Advanced Roles of Physical Therapy in Spinal Cord Injury: A model for lifelong care

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APTA Combined Sections Meeting February 18, 2016
Disclosure

• No conflicts of interest.
• I work for the U.S. Department of Veterans Affairs.

• I am the current President of the Therapy Leadership Council in Spinal Cord Injury.
  – 1 of 4 sections which comprise the Academy of Spinal Cord Injury Professionals (ASCIP) organization.
Objectives

Upon Completion of this Presentation:

1. Participants will gain an understanding of the incidence of spinal cord injury in the general population, military, and veteran population.

2. Participants will gain understanding and appreciation of the multiple medical complications individuals experience post spinal cord injury, and how they relate to dysfunction of multiple body systems and Physical Therapy management.

3. Participants will become familiar with the Model Systems of Spinal Cord Injury care as well as the Spinal Cord Injury System of Care in the Veterans Health Administration and identify trusted sources for additional information.
Objectives

Upon Completion of this Presentation:

• 4. Participants will be able to discuss advanced clinics utilized by PT’s to provide optimal lifelong care in the rehabilitation of individuals with SCI/D.

• 5. Participants will gain new insight into assistive technologies available to individuals with SCI that optimize participation in the community.

• 6. Bottom line (see next slide)
Overall Goal of Presentation

- Present an overall snapshot of spinal cord injury in terms of pathophysiology, statistics, and PT rehabilitation practices.
- Provide immediate strategies for expanding the roles of PT in the management of individuals with SCI: Lifelong Care
- Share the implementation of the evidence in practice
- Improve outcomes
- Provide re-assurance you that what you are doing is consistent with current evidence
Outline

I. Brief overview: “SCI from the 20,000 foot view”
II. Pathophysiology of SCI
III. Brief overview of Epidemiology in the United States
   I. Incidence of traumatic SCI in U.S.
   II. Incidence in Military and Veteran population
IV. Brief overview of who provides SCI Care
   I. Private Sector Model Systems
   II. Department of Veterans Affairs SCI/D System of Care
V. Brief overview of the Neurologic Examination
VI. Medical Complications post SCI
VII. Roles of the Physical Therapists in SCI Care
   I. Advanced Roles of Physical Therapy in providing life-long care
   II. Details of specialty clinic implementation
   III. Recent advances, technology, and research in SCI rehabilitation care
Cleveland VA Medical Center
Cleveland VA Medical Center
SCI/D Regional Center of Excellence

- 32 Bed Inpatient Unit
  - CARF Accredited Acute Rehabilitation Program
- 26 Bed SCI/D Long Term Care Facility
- Full outpatient services
- One of 24 VA Regional SCI/D Centers throughout the country
- Providing lifelong care to veterans with SCI/D from Ohio, Pennsylvania, Michigan, Indiana, Kentucky, West Virginia and New York
Let's get back to the point of this presentation
Apology before going further

“I can’t possibly cover everything!”

_In the allotted time_.............
Part I: "20,000 Foot View"

To understand what we do, we must first understand what we are dealing with.

- What is a SCI?
  - Traumatic vs. Non-traumatic injury
  - Cliff notes version
- Statistics of traumatic SCI in the U.S.
- Who provides specialized SCI care in the U.S.?
- Neurologic Classification of SCI
- Medical Complications following SCI
Part II: “Ground Level View”

How do we as PT’s address the complexity of care for individuals with SCI?

- Traditional Roles of PT in the SCI health care model
- Advanced Roles of PT in the SCI Model
- Providing Lifelong care
- What’s on the horizon:
  - Technological Advances in Rehabilitation
As PT’s: We are Doctors!

• With the Doctoral Level profession comes:
  – The responsibility of understanding pathology and the medical complications associated with the pathology we are working with.

• As soon as we initiate our care with any individual and open with, “Hi. My name is Dr. John Smith, I will be your Physical Therapist.”
  – We engage in a “social contract” with the implied understanding and trust of the individual that we will be providing he/she optimal rehabilitation care.
Spinal Cord Injury
Pathophysiology of SCI
Anatomy and Physiology

• Spinal cord injury → damages the primary pathway for transmission of information between the brain and the peripheral nervous system.

• Injury causes disruption of:
  – Movement: strength, balance, coordination, etc.
  – Sensation
  – Autonomic Nervous System Function
Pathophysiology of SCI

- Immediate events in acute traumatic injury include damage to tracts and motor neurons due to:
  - **Fracture** of vertebral body with cord impingement from bony fragments.
  - **Dislocation** of vertebral bodies with loss of normal spinal canal diameter.
  - **Transient narrowing** of spinal canal diameter without bony fracture or dislocation.
  - **Traction** of cord with disruption of neurological structures.
Pathophysiology of SCI

• Complete transection of the cord is rare.

• Subacute and secondary effects include:
  – Edema
  – Hemorrhage
  – Ischemia
  – Onset of inflammatory response

• Vascular compromise results when there is occlusion of cortical branches of either the anterior or posterior spinal arteries resulting in cord ischemia and necrosis.
Non-Traumatic Spinal Cord Conditions

• Multiple Sclerosis
• ALS
• Spondylotic Myelopathy
• Syringomyelia
• Epidural Abscess or hemorrhage
• Tumor
• Viral Transverse Myelitis
• Spinal Cord Infarction
• Vitamin B-12 deficiency
• HIV related myelopathy
What are we typically left with?
When LE function is lost in SCI

- Shoulder → Hip
- Elbow → Knee
- Wrist/Hand → Ankle/Foot
Let's Look At Some Statistics

Pastor Doug could usually tell when he began to lose his flock.
Paralysis in the U.S.

- Estimated 5,596,000 living with paralysis
- SCI estimated at 1,275,000
  - www.christopherreeve.org/site/c.mtKZKgMWKwG/b.5184255/k.6D74/Prevalence_of_Paralysis.htm
Epidemiology
National SCI Statistical Center 2015

• Incidence: Approximately 12,500 new cases per year.
  • 40 cases/1 million people
  • Does not include those who die at the scene of an accident

• Estimated 276,000 people living with SCI in the U.S.
  – Range 240,000 - 337,000

• Average age of injury 42 years (since 2010)
  – Almost half of the injuries occur between the ages of 16 and 30
  – Average age was 29 years (in mid 1970’s)
  – Males make up ~80 % of all SCI injuries (trend decreased)
  – 11.5% are >60 years of age (trend increasing)

Epidemiology
National SCI Statistical Center 2015

• Breakdown according to Ethnicity
  – Non-Hispanic White: 64%
  – Non-Hispanic Black: 23%
  – Hispanic Origin: 10%
  – Asian: 2%
  – Other: 1%
  – Native American: 0.5%

Epidemiology
National SCI Statistical Center 2015

• Causes of Injury (since 2010)
  – Motor Vehicle Crashes: 38%
  – Falls: 30%
  – Violence: 14%
  – Sports: 9%
  – Medical/Surgical: 5%
  – Other: 4%
Epidemiology
National SCI Statistical Center 2015

• Injury Level Breakdown:
  – Incomplete Tetraplegia 45%
  – Incomplete Paraplegia 21%
  – Complete Paraplegia 20%
  – Complete Tetraplegia 14%
  – < 1% experience complete recovery by discharge from acute hospital stay
  – ~ 2/3 of all injuries are incomplete

Long-Term Survival
(Life expectancy in years)

<table>
<thead>
<tr>
<th>Age at Injury</th>
<th>No SCI</th>
<th>AIS D−Motor Functional at Any Level</th>
<th>Low Tetra (C5−C8)</th>
<th>High Tetra (C1−C4)</th>
<th>Ventilator Dependent Any Level</th>
<th>No SCI</th>
<th>AIS D−Motor Functional at Any Level</th>
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Data Source: Economic Impact of SCI published in the journal *Topics in Spinal Cord Injury Rehabilitation*, Volume 16, Number 4, in 2011. ASIA Impairment Scale (AIS) is used to grade the severity of a person’s neurological impairment following spinal cord injury.
The average yearly expenses include health care costs of living.

