solid Organ Transplants in U.S.

- Liver
  - 4,208 (2012)
  - Large (3-4 lbs.)
  - 4 lobes
  - Processes fats, proteins, carbohydrates
  - Stores vitamins
  - Vital for blood clotting
  - Secretes bile to break down toxic drugs/alcohol
  - Deceased donor: transplanted whole
  - Live donor: transplanted in segments

Causes

- Non-cholestatic Cirrhosis (alcoholic and non-alcoholic)
- Cholestatic liver disease/Cirrhosis (Crohn’s dx, Ulcerative colitis)
- Biliary Atresia
- Acute hepatic necrosis (Hepatitis C and B)
- Metabolic disease (A-1-A deficiency, Wilson’s dx, Hemosiderosis)
- Malignant neoplasms
- Other (Cystic Fibrosis)
Solid Organ Transplants in U.S.

- Intestines
  - 68 (2012)
  - Lower alimentary canal: stomach to anus
  - Small intestine
    - Narrow and convoluted
    - Further digestion of food
    - Absorbs nutrients
  - Large intestine
    - Wide
    - Reabsorbs water and sends to blood
- Deceased donor: whole or segment with liver
- Living donor: segment

Causes

- Short Gut Syndrome
- Functional Bowel Problem
- Retransplant/Graft failure
Solid Organ Transplants in U.S.

- **Kidney**
  - 11,167 (2012)
  - From deceased donor--1 or 2 kidneys
  - From living donor--1 kidney
  - Removes waste from body
  - Regulates BP, Blood volume, electrolytes
  - Acute/Chronic (fatigue, sluggishness, ↓ urine output, anemia, HTN, CHF)
  - Rx: dialysis, transplant

**Causes**
- Glomerular Disease (Sickle cell, Lupus, Goodpasture’s, Wegener's Granulomatosis)
- Diabetes
- Hypertensive (Malignant hypertension, Scleroderma)
- Renovascular and other vascular
- Congenital
- Tubular and interstitial disease (Sarcoidosis)
- Neoplams
- Retransplants/graft failure
- Transplant drugs (cyclosporin)
Solid Organ Transplants in U.S.

• **Pancreas**
  – 168 (2012)
  – Kidney & Pancreas (543)
  – Produces enzymes used for digestion and insulin
  – Often involves transplantation of duodenum
  – Deceased donor: whole pancreas or kidney/pancreas
  – Living donor: segmental transplant possible

• **Causes**
  • Diabetes Mellitus
  • Pancreatic Cancer
  • Bile duct cancer
  • Retransplant/graft failure
Solid Organ Transplants in U.S.

- Heart
  - 1609 (2012)
  - Muscle and fibrous tissue
  - Cone shape, size of fist
  - Heart failure = muscle weakness
  - Most orthotopic vs heterotopic
  - Deceased donor
  - Live donor: “domino” tx

Causes
- Cardiomyopathy (Dilated, Hypertrophic, Restrictive)
- Coronary Artery Disease
- Congenital Heart Disease
- Valvular Heart Disease
- Retransplant/Graft failure
- Cancer
Solid Organ Transplants in U.S.

• Lung
  – 1201 (2012)
  – Highly elastic, spongy
  – Allows oxygenation of blood
  – Deceased donor: 2 lungs, single lung
  – Live donor: Cystic Fibrosis, 2 lobes from living related donors

Causes

• Congenital: Eisenmenger’s Syndrome (VSD, ASD)
• Emphysema/COPD: Bronchiectasis, A-1-A deficiency
• Cystic Fibrosis
• Pulmonary Fibrosis
• Pulmonary Hypertension
• Retransplant/Graft failure: Bronchiolitis Obliterans (BO)
• Other: Sarcoidosis, Lymphangioleiomyomatosis (LAM), Rheumatoid Arthritis, Occupational, Inhalation burns/Trauma
• Heart/Lung
  – 22 (2012)
  – Deceased donor
    • Heart and 2 lungs
    • Heart and 1 lung (rare)

Causes

• Congenital: Eisenmenger’s Syndrome (VSD, ASD)
• Emphysema/COPD: Bronchiectasis, A-1-A deficiency
• Cystic Fibrosis
• Pulmonary Fibrosis
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• Other: Sarcoidosis, Lymphangioleiomyomatosis (LAM), Rheumatoid Arthritis, Occupational, Inhalation burns/Trauma
Solid Organ Transplants in U.S.

