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Part 2. Treatment Approaches and Equipment Needs for Patients with Dual Diagnosis: Spinal Cord Injury and Brain Injury

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As a result of the course:

1. The participate will be able to describe at least one example of expected functional outcome for a given level of spinal cord injury.
2. The participant will be able to explain at least two ways to adapt the therapy environment based on cognitive function.
3. The participant will be able to describe one example of an alternative handling technique to improve motor activation.
4. The participant will be able to identify an example of an appropriate wheelchair based on cognitive and functional level.

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Spinal Cord Injury

- Defined as a traumatic event resulting in changes in sensory, motor, and autonomic function[7]
- Incidence: about 11,000 new cases of spinal cord injuries each year[5]
- Prevalence: 183,000 to 230,000 individuals are living with spinal cord injuries, 86% male[5] , majority under 30 years of age[7]
- Etiology: motor vehicle accidents (38.5%), acts of violence (24.5%), falls (21.84%), and sporting events (7.2%)[5]
- Classification based on the American Spinal Injury Association (ASIA) exam[5]
  - Tetraplegia: C1 to C8
  - Paraplegia: T1 to L4
  - Complete: A
  - Incomplete: B,C,D

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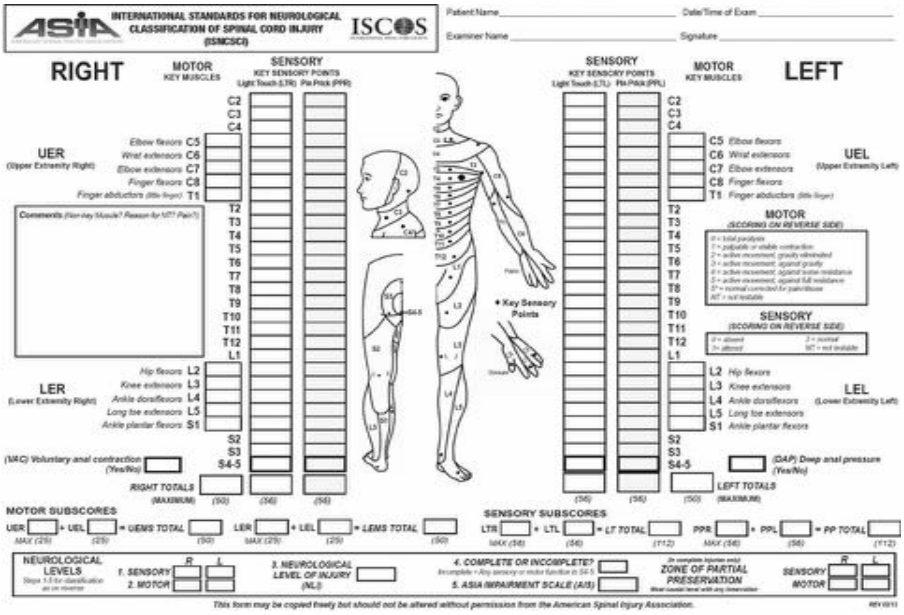

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Traumatic Brain injury

- An insult to the brain, not of a degenerative or congenital nature, but caused by an external physical force that may produce a diminished or altered state of consciousness, resulting in impairment of cognitive abilities and/or physical functioning.[4]
- Diagnosis must have one of the following: [4]
  - Loss of consciousness (not reliable as sole diagnosis indicator)
  - Glasgow Coma Scale
  - Post Traumatic Amnesia
  - Skull fracture, seizure activity or abnormal brain imaging

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Traumatic Brain Injury

- Glasgow Coma Scale (GCs) is a reliable neurological tool that gives medical professionals an objective way of recording the level of consciousness. Resulting points give a patient score between 3 (indicating deep unconsciousness) and 15 (indicating fully conscious)