Costs do **not** include indirect expenses:
- E.g. Lost wages, fringe benefits, productivity, etc.
- Estimate indirect costs averaged $71,961 /year in 2014 dollars

Military Statistics

- Iraq and Afghanistan 2003-2011
  - 5,424 deceased service members
    - 38.5% (2,089) were found to have at least 1 spinal injury
    - SCI in ~ 40%

- 2003-2011 focus on pelvis, spine, extremity
  - 67% (472/701) of Calvary Scouts injured sustained 1 or more msk injury
  - Majority of causalities in Iraq theatre
  - 69% resulted from explosions
  - 20% from GSW
  - 12% SCI
Military Statistics

- **DOD Trauma Registry from 2005-2009**
  - 7877 combat wounded
    - 11.1% (872) casualties with spine injuries
      - Spine fractures 80% of the 872
      - SCI rate of 4.0/10,000
      - SCI more likely to occur in Afghanistan among Army personnel

Veterans Statistics

• Veterans with SCI
  – Estimated ~ 42,000 Veterans (2009)
    • http://www1.va.gov/opa/publications/factsheets/fs_spinal_cord_injury.pdf

• VA SCI/D System of Care (2015)
  – 22,133 Veterans provided SCI/D specialty care
    • “Uniques” (coded with 22, 210, or 215 stop codes)

  – Complexity of interpreting the numbers
    • Many spoke sites do not report stop codes for SCI, so the number is most likely higher
    • Not all Veterans with SCI actively utilize VA SCI/D care
    • Numbers can be further complicated due to some regional centers providing care for MS and ALS under SCI/D system
      – E.g. Cleveland SCI/D Center covers MS and ALS
Leading Causes of Death in SCI

- **Since 1973:**
  - Pneumonia
  - Septicemia
  - Prior to 1973 the leading cause was Renal Failure

- **Mortality Rates are declining for:**
  - Cancer, heart disease, stroke, arterial diseases, pulmonary embolus, urinary diseases, digestive diseases, and suicide.

- **Mortality Rates are increasing for:**
  - Endocrine, Metabolic and Nutritional Diseases, accidents, nervous system, musculoskeletal, and mental disorders.

In response to mortality trends....

- **Goals as PT’s:**
  - Educate!
  - Get individuals actively involved in the ownership of their disease and care as soon as possible!
  - Restore maximum functional potential to improve:
    - Participation in self-care
    - Mobility
    - Fitness
    - Social Roles:
      - Relationships
      - Family obligations
    - School
    - Work
    - Recreation and Leisure
Who does SCI Care?

• Any acute hospital
  – Traumatic depending on geography
  – Atraumatic

• Level I and II trauma centers depending on geographic location

• SCI Model Centers

• Department of Veterans Affairs SCI/D System of Care
SCI Model Systems

- Spinal Cord Injury (SCI) Model System, sponsored by the National Institute on Disability and Rehabilitation Research (NIDRR), Office of Special Education and Rehabilitative Services, U.S. Department of Education, supports innovative projects and research in the delivery, demonstration, and evaluation of medical, rehabilitation, vocational and other services to meet the needs of individuals with SCI.

- NIDRR awards SCI Model Systems Center grants to institutions that are national leaders in medical research and patient care and provide the highest level of comprehensive specialty services, from the point of injury through rehabilitation and re-entry into full community life.

- Grants are awarded in five-year cycles (the current cycle is 2011-2016). Each SCI Model Systems Center contributes to the SCI Model Systems Data Center, participates in independent and collaborative research, and provides information and resources to individuals with SCI, their family and care givers, health care professionals and the general public.

- See more at: http://www.msktc.org/sci/model-system-centers
SCI Model Systems

• University of Alabama at Birmingham SCI Model System
  – University of Alabama at Birmingham, Birmingham, AL

• Southern California SCI Model System
  – Rancho Los Amigos National Rehabilitation Center, Downey, CA

• The Rocky Mountain Regional Spinal Injury System
  – Craig Hospital, Englewood, CO

• South Florida SCI Model System
  – University of Miami, Miami, FL

• Southeastern Regional SCI Care System
  – Shepherd Center, Inc., Atlanta, GA

• Midwest Regional SCI Care System (MRSCIS)
  – Rehabilitation Institute of Chicago, Chicago, IL

• Kentucky Regional Model SCI System
  – Frazier Rehabilitation, Louisville, KY
SCI Model Systems

• Spaulding-Harvard SCI System
  – Spaulding Rehabilitation, Boston, MA

• New England Regional SCI Center Network
  – Boston University Medical Center, Boston, MA

• University of Michigan SCI Model System
  – University of Michigan, Ann Arbor, MI

• Northern New Jersey SCI System
  – Kessler Foundation Research Center, West Orange, NJ

• Regional SCI Center of the Delaware Valley
  – Thomas Jefferson University, Philadelphia, PA

• University of Pittsburgh Model Center on SCI
  – UMPC Rehabilitation Institute, Pittsburgh, PA

• Northwest Regional SCI System
  – University of Washington, Seattle, WA
VA SCI/D System of Care
www.sci.va.gov

- VA Spinal Cord Injury and Disorders System (SCI/D) of Care
  - VHA Handbook 1176.01
    - http://www.va.gov/vhapublications/publications.cfm?pub=2
- Procedures for providing extended care services for SCI/D veterans
  - VHA Handbook 1176.02
What is 1176.01?

- VHA Handbook defines the SCI/D System of Care
- Establishes a provision of specialized services for Veterans who qualify under SCI/D
- Establishes the National System with regionalized HUB and Spoke model
- Emphasize the importance of rehabilitation and a comprehensive continuum of health care
  - Covers wide variety of services:
    - Benefits, Home Modifications, Personal Care, DME, Transportation, Drivers Rehab, Voc Rehab, Fee basis, etc.
VA Regional SCI Centers

http://www.sci.va.gov/SCI_Centers.asp
VA SCI Centers

• 24 Regional Centers
  – 22 Centers are Acute Care
  – 6 long-term care centers
    • 4 of the long-term care centers are within the medical facilities with acute centers
  – 6 designated as VA SCI Regional Centers of Excellence
    • E.g. Cleveland, OH
VA Regional SCI Centers
VA Regional SCI/D Centers

- Albuquerque, NM
- Augusta, GA
- Boston, MA
- Bronx, NY
- Castle Point, NY
- Chicago, IL
- Cleveland, OH
- Dallas, TX
- East Orange, NJ
- Houston, TX
- Long Beach, CA
- Memphis, TN
- Hampton, VA
- Miami, FL
- Milwaukee, WI
- Minneapolis, MN
- Palo Alto, CA
- Richmond, VA
- San Antonio, TX
- San Diego, CA
- San Juan, PR
- Seattle, WA
- St. Louis, MO
- Tampa, FL
- Syracuse, NY
VA SCI Center: Cleveland

- Cleveland is the “hub” for the following spokes:

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<td><strong>Buffalo, NY</strong></td>
</tr>
<tr>
<td>Dayton, OH</td>
<td>Pittsburgh, PA</td>
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</tbody>
</table>
Active Duty and Veteran Status

- There is a long-standing Memorandum of Agreement between VA and the Department of Defense (DoD) to provide specialized care at VA medical facilities for Active Duty Service members who have sustained a spinal cord injury.

