FLEX CEUs

Wheelchairs – Clinical Perspectives

Course Introduction

Seating and mobility is a challenging, yet integral field within physical therapy practice that significantly contributes to the patients' functional independence, quality of life, and overall well-being. When selecting appropriate seating and mobility devices for individuals, clinicians should utilize a client-centered approach that maximizes functional mobility without sacrificing quality of life. As such, practitioners often struggle to complete this process of seating and mobility assessment due to the daunting task of understanding wheelchair prescription in its entirety.

This course will serve as a resource for physical therapists and physical therapy assistants who are interested in gaining an in-depth overview and analysis of manual and power wheelchairs as well as the considerations for wheelchair prescription and physical therapy practice. Lastly, several case studies will be provided to emphasize important concepts contained in each individual section.

Section 1: Overview and Analysis of Manual and Power Mobility Options

Introduction[1]

Options for wheeled mobility prescription have significantly evolved since the induction of wheelchairs in the mid-1930s.[1] While the individual's medical diagnosis can certainly contribute to the wheelchair prescription, it alone cannot dictate all aspects of the chair's precise specifications. Fortunately, wheeled mobility prescription has also evolved alongside the device design and includes multiple domains of information that culminate in the user's most appropriate prescription.

Wheelchair types can be divided into two categories: manual and power wheelchairs. When selecting the appropriate type of wheelchair for the patient, clinicians should consider multiple factors that may affect the patient's ability to effectively and safely use the device. Furthermore, the decision to prescribe a manual or power wheelchair (MWC and PWC, respectively) is dependent upon several intrinsic and extrinsic factors that can be delineated into three separate components[1]:

1. **Factors intrinsic to the patient**

   Example: Integrity of the patient's cardiopulmonary, integumentary, and musculoskeletal systems as well as cognition

2. **Extrinsic factors to the patient's necessary activities**

   Example: Transfers, indoor/outdoor mobility needs, sport/recreation versus daily function

3. **Extrinsic factors of the wheelchair itself**

   Example: wheelchair seating and cushion, brakes and parts, weight of chair

It is also important to remember that wheelchairs can be used as a primary or secondary means of mobility in which the clinician should take into consideration whether the wheeled device is aimed at improving functional independence and community access, mitigating progressive or degenerative disease processes, and/or facilitating participation in recreation or sports.

The following sections will provide an overview and in-depth description of both categories of wheelchairs: manual and power. Some are designed for individuals to propel them full time whereas other types of wheelchairs are designed for patients who will use them for a short amount of time or will be transported by others. Wheelchairs that are designed for short-term use are not optimally designed for efficient, self propulsion. Generally, they are designed for the ease of pushing by a caregiver or for increased stability of the wheelchair. Knowledge surrounding both types of mobility devices is essential in creating an appropriate wheelchair prescription for the patient, which will be discussed later in the course.

Manual wheelchairs[1,2,3,4]

Manual wheelchairs (MWC) are named for the manner in which they produce mobility, which is either manually by the patient or assistance from another individual.

Overview of manual wheelchairs

- MWC have four wheels of varying sizes, depending on the mode of utilization. For patients who are able to self-propel, the two wheels on the posterior aspect of the chair's frame are large and used for propulsion. Conversely, MWC that are used for transportation may have four wheels that are similarly sized since the patient is not propelling the wheelchair independently.
- The frame of the MWC can be classified as folding or rigid and will be designed according to the patient's needs. Other key aspects of a MWC include the seating system, leg rests, arm rests, positioning straps, head rest, push handles, wheel locks, and hand rims. Many of these designs can be customized or altered based upon an individual's medical and functional needs.

- MWC configuration plays a direct role on the manner by which the patient can utilize his or her device.
    - Configuration refers to the size, shape, and design of the chair itself. Specific measurements of the patient's hip width, leg length, and girth must be taken as well as the measurements of the patient's home and/or work environments. While many newer homes and office buildings are capable of accommodating for wheelchair access, older homes may not have optimal table or counter heights or doorway widths in which a person with a wheelchair can freely enter and exit.
    - Alignment of the wheels and axle in relation to the seated position of the patient is a primary factor when determining the configuration of the chair's center of gravity. This is necessary if the patient is to manually propel the chair as a configuration that is not conducive to self propulsion can lead to shoulder and wrist pain and/or overuse injuries. Also, consideration of the MWC's configuration in relation to gravity allows the patient to be seated in a safe and functional position to optimize his or her ability to perform wheelies to negotiate ramps, curbs, or other environmental settings. However, it is important to know that altering the wheelchair's center of gravity to accommodate for function and mobility will sacrifice the stability of the chair itself.

Different types of manual wheelchairs

1. **Dependent manual wheelchairs** are best utilized for patients who will not propel themselves. Dependent manual wheelchairs include chairs that are meant to enhance positioning, like tilt-in-space designs, or reclining wheelchairs that are often appropriate to off-load weight-bearing surfaces to protect skin integrity.

    - MWC that are used for positioning come in adult and pediatric versions and may be appropriate for those with neurologic or cognitive impairments that affect the patient's ability to manually weight shift or remember to perform weight shifts.

    - In pediatric populations, an adaptive stroller may be used for patients who are too young to operate a manual or power wheelchair. When appropriate, children can be transitioned from an adaptive stroller to a manual or powered chair as early as 18 to 24 months of age.

2. **Transport wheelchairs** are mainly used to take an individual from one place to another, like from the car to facility or throughout areas with long walkways, like the airport. Because they are not intended to be used as a primary means of mobility, transport chairs do not offer special seating systems or wheels for self propulsions. However, they are lightweight and easy to fold which makes them ideal for travel and storage.