Response	Score
Eye opening	
Opens eyes spontaneously	4
Opens eyes in response to speech	3
Open eyes in response to painful stimulation (eg, endotracheal suctioning)	2
Does not open eyes in response to any stimulation	1
Motor response	
Follows commands	6
Makes localized movement in response to painful stimulation	5
Makes nonpurposeful movement in response to noxious stimulation	4
Flexes upper extremities/extends lower extremities in response to pain	3
Extends all extremities in response to pain	2
Makes no response to noxious stimuli	1
Verbal response	
Is oriented to person, place, and time	5
Converses, may be confused	4
Replies with inappropriate words	3
Makes incomprehensible sounds	2
Makes no response	1

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Traumatic Brain Injury

Severity	LOC	GCS	PTA	Imaging
Mild	With or without LOC (If LOC = <20 min)	GCS >13 – 15; Usually does not require rehab		No
Mild complicated	With or without LOC (If LOC = <20 min)	GCS >13 – 15; Usually does not require rehab		Yes
Moderate	>20 min	GCS 9-12, requires rehab long term neuro deficits typically observed		Yes or no
Severe	>6 hrs	GCS <8 Long term rehab with more severe deficits	>24 hours but <10-14 days good outcomes	Yes or no

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Traumatic Brain Injury

- Incidence: 100 per 100,000 people each year[4]
- #1 cause of death for children and young adults[4]
- Estimated that 70-90,000 people will have long term loss of function[4]
- Prevalence: Estimated 2.5 to 6.5 million survivors of brain injury living with sequelae that affect their daily lives in some way[4]
- Two phases of injury:[4]
  - Primary : initial cause of injury
  - Secondary: complications from injury
- Classification of Cognitive Functioning following TBI[4]
  - Rancho Los Amigos Scale aka Level of Cognitive Functioning Scale

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Traumatic Brain Injury

- Common Symptoms of Traumatic Brain Injury which will affect rehab:
  - Headaches and sleep impairments
  - Dizziness and other vestibular impairments
  - Imbalance, dyscoordination, weakness and impaired sensation
  - Emotional and personality changes
  - Memory impairments, exec dysfunction,
  - Visual impaired
  - Impaired communication and dysphagia
  - Spasticity
  - Medical complications including: neurostorming, neuro endocrine impairments, electrolyte regulation, hydrocephalus, HO formation
- These symptoms are complicated in SCI patients by increased risk of hypoxia, intubation, sedation, and seizures

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Dual Diagnosis: SCI and TBI

- Incidence: 39.6 to 58.1%[1,6] up to 74%[7]
- 58.5 to 60.9% are not diagnosed[7]

- Macciocchi found that other articles which stated a lower incidence of undiagnosed brain injuries in SCI populations used less reliable sources of diagnosis (i.e. - only positive neuroimaging or LOC)[3]
- Study of radiological readings found that there were 67% of mild to moderate TBIs missed by inexperienced radiologists[2]

- Majority of undiagnosed dual TBI are mild TBI (followed by severe and then moderate)[3]
- Patients with SCI with undiagnosed TBI are often misconceived as noncompliant, decreased ability to learn, maladaptive reactions to their SCI or poor motivation

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Dual Diagnosis SCI and TBI

- Yellow flags for clinicians
  - Cervical injuries = higher correlation with TBI[2]
    - Specifically C1-C4
    - TBI not associated with completeness of injury
  - MVC and falls have highest association of dual TBI[3]
  - Etiologies other than MVC, falls were 31.6% undiagnosed[1]
  - Alcohol related injuries often result in increased co-occuring TBI[2]
- Positive factors for clinicians for suspicion of co-occuring TBI[1]
  - Presence of PTA
  - Positive Loss of Consciousness
  - Less than 14 on initial Glascow Coma Scale
  - Presence of confusion and other cognitive impairments

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Dual diagnosis rehabilitation

- Severe TBI impacted SCI recovery outcomes (lower FIM motor scores)[6,7]
- Overall found to have same FIM scores compared to single SCI FIM scores[6]
- Length of stay was around 61 days longer than patients with SCI[6]
- Experienced increased personal and family adjustment difficulties[6]
- TBI can affect neural recovery[1]
- PTA has been found to be best predictor in TBI population if person had less than 10-12 days PTA[3]
- Worse outcomes for dual diagnosis patients associated with medical complications related to brain injury including:
  - neuroendocrine dysfunction, disorders of sodium regulation, depression, hydrocephalus, VP shunt malfunction[2]
- Brain injury will take precedent over spinal cord injury rehabilitation in the beginning of recovery