- Ongoing collaboration and education between VA and DoD ensures continuity of care and services.

- A study conducted by a major consulting firm in 2000 comparing VA's SCI services to those funded by several private and public health insurers showed that VA's coverage was more comprehensive.

How is SCI Diagnosed?
Neurological Examination

• **INSCI =**
  – International Standards for Neurological Classification of Spinal Cord Injury

  ○ Standardized system for classification of neurological function in Spinal Cord Injury.
  
  ○ Allows for effective communication between providers.
  
  ○ Prediction of an expected level of function for a patient based on motor level. (Patient diagnosed with “C5 AIS A Tetraplegia” will need assistance for transfers)
Neurological Examination

- **INSCI** = commonly still referred to as the “ASIA Exam”
  - International Standards for Neurological Classification of Spinal Cord Injury

  - Assessment of the effectiveness of interventions in the treatment SCI.
  - Determination that neurologic function remains stable over time even with different examiners.

www.asia-spinalinjury.org
ISNCSCI Exam

• **INSCI** =
  - International Standards for Neurological Classification of Spinal Cord Injury

• Classification system uses findings from motor and sensory exam to determine the level of injury and degree of preserved neurologic function.

• Best Predictor of future for SCI Patients!

• Most caudal level with normal function.
  - Not the first level with abnormal function.
ISNCSCI Exam

- AISA Website: http://www.asia-spinalinjury.org/
AISA Website: [http://www.asia-spinalinjury.org/](http://www.asia-spinalinjury.org/)

Sensory Assessment

- 28 Dermatome sites from C2 to S4/5
  - Testing done in supine
  - Recommended Sequence when testing:
    • Sharp/dull → Light touch discrimination
    • From impairment zone to cephalad
    • Use cues of “normal or different”
  - Presence or absence of sensation on rectal examination also recorded
  - Neurologic Level: Most Caudal level with normal light touch and sharp/dull discrimination
  - Provided all rostral levels above have normal sensory function
Motor Assessment

- Key Muscles determine motor level
- Testing done in supine position
- ISNCSCI Exam: Muscles are assigned to the proximal nerve root (associated with given muscle)
  - E.g. Biceps are innervated by C5-6 Myotome but assigned to the C5 Myotome.

- Grade of 3 or better will indicate that the proximal of the 2 segments is to be regarded as normal if the next most rostral key muscle action is normal.
  - at least a 3 and normal (5) above
Motor Assessment

• Upper Extremity Key Muscles:
  • **C5** = Elbow Flexors (Biceps)
  • **C6** = Wrist Extensors
  • **C7** = Elbow Extensors (Triceps)
  • **C8** = Finger Flexors (Grip)
  • **T1** = 5th Finger Abduction

– Not include in ISNCSCI Exam but important to PT's functionally: Shoulder Elevation/ABD and Cervical Flex, Ext, Rot.
Motor Assessment

- **Lower Extremity Key Muscles:**
  - L2 = Hip Flexors
  - L3 = Knee Extensors (Quads)
  - L4 = Ankle Dorsiflexors (Ant. Tibialis)
  - L5 = Great Toe Extensors
  - S1 = Ankle Plantarflexors (Gastroc and Soleus)

- Not included in ISNSCI Exam but important to PTs functionally: Hip ABD and Hip Ext as well as Knee Flex. Also Trunk Control.
Complete vs. Incomplete

- **Complete Injury**
  - The ABSENCE of sensory and motor function in the lowest sacral segment (S4/5).
  - AIS A

- **Incomplete Injury**
  - Some preservation of sensory and/or motor below the neurological level with function in the lowest sacral segment.
  - AIS B
  - AIS C
  - AIS D
  - AIS E
Predictability of Neurological Recovery

- An individual with T 10 Paraplegia AIS A
  - Given no other medical complications, will have a predicted functional outcome of being Independent with:
    - Bed Mobility
    - Transfers
    - ADL’s (wheelchair level)
    - Wheelchair propulsion
      - Manual Wheelchair
    - Non-ambulatory

-Free download at www.pva.org
• SCI Outcome Measures Recommendations
  – www.neuropt.org/professional-resources/neurology-section-outcome-measures-recommendations/spinal-cord-injury

• SCI Special Interest Group
  – www.neuropt.org/special-interest-groups/spinal-cord-injury
Excellent Comprehensive Reference

http://www.scireproject.com/home
The online format allowed the content for a relatively specialized field to have far reach (e.g. 26 countries and over 6500 users per month).

The website survey and targeted end-user survey confirmed that health care providers, as well as researchers perceived that the website increased their access to SCI evidence.

Access to SCIRE not only improved knowledge of SCI evidence but helped inform changes to the health providers' clinical practice and improved their confidence in treating SCI clients.

The SCIRE information directly influenced the health providers' clinical decision making, in terms of choice of intervention, equipment needs, or assessment tool.

Medical Complications associated with Spinal Cord Injury
Medical Complications after SCI

- Autonomic Dysreflexia
- Cardiovascular and Respiratory Dysfunction
- Orthostatic Hypotension
- Genitourinary Dysfunction
- Gastrointestinal Dysfunction
- Pressure Ulcers
- Spasticity/Contractures
- DVT/PE
- Heterotopic Ossification
- Concomitant Injuries/Polytrauma (VA)
- Traumatic Brain Injury
- Syringomyelia
PT Evaluation: Systems Review

Looking closer at Medical Complications

- Cardiovascular/Pulmonary System
- Integumentary System
- Neuromuscular System
- Musculoskeletal System
Vagus nerve originates from the medulla and innervates the sinoatrial node, atrioventricular node, ventricles and remains intact in SCI.
Orthostatic Hypotension

Sustained decrease in BP > 20 mmHg Systolic or >10 mmHg Diastolic within 3 min. of moving from supine to upright.
Deep Vein Thrombosis and Pulmonary Embolism
Respiratory Dysfunction
Leading Cause of Death post SCI

Primary Muscles of Inspiration

- Diaphragm C3-C5
- Scalenes C2-C7

Accessory Muscles of Inspiration & Muscles of Expiration

- Sternomastoid Accessory Nerve & C2-C3
- Intercostals T1-T11
- Abdominal Muscles especially Transversus Abdominus T7-L1
Respiratory Dysfunction

Diaphragm is innervated by C3,4,5. Injuries C1-3 require mechanical ventilation.

Pulmonary Complications post SCI:

- Impaired cough leading to Pneumonia
  Cough is primarily due to function of the abdominal muscles (T6-T12) and internal intercostals.
- Impaired ventilation (may require mechanical vent)
- Low Forced Vital Capacity (FVC)
  FVC < 1.0 L often require mechanical vent
Respiratory Management

• **Main Goals for Treatment:**
  – Expand the Lungs:
    • Airway Clearance
    • Mobility of Chest Wall
    • Strength and Control

Integumentary System
Pressure Ulcers
Neuromuscular & Musculoskeletal Systems

- Neuromuscular
- Musculoskeletal
Neuromuscular & Musculoskeletal Systems Dysfunction

- Absent/Impaired:
  - Sensation
  - Balance
  - Proprioception
  - Motor Control
  - Strength
  - Transfers (and transitions)
  - Mobility (wheelchair)
  - Gait

- But wait, there are more serious dysfunctions.........
Autonomic Nervous System

- Sympathetic innervation of the heart originates from T1-T5 and reaches the heart via branches from the sympathetic chain.