- Many patients who require transplant have chronic diseases pre-operatively leading to:
  - Muscle weakness
  - Possible prolonged hospitalization
  - Fatigue
  - Extended confinement to bed, room, or house
  - Poor ambulatory skill
  - Poor breathing mechanics
  - Inability to adequately clear pulmonary secretions

*Therefore*.............

Physical Therapy is consulted for.....balance abnormalities, weakness, poor endurance, poor flexibility and decreased range of motion, fall risk, loss of independent ambulation, poor bed mobility, inability to perform transfers, skin breakdown, edema, breathing re-training, airway clearance, etc.
Functional Level versus Organ Function

- Pre-Transplant
  - Functional Level
  - Organ Function
- Post-Transplant
  - Functional Level
  - Organ Function
Solid Organ Transplants in U.S.

- Post-operatively, patients may experience:
  - Weakness
  - Possible prolonged hospitalization
  - Fatigue
  - Extended confinement to bed, room, or house
  - Poor ambulatory skill
  - Poor breathing mechanics
  - Inability to adequately clear pulmonary secretions

Therefore.............

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Physical Therapy for the hospitalized pre-transplant patient: Implications and Considerations

Christina Schiel, DPT
Indiana University Health, University Hospital
Common causes of Pre-operative hospitalization

• Liver Failure
  – Hepatic Encephalopathy
  – Ascites
  – Spontaneous bacterial peritonitis (SBP)
  – Esophageal varices
  – GI Bleeding
  – Renal decompensation
  – Obstructive jaundice
  – Falls due to progressive weakness/muscle atrophy

• Presentation
  – Jaundice
  – Confusion
  – Coma
  – Nausea/vomiting
  – Edema
  – Abdominal pain
  – Abdominal distention
  – Muscle wasting
  – Fatigue
  – Insomnia
  – Anemia
  – Peripheral Neuropathy

• Diagnostic Tests and Measures
  – Abdominal CT
  – Endoscopic retrograde cholangiopancreatography (ERCP)
  – Magnetic resonance cholangiopancreatography (MRCP)
  – Esophagogastroduodenoscopy (EGD)
  – Abdominal Ultrasound
  – Liver Biopsy
  – Lab Values
Common causes of Pre-operative hospitalization

• Intestinal Failure
  – Failure to thrive
  – Bowel obstruction
  – Bowel necrosis
  – Bowel adhesions
  – Symptoms of liver failure

• Presentation
  – Lack of appetite
  – Nausea/vomiting
  – Abdominal pain
  – Abdominal distention
  – Fatigue
  – Muscle wasting
  – Complications of liver failure

• Diagnostic Tests and measures
  – Abdominal CT
  – Colonoscopy
  – Esophagogastroduodenoscopy (EGD)
  – Lab values
Common causes of Pre-operative hospitalization

• Kidney Failure
  – Dehydration
  – Elevated Creatinine/BUN
  – Malfunction of HD venous access
  – Cardiovascular complications
  – Electrolyte imbalances
  – Diabetic complications

• Presentation
  – Nausea/vomiting
  – Fatigue
  – Confusion
  – Progressive weakness
  – Falls
  – Malnutrition
  – Neuropathy/retinopathy

• Diagnostic Tests and measures
  – Renal Ultrasound
  – Renal biopsy
  – Urine studies
  – Echocardiogram
  – Lab values
Common causes of Pre-operative hospitalization

- **Pancreatic failure**
  - Delayed gastric emptying
  - Complications from DM
  - Pancreatic necrosis
  - Pancreatitis

- **Presentation**
  - Poor blood sugar control
  - Neuropathy
  - Abdominal pain
  - Fatigue
  - Fevers
  - Confusion/altered mental status