3. **Standard wheelchairs** are characterized by a firm folding frame with limited options for seat sizing and other modifications, like armrest height or different types of footplates. Because standard wheelchairs are intended for temporary use, they are readily available for purchase at durable medical equipment retailers, online retailers, or large retail chains. The frame itself is heavy yet sturdy to accommodate for various body shapes and sizes, which makes standard wheelchairs ideal for medical facilities and public venues in cases of emergencies. Standard chairs are most often prescribed for patients with short-term seated mobility needs, like patients who are non-weightbearing after an ankle surgery, but not recommended for those who need special seating systems or a chair for long-term self propulsion. Also, due to their weight, they are not typically recommended for short-term transportation solutions, like transport chairs.

4. **Independent manual wheelchairs** are classified as chairs that are intended for primary or intermittent self-propulsion and are most commonly operated without assistance.

5. **Lightweight wheelchairs** are a specific type of independent manual wheelchair that weigh between 30 to 35 lb. While not entirely custom-made, it is possible to adjust and add customized options to lightweight wheelchairs, depending on the needs of the patient. These wheelchairs also have folding frames that are lighter in weight compared to standard wheelchairs.

6. **Ultra Lightweight wheelchairs** are intended for those who use their chair as a primary means of mobility through self-propulsion. These chairs are ideal for those individuals because they weigh less than 30 lb. Ultra Lightweight chairs are entirely customizable with wheelchair specifications that are determined by the patient's anthropometric measurements and wheelchair evaluation. Additionally, these chairs can have a folding or fixed frame with a variety of componentry and options to suit the patients' needs. However, clinicians who wish to design an ultra lightweight wheelchair for their patients should understand that, while there are many options to customize the chair itself, each non-welded component adds

weight to the chair's frame. Furthermore, these chairs are capable of adapting for the needs of the patient as he or she becomes more accustomed to the chair itself. For example, the positioning of the wheels and axles are easily adjusted to perform wheelies and ascend curbs.

As a rule, rigid wheelchairs are generally lighter in weight than folding wheelchairs. Since they have fewer moving parts, rigid wheelchairs are ideal for self propulsion because the energy is transferred into the ground as opposed to a moving frame on folding wheelchairs. Further, the cross braces on a folding wheelchair can twist and move in response to rolling across uneven surfaces, which results in energy loss during self propulsion.

One drawback to ultra lightweight wheelchairs is the fact that they can be quite costly. Despite this, research has shown that these types of chairs have longer life spans than that of the lightweight and standard options, which may make them cheaper with respect to long-term cost. They are also highly recommended for pediatric populations due to research that suggests that pediatric wheelchair users are capable of longer distances when using ultra lightweight chairs as opposed to lightweight wheelchairs.

For individuals who would benefit from an ultra lightweight wheelchair but may require power add-on options, pushrim-activated power-assist are available. This option is best suited for those who are appropriate for manual wheelchairs but may benefit from a secondary power source. Using pushrim-activated power-assist wheels function to preserve the patient's upper extremities as well as allow for increased access to the community.

7. **Sports and recreation wheelchairs** are available for individuals who require high performance chairs designed for activity-specific dynamic mobility. These chairs typically have increased camber, added casters for stability, and a pelvis positioning belt to enhance the safety for the patient. Like ultra lightweight wheelchairs, sports and recreational wheelchairs are custom made, and the specifications of the wheelchair should be consistent with the governing body regulations for equipment for the primary sport or activity the wheelchair or activity will be used. Due to the complex sport-like design, these chairs are not practical for daily use and primary mobility.

Power Wheelchairs[1,4,6]

Power wheelchairs (PWC) are named for the manner in which they produce mobility, which is controlled by a battery or secondary mechanism that is controlled by another individual. For many, powered mobility is medically necessary to prevent pain or overuse syndromes as well as manage positioning for those at risk for pressure injuries. Power wheelchairs have applications from pediatric through adult to geriatric populations, however, they are generally considered in those up to 18 years of age.

Powered mobility for individuals over the age of 18 years needs to meet the widest range of needs from very basic to the most challenging. Adults who use powered mobility in the widest range of environments (e.g., home, community, social, educational, recreational, and occupational settings) require the highest possible level of independence and participation but also may require assistance with activities of daily living. Powered mobility for older adults may be required for participation in activities of daily mobility but also be necessary for managing the aging process. Indoor safety, accessibility, and maneuverability are key factors in powered mobility for the elderly.

Indications for use of power wheelchairs may include the following:[4]

1. The patient has a mobility impairment that cannot be safely mitigated through use of a cane or walker.
2. The patient demonstrates insufficient strength, range of motion (ROM), coordination, or endurance for manual wheelchair self propulsion.
3. The patient presents with cardiorespiratory endurance deficits that impair participation in activities of daily mobility.
4. Manual mobility is painful for the patient; self propulsion is not functional.
5. Manual mobility places the patient at risk for development of overuse/pain syndromes.
6. The patient is at risk for pressure injury development and requires power positioning to mitigate these risks.
7. The patient has a progressive medical condition or disability where use of power mobility or powered seating systems are anticipated and may improve quality of life.
8. Manual propulsion method increases muscle tone and/or postural asymmetry.
9. The weight of the patient negates independent manual or caregiver assisted mobility.

Furthermore, individuals who may benefit from powered mobility can be broadly categorized into three classifications:

1. Intermittent in-home or community use
2. Active user—not at risk for pressure injuries
3. Active user—at risk for pressure injuries and requires individualized seating systems

Knowledge of each classification will be useful when determining the most appropriate prescription for individuals who may require powered mobility.

Power wheelchairs can make a significant impact on the patients' independence and functional mobility. When choosing between a manual wheelchair versus a power wheelchair, some key considerations and include:

- Severe upper extremity and trunk weakness leading to inability to propel any manual wheelchair
- Limited neuromuscular or cardiovascular endurance
- Frequent long-distance or rough terrain travel
- History or ongoing problem with the upper extremity joints
- Progressive conditions that will likely lead to loss of endurance and strength in the upper extremities

When discussing the types and configurations of power wheelchairs, there are a large variety of seating systems and driver controls available which can be further categorized in many ways. One method is by drive wheel configuration.