- Injuries at T6 and above: Autonomic imbalance occurs with intact parasympathetic innervation and either a reduced or hyper-reflexic sympathetic response to stimuli.
Autonomic Dysreflexia

Emergency Situation!

SCI with Brain Injury
Syringomyelia
Spasticity
Heterotopic Ossification (HO)
Bowel and Bladder Dysfunction
Bowel Issues
Bladder Issues
Bowel and Bladder Issues

- Bowel and Bladder are innervated by Sacral Segments S2-S4.
- Injuries **above** T12 (UMN injuries) results in a **Reflexive (Spastic)** bladder and bowel.
- Injuries **below** T12 (UMN injuries) results in a **Flaccid** bladder and bowel.
How do we go from here?
To here
Interdisciplinary Care Coordination

- Patient
- Family Members/Friends
- Primary Providers
  - MD, PA, NP's
- Nurses
- Social Workers
- Psychologists
- Dieticians
- Pharmacists
- Respiratory Therapists
- Physical Therapists
- Occupational Therapists
- Recreation Therapists
- Vocational Rehab Counsellors
- Kinesiotherapists (VA)
- Chaplain
- Patient Advocate/Military
Therapy Roles May Vary
or overlap depending on:

- Facility Policies
- Staffing
  - PT vs. OT ratio’s
    - E.g. Wheelchair seating, support surface selection, assistive technology
  - Workload distribution
  - Experience/Advanced Training
  - Recreation Therapy on staff (for community outings)
- State practice acts
- Reimbursement
- Bottom Line:
  - **Collaboration and co-treatment are necessary for success!**
    - Roles at times can be shared and overlap.
    - Abolishment of Therapy “turf battles” has been highly successful in our model.
Physical Therapists are integral to the IDT

- Traditional Institutional based SCI care settings in which PT's are integral members of the IDT:
  - ICU
  - Acute rehab
  - Sub-acute rehab
  - Outpatient rehab
  - Long term care
  - Home care
  - Specialty Clinics
Traditional Roles of PT
Management of Neuromuscular & Musculoskeletal Systems Dysfunction

- Address Dysfunction
  - Absent/Impaired:
    - Sensation
    - Balance
    - Proprioception
    - Motor Control
    - Strength
    - Transfers (including bed mobility)
    - Mobility (wheelchair)
    - ADL’s (OT focus at most centers)
    - Adaptive Equipment
    - Gait
Physical Therapists

How do we manage individuals with SCI?

• **Examination**
  – Findings (data collected from the history, systems review, and tests and measures)
  – Imperative as a Doctoral level profession that we understand the pathophysiology and all systems affected by spinal cord injury

• **Evaluation and Diagnosis**
  – Supports physical therapy interventions

• **Prognosis**
  – Associated with improved or maintained health status through risk reduction; health, wellness, and fitness programs; or the remediation of impairments, activity limitations, participation restrictions, or environmental barriers

• **Plan of care**
  – Designed to improve, enhance, and maximize function

• **Interventions**

• **Outcomes**

Physical Therapists
How do we manage individuals with SCI?

• Examination
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• Evaluation and Diagnosis
• Prognosis
• Plan of care
• Interventions
• Outcomes

Physical Therapy Intervention
Starts in the ICU

• Education
  – Patient and Family
  – Providers (e.g. Nurses and Caregivers)
• Positioning (Skin Protection)
• ROM
• Strengthening and Endurance
• Early Mobilization
  – bed mobility and out of bed activity if stable
• ADL’s
• Respiratory
• Encourage empowerment through involvement
  – Eg. Teach Independent or patient directed (caregiver assist)
    rolling/positioning in bed for pressure ulcer prevention.
Physical Therapy Intervention
Acute Rehab phase and beyond

• Maximize functional independence
  – Goal directed Acute Rehab
• Community reintegration
• Transition to home
• Restoring social roles (e.g. father/mother)
• Outpatient Therapy
• Return to work or school
• Recreation and Sports
• Promotion of Health, Wellness, and Prevention
What happens when our patients leave traditional skilled settings?
Re-hospitalization

• ~ 30% of individuals in the first year post injury (1 or more times)
• Average length of stay is ~ 22 days
• Leading causes:
  – 1st: Genitourinary system diseases
  – 2nd: Skin (wounds)
  – 3rd: Respiratory, Digestive, Circulatory, Musculoskeletal


• Common theme: all of the above may be preventable!
What else is going on?

- Many still have problems adjusting to their new disability.
- The outside world isn’t so accessible!
- Isolation
- Develop secondary complications due to living with SCI.
- They age………. and develop complications associated with aging.
- How do we combat these problems?
- Provide comprehensive lifelong care after the traditional model has been exhausted via:
  - Specialized SCI Clinics
Advanced Physical Therapy Roles
in specialty clinics

- Annual Evaluations
- Community reintegration
- Home evaluations
- Seating and Mobility
- Wheelchair Skills
  - Including Propulsion
- Wound Care
- Spasticity Management
- Education Lectures
- Fitness
- Locomotor Training
- Functional Electrical Stim
  - Neural Prosthesis
- Sports/Recreation
- Vocational Rehab
- Assistive Technology
- Driver Training
- Adaptive Equipment
- UE Preservation
- Telehealth “Tele-rehab”
Caveat: before going any further

- Many of the following clinics are utilized and are implemented in some manner during the acute rehabilitation phase of care.

- Problem: length of stays have declined
  - Acute hospitalization: Avg. 11 days since 2010
    - Avg. of 24 days in 1970's
  - Rehabilitation: Avg. 36 days since 2010
    - Avg. of 98 days in 1970's


- Depending on an individual's progress many of the following can't be addressed during the Acute and Rehab stays.
Annual Evaluations

• Every year Veteran’s with SCI in the region receive comprehensive Annual Evaluations
  – Physical Therapy Evaluations to assess the following:
    • Strength, ROM, Sensation, Balance
    • Functional Mobility (FIM)
      – Bed Mobility, Transfers, Ambulation (W/C), Stairs, ADL’s (OT)
    • IADL’s
    • Seating/Positioning/Wheelchair
    • Pain, decline in function, etc.
    • Need for further rehab

• Many SCI Model Systems have similar care.
• Provides a proactive approach to life long management.
Ongoing Education

“Education is the most powerful weapon which you can use to change the world.”

NELSON MANDELA
Patient Education Lecture Series

• What is a Spinal Cord Injury/Disorder?
• Coping After a Spinal Cord Injury
• Autonomic Dysreflexia
• Bladder Management
• Bowel Care
• Pressure Ulcer Prevention
• Medication Management
• Safety in the Home and Community
• Benefits
• Nutrition and Weight Management
• Sports and Recreation

- All topics are presented live as well as broadcasted throughout the country to Spoke sites via Telehealth technology.
Advanced Education Lecture Series

- Sexuality after a spinal cord injury
- Managing personal assistants
- Veteran Benefits
- Aging with a spinal cord injury
- Accessible travel domestic and international
- Computers as adaptive devices for daily living
- Abuse prevention in spinal cord injury
- Vocational Rehabilitation
- ADA presentation

- All topics are presented live as well as broadcasted throughout the country to Spoke sites via Telehealth technology.
Seating and Mobility Clinic
Importance of a Specialized SCI Seating Clinic

- Persons with SCI have complex medical and functional needs necessitating customized medical equipment.

- Needs are best met when assessed by clinicians who employ a holistic, comprehensive team approach and their caregivers

- Consultations with persons with specific knowledge of complex seating and positioning equipment should be sought in order to achieve optimal outcomes.