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Expected Outcomes by SCI Level

C1 to C4 complete injuries

- Verbalize all aspects of care
  - hoyer net placement & manual hoyer transfers
  - Dependent bed mobility
  - padding and positioning at night for turns every 4 to 6 hours
  - power wheelchair management
    - Sip and puff driving
    - Positioning in the chair
  - bowel and bladder care- often looking into colostomies and/or SPT tube placement

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C1 to C4 treatment ideas

- Muscles innervated: upper trap, SCM, scalenes
- Daily range of motion
- Tilt table for upright tolerance
- Edge of mat sitting with bolster behind and working on upper extremity weight bearing with airsplints to block elbow flexion
- Prone lying to promote skin health and hip flexor stretch
- Mouth stick work to manage phone, pages, remotes
- Respiratory goals: working on inspiratory and expiratory capacities- incentive spirometer, blowing through a straw
- Power wheelchair driving
- assistive technology: dragon dictation, Alexa

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Expected Outcomes by SCI Level

C5

- Verbalize all aspects of care
- Independence at power wheelchair level
  - Manage lever handle doors with loops
  - Press elevator buttons
  - Feed themselves with min assist or set up
  - Brush teeth & hair with min assist
  - Dependent for bathing, dressing, bowel & bladder care
  - Bed mobility total or max assist
  - May learn dependent to max assist slidboard transfer

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C5 TREATMENT IDEAS

- Muscles innervated: cervical muscles, bicep, levator, rhomboids, supraspinatus, infraspinatus, deltoid, serratus anterior, pectoralis major, teres minor
- Pre transfer skills
  - Posterior/anterior prop sitting with and without airsplints
  - Throw backs from anterior to posterior prop sit
  - Elbow prop to upright seated position
- Wheelchair goals
  - Power: forward lean to upright seated position
  - Manual: indoor propulsion with heavy emphasis on shoulder mechanics
- Pre bed mobility goals
  - Working on rolling with loops and/or bed rails

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Expected Outcomes by SCI Level

C6

- Independence with manual wheelchair mobility
  - Work toward full-time use, depending on scapular muscles
- Independence with transfers & bed mobility
  - Min assist to modified independence for all bed mobility
  - Min assist for transfer to bed with or without a slideboard
  - Mod assist for shower equimpent transfer
  - Mod to max assist for car transfer
- Bladder & bowel training with min to mod assist
- Can begin to think about driving with a modfied vechicle

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Treatment ideas

- Muscles innervated: subscapularis, coracobrachalis, teres major, supinator, extensor capri radialis brevis/longus, latissimus dorsi
- Add leg management on/off of surfaces
- Focus on pushing manual wheelchair up/down ramped surfaces
- Focus on manual wheelchair tolerance
- Looking at transferring into a regular van seat for driving
- May or may not be able to break down manual wheelchair
- Continue to work transfers, bed mobility, and focus on posterior shoulder strengthening

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Expected Outcomes by SCI Level

C7 to C8

- Independence with all transfers
  - Modified independent with bed, toilet, & car transfer
  - Max assist for floor transfers
- Advanced wheelchair skills
  - Mostly ordering a manual wheelchair for main means of mobility
  - Curbs min to mod assistance
  - Loading/unloading chair min assitance
- Independence with all ADL's
  - Modified independent

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C7 to C8

- Muscles innervated: flexor carpi ulnaris, palmaris longus, flexor digitorum superficialis/profundus, flexor pollicis longus, pronator quadratus
- Advanced manual wheelchair skills: curbs, rough terrain,
- door management
- Shoulder strengthening
- Endurance- NUSTEP, UBE bike
- Assisting with padding and positioning in bed
- management of wheelchair in/out of a regular car