- Power wheelchairs are typically categorized by their base unit that is capable of front, mid, and rear-wheel drive configurations. It is important to note that each configuration will have different turning radii, which may affect wheelchair prescription for certain clients with environmental restrictions. Power wheelchairs with mid-wheel drive configurations have the smallest turning radius and are arguably the best option for small spaces. Chairs with front wheel drive are advantageous when negotiating uneven terrain due to the position of the front wheels. Lastly, rear-wheel drive power wheelchairs have the largest turning radius and may not be feasible for individuals with small apartments or homes.

  Directly above the base sits the highly individualized seating system and similar wheelchair components to those found on manual wheelchairs (armrests, leg rests, seatback). The seating system itself is highly customizable and can include tilt, recline, and elevating functions to accommodate the needs of the patient. Power seating functions, including tilt, recline, seat elevation, and elevating or swing away leg rests, may improve patient's alignment in sitting, physical ability to transfer, perform bowel and bladder management, and reduce the risk for contractures, edema, spasticity, or pressure sores.

Another unique aspect of power wheelchairs that is highly customizable is the control interface and electronic mount. This option is desirable for special populations, like spinal cord injury, that may require control modifications based upon available movement and function. Therefore, control interfaces and electric mounts will vary based upon the patient's function, impairments, and overall level of disability.

- A significant factor that will determine the power wheelchair interface is the patient's available dexterity. The most commonly prescribed controller for a power wheelchair is a joystick. Depending upon the body part that will be controlling the joystick, there are various mounting options available. Additionally, joysticks are easily adaptable by altering the shape to model a ball, mushroom, dome, or a U-shaped handle that can be added for patients with decreased intrinsic hand control. For patients with limited dexterity, a mini-joystick can be mounted or placed in an alternate location. Sip-and-puff and head units are available for those with cervical dysfunction that prohibits movement below the cervical spine.

- Due to the extensive adaptability of power wheelchair technology, switches, head mounts, and alternate control interfaces are available to alternate between wheelchair speeds or modes or to further improve patients' experience when interacting with the environment. The recommended interface is proportional control for patients with fair-to-full dexterity and non-proportional control for patients who require a preset speed, regardless of the displacement of the controller. For patients with excessive fatigue, sundowning, or other progressive

pathologies, secondary attendant controls can be included for caregivers. This allows the caregiver to operate the chair while walking behind the wheelchair.

- Other alternative access controls include:
    - Head Controls - controls are located inside a headrest attached to the wheelchair.
    - Tongue Controls - a specially made mouthpiece that is affixed to the roof of the patient's mouth, allowing use of the tongue for control.
    - Sip-n-Puff Controls - the patient is able to control the device with his or her breath, inhaling and exhaling to propel and to stop the power wheelchair.

Standing wheelchairs[1,6,9]

Standing wheelchairs are often prescribed as power wheelchairs due to their powered standing mechanism. While they can be very beneficial for certain patients, there are contraindications associated with them, and the likelihood of all should be carefully assessed. As a result, the prescription of standing wheelchairs typically requires a multidisciplinary evaluation and extensive training for the patient and/or caregiver(s).

Potential benefits to standing wheelchairs:

- Improved respiratory function
- Improved bowel and bladder function
- Reduced gastrointestinal complications
- Decreased incidence of urinary tract infections
- Improve or preserve bone mineral density
- Pressure relief, especially on the ischial tuberosities
- Improvements in psychological and psychosocial state for patients

Contraindications for use:

- Contractures or skeletal deformities which would inhibit standing safely
- Increased risk of bone fracture from bone mineral density loss

- Postural hypotension
- Need for a complex seating system which would not integrate with change in wheelchair position

Scooters[6]

Referred to as power-operated vehicles, scooters are a reasonable option for individuals who require a mobility device in the community but not in the home. Seating for scooters is not customizable.

Section 1: Summary

- Wheeled mobility options are vast and encompass multiple configurations to meet a variety of health conditions and medical needs.
- Wheelchair types can be divided into two categories: manual and power wheelchairs. The decision to prescribe a manual or power wheelchair is dependent upon several intrinsic and extrinsic factors.
- Clinicians should be aware that wheelchairs can be used as a primary or secondary means of mobility in which the wheeled device can improve functional independence and community access, mitigate progressive or degenerative disease processes, and/or facilitate participation in recreation or sports.
- Manual wheelchairs (MWC) are named for the manner in which they produce mobility, which is either manually by the patient or assistance from another individual. They can be classified as folding or rigid and may include customized seating systems, leg rests, arm rests, positioning straps, head rest, push handles, wheel locks, and/or hand rims.
- Different types of manual wheelchairs exist and can be prescribed according to the patient's needs and functional capabilities. Some examples of manual wheelchairs include: Dependent manual wheelchairs, Transport wheelchairs, Standard wheelchairs, Independent manual wheelchairs, Lightweight wheelchairs, Ultra Lightweight wheelchairs, and Sports and recreation wheelchairs.
- Power wheelchairs (PWC) are named for the manner in which they produce mobility, which is controlled by a battery or secondary mechanism that is

controlled by another individual. They are typically categorized by their base unit that is capable of front, mid, and rear-wheel drive configurations.

Differences in wheeled drive configurations - variations can determine the turning radius as well as the ability to traverse varying terrains.

Front wheel-drive - performs best for navigating obstacles due to the forward position of the larger wheel. It demonstrates a larger turning radius for U-turns and performs as well as mid-wheel drive when making 90 degree turns.

Mid wheel-drive - best option for tight spaces due to its compact dynamic footprint. This would be best for mostly indoor use.