- **Diagnostic Tests and Measures**
  - Blood sugars
  - Abdominal CT
  - Abdominal Ultrasound
  - Endoscopic Ultrasound (EUS)
  - ERCP
  - MRCP
  - MRI
  - Lab Values
Common causes of Pre-operative hospitalization

• Heart failure
  – Ischemic heart failure
  – Non-ischemic failure

• Presentation
  – SOB/DOE
  – Fluid overload
  – Weight gain
  – Fatigue

• Diagnostic Tests and Measures
  – Echocardiogram
  – Heart catheterization
  – Lab values
Common causes of Pre-operative hospitalization

- Lung
  - Pneumonia
  - Infection
  - COPD exacerbation
  - CF exacerbation
  - Idiopathic fibrosis

- Presentation
  - Severe SOB/DOE

- Diagnostic Tests and Measures
  - Chest X-ray
  - Chest CT
  - Pulmonary Function Tests (PFTs)
  - Lab Values
Implications for Physical Therapy within pre-transplant inpatients

• Symptoms we as PTs are uniquely trained to address:
  – SOB/DOE
  – Weakness
  – Fatigue
  – Pain
  – Edema
  – Fall risk (Balance/strength)
  – Decreased mobility
Components of the Physical Therapy Inpatient Evaluation

• Social situation
• Vital signs/Lab values
  – Working with physicians for approved ranges for PT to work within as many of these patients can be highly atypical (Platelet, INR levels, BP ranges, O2 levels, HR, etc.)
• Strength
• ROM
• Aerobic capacity (6-min walk, 10m walk, etc.)
• Functional mobility
• Balance
• Compliance with HEP
• Discharge recommendations
  – Is inpatient rehab more appropriate pre-transplant before starting immunosuppression and lifting restrictions?
  – What are their financial rehab benefits?
Goals of Pre-operative Inpatient Physical Therapy

- Patients to receive transplants are in the majority of cases chronically ill and the range of physical recovery in the presence of organ failure is highly variable based on the progression of their disease. PTs work to:
  - Optimize aerobic capacity
  - Maximize musculoskeletal strength
  - Maximize functional endurance
  - Maximize and maintain functional independence
  - Exercise education to form good habits for post-operative recovery to optimize outcomes
    - Making sure patients are independent with a HEP to continue addressing goals after D/C
  - Education about post-operative activity requirements and expectations to reduce anxiety and increase post-operative compliance
  - Make disposition recommendations to allow patients to meet above goals
Treatment of the pre-transplant inpatient

- Thoracic organ patients are more likely to be ambulatory, but with severe endurance deficits, whereas visceral organ patient’s baseline mobility can range from bed-bound to ambulatory

- Areas to consider when planning treatments:
  - Musculoskeletal strengthening
    - Patients can get return even in the setting of organ failure
  - Bed mobility and transfer ability
    - maximize independence, as well as teaching techniques that patient will use after surgery, ie. log rolling, sternal precautions
  - Balance skills and core strengthening
    - optimize balance; post-op patient is compromised from large trunk incisions as well as post-operative medications that can have neuro-toxic side effects
  - Gait training
    - optimize gait for preservation of strength, endurance, and functional independence
    - provide and teach proper use of appropriate assistive devices to help patient get to transplant
Treatment of the pre-transplant inpatient

- **Endurance training and Energy Conservation**
  - Often need to work on sleep schedules and limiting naps
  - Increasing exercise capacity/aerobic tolerance

- **Edema control**
  - Wound care involvement as appropriate

- **Postural training**
  - May need to include back strengthening and ROM activities

- **Pulmonary Enhancement/Breath Control**
  - Management of endurance pre-operative; use of supplemental oxygen to optimize exercise capacity
  - Preparation for post-op limitations

- **EDUCATION !!**
  - Provide an HEP and train with it, now is the time for weights if appropriate
  - If not going to an inpatient rehabilitation facility, ensure they know how to follow up with physical therapy as needed
  - Treatment session that may just be talking with patients and family members to answer questions about pre-op goals, as well as helping set post-op goals to prepare their expectations
Barriers to Inpatient PT progression

• Acuity of illness
  – Medical status
  – Cognitive status
• ICU ventilation and sedation
• Line placement (can vary by facility)
• Lab values and vital signs outside treatable ranges
  – Instability of vital signs
  – Abnormal responses to exercise
• Inpatient testing and procedures
• Patient compliance
PT considerations for the hospitalized pre-transplant inpatient

• Is the patient currently listed or still in the work-up phase?