- Evidence shows that attendance at specialized seating assessment clinics increases the skin management abilities of individuals post-SCI.


Cleveland SCI/D Center
Specialized Wheelchair Clinics

• **Acute Rehab and Inpatient**
  • Primary PT, OT, and Seating Specialist all collaborate to determine optimal seating system for patient.

• **Outpatient**
  • Monthly rotation for PT’s and OT’s; Seating Specialist oversees and provides mentorship and training.
  • All collaborate to determine optimal seating system.

• **Adaptive Sports**
  • Primary TR coordinates with input from PT, OT, and Seating Specialist
  • All collaborate to determine optimal seating system.

• “Pressure relief” is part of fitting and skills training classes.
Pressure Relief in a Manual Wheelchair
Advanced Wheelchair Skills Clinic
Advanced Wheelchair Skills Clinic

- Wheelies
- Opening Doors
- Pushing and pulling open doors
- Negotiating Ramps
- Ascending and descending
- Negotiating Curbs
- Ascending and descending
- Floor Recovery
- Negotiating Stairs (when necessary)
- Should Include Advanced Transfers
- Advanced terrain (e.g. grass, gravel, sand)


SmartWheel®
http://www.out-front.com/smartwheel_overview.php
Wheelchair Propulsion Assessment
What is the SmartWheel®?

For each push, the SmartWheel Measures:

- Push forces exerted on pushrim
- Push frequency
- Push length/angle
- Push smoothness
- Velocity

Automated Reports Allow You To:

- Review patient performance and outcomes
- Compare outcomes with a national database
- Compare with patient’s past performance
Support Surfaces for Wheelchairs
Equipment Selection
Therapeutic Mattresses

Support surfaces - Mattress
Interface Pressure Mapping

1. Interface Pressure Mapping
2. Bodyfitter® sensor upon a mattress in a retail environment
3. Seat pad sensor element shown on a wheelchair
Interface Pressure Mapping

**PROS:**

- **Measure interface pressure between user and support surface.**
  - Reliable variables: Peak Pressure Index - Peak and surrounding values; Average Pressure; Contact Area; Dispersion Index - Ratio of IT/Sacral loading to total loading.

- **Most beneficial use of pressure mapping**
  - Education to patient and family/caregivers.
  - Biofeedback via visual imaging in time and place.
  - Rule out worst options

- **Interface pressure mapping technologies demonstrated improved adherence to pressure-relief schedules**
Interface Pressure Mapping

**CONS:**

• Interface pressure numbers do **NOT** predict development of PU

• It provides a static measurement in place and point in time
  – **NOT** representative of a range of activities (bed mobility & transfers), postures and other seating surfaces (commode, shower, vehicle).

• IPM reports up to the maximum calibration value: 0-200 or 300 mmHg

• **Calibration will effect the accuracy of the values:** expect errors.

• **Mat creep will effect the accuracy of the value.**
  – Creep is the slow increase in pressure over time with constant load applied
  – Decide a time to collect data and adjust calibration parameters accordingly
  
PT Wound Care Clinic
PT Wound Care Clinic

• Wound Evaluation
• Functional Mobility Assessment
  – Bed mobility & transfers
• ADL Assessment
• Positioning in bed
• Support Surface Assessment (cushion & mattress)
• Seating System Assessment (wheelchair)
• Interface Pressure Mapping
• Biophysical Agent Application
• Education
• Promoting Self Ownership
IDT Wound Rounds

• Physical Therapy participation
  – Initiated ~ 6 years ago
• Meet weekly
• Examine wound
• Obtain Measurements
• Assess/review positioning and offloading
  – Generate appropriate therapy consults
• Provide Education
• Optimal Wound healing environment established
• IDT discussion regarding plan of care
  – Review of strategies and outcomes
• Implementation of Biophysical Agents: as appropriate
  – Determined by Physical Therapist: Autonomy!
Appropriate Terminology

- In January 2007, the National Pressure Ulcer Advisory Panel (NPUAP) redefined critical terminology to facilitate universal standards when discussing pressure ulcers.

- **Pressure Redistribution**: defined as the ability of a support surface to distribute load over the contact areas of the human body. Pressure-reduction and pressure-relief surfaces are no longer accepted terms.

- **Support Surfaces**: Specialized devices for pressure redistribution designed for management of tissue loads, microclimate, and/or therapeutic function.

Clinical Practice Guidelines for Pressure Ulcer Management in SCI


-Free download at www.pva.org
This guideline is the result of a collaborative effort among the National Pressure Ulcer Advisory Panel (NPUAP), European Pressure Ulcer Advisory Panel (EPUAP) and Pan Pacific Pressure Injury Alliance (PPPIA).
Quick Reference Guide


• Skilled vs. Unskilled?
  – Establishment of therapy goals
• Strengthening
  – Weights
  – Thera-Band
• Cardiovascular Training
  – MOTOmed Letto 2
• Range of Motion
  – Spasticity
  – Contracture Management
  – Restorative manual ROM program
    • Performed by Caregivers, Restorative Aides, etc.
Out of Bed Option with Offloading

Ergonomic Power Prone Cart

Power Prone Cart

Pre-trial

- Chart review - level of injury, hardware/fixation of spine, cardio-respiratory function
- Range of motion and control assessment upper and lower extremities
- Precaution identification - catheters, lines, colostomy bag, wound vac

Prone Bed Tolerance

- Day 1 - 15-30 minutes prone on in bed, assess cardio-respiratory tolerance, cervical spine control and visual fields, comfort.
- Days 2-4 assess effects from previous day, increase prone time by 15 minutes, 60 minute maximum (once 60 minutes have been reached, progress to prone cart trial)

Prone Cart

- Day 5-6 prone cart assessment and training with PT.
- Day 7+ independent use by patient, add 30-60 minutes every 3 days.
Pre-Surgical Reconstruction Screening Clinic

• Full evaluations performed by PT, OT, TR:
  – Ideally performed in advance (via outpatient) as part of IDT decision on surgical candidacy.
  – Investigate underlying cause?
  – Has conservative treatment failed?
    • If so, why?
    • May be a key indicator of post-surgery success vs. failure.
  – PT, OT, Rec:
    • Can the individual tolerate positional offloading for post-op precautions?
    • Order positioning devices
    • Transfers
    • Bed Mobility
    • Current support surface (mattress), seating system and cushion, how are ADL’s performed, etc.
    • Explore leisure outlets that can be performed while on bed rest.
    • Implement new leisure outlets: while on bed rest
    • Caregiver support
  – Educate on post-op plan of care and expectations!
Post-Surgical Reconstruction

• Full evaluations performed by PT, OT, TR:
  – Team Huddle at bedside
  – Inspect and evaluate surgical site
  – PT, OT, TR:
    • Review positional offloading for post-op precautions (ensure healing).
    • Educate Nursing.
    • Issue and instruct patient and staff on proper positioning to offload.
    • Implement bedside strengthening, cardiovascular conditioning, ROM as precautions allow (prevent contractures and mobilize scar).
    • Prone Cart
    • Implement new leisure outlets
    • Initiate sitting protocol and rehab
  – Educate on post-op plan of care and expectations!
Community Reintegration
Architectural Evaluations
Home, workplace, school, community
Home Evaluations
Looking beyond the physical layout

• Caregiver/Family Support: Education
• Support surfaces: Commode, Shower, Bed
• Transfer systems and slings: Floor vs. Ceiling lift
  – Condition and size of sling?
• Backup w/c and support surface?
• What does a typical day look like?
  – How are ADL’s performed: Bed vs. Chair vs. Alternate Chair
    • Is every room of home (apartment) accessible?
  – How are IADL’s performed: Independent vs. Assistance
  – How many hours are spent in: Chair vs. Bed vs. Other
  – What other activities are they engaged in?
    • E.g. long hours on computer, work, school, etc.
PT Evaluations may involve