Rear wheel-drive - largest turning radius of all options

Section 1: Key Words

Primary means of mobility - refers to your preferred method of mobilization, whether that be ambulation or wheeled mobility

Secondary means of mobility - refers to your secondary method of mobilization, whether that be ambulation or wheeled mobility

Manual wheelchairs - describe the manner in which the wheelchair produces mobility, which is either manually by the patient or assistance from another individual

Self-propel - refers to the ability of wheelchair users to propel themselves

Reclining wheelchairs - refers to a specific type of manual dependent wheelchairs that allow the backrest to recline at various angles

Tilt-in-space wheelchairs - refers to a specific type of manual dependent wheelchairs that allow the seating system to be tilted forward or backward while the seat-to-back angle remains constant

Wheelies - name given to wheelchair maneuvers when the front wheels or caster wheels rise from the surface while the rear wheels remain in contact with the support surface

Wheelchair configuration - general term given to the wheelchair's specifications

Seating systems - general term given to the seat, backrest, and cushion options for a manual or power wheelchair

Pushrim-activated power-assist - motorized tires that are featured on Pushrim-Activated Power Assist Wheelchairs to reduce the physical demands on manual wheelchairs

Power wheelchairs - describe the manner in which a wheelchair produces mobility, which is controlled by a battery or secondary mechanism that is controlled by another individual.

Secondary attendant controls - useful accessories for power wheelchairs when the user is unable to operate drive controls or when a caregiver needs the option to control the mobility of a wheelchair

Section 1: Personal Reflection Question

Is it important for physical therapists and physical therapy assistants to have a thorough understanding of the types of wheelchairs that are available to patients? Name three ways in which this understanding can affect your patients' mobility goals and functional outcomes.

Section 1: Case Study

As the director of an inpatient rehabilitation unit, you have been tasked with creating an equipment list to be submitted for the department's annual capital budget. Your therapists have been requesting several different types of wheelchairs, and you have allocated a specific amount of funds to be used for this purpose.

As part of your budget proposal, you are required to justify the request for each item and indicate its clinical purpose. For the following wheelchairs, please write 2-3 sentences describing its purpose, clinical utility, and benefit.

1. Tilt-in-space manual dependent wheelchair
2. Standard manual wheelchair
3. Ultra lightweight manual wheelchair
4. Power wheelchair with mid-wheel drive
5. Power wheelchair with secondary attendant controls

Section 2: Considerations for Wheelchair Prescription

A full assessment of the individual who is in need of a wheeled mobility device is a multifaceted process. It includes obtaining subjective and objective information about a person's mobility needs, his or her environments and functional abilities, postural support needs, and any risk factors for skin breakdown or pressure injury that could result from sitting for long periods. This section presents considerations needed to conduct an effective seating and mobility assessment in preparation for the wheelchair prescription.

Considerations for size, age, and weight

Bariatric populations[6]

Those with higher body mass indexes and weight may require specialty chairs, known as bariatric wheelchairs. These wheelchairs are intended for use by individuals who weigh more than 250 pounds, but maximum capacity varies between manufacturers. These types of wheelchairs are a valid option for individuals who qualify for a manual wheelchair but are over the weight limit.

Geriatric populations[7]

While most older wheelchair users have needs specific to disease, injury or illness, there are some additional age related characteristics that should be taken into consideration when selecting an appropriate wheeled mobility device. Some of these include:

- Thinner skin increases vulnerability for skin tears and bruising.
- Visual changes that can cause problems with glare, as well as the need for more light.
- Increased urinary urgency and frequency due to changes in kidney and bladder function.
- Changes in the cardiovascular system that result in a drop in blood pressure upon standing, as well as a longer post exercise recovery.
- Diminished muscle mass and a higher prevalence of osteoporosis.

- Decreased respiratory function resulting in greater energy expenditure while breathing, an increased susceptibility for pneumonia, and an overall increase in fatigue and shortness of breath.

  Clinicians should also realize that cognitive functioning declines with age, even for individuals without dementia and Alzheimer's, which can pose an increased safety risk with durable medical equipment and wheeled devices**.**

Pediatric populations[6]

Wheelchairs designed for the pediatric patients must be flexible and able to accommodate the growth and changing needs of this population.

Typically, a few inches are added to the dimensions for width and depth to allow for growth. Prescribed wheelchairs may also include unique additions, such as a removable extended push handle for improved ergonomics for the caregiver, or a posterior caster which is commonly seen on sports and recreation wheelchairs. It is generally accepted that young children transfer from a stroller to a manual wheelchair between the ages of 18-24 months. Ultra lightweight wheelchairs are often preferred for the pediatric population since research shows these chairs are built to facilitate longer bouts of self-propulsion.

A child's physical and cognitive abilities should be thoroughly assessed when determining if they would benefit from a power wheelchair. Ideally, they must demonstrate the ability to use a joystick or switch, have adequate visual motor perceptual and motor planning skills in order to navigate through doorways and around obstacles, and understand basic cause and effect. Thorough wheelchair training skills should promote the child's motivation and curiosity while incorporating functional skills through games and interactive play sessions.

Considerations for Indoor and Outdoor Use[6]

- The type of tire, positioning of the axle, absence or presence of anti-tipping mechanisms, and specific add ons can make a wheeled mobility device more appropriate for indoor or outdoor use.

- Clinicians should realize that the position of the axle changes the wheelchair's center of gravity. The further posterior the axle is placed, the more secure the patient will be in the chair. This is more suitable for an individual who spends most time indoors and is not excessively self-propelling. However, be aware that

this position is less functional and efficient for community mobility and places the shoulder in a poor position that is prone to overuse injuries.

    - Conversely, moving the axle anteriorly provides: (1) increased independence; (2) ease of use; and (3) decreased backward stability. Benefits to moving the axle anteriorly include:
        - Decreased rolling resistance
        - Improved ease for propulsion
        - Optimal shoulder positioning and decreased risk of overuse injury
        - Improved mechanics for performing wheelies
        - Superior turning radius
    - An adjustable axle position is ideal to allow the patient to adjust the wheelchair as needed in order to find the most appropriate configuration.
- Anti-tipping devices can be added for increased safety and can decrease the likelihood of a backward fall. On the other hand, they will inhibit the ability to perform a wheelie to mount a curb, for example. Therefore, anti-tippers are most appropriate for indoor use.