• If listed, is the patient still active on the list or have they been down graded to inactive during the hospitalization?

• What is the physician's plan? Is that patient going to be hospitalized until transplant?

• Pre-transplant patients are complex and require a full team approach to coordinate treatment
Solid Organ Transplants: Inpatient Post-Operative Considerations

Meghan Lahart PT, DPT
Cardiopulmonary Resident
Ann Arbor VA
Medications

• Majority of medications used post operatively are immunosuppressive agents
• Immunosuppressives are necessary in order to prevent rejection of donor organ
Medications

• Induction Therapy: strong dose at the time of transplantation
  – Reduces acute rejection
  – Allow for later introduction of nephrotoxic calcineurin inhibitors
  – Decrease the incidence of bronchiolitis obliterans syndrome
  – However the 5 year survival rate in patients who received induction therapy vs none demonstrated no significant difference
Medications

• Common Immunosuppressive Agents
  – Corticosteroids (Prednisone): antiinflammatory agent inhibits cytokine synthesis, interleukin-1 and T-cell activation
    • Side Effects: HTN, glaucoma, osteopenia, myopathy dyslipidemia
  – Calcineurin Inhibitors (Prograf): inhibits T-lymphocyte proliferation, inhibits interleukin-2,
    • Side Effects: Nephrotoxicity, HTN, hyperglycemia, GI disturbances, neurotoxicity
Medications

– Antiproliferative Agents (Cellcept): inhibits synthesis of DNA precursors in T and B lymphocytes, interferes with DNA synthesis, limits cellular proliferation
  • Bone marrow suppression, GI distress, hepatotoxicity

Medications

- Complications of Immunosuppression
  - Increased susceptibility to infections and malignancy
  - Nephrotoxicity
  - Hepatotoxicity
  - Hyperkalemia
  - HTN
  - Tremor
Heart Transplant

• Special Considerations:
  – Changes in Cardiovascular status following transplantation
    • Resting HR
    • HR with exercise/activity
    • Peak HR with exercise
    • Cardiovascular Response
    • Stroke Volume
    • Left Ventricular Ejection Fraction
    • Blood Pressure
Heart Transplant

• Special Considerations
  – Changes in Pulmonary Status following transplantation
    • VO2 Max
    • Ventilatory threshold
    • Anaerobic threshold

• ACSM Exercise Prescription for Patients with Cardiac Disease. 8th ed. p 218
Heart Transplant

• Signs of symptoms of rejection
  – Low grade fever
  – Fatigue
  – Decreased exercise tolerance
  – Ventricular dysrhythmias
  – Myalgia
  – Increased rest blood pressure
  – Hypotension with activity

Lung Transplant

• Special Considerations
  – Changes in Pulmonary Status
    • V02 max
    • Ventilatory threshold
    • Anaerobic threshold
    • Respiratory Rate
    • Minute ventilation

Lung Transplant

• Signs and Symptoms of Rejection
  – GERD
  – Low grade fever
  – Leukocytosis
  – Decreased arterial oxygen saturation
  – Decreased Exercise tolerance

Renal Transplant

• Special Considerations:
  – Diabetes Mellitus
  – Infections: upper respiratory infection, UTI
  – Anemia
  – Cardiovascular Disease
Renal Transplant

• Signs and Symptoms of Rejection
  – Fever
  – Flu-like symptoms
  – Tenderness around the kidney
  – Fluid retension
  – Weight gain >2-4 pounds within 24 hours
  – Decrease in urine output

Liver Transplant

- Special Considerations
  - Delayed cognitive recovery
  - Malnutrition
  - Delayed liver function
Liver Transplant

• Signs and Symptoms of Rejection
  – Fatigue
  – Fever
  – Abdominal pain or tenderness
  – Dark yellow/orange urine
  – Clay-colored stools
  – Decreased exercise tolerance