- **Home** (should be done prior to completion of acute rehab)
- **School**
- **Workplace**
- **Other Considerations:**
  - Transportation
  - Geographical areas: urban vs. rural
  - Emergency preparation!
Examples of home modifications

- Ramp vs. porch lift for home access
- Widening entryways and doorways
- Switching doorknobs to lever type
- Modifying bathroom
- Modifying the kitchen (sink and counter height)
- Installing ceiling lift/track lift
- Environmental controls
  - E.g. Automatic door openers, lights, phone, TV

- **Cost is biggest barrier!**
  - Does individual own the home?
  - Relocation? (accessible apartment?)
  - Does individual require extensive assistance?
Resources

• **Americans with Disabilities Act**
  - [www.ada.gov](http://www.ada.gov)

• **Home and environment modifications:**
  - [www.spinalcord.org](http://www.spinalcord.org)
  - [www.christopherreeve.org](http://www.christopherreeve.org)
  - [www.pva.org](http://www.pva.org)

• **VHA 1176**
  - Specially Adapted Housing Grant (SAH)
  - Special Housing Adaptation Grant (SHA)
  - Home Improvement Structural Alterations Grant (HISA) Grant
VHA Special Grants

- **Specially Adapted Housing Grant (SAH).** Veterans who have specific service-connected disabilities may be entitled to a grant for the purpose of constructing an adapted home, or modifying an existing home to meet their adaptive needs. The SAH grant is generally used to create a wheelchair accessible home and is currently limited to $63,780, and is adjusted every October. This grant amount is reviewed and adjusted annually in October.

- **Special Housing Adaptation Grant (SHA).** Veterans who have specific service-connected disabilities may be entitled to a grant for the purpose of modifying an existing home to meet their adaptive needs. The SHA grant is generally used to assist Veterans with mobility throughout their homes. This grant is currently limited to $10,000.

- **Home Improvement Structural Alterations Grant (HISA) Grant.** Veterans with service-connected or non-service connected disabilities may receive assistance for any home improvement necessary for the continuation of treatment or for disability access to the home, and essential lavatory and sanitary facilities. A HISA grant is available to Veterans who have received a medical determination indicating that improvements and structural alterations are necessary or appropriate for the effective and economical treatment of the Veteran’s disability. In addition to a HISA grant, a Veteran can receive either a SHA or SAH grant.
Assistive Technology Clinic
Roles may vary depending on facility

Remember it is under your scope of practice as a PT!
Service Dog Evaluation Clinic
Driver Rehabilitation

• Driver Training (DT) Specialist at the facility may be a PT

• If not:

• PT’s work closely with DT Specialist
  – Routinely provide functional screening
  – Recommendations
Driver Rehabilitation/Training

www.rehab.va.gov

- Driver Evaluation
- Driver Rehab/Training
- Adaptive Training
  - E.g. Hand Controls for SCI & Amputees
- Vehicle Modifications
  - Recommendations made by Specialists
  - Benefits under 1173.16
  - Mod’s performed VA Vendor
- Specialists in VA can be:
  - PT’s, OT’s, KT’s
- # of high tech
VA Centers with Driver Rehab Programs

- Albany, NY  
- Albuquerque, NM  
- Ann Arbor, MI  
- Atlanta, GA  
- Augusta, GA  
- Biloxi, MS  
- Birmingham, AL  
- Boston/Brockton/West Roxbury, MA  
- Bronx, NY  
- Buffalo, NY  
- Castle Point, NY  
- Cleveland, OH  
- Columbia, SC  
- Dallas, TX  
- Denver, CO  
- East Orange, NJ  
- Fort Howard, MD  
- Hampton, VA  
- Hines, IL  
- Houston, TX  
- Indianapolis, IN  
- Knoxville, TN  
- Long Beach, CA  
- Memphis, TN  
- Miami, FL  
- Milwaukee, WI  
- Minneapolis, MN  
- Palo Alto, CA  
- Phoenix, AZ  
- Pittsburgh, PA  
- Portland, OR  
- Richmond, VA  
- St. Louis, MO  
- Salisbury, NC  
- Salt Lake City, UT  
- San Antonio, TX  
- San Juan, PR  
- Seattle, WA  
- Sepulveda, CA  
- Tampa, FL  
- Topeka, KS  
- West Palm Beach, FL
• Vehicle Modification Benefits

  - VA offers vehicle modifications and subsidies for Veterans with limited mobility to install equipment to enable driving.
  
  - For some 100 percent service-connected Veterans, VA will purchase and install the technology and offer up to $11,000 for a new vehicle.
  
  - VA prefers to install the equipment on new vehicles, but will retrofit any vehicle less than three years old and with less than 35,000 miles.
Vocational Rehabilitation


Sexuality and Reproductive Health following Spinal Cord Injury
PT Roles in sex and sexuality post SCI

- Often OT takes therapy lead, but it is unacceptable as DPT’s to passively defer to OT as solely responsible for this area.
- Co-treatment often critical!
  - Education: encourage questions and open discussion
    - Involve partners, caregivers
  - Maximizing Functional mobility
    - Bed Mobility, transfers, UE & LE strength, fine motor, ADL’s
  - Positioning
  - Spasticity
  - Skin (pressure ulcer risk)
  - Autonomic Dysreflexia
Fitness Clinic
Importance of Fitness in SCI


- **Exercise is Medicine™: Exercise Prescription After SCI to Manage Cardiovascular Disease Risk Factors**
“WHEELs” Program

• Working on Healthy Eating, Exercise and Lifestyle Program

• Developed by Cleveland VAMC Therapists with interdisciplinary focus on lifelong management of healthy lifestyle post spinal cord injury.
  • Dietary: Healthy Eating
  • Exercise: PT and Rec
  • Lifestyle: Psychology

• Participation in organized sports is positively associated with employment in adults with spinal cord injury.
  

• Participation in athletic activities have been associated with less pressure ulcer development in individuals with SCI of comparable age, severity of SCI, and pre-injury health.
  
Sports and Recreation Clinics
Benefits of Health, Employment, and QOL

- Community integration and quality of life scores were higher in sports participants vs non-sport participants with spinal cord injury.


Sports and Recreation
Sports and Recreation
Sports and Recreation
Locomotor training Clinic

- Traditional gait training
- Functional Electrical Stimulation
- Neural-prosthesis
- Body weight support
- Aquatic therapy
- Robotic Exoskeletons
Body Weight Support Gait Training

LiteGait®

SoloStep®

ZeroG®
Body Weight Support Gait Training

Hocoma’s new Andago®
Stationary Robotic Assisted Gait Training
“the early pioneer device”

Hocoma’s Lokomat®  www.hocoma.com
Commercially Available Robotic Assisted Gait Training

Hocoma’s Erigo®

Restorative Therapy’s RT600®
Robotic Exoskeletons
Robotic Exoskeletons (FDA Approval): Now a Reality!
Current Robotic Exoskeletons

- **Ekso®** (currently working on FDA approval)
  - www.eksobionics.com
- **Indego®** (currently working on FDA approval)
  - www.indego.com/indego/en/home
- **ReWalk®** (**only FDA approved device on market as of 2015**)
  - www.rewalk.com
- **Rex®**
  - www.rexbionics.com
We still have a way to go

Many spinal cord injured persons prefer a wheelchair to walking with braces and crutches.
Functional Electrical Stimulation