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Treatment ideas for each level

- Posterior shoulder strengthening
- Estim to provide sensory input to assist with driving motor output
- FES bike both LE and UE
- WAVE Whole Body Vibration
- Soft tissue massage
- Cervical strengthening

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Expected Outcomes by SCI Level

Paraplegia

- Advanced transfers
  - Modified independent for floor, bottom of tub, & car
- Advanced wheelchair skill
  - 6" curbs modified independent
  - Stairs mod assist to modified independent
    - Both in & out of chair
- Complete independence with bed mobility and ADL's

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Paraplegia treatment ideas

- Muscles innervated: depending on thoracic level with determine abdominal innervation, quadratus lumborum(below T12)
- Manual wheelchair pushing
- NuSTep
- Weight lifting with hand weights/ CRT/ regular gym equipment
- Depressions from high/low
- Floor transfers
- Long leg bracing- depending on body type
- Prone
- Tall kneeling and quadraped exercises

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Expected Outcomes by SCI Level

Motor Incomplete SCI

- Independence with gait training
  - Long leg brace walking
  - Assisted or unassisted walking
- Establish home stretching program
  - Majority have spasticity
- Combination of all goals described, based on motor preservation

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Treatment ideas

- Muscles innervated: depend on degree of incompleteness
- Quadraped/prone/tall kneeling
- Working on pre sit to stand
- Standing balance
- Pre gait and/or gait
- Lokomat/ treadmill training
- FES bike both UE/LE
- WAVE
- Often need daily stretching program

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Rancho Los Amigos Scale

- Behavioral rating system that measures cognitive functioning and recovery.
- Originally 8 levels but now modified to 10 levels
- TBI patients will frequently exhibit behaviors from more than one level at a time.
- Patients at lowest levels and at the highest levels may not be seen in a rehab setting.
- Can track progress over time but RLAS is not predictive of outcomes.

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Rancho Los Amigos Brain injury Severity Scale

I	No response	Completely unresponsive to stimuli
II	Generalized Response	Inconsistent and nonpurposeful response to stimuli
III	Localized Response	Specifically but inconsistently to stimuli
IV	Confused-Agitated	Behavior is bizarre and nonpurposeful relative to immediate environment
V	Confused-Inappropriate	Responds to simple commands fairly consistently
VI	Confused-Appropriate	Goal directed behavior but is dependent on external input or direction
VII	Automatic-Appropriate	Appears oriented and appropriate within hospital and home setting, goes through routine automatically
VIII	Purposeful-Appropriate	Recalls and integrates past and recent events, responsive to environment

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Overview for treatment of dual diagnosis

- Repetition & consistency of care!
- Decreased complexity & amount of verbal cues
  - as patient improves cognitively, increase distractions & complexity
- Slow down, give additional time for processing
- Schedule frequent rest breaks, schedule therapy at patient's most alert or best time of day
- Plan & document for longer length of stay
- Perform cognitive screen, visual-spatial, & vestibular assessments as needed, to identify impairments/strengths to utilize in therapy

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Treatment Approaches for Dual Diagnosis

Rancho II & III/Disorders of Consciousness (DOC)

- Focus on emergence of consciousness
- Stretching
  - Prevent contractures & secondary impairments
- Midline positioning & upright tolerance
  - Most likely in tilt-in-space wheelchair
- Skin protection plan & schedule for weight shifts & turns

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Treatment Approaches for Dual Diagnosis

Rancho II & III/DOC Continued:

- Bowel & Bladder management plan
  - Schedule for dependent management
- Include family in education & training
  - Start with very basic tasks
  - Getting them more comfortable with hands-on patient care
  - Assisting staff with rolling, grooming, dressing
  - Don't overload family with too much education/responsibility- let them set the pace, but encourage/support as necessary

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Treatment Approaches for Dual Diagnosis