Intestinal Transplant

• Special Considerations
  – Adequate perfusion and oxygenation of graft
  – Nutrition
  – Bowel regimen
Intestinal Transplant

• Signs and Symptoms of Rejection
  – Fever/malaise
  – Change in ostomy output (either increased or decreased)
  – Intestinal bleeding
  – Nausea/vomiting
Pancreas Transplant

• Special Considerations
  – Inflammation
  – Fluid collection around graft
  – Duodenal wall thickening
  – Pancreatic duct dilation

Pancreas Transplant

• Signs and Symptoms of Rejection
  – Fever
  – Tiredness/fatigue
  – Abdominal pain
  – Hyperglycemia

Post-Operative Care in the ICU

• PT Evaluation
  – Vitals
  – ROM/strength
  – Skin/wound assessment
  – Posture assessment
  – Pulmonary assessment
  – Endurance/activity tolerance
  – Functional mobility
Post-Operative Care in the ICU

• Interventions
  – Focus on impaired gas exchange
  – Airway clearance
  – Positioning
  – Therapeutic exercise
  – Transfer training
  – Gait training
Post-Operative Goals

• Optimizing pulmonary hygiene and chest wall mobility to wean from ventilator and supplemental oxygen
• Improve strength and ROM
• Improve exercise tolerance through low to moderate intensity exercise and ADLs
Monitoring in ICU

• Heart Rate
• Rating of Perceived Exertion Scale
• Blood Pressure
• Dyspnea Index
• Signs and symptoms of Fatigue
• Lab Values
After the ICU

• Increasing MET level
• Focus on independence of ADLs
• Increase endurance
• Progression of exercises and guidelines for termination of exercise
• Preparing for discharge
• Patient education
  – Home exercise program
REHABILITATION FOR SOLID ORGAN TRANSPLANTATION

Physical Therapy Considerations for Outpatient Treatment, Pre- and Post-Transplant

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APTA—Combined Sections Meeting
January, 2013
Functional Level versus Organ Function

- Pre-Transplant
- Post-Transplant

- Functional Level
- Organ Function
Limitations of Transplant Candidates and Recipients

- Reduced exercise and functional capacity
- Decreased health-related quality of life
- Weakness
- Muscle atrophy
- Decreased bone density
- Increased fatigue
- Decreased cardiopulmonary capacity of 40-60%
- Psychosocial factors
Exercise and the PeriOp Patient

- Increased work capacity
- Improved muscle efficiency
- Enhanced distribution of muscle fibers
- Improved psychosocial factors such as anxiety and depression
Goals for the Patient Pre-Transplant

• Preserve muscle strength and endurance
  – Focus on proximal muscle groups to counteract effects of corticosteroids and decreased mobility expected as inpatient, preserve UE/LE function, and improve breathing mechanics

• Maximize functional abilities

• Educate patient on what to expect post-transplant
Goals for the Patient Post-Transplant

• Maximize muscle strength and endurance
• Improve exercise capacity
• Maximize quality of life
• Patient education
  – Signs and symptoms of rejection
  – Osteoporosis prevention
  – Co-morbidities such as diabetes
Physical Therapy Considerations for Heart Transplantation

• Pre-transplant, patients will have greatly reduced exercise tolerance due to decreased cardiac output

• Sternal precautions

• Denervation of the heart
  – Importance of warm-up and cool-down
  – Use of RPE scale to monitor exercise intensity

• Close monitoring of vital signs before, during, and after exercise
Physical Therapy Considerations for Lung Transplantation

• CO2 retention
• Pulmonary hypertension precautions
• Incisional precautions
• Breathing re-training
• Airway clearance
• Postural considerations
Physical Therapy Considerations for Liver Transplantation

- Complications from cardiopulmonary bypass
- Pulmonary involvement
- Central nervous system complications
- Abdominal scar can contribute to poor posture
- May also exhibit poor balance, coordination, endurance
- Energy conservation education
Physical Therapy Considerations for Kidney Transplantation