Mobility Needs and Preferences[3,5]

- Research has shown that there is a sizable difference between daily distance traversed for patients who require wheelchairs versus those who ambulate. On average, those who use wheelchairs as a primary means of mobility are mobile for less than one hour and travel between 1 and 1.5 miles per day.[3] Conversely, the daily average for the ambulatory population is 4 miles.[3] Interestingly, individuals who are younger, employed, or in school are more likely to spend time being active in their wheeled devices than others in similar situations.

  It should be noted that the distance and duration for individual bouts of mobility, however, are more similar. Research shows that 60% of walking in children and healthy adults lasts for 30 seconds or less, and in this study, 65% of manual, and 70% of power wheelchair movements lasted less than 30 seconds.[3] Overall, wheelchair use in everyday life is similar to ambulation for functional tasks.

Regardless of whether individuals ambulate or use wheelchairs as their primary means of mobility, most of the day is spent performing functional tasks, like running errands, and is characterized by short bouts of starting, stopping, and turning. The frequency of this type of mobility highlights the importance of devices that are user friendly, as well as the need for proper training to encourage safe mobility.

- Combined with an overall decreased level of mobility, short episodes of mobility in patients with manual wheelchairs emphasize that these patients are not achieving recommendations for daily exercise. This inactivity often correlates with a negative psychosocial condition as well as many secondary complications such as pressure ulcers, obesity, diabetes, osteoporosis, and cardiovascular function.

  Daily physical activity should be encouraged for patients with wheelchairs, but emphasis must be placed on (1) proper body mechanics; and (2) upper extremity strengthening. This is due to the fact that wheelchairs often place an increased burden on the upper extremities since a loss of lower extremity function is common.

  Unfortunately, many individuals who self propel their manual wheelchairs frequently report widespread fatigue and musculoskeletal pain affecting the wrist, shoulder, neck and back. That pain and fatigue often leads to injury or, even worse, decreased mobility. Consequently, a higher emphasis on upper extremity exercise is extremely important in this population and should be emphasized during skills training and/or rehabilitation services.

Considerations for Functional Skills, Abilities, and Long-Term Disability

To evaluate one's needs for wheeled mobility, clinicians should consider the following:

- The patient's capability to ambulate and quality of gait pattern, presence of fatigue, and fall risk
- The patient's sitting balance and his/her ability to reposition if off-balance
- Any current or future risk for skin breakdown

Additionally, the following interview questions may be pertinent in determining functional skills, abilities, and the potential for long-term disability:

- Do you have any problems keeping your balance when you are seated?

- Do you easily lose your balance when sitting without support?
- Can you reposition yourself if you lose your balance?
- Do you have any problems with your skin—red marks, wounds, or open areas?
- Are you able to reposition yourself when you are uncomfortable?

Based upon the patient's responses, he or she may be appropriate for a seating and mobility needs assessment and clinical evaluation, otherwise known as a wheelchair evaluation. Additionally, if the patient meets any of the following criteria, then the clinician should proceed with a wheelchair evaluation.

Criteria for a wheelchair evaluation include:

- Limited functional mobility —e.g., unable to walk, having difficulty self-propelling a manual wheelchair, or will need powered mobility because of the inability to ambulate
- Needs external support to maintain upright sitting position, especially when driving a power wheelchair or riding in a car
- Risk for skin breakdown—impaired sensation and is not able to reposition if uncomfortable

Wheelchair Evaluations[6,15]

Wheelchair evaluations are structured similarly to physical therapy evaluations but are conducted for the sole purpose of determining the patient's appropriateness of a wheelchair and the wheelchair prescription. It is important to perform a thorough seating and postural assessment when considering how to prescribe the correct wheelchair for the individual.

- For example, a high backrest may be necessary to provide adequate trunk support but may not allow for adequate scapular movement during wheelchair propulsion, which can lead to negative compensatory actions.
- Slumped postures used as compensation for trunk instability can contribute to chronic fatigue and pain. Therefore, it's crucial to evaluate a patient's postural deformities and capabilities when the ability to compensate is removed.

Wheelchair evaluations should include the following:

- Review of systems (cardiopulmonary risk factors, vision and hearing, pre-existing medical conditions)
- Demonstration and assessment of sitting balance and the ability to reposition oneself in the seated position
- Assess of range of motion (ROM) of hips, knees, and upper extremities
- Note the presence of reflexes and muscle tone and their influence on body movements and posture.
- Assess upper extremity ROM, strength, and coordination to determine best prescription for manual wheelchair, scooter, or power wheelchair
- Conduct sensory testing to include a thorough examination of the patient's ability to sense pain, pressure, temperature, position, and balance
- Assess vision to determine impairments that may affect safety of self and others when operating a wheelchair
- Assess judgment and problem-solving skills to determine suitability for power mobility

If you are working with a patient who is non-ambulatory, does not have the balance to sit on the side of a treatment mat, or has poor sensation or an inability to weight shift independently, then you should consider starting the evaluation with the mat assessment.

Mat Assessment[5,6]

A mat assessment is an important component of a wheelchair evaluation, specifically the seating evaluation, because it determines the seated angles and support surfaces required by the wheelchair user. During the mat assessment, the patient should be examined both in supine and sitting on the edge of the mat table.

It is also important to look for causes of deformities observed. For example, if the patient exhibits an anterior pelvic tilt, aim to find the source of the abnormality. Is it due to tight hip flexors that pull the pelvis, or is the patient actively arching into the position?

- Begin by observing the patient sitting on the edge of a mat, noting the amount of support that is necessary to maintain upright posture. The three most common postural deviations of the pelvis are included in Table 3.2.
- The assessment should include observation of any deformity, as well as an assessment of the positioning being fixed or flexible.
- Based upon the results of the seating examination, it is generally recommended that the pelvis should be initially stabilized using a cushion mounted on a firm

surface. This provides postural support, as well as pressure distribution and comfort. If the individual is unable to maintain a stable upright posture, then it may be helpful to provide an anterior and lateral trunk support.