Rancho IV- Confused & Agitated State

- Often brief and non purposeful sustained attention, absent short term memory, inappropriate responses to stimuli and environment, possibly aggressive or avoidant behaviors, verbalizations often incoherent or inappropriate
- Focus on managing cognitive impairments
- Continued prevention of contractures, skin breakdown & other secondary impairments
- Keep patient safe, maintain restraints and decrease risk for falls/injury
- Neuropyschology to assist with behavior plan as needed and aggressive/inappropriate behavioral managed consistently and firmly

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Treatment Approaches for Dual Diagnosis

Rancho IV- Confused & Agitated State

- Schedule
  - Have it written out, including nursing needs, down/rest time, bed time
  - Try to keep similar or same schedule every day
- Consistency with redirection of negative behaviors & scheduling
- Reward system for successes
  - **Do not use rest from therapy as a reward!**
- Prevent overstimulation & triggers for agitation
  - Therapists communicate in calm voices, use one step commands with time for processing, avoid treating in crowded gyms or noisey spaces
- Approach patient from front, avoid personal space invasion, explain what you're going to do prior to doing it, give choices when possible

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Treatment Approaches for Dual Diagnosis

Rancho IV- Confused & Agitated State

- Use error-free/errorless learning techniques
- Cognitive focus on orientation, decreased agitation, basic memory
- Sitting balance, tilt table, basic ADLs, basic leisure activities
- Focus only on simple gross motor activities – no new learning
- Can attempt to get basic ASIA assessment information as tolerated
- Can attempt to begin to evaluation visual and perceptual impairments
- Co-treating when possible for safety, with one person giving feedback

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Treatment Approaches for Dual Diagnosis

Rancho V- Confused & Inappropriate

- Structure with variety
  - Have options available, but within structured environment , with clear goals & end point
- Slowly increase level of stimulation around patient
  - Continue to give down time and limit overstimulation
- Continue with clear behavior modification plan
  - But increase patient verbalization of those behavior goals and rewards
- Begin use of basic visual cues for memory aids
  - writing in room and notebook , basic orientation, therapists pictures, schedule & information on what patient did in sessions

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Treatment Approaches for Dual Diagnosis

Rancho V- Confused & Inappropriate

- Continued focus on Cognitive Tasks with small increases in new physical tasks
  - Main focus continues to be on familiar ADLs, wheelchair mobility, leisure activities
- What activities did that patient like doing in their free time pre-injury?
  - Ex: grab for tools if carpenter instead of therapy cones

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Treatment Approaches for Dual Diagnosis

Rancho VI- Confused & Appropriate

- Begin incorporating more SCI rehab & compensatory movements for improved functional mobility
- Begin small groups, focusing on cognitive skills & early care needs
- Continue with memory & schedule aids
- Cognitively working on more complex memory, reasoning, & sequencing tasks with focus on real-life SCI tasks
  - Sequencing transfer, IC steps
- Begin having patient participate in short-term weekly goal setting

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Treatment Approaches for Dual Diagnosis

Rancho VI- Confused & Appropriate

- Begin allowing patient to "fail" & make mistakes for increased intrinsic feedback
  - BUT do not allow to fail to point of frustration or giving up
- Trial appropriate wheelchair for SCI needs (rigid, upright)
- Focus on ability to verbalize care & precautions with reasoning
- Increase understanding & independence with weight shifts
- Begin early stages of medication, bowel, & bladder management
- Should be following schedule with less cues
  - Can decrease length of breaks in day

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Treatment approaches for dual diagnosis

Rancho VII- Automatic & Appropriate

- More self-directed therapy sessions with patient goals for each session/week
- Increase level of stimulation & distraction with decreased feedback and redirection
- Increased sequencing steps for tasks that patient self-initiates (minimize cues)
- More self-initiation of use of memory cues – self-direct type of memory cue

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Treatment Approaches for Dual Diagnosis

Rancho VII- Automatic & Appropriate

- Cognitively working on more complex problem solving for real-world issues for patient life and SCI
  - community accessibility, dysreflexia, UTI, medication mgmt
- Should be practicing own bowel/bladder program, self-care
- Increase problem solving abilities
  - Identify problems, potential issues, & solutions
  - Patient-specific diagnoses & situations (e.g., job, parenting, school)
- More group participation & group education
- Begin transference of learned skills into new environments