• Effects of exercise on blood glucose control
• Increased incidence of cardiovascular disorders, HTN, dyslipidemia, cancer, osteoporosis
• Close monitoring of vital signs, particularly BP, prior to and during exercise
• Resistive exercises and osteoporosis precautions
• Increased incidence of tendon injuries, especially Achilles
Transplant Rehabilitation—The Canadian Experience

• ~ 1/3 of centers participating had transplant rehab programs
  – Of those, 92% were either heart or lung
  – Only 1 center had rehab services for patients undergoing liver transplantation; none had a kidney transplant rehab program
Transplant Rehabilitation—The Canadian Experience

<table>
<thead>
<tr>
<th></th>
<th>Kidney</th>
<th>Liver</th>
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<tbody>
<tr>
<td>Pre-transplant</td>
<td>69%</td>
<td>60%</td>
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<tr>
<td>Post-transplant</td>
<td>75%</td>
<td>50%</td>
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</table>

- Despite the lack of transplant rehab programs for kidney and liver recipients, centers agreed on the need for such programs.
- Potential barriers
  - Lack of funding
  - Shortage of qualified personnel
  - Low volume of patients
  - Insufficient standardized rehab protocols
Functional Impairments

- Posture Changes due to Breathing Patterns
- Flexibility impairments
- Skeletal Muscle Weakness
- Endurance changes in muscle
- Endurance changes in activity
- ADL impairments
- Assistive Device Requirements
- Anxiety/Depression
Postural Changes

**Kyphosis**

**Posture Decay**

“To live a long, active, energetic life, few things matter more than good posture.”

How do you wish to age?
How to Measure Change In Posture

• Take a picture pre and post
• Use plumb line and measure amount of distance from normal posture line
Skeletal muscle impairment

Skeletal muscle dysfunction characterized by:

– Reduction in muscle mass and strength
– Atrophy of slow twitch oxidative endurance muscle fibers
– Decrease in fiber capillarization
– Decrease in oxidative enzyme capacity
– In effect: decrease in muscle endurance
– Lactic acidosis at lower exercise workloads
Strength Assessment

- Hand held dynamometer
- Manual muscle test of specific muscle groups
- 1 repetition max
- Multiple repetition max
- Chair Rise test for functional quad strength
Hand Dynamometry
Impairments: Decreased Activity

Endurance

• Decreased ability to perform ADLs
• Decreased walk distance with or without assistive device
• Decreased ability to perform stair climbing, incline walking as well as walking on level surfaces
• Increased symptoms with all activities
Activity Testing: assessing ADLs and other activities restricted due to disease

• Rate own activity performance: Patient Specific Functional Scale
  – Nominate 5 tasks they have difficulty with due to breathing problems & rate performance of each (0-10)
  – Determine score by averaging individual ratings and sum. (Stratford 1995) Reliability: (O’Shea 2005)
Walking Tests

Six minute walk: Evaluation of the global and integrated responses of all systems involved during exercise.  ATS Statement  March 2002

Gait Speed Test: high relationship with prediction of function
Six Minute Walk Test

Six Minute Walk Results: 7 laps or 1050 ft.

<table>
<thead>
<tr>
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<th>HR</th>
<th>SpO2</th>
<th>Dysp</th>
<th>BP</th>
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<tr>
<td>Rest</td>
<td>72</td>
<td>93</td>
<td>2</td>
<td>122/64</td>
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<tr>
<td>1</td>
<td>101</td>
<td>90</td>
<td>3</td>
<td></td>
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<tr>
<td>2</td>
<td>107</td>
<td>83</td>
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<td>113</td>
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<td>8</td>
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<td>4</td>
<td>116</td>
<td>78</td>
<td>9</td>
<td>stopped @ 4:10</td>
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<td>5</td>
<td>105</td>
<td>82</td>
<td>5</td>
<td>started back 5:30</td>
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<tr>
<td>6</td>
<td>108</td>
<td>83</td>
<td>6</td>
<td>164/80</td>
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<tr>
<td>Post ex</td>
<td>87</td>
<td>89</td>
<td>4</td>
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Six Minute Walk Test - Post

Six Minute Walk Results: 8+ laps  1270 ft.