- General recommendations for maintaining a well-aligned seating posture of the head and neck will be (1) vertical with the hips flexed to 100 degrees, and; (2) 90 degrees of knee flexion with both feet flat on the floor.

Table 2.1 Postural Pelvic Deviations and Effects

Postural Deviation	Potential Cause(s)	Postural Effects
Posterior Pelvic Tilt	• Gravitational pull on the pelvis • Muscle fatigue	• Flexion of the lumbar and thoracic spine and hyperextension of the cervical spine • Abnormally high disc pressures leading to discomfort and pain
Pelvic Obliquity	• Asymmetrical muscle tone	• Asymmetrical positioning of hips and thighs • Scoliosis
Pelvic Rotation	• Uneven distribution of hypertonicity that is acting on the pelvis and lower extremities	• Scoliosis • Increased pressure to bony prominences

Clinicians should be aware that adjustments to the wheelchair itself can also address postural deformities, such as posterior pelvic tilt, exaggerated kyphosis, or hip extension, that can indirectly affect upper extremity function and head posture. The seat slope, or backward seat angle positions, can be positioned so that the hips are lower than the knees in such a way as to prevent the hips from sliding forward in the seat. Additionally, tilting the seat to back angle can accommodate for a kyphotic, forward head posture; thus improving upright head position. A smaller seat-to-back angle can improve pelvic

stabilization but will make transfers difficult. Refer to Table 3.1 for other possible equipment solutions to common pelvic deformities.

Table 2.2 Equipment Solutions to Common Pelvic Deformities

Deformity	Potential Cause(s)	Potential Equipment Solution(s)
Posterior Pelvic Tilt	• Inappropriate seat depth • Inadequate lumbar support	• Add lumber wedge • Shorter seat depth
Pelvic Obliquity	• Scoliosis • Asymmetrical hip range of motion	• Fixed: build up under high side, relieve pressure under low side with custom cushion to accommodate leg length discrepancy • Flexible: build up under low side
Hips Adducted/ Abducted	• Tone • Deformity	• Adducted: Adductor pummel in the cushion, adductor wedge, knee separator external brace • Abducted: lateral thigh support, abductor wedge in the cushion
Thoracic Kyphosis	• Pelvic obliquity and rotation • Weakness • Asymmetric tone/strength	• 3 point control: pelvic/trunk support in the backrest and lateral support • Curved lateral support • Custom-contoured seating system
Anterior Pelvic Tilt	• Muscle imbalances	• Pelvic belt along ASIS • Custom-contoured seating system

Positioning for pain/pressure relief [4,6,7]

A seating examination is key to help determine the appropriate seating system and necessary supports in a wheelchair. The primary goal of the seating examination is to determine the most appropriate type of pressure relief cushion to prevent skin breakdown.

- There are two types of pressure relief cushions, passive and dynamic.
    - Passive cushions are frequently provided due to lower cost and consist of a cushion plus related seating components. Together, they increase the surface area for weight bearing in order to decrease the risk of pressure sores.
    - Dynamic cushions involve a motor that pumps air or fluid through different chambers in the cushion to alter the configuration of the support surface. These types of cushions are most appropriate for patients who are unable to shift weight independently and/or are at a high risk for developing pressure sores. They are often costly and will require justification for purchase.
- Force isolation, or offloading, is another means to decrease the risk of skin breakdown. In this technique, the pressure is completely removed from an area. Typically, this targets bony prominences that are at increased risk of skin breakdown, such as the ischial tuberosities, coccyx, greater trochanters, spinous processes, and scapulae by carving out or building up portions of an existing surface. Patient education should emphasize the importance of monitoring the areas in which the pressure is displaced.
- For individuals who are unable to independently weight shift, specialized seating is crucial for pressure and pain relief. Advanced specialty seating options for power wheelchairs that are typically used for these individuals.
    - Advanced specialty seating options include tilt and standing features which change the individual's position in space to relieve pressure.
    - It should be noted that these features may cause anxiety and discomfort in individuals if the alternative positions evoke feelings of discomfort or insecurity. Ultimately, this may lead to lack of use and non-compliance.

- Interface pressure mapping can provide the patients and caregivers with additional information and justification for the advanced specialty cushion.
    - Visual feedback presented on a mapping monitor shows what desirable pressures look like when using an appropriate cushion.
    - Documentation should reflect that the seat is important for positioning and pressure relief. In addition to this, there may need to be adjustments to the seating system in the following three planes:
        - Anterior/posterior in the sagittal plane
        - Rotation in the horizontal plane
        - Obliquity in the frontal plane
    - For power wheelchair users, this provides valuable information regarding cushion selection, specifically how appropriate pressure relief can best preserve circulation. For the manual wheelchair user, it can help determine the most effective lean or weight shift for pressure relief.
        - This is especially beneficial for individuals with limited sensation, as they may mistakenly think they are adequately relieving pressure.
        - These systems can also be used in place of manual palpation of bony prominences, a skill that requires extensive clinical practice and experience.

Range of motion, Strength, Leg/foot Positioning[8]

- Range of motion and strength should be assessed in the supine position. This eliminates the forces of gravity to enable the clinician to capture the patient's total available range of motion that will ultimately impact the seated position.
    - Clinicians should passively flex the hips and knees slowly until the pelvis is in a posterior pelvic tilt. This position determines the best seat-to-back angle of the seating system.
- Any limitations or abnormalities in range of motion and strength should be carefully noted and considered when determining positioning for posture and lower extremities in a manual or power wheelchair. For example, plantar or dorsiflexion contractures at the ankles may limit the individual's ability to keep

their feet at 90 degrees on standard footrests. As a solution, angled and/or adjustable footplates may be beneficial.