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Treatment Approaches for Dual Diagnosis

Rancho VIII, IX, X - Purposeful & Appropriate

- Focus primarily on SCI mobility in variety of scenarios
- Patient-driven goals & patient-initiated treatments
- Intrinsic feedback primarily with abstract reasoning & cognitive flexibility
- iADLs & more unfamiliar ADLs
- Higher-level goals for return to driving, work, school, child care
- Purposely introduce distractors & limitations into therapy with divided attention

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Treatment Approaches for Dual Diagnosis

Rancho VIII, IX, X - Purposeful & Appropriate

- Large focus on divided attention activities & multi-tasking
- Improved speed & intensity of demands
- High-level skills
  - Mobility, return to work, return to prior activities, school, budgeting
- Large social support networks setup for stress, depression, anxiety management
- Engage Psychology to focus on social support, family issues, & relationships

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Motor Skill Acquisition with Dual Diagnosis

- Mass repetition of optimal movement patterns when patient is unable to initiate due to sensation, cognition, or coordination
  - Lokomat treadmill training
  - Treadmill training with body weight support (consider high level of stimulation)
  - FES bike & other functional electrical stimulation if not too overstimulating
  - Use of slow activation of one side of body or UE vs LE to activate other side – irradiation
  - Bilateral UE and LE weight bearing with proper alignment
  - Developmental sequencing

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Use of Supervision Rating Scale

- Tool designed to assist guidance & description of supervision needs with clients with TBI
- Important to discuss current needs in goal setting & how to trial increasing patient's independence in safe environment.
- Helpful for patients with dual diagnosis in discharge planning, equipment needs, & caregiver needs.

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Restraints & Safety Considerations

- Decisions regarding need for restraints or creative planning to protect patient
  - Move straps out of reach on cervical collars & braces
  - Clothing over braces
  - Abdominal binders over PEG tubes
  - Restraints when necessary (do the restraints cause increased agitation?)
  - Visual observation/supervision
  - Objects to keep motor restless patients busy
  - Family education

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Patient & Family Education

- Involve family & patient early
  - Identify best caregiver for 1:1 training with client
- Neurorehabilitation Psychology & Speech Therapy
  - Begin brain injury education early
- Set expectations to convey information to caregivers
  - Text, weekly family meeting, call, email
- Educate family on performance variability
  - Fatigue, new environment, distractions, mood changes
- Ask patient & family their top 3 goals
  - Family wants to address morning routine to decrease burden of care
- Review typical increased length of stay & supervision needs

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Equipment considerations

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Equipment Considerations

- Often considering more extensive equipment for bowel & bladder programs
  - Para-level patient may use shower chair to eliminate additional transfers
  - Gives family more time to leave patient alone safely during morning care



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Equipment Considerations

Power Tilt wheelchair

- For all high quads & any patient who cannot do other mode of weight shift
- To be considered for patients where “energy conservation” is an issue
- Often considered for all persons with quadriplegic injury and older persons with paraplegic injury

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Equipment Considerations

Manual Tilt Wheelchair

- ABI or dual dx- If they cannot use a power w/c at all
- For vent dependent high quads as backup w/c
  - manual recliners do not have the head support for someone with

    NO head/neck control

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Equipment considerations

Rigid Manual Upright Wheelchair

- Preferred for durability & performance
- More lightweight than folding wheelchair, & what we script for

full time wheelchair users

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Equipment considerations

Folding manual wheelchair

- Preferred for people that are using lower extremities to assist with propulsion
- Preferred for clients who will be full time ambulators
- Heavier than rigid chair and harderd to propel full time

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Discharge planning

- Begin family training as early as possible without overwhelming family
- Begin with simple care assistance like assistance with bed mobility and transfers with family serving as secondary hands on to increase family comfort
- Begin early family education on both spinal cord and brain injury
- Begin early communication regarding home modifications and possible future transportation needs

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