• Provides Muscle Contraction via Electrical Stimulation
  – Utilization in Clinical Practice:
    • NMES with PRE’s
    • NMES with Functional Activities
      – Transfers
      – Swiss Ball
      – Standing Frame
      – Gait Training
  – Surface or Implanted (Research Program at VA)
  – Commercially Available Devices
Functional Electrical Stimulation
VA Leaders in Clinical Research

- www.aptcenter.research.va.gov
- www.fescenter.org
Commercial FES Devices
“Pioneer”

- Cycling Systems
- ERGYS® FES leg cycle ergometer
Commercial FES Devices

- Cycling Systems
- RT300® FES leg and arm cycle ergometer
Commercial FES Devices

- Standing/Exercise Systems

RT600® Step and stand
Neural Prosthesis

• Utilizes FES to create desired movement.
• Neural Plasticity/Motor Recovery?
• Commercial Device FES System (AFO):
  – Bioness NESS L300 Foot Drop System
  – WalkAide FES

Bioness L300 Plus

- Additional thigh to control the knee
- Same Gait Sensor as L300
- Hand-Held Remote Control
- Can stimulate either the Quadriceps or the Hamstrings
UE Neural Prosthesis

• Commercial Device UE FES System
  – Bioness NESS H200 Hand Rehabilitation System
Falls Risk Prevention

- Initiated early on in rehab.
- Solid PT intervention utilized in all aspects of care throughout rehab continuum:
  - Examples including but not limited to:
    - Transfers to wheelchairs
    - ADL’s
    - Caregiver training
    - Ambulation training
    - Advanced Mobility Clinics
- VA SCI/D Center data compilation to be discussed in outcome measure section of lecture.
Falls risk in ambulatory SCI


History of Research on Shoulder Exercise Interventions in SCI

• 6 Month Exercise Protocol

• Consortium Guidelines

• 8 Week Exercise Intervention

• 12 Week Home Based
History of Research on Shoulder Exercise Interventions in SCI

• **16 Weeks utilizing EMG**

• **12 Week Home Based with Tele-rehab**

• **Common Theme with all the studies:**
  - “Doing something is effective.”

• **Critical Analysis:**
  - “Is what we are doing the most effective?”
  - “Can we improve this by incorporating more evidence?”
Pain Management Clinic
“Telehealth” (Tele-rehabilitation)

Utilization of Telehealth in Spinal Cord Injury and Pressure Ulcer Management

• **Effective means of providing skilled services**
  – Prevention and intervention management

• **Cost Effective**
  – Reduce Hospitalizations and travel to centers

• **Ability to reach rural patients**
  – Education of patients & providers in rural settings

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Utilization of Telehealth in the management of individuals with spinal cord injury

- Prevention!
- Consultation with Specialty Providers and Clinicians – Intervention recommendations
- Education
  - Patients, Caregivers, Providers at local facilities
- Admissions
  - Pre-screening
  - Expectations for hospitalization at SCI/D Center
- Post-discharge follow-up
- Positioning and Seating Evaluations
- Equipment recommendations
- Education Lecture Series
SCI DMP Pilot Study

• **DMP:** Disease Management Pilot

• *Cleveland VAMC* created a pilot study utilizing telehealth to manage patients in their home

• Patients must respond to various questions either about current risks of developing complications.
  – Answers to questions generate a provider alert to call patient and/or schedule an outpatient office visit to evaluate.

• *Consults generated to PT via DMP monitoring.*

Telehealth in SCI specialty clinics
in which PT’s have a significant role

- Home evaluations
- Seating and Mobility
- Wound Care
- Spasticity Management
- Education Lectures
- Fitness
- Locomotor Training
- Sports/Recreation
- Vocational Rehab
- Assistive Technology
- Driver Rehabilitation
- Adaptive Equipment
- UE Preservation
Research Opportunities for PT in spinal cord injury

- Functional Electrical Stimulation
- Neural Prostheses
- Spasticity/Contractures
- Wheeled Mobility
- Pressure Ulcers
- Robotic/Locomotor
- Activity based therapy (neuro recovery)
- Project Walk
- Miami Project
- Stem cells
Emerging Trends in SCI

• **Activity Based Therapy**
  - Neuroplasticity theories in the rat and human spinal cord
  - Attempts to regain motor and sensory function below level of lesion
  - Utilizes repetitive training of specific motor tasks


  • Many further studies can be found performing pubmed search of “activity based therapies SCI”
Utilization of Outcome Measures in SCI
Utilization of Outcome Measures
in management of individuals with SCI

**FIM: Functional Independence Measure**
- © 1999 - 2014 Uniform Data System for Medical Rehabilitation, a division of UB Foundation Activities, Inc.
- [www.udsmr.org/WebModules/FIM/Fim](http://www.udsmr.org/WebModules/FIM/Fim)

**Relevance of FIM as an objective measure of functional mobility for individuals with spinal cord injury**
Utilization of Outcome Measures in management of individuals with SCI

- **FIM**: Functional Independence Measure
  - Eating
  - Grooming
  - Bathing
  - Dressing Upper Body
  - Dressing Lower Body
  - Toileting
  - Bladder Management
  - Bowel Management
  - Bed, Chair, Wheelchair Transfers
  - Toilet Transfer
  - Tub/Shower Transfer
  - Walk/Wheelchair
  - Stairs
  - Comprehension
  - Expression
  - Social Interaction
  - Problem Solving
  - Memory
Braden Scale
for Pressure Ulcer Risk

Braden Scale Scoring

- 6 Parameters:
  - Sensory Perception
  - Moisture
  - Activity
  - Mobility
  - Nutrition
  - Friction and Sheer

- Ratings 1-4
  - Severe Risk: ≤ 9
  - High Risk: 10-12
  - Moderate Risk: 13-14
  - Mild Risk: 15-18

Pressure Ulcer Specific Measurement Tools

- **SCI PUMT:**
  - Pressure Ulcer Management Tool
    - Site:
    - Body Side:
    - Orientation:
    - Positioning: for measurement
  - Scoring
    - Surface Area: L x W
    - Depth:
    - Edges:
    - Tunneling:
    - Undermining:
    - Exudate Type:
    - Necrotic Tissue Amount:

List of SCI Outcome Measures including comprehensive reviews

SCIRE Project
www.scireproject.com/outcome-measures/list

APTA
www.neuropt.org
SCIRE Project
www.scireproject.com/outcome-measures/list

• **Assistive Technology**
  - Assistive Technology Device Predisposition Assessment (ATD-PA)
  - Quebec User Evaluation of Satisfaction with Assistive Technology (QUEST 2.0)
SCIRE Project
www.scireproject.com/outcome-measures/list