- Hip flexion ROM should be greater than 90 degrees to achieve the optimal pelvic position described above. Hip joint contractures that limit hip flexion can result in pelvic alignment asymmetries, such as a posterior pelvic tilt, pelvic obliquity, and pelvic rotation. However, clinicians should be aware that it is possible for individuals with hip contractures to achieve a symmetrical sitting posture and a neutral pelvic tilt if provided a seating system that accommodates the contracture. Possible seating system modifications used to accommodate this contracture would include adjusting the seat-to-back support angle or using custom shapes to accommodate the lack of hip flexion. If the hips cannot be flexed to 90 degrees without excessive movement of the pelvis, then a seated angle of greater than 90 degrees is indicated.
- A lack of knee ROM does not significantly affect the patient's ability to sit, provided that the contracture is adequately accommodated by the seating and mobility system. For example, a knee flexion contracture greater than 90 degrees would require the seat depth and foot support placement

accommodate the lost ROM. Swing-away leg rests with heel loops or elevating leg rests with calf supports are not supportive and should not be prescribed for those with knee flexion contractures. Clinicians should also be aware that any musculoskeletal condition, cast, or brace may inhibit 90 degree flexion at the knee. In this case, elevating leg rests should be considered to improve the patient's comfort and safety when seated in the wheelchair.

- Increased or decreased tone, including spasticity, can also prevent the individual from keeping their feet or calves on footrests and calf pads. Ankle straps and calf panels provide stabilization in these instances.
- Spasticity in the lower extremities can cause increased pressure on the footplates which can result in thrusting. This causes asymmetrical elevation of the pelvis and prevents a stable, neutral posture in sitting. Gas struts can be added to the footrests to absorb motion and help keep the individual in a neutral position. Dynamic/Articulating footrests, in place of standard footrests, are also an option.
- Manual muscle testing needs to be performed to determine the patient's baseline strength. In conjunction with manual muscle testing, functional tests, like the Functional Independence Measure (FIM), can provide the clinician with a better understanding of the individual's progress toward independence with activities of daily living and mobility. Functional testing also identifies the level of assistance required to perform each task. In addition, wheelchair skills testing will help the clinician determine whether a patient is best suited for manual or power wheelchair mobility.

Wheelchair Cost[6,10]

- Generally speaking, wheelchairs provided either through insurance or the government are only reimbursed by that entity once every five years. Realistically, five years is the minimum, as the wheelchair must have reached its Reasonable Useful Lifetime (RUL), which begins on the day it is issued.
- There are, however, two exceptions: (1) a new diagnosis; or (2) weight change significant enough to render the wheelchair unusable.
    - Extensive documentation from the patient's primary care provider, medical doctor, and/or rehabilitation team must be included to prove the medical necessity of a new wheelchair.

- Medicare, as well as many private insurers, mandate an in-person appointment with the patient and the physician within 45 days of a prescription for a new powered device and six months for a manual wheelchair. The involvement of a seating specialist is crucial, as insurance and Medicare will not pay for a new device if it is incorrectly prescribed.
- A seating evaluation must be performed by a seating specialist, typically an occupational therapist or physical therapist, who is trained in seating and mobility. Ideally, the seating specialist should hold an ATP/SMS certification, which stands for Assistive Technology Professional and Seating and Mobility Specialist, respectively. Specialty or customized wheelchairs, in particular, can be very expensive and are often denied by insurance companies; thus, highlighting the importance of a thorough and comprehensive evaluation.
- Following completion of the aforementioned items, the equipment supplier collects and submits documentation to payer source. If approved, the equipment will then be ordered. If the application is denied, then the supplier will collaborate further with the seating specialist to assist the patient through the appeals process.

Considerations for Special Populations[4,5,11,12]

Stroke

- Individuals who have suffered a stroke have several special considerations that must be noted when determining best options for a wheelchair.
    - For example, they are more likely to have absent or decreased sensation and, while this should be assessed in any individual, special attention is warranted in this population.
    - A specialized pressure relief cushion may be required, especially if the patient is unable to independently weight shift to relieve pressure.
- The typical manual wheelchair user with hemiplegia propels their wheelchair using their unaffected arm and leg. Therefore, patients following a stroke should have footrests that easily flip up or away so they can use one or both feet for self propulsion. Furthermore, the seat height must be low enough and their pelvis stable on a supportive cushion to prevent sliding out of the seat in an attempt to

use their leg for propulsion and steering. Clinicians should be aware that self propulsion by lower extremities backward up inclines, curb cuts, ramps is safer and more successful using quadriceps muscles than trying to propel in a forward direction.

- An arm trough, as well as strap, may be beneficial for individuals with unilateral neglect and flaccidity in their upper extremity. A pelvic belt to keep the pelvis from sliding anteriorly may also be appropriate.

- In addition to hemiparesis, many exhibit cognitive, sensory, and perceptual deficits following stroke. These impairments can adversely affect the patient's ability to safely and functionally perform wheelchair skills in a timely manner with good motor planning and safety judgment. These impairments may also increase the risk of adverse events in the wheelchair. Therefore, it is important that the patient's wheelchair is best configured for seated postural stability and efficient and effective propulsion to facilitate successful function and mobility.

Spinal Cord Injury[2,6,12]

- The loss of sensation and motor abilities make this population especially susceptible to pressure sores. Bowel and bladder incontinence is also common, and the moisture associated can further exacerbate this risk. A pressure relief cushion should be included for these individuals. A spare cushion and/or a cushion with a removable, washable cover can be beneficial in instances of incontinence.

- The level of the injury is a determining factor when identifying if a manual or electric powered wheelchair is appropriate. Individuals with C1-4, C5 and C6 injuries will likely require an electric powered wheelchair.

- Tilt-in-space wheelchairs can be beneficial for those without upper extremity function to assist with weight shifting and pressure relief. Individuals with C1-4 lesions commonly fall into this category. Small, frequent tilts have shown to improve blood flow for individuals with SCI. Larger tilts with recline have also shown to increase skin blood perfusion over the ischial tuberosities. However, be aware that tilting may not be appropriate for individuals with an indwelling catheter as it can cause backflow.

- Individuals who are unable to maintain an upright seated position in midline are often referred to as prop sitters. Such individuals may require extensive external

supports on the sides of the wheelchair or a contoured backrest to maintain optimal posturing in the wheelchair.