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Evidence of 6 Min Walk

- Mean 6 MWD was 524 m (1719 ft) for healthy males (≥ 60 yrs) and 475 m (1558 ft) for healthy females (≥ 60)
  - 1 ft = 0.3048 meters  
    - Bohannon 2007

- Individual pts with COPD an improvement of more than 70 m (230 ft) is necessary to be 95% confident that improvement was significant.  
  - Redelmeier 1997
Rollators
4 Meter Walk Test

Quick Gait Speed Test

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<td>1.3 m/s</td>
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<tr>
<td>4 seconds</td>
<td>1.0 m/s</td>
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<tr>
<td>5 seconds</td>
<td>0.8 m/s</td>
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<tr>
<td>6.7 seconds</td>
<td>0.6 m/s</td>
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Conversion

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<th>Meters/second</th>
<th>Miles / hour</th>
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<tr>
<td>0.6</td>
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<td>1.2</td>
<td>2.7</td>
</tr>
<tr>
<td>1.4</td>
<td>3.1</td>
</tr>
</tbody>
</table>
Walking Speed
[meter per second (m/s)]

0 mph  0.4 mph  0.9 mph  1.3 mph  1.8 mph  2.2 mph  2.7 mph  3.1 mph
10 meter walk time  50 sec  25 sec  16.7 sec  12.5 sec  10 sec  8.3 sec  7.1 sec
10 foot walk time  15.2 sec  7.6 sec  5 sec  3.8 sec  3 sec  2.5 sec  2.2 sec
Interventions for Endurance

• Multiple repetitions of any activity
• Interval training with ambulation or any other activity. Short duration with frequent rests, increasing activity and decreasing rests.
How to measure change in endurance

- 6 minute walk distance
- Symptom history with activities
ADL Impairments

• Patients with moderate to severe COPD have difficulty performing ADLs that involve use of UEs
  – Arm elevation associated with high metabolic and ventilatory demand
  – Activities involving arms can lead to irregular or dyssynchronous breathing
  – Altered patterns of muscle utilization may be responsible for impairments using UEs. (Utilization of muscles for work and away from being used for respiration, leading to intolerance to activity.)
Measuring Change in ADL Performance

• Assess ADL performance measuring HR, BP and dyspnea
• Assess individual’s perception of dyspnea with all activities
• Time the ADL performance pre and post intervention
Nutritional Impairments: Obesity vs. Anorexia

"ink puffer." Note the use of accessory muscles and an effort to get more air out of the lungs.
Measuring change in Nutrition Impairments

- Weight
- Dyspnea with eating
- Patients perspective of dyspnea with eating
UE Functional Tests

• Grocery Shelving Test
  – Place 20 items from each of 2 grocery bags onto shelf 15 cm above shoulder ht as fast as possible. Three trials, average final 2. (Hill 2001)

• ADL tests
Grocery Shelving Task

Use 420 g cans: 20 cans

Shelf should be 15 cm above shoulder level, Table 90 cm tall,

Performs activity standing

Time amt of time to place 20 cans on shelf. 3 trials.
Grocery Shelving
LE Tests

• Chair Rise
  – Single Chair Rise
  – Multiple chair rise
  – 30 second chair rise

• Short Physical Performance Battery (SPPB)
  – Group of 3 tests:
    • Chair Rise
    • Gait Speed
    • Balance
Chair Rise Test

• **Single Chair Rise**: To test strength in legs in functional position. Test in chair like a dining room chair without arms.

• **Repeated Chair Rise**: Repeat procedure without stopping and without using arms (5 times)

• **30 Second Chair Rise**: count number of chair rises in 30 seconds
Chair Rise Test
Lower Extremity Function