• Community Reintegration:
  • Assessment of Life Habits Scale (LIFE-H)
  • Community Integration Questionnaire (CIQ)
  • Craig Handicap Assessment & Reporting Technique (CHART)
  • Impact on Participation and Autonomy Questionnaire (IPAQ)
  • Physical Activity Recall Assessment for People with Spinal Cord injury (PARA-SCI)
  • Reintegration to Normal Living (RNL) Index
  • Physical Activity Scale for Individuals with Physical Disabilities (PASIPD)
• **Lower Limb & Walking:**
  - 6-Minute Walk Test (6MWT)
  - 10 Meter Walking Test (10 MWT)
  - Berg Balance Scale (BBS)
  - Clinical Outcome Variables Scale (COVS)
  - Functional Standing Test (FST)
  - Spinal Cord Injury Functional Ambulation Inventory (SCI-FAI)
  - Timed Up and Go Test (TUG)
  - Walking Index for Spinal Cord Injury (WISCI) and WISCI II
• **Mental Health:**
  - Beck Depression Inventory (BDI)
  - Brief Symptom Inventory (BSI)
  - CAGE Questionnaire
  - Center for Epidemiological Studies Depression Scale (CES-D and CES-D-10)
  - Depression Anxiety Stress Scale-21 (DASS-21)
  - Fatigue Severity Scale (FSS)
  - Scaled General Health Questionnaire-28 (GHQ-28)
  - Hospital Anxiety and Depression Scale (HADS)
  - Patient Health Questionnaire-9 (PHQ-9)
  - Symptom Checklist-90-Revised (SCL-90-R)
  - Zung Self-Rating Depression Scale (SDS)
• Neurological Impairment and Autonomic Dysfunction:
  • American Spinal Injury Association Impairment Scale (AIS): International Standards for Neurological Classification of Spinal Cord Injury
  • Surface Electromyography (sEMG)
SCIRE Project
www.scireproject.com/outcome-measures/list

• **Other Affected Physiological Systems:**
  - Spinal Cord Injury Secondary Conditions Scale (SCI-SCS)
  - Exercise Self-Efficacy Scale (ESES)
  - Moorong Self-Efficacy Scale (MSES)
  - Spinal Cord Lesion Coping Strategies Questionnaire (SCL CSQ)
  - Spinal Cord Lesion Emotional Wellbeing Questionnaire (SCL EWQ)
  - Wingate Anaerobic Testing (WAnT)
• **Pain:**
  - Classification System for Chronic Pain in SCI
  - Donovan SCI Pain Classification System
  - Multidimensional Pain Inventory (MPI) - SCI version
  - Multidimensional Pain Readiness to Change Questionnaire (MPRCQ2)
  - Quantitative Sensory Testing (QST)
  - Tunk’s Classification Scheme
  - Wheelchair Users Shoulder Pain Index (WUSPI)
  - Brief Pain Inventory (BPI)
SCIRE Project
www.scireproject.com/outcome-measures/list

• Quality of Life and Health Status:
  • Incontinence Quality of Life Questionnaire (I-QOL)
  • Life Satisfaction Questionnaire (LISAT-9, LISAT-11)
  • Quality of Life Index (QLI) – SCI Version
  • Quality of Life Profile for Adults with Physical Disabilities (QOLP-PD)
  • Quality of Well Being (QWB) and Quality of Well Being-Self-Administered (QWB-SA)
  • Qualiveen
  • Satisfaction with Life Scale (SWLS, Deiner Scale)
  • Short Form 36 (SF-36)
  • Sickness Impact Profile 68 (SIP 68)
  • World Health Organization Quality of Life- BREF (WHOQOL-BREF)
**SCIRE Project**
www.scireproject.com/outcome-measures/list

- **Self Care & Daily Living:**
  - Appraisals of DisAbility: Primary and Secondary Scale (ADAPSS)
  - Rivermead Mobility Index (RMI)
  - Barthel Index (BI)
  - Frenchay Activities Index (FAI)
  - Functional Independence Measure (FIM)
  - Functional Independence Measure Self-Report (FIM-SR)
  - Klein-Bell Activities of Daily Living Scale (K-B Scale)
  - Lawton Instrumental Activities of Daily Living scale (IADL)
  - Quadriplegia Index of Function (QIF)
  - Quadriplegia Index of Function-Short Form (QIF-SF)
  - Self Care Assessment Tool (SCAT)
  - Self Reported Functional Measure (SRFM)
  - Spinal Cord Injury Lifestyle Scale (SCILS)
  - Spinal Cord Independence Measure (SCIM)
  - Quadriplegia Index of Function Modified (QIF-Modified)
Sexuality and Reproduction:
- Emotional Quality of the Relationship Scale (EQR)
- Knowledge, Comfort, Approach and Attitude towards Sexuality Scale (KCAASS)
- Sexual Attitude and Information Questionnaire (SAIQ)
- Sexual Behavior Scale (SBS)
- Sexual Interest, Activity and Satisfaction (SIAS) / Sexual Activity and Satisfaction (SAS) Scales
- Sexual Interest and Satisfaction Scale (SIS)
Skin Health:

- Skin Management Needs Assessment Checklist (SMNAC)
- Abruzzese Scale
- Braden Scale
- Gosnell Measure
- Norton Measure
- Spinal Cord Injury Pressure Ulcer Scale (SCIPUS) Measure
- Spinal Cord Injury Pressure Ulcer Scale – Acute (SCIPUS-A)
- Stirling’s Pressure Ulcer Severity Scale
- Waterlow Scale
• **Spasticity:**
  - Pendulum Test (Wartenberg)
  - Ashworth and Modified Ashworth Scale (MAS)
  - Penn Spasm Frequency Scale (PSFS)
  - Spinal Cord Assessment Tool for Spastic Reflexes (SCATS)
  - Spinal Cord Injury Spasticity Evaluation Tool (SCI-SET)
• **Upper Limb:**
  - Box and Block Test (BBT)
  - *Capabilities of Upper Extremity Instrument (CUE)*
  - Grasp and Release Test (GRT)
  - Hand-Held Myometer
  - Jebsen Hand Function Test (JHFT)
  - Modified Functional Reach Test (mFRT)
  - Sollerman Hand Function Test
  - Tetraplegia Hand Activity Questionnaire (THAQ)
  - Van Lieshout Test Short Version (VLT-SV)
  - *Graded Redefined Assessment of Strength, Sensibility and Prehension (GRASSP)*
  - Six-Minute Arm Test (6-MAT)
• Wheeled Mobility:
  • 4 Functional Tests for Persons who Self-Propel a Manual Wheelchair (4FTPSMW)
  • Tool for assessing mobility in wheelchair-dependent paraplegics
  • Timed Motor Test (TMT)
  • Wheelchair Circuit (WC)
  • Wheelchair Skills Test (WST)
Other Outcome Measures

Transfer Assessment Index
- Transfers (including advanced transfers)

VA SCI Data Compilation (see next slide)
VA SCI/D Data Compilation
Falls in ambulatory individuals with SCI

• Multi-center data collection underway among the VA regional SCI/D centers.
  • Cleveland VAMC is a participating site

• Pilot started with 6 centers on tracking data on ambulatory patients with SCI.

• Outcome measures to predict falls:
  • Functional Reach
  • TUG
  • SCI-FAI
Trusted sources of information

- International Spinal Cord Society (ISCOS)
  - http://www.iscos.org.uk/
- American Spinal Injury Association (ASIA)
  - http://www.asia-spinalinjury.org/
- United Spinal Association
  - http://www.unitedspinal.org
- National Spinal Cord Injury Association
  - http://www.spinalcord.org
- Christopher and Dana Reeves Foundation
  - http://www.christopherreeve.org
- Model Systems
  - http://www.msktc.org/sci
- Veterans Administration
  - http://www.sci.va.gov
- Paralyzed Veterans of America (PVA)
  - http://www.pva.org
What does this all mean?
Bottom line........

- PT involvement in the care of individuals with SCI
  - Time of Injury → Lifespan

- Physical Therapists play an integral role in the comprehensive care of individuals with spinal cord injury.

Apology

“Sorry I couldn’t cover everything!”

If I only had a week’s time.........
QUESTIONS?
References

7. www.christopherreeve.org/site/c.mtKZkMWkG/b.5184255/k.6D74/Prevalence_of_Paralysis.htm
References


References

References


References


References

References


References

References


82. www.scireproject.com/outcome-measures/list