- **Short Physical Performance Battery:**
  - 3 performance measures scored from 0 to 4 points.
    - Standing balance test: subjects must maintain their feet in a side-by-side, semi-tandem stand (heel of one foot next to the big toe of the other foot), or tandem stand (heel of one foot directly in front of the other foot) for 10 seconds.
      - The maximum score of 4 is assigned for maintaining the tandem stand for 10 seconds; a low score of 1 is assigned for side-by-side standing for 10 seconds, with inability to hold a semi-tandem position for 10 seconds.
    - A test of walking speed requires subjects to walk 4 meters at their normal pace. Participants are assigned a score from 1 to 4 based on the quartile of length of time needed to complete the test.
    - The chair stand test, which reflects lower extremity extensor muscle strength, measures the time required for the subject to stand up and sit down from a chair 5 times with arms folded across the chest. The chair height is standardized for all subjects. Scores from 1 to 4 are assigned based on quartile of length of time to complete the task.
  - A summary performance score integrates the 3 performance measures, ranging from 0 to 12. The battery has excellent inter-observer reliability, test-retest reliability, and predictive validity. (Gurainik 1995, 2000)
Balance Assessment

• Numerous balance assessments
  – Forward Reach
    • A single item test as a quick screen for balance problems with older adults
  – Berg balance
  – Tinetti
  – Romberg
  – Modified Romberg (Guralnik SPPB)
Forward Reach: assessing functional balance
Forward Reach

- Maximum sideways reach
- Elbow height
- Forward reach
- Max. upward reach for high shelves
- Upward reach
- Sideways reach
- Downward reach
- Max. forward reach
- Max. downward reach for low shelves
Balance Assessment

Three Stances

- Side-By-Side
- Semi-Tandem
- Tandem

Interpretation

- Maximum possible score is 4 points
- Maintain foot position for 10 seconds
- 1 point for 10 secs, 0 pts for < 10 secs
- Third position of full tandem: 2 pts for 10 secs, 1 pt for 3-9 secs
Balance Error Scoring System
Activity Testing

Mobility measurements:

– Timed up and Go
– Glittre Test
Timed Up and Go

- Start in standard armed chair
- Stand up and walk 3 meters (10 feet)
- Turn around and return to chair
- Sit down
- Independent older adults <12 secs
- 13-16 secs predicts falls in community dwelling older adults
- Avg TUG for 60-99 9.4 secs

Bischoff Age Ageing 2003
Shumway-Cook Physical Ther 2000
Timed Up and Go
Glittre Test

• Standardized test using ADL like activities
  – Chair stand
  – Lifting
  – Bending
  – Minimal stair climb

• Mean time: 4.67 min for pop with mean FEV1 of 48%
  – Range 2.57-14-47 min
Glittre Test

Subjects are instructed to:

• rise from a chair and walk 10 meters,
• ascending a 2-step rise about half way along that distance, to reach a shelving unit. The shelves are positioned at shoulder and waist height.
• The subject moves 3 cartons, each weighing 1 kg, from the upper to the lower shelf and then to the floor.
• The sequence is reversed so that each carton is returned to the top shelf before the subject returns to the starting position at the chair.
• At that time the subject sits down and immediately rises to begin the next lap.
• The test ends when a subject completes 5 of these laps.
Glittre Test

Depression/Anxiety Tools

• Beck Depression Inventory
• Mood/depression questionnaire
• Center for Epidemiologic Studies Depression (CESD) Scale
• Hospital Anxiety Depression Scale (HADS)
Center for Epidemiologic Depression Scale (CESD)

20 questions, rate rarely to most (4 columns)
Score: 0 first column, 1 second column, etc.
• I was bothered by things that usually don’t bother me.
• I did not feel like eating; my appetite was poor.
• I felt that I could not shake off the blues even with help from my family or friends.
• I felt I was just as good as other people.
• I had trouble keeping my mind on what I was doing.
• I felt depressed.
Hospital Anxiety and Depression Score (HADS)

• 12 questions 6 for anxiety, 6 for depression
• Anxiety ? I feel tense or 'wound up':
  – Most of the time 3
  – A lot of the time 2
  – From time to time, occasionally 1
  – Not at all 0
• Depression ? : I still enjoy the things I used to enjoy:
  – Definitely as much 0
  – Not quite so much 1
  – Only a little 2
  – Hardly at all 3
HADS Scoring

Scoring (add the As = Anxiety. Add the Ds = Depression).

The norms below will give you an idea of the level of Anxiety and Depression.

0-7 = Normal
8-10 = Borderline abnormal
11-21 = Abnormal

Zigmond and Snaith (1983)
Quality of Life tools
Research
Reimbursement