Multiple Sclerosis[5,11]

- In a systematic review for individuals with Multiple Sclerosis (MS) and mobility assistive technology (MAT), manual wheelchairs were reported as the most common MAT used by patients with MS at about 60%. However, the quality of wheelchairs being recommended for individuals with MS is typically inferior (i.e. less adjustable for the user) to that of devices issued to patients with SCI.
    - One reason why individuals with MS may be issued a poorer quality (heavier and with limited options) manual wheelchair, as compared to those with SCI, is because clinicians may anticipate the slow progression of MS.
    - This can lead some clinicians to view a manual wheelchair as an intermediate step in the disease progression, which is going to be followed by an increased reliance on a power device for mobility.
- Many individuals with MS will use a manual wheelchair to alleviate some of their daily fatigue. Since they are marginal users or may not initially use a wheelchair as their primary means of mobility, they may be issued a wheelchair with limited options.
    - Ironically, this inferior, non-adjustable wheelchair can cause an increase in fatigue symptoms that they are attempting to overcome due to the fact that the prescribed wheelchairs are heavier and non-adjustable. Therefore, they will exert increased effort and higher energy expenditure.
    - The higher energy requirement for obtaining functional mobility is a significant problem for those with MS for whom fatigue is a major limiting factor. The reduced mobility caused by less adjustable heavier wheelchairs can be generalized to the elderly and aging population and are also associated with difficulty in activities of daily living and reduced quality of life.

Foot Propulsion Users

- Those with manual wheelchairs may use one or both feet to propel their chairs if arm function is impaired. Clinicians should be mindful that foot propulsion users require a wheelchair frame with an adjustable seat slope or seat height to allow the foot to rest flat on the ground. They do not necessarily require the adjustability of a forward axle.
- An example of those who utilize foot propulsion for mobility are people with hemiplegia who typically use their unaffected arm and leg for hemi propulsion. Another example is people with amputated limbs who will typically use a combination of both arms and/or one leg. Without a lower seat height position for foot propulsion, these patients are either dependent on mobility from a caregiver or at risk for sliding out of the seat trying to reach the floor to push with their feet.

Neurological conditions

- One of the challenges that frequently arises within this population is the rapid functional decline that can occur, especially in patients with progressive neurological conditions. Therefore, predicting functional movements, postural stability, and overall decline can present challenges for wheelchair prescription.
- When working with individuals with degenerative neurological diseases, it is considered to be good practice to follow up every 1-3 months to determine if their decline warrants updates or changes to equipment.
- Wheelchair prescriptions that optimize pelvic alignment, maintain postural control, and provide pressure relief are commonly needed.
- Although several neurological conditions spare sensation, which is beneficial for self awareness of skin breakdown, others may exacerbate pain associated with prolonged periods of sitting. Therefore, additions to the wheelchair for overall support and stability, from the head to feet are often warranted.
- Bowel and bladder incontinence often occurs concurrently with neurological dysfunction, and measures to prevent moisture related skin breakdown may be necessary.

Orthopedic conditions

- Postural support and alignment should be prioritized to maintain optimal joint positioning. This can help facilitate symmetrical weightbearing and oppose rotational torque and strain on soft tissues.
- Common orthopedic conditions requiring specialized seating include subluxed or dislocated hip, spinal curvature and rotation, pelvic obliquity and contractures of the elbow, wrist, knee, and ankle.
- Abnormalities in tone and/or uncontrolled movements should be considered in which dynamic positioning systems can inhibit abnormal movement patterns and help the individual stay upright and in midline.
- Individuals with complex orthopedic conditions who are candidates for surgery may require targeted positioning pre- and post-operatively to improve health outcomes. In these instances, interdisciplinary collaboration between surgical, rehab and seating teams is critical.

Section 2: Summary

- A full assessment of the individual who is in need of a wheeled mobility device is a multifaceted process. It includes obtaining subjective and objective information about a person's mobility needs, his or her environments and functional abilities, postural support needs, and any risk factors for skin breakdown or pressure injury that could result from sitting for long periods.
- Clinicians should consider the patient's size, age, and weight as this may also affect wheelchair prescription.
- When deciding if the wheeled device is to be used primarily indoors or outside, clinicians should understand that the type of tire, positioning of the axle, absence or presence of anti-tipping mechanisms, and specific add ons can play a significant role in the wheelchair prescription.
- Research has shown that there is a sizable difference between daily distance traversed for patients who require wheelchairs versus those who ambulate. Combined with an overall decreased level of mobility, short episodes of mobility in patients with manual wheelchairs emphasize that these patients are not achieving recommendations for daily exercise. This inactivity often correlates with a negative psychosocial condition as well as many secondary complications such

as pressure ulcers, obesity, diabetes, osteoporosis, and cardiovascular function. As a result, daily physical activity should be encouraged for patients with wheelchairs.

- Consideration of the following is critical to the wheelchair prescription: the patient's capability to ambulate and quality of gait pattern, presence of fatigue, and fall risk; sitting balance as well as the ability to reposition if off-balance; and any current or future risk for skin breakdown.
- Wheelchair evaluations should, at minimum, include these components: Review of systems, sitting balance, range of motion (ROM) of hips, knees, and upper extremities, assessment of reflexes and muscle tone, strength and coordination, sensory testing, vision screen, and cognitive testing.
- Patients with Multiple Sclerosis, spinal cord injuries, or other neurological and orthopedic conditions may have additional needs that will inform wheelchair prescription. Targeted interventions to prevent skin breakdown are crucial for individuals in these populations, and additional seating support to maintain proper positioning and good body mechanics are often needed.

Section 2: Key Words

Bariatric wheelchairs - specialty wheelchairs manufactured for individuals who weigh more than 250 pounds

Anti-tipping mechanisms - component on the posterior aspect of the wheelchair to prevent the chair from tipping over backwards

Wheelchair evaluation - a biomechanical assessment and physical evaluation to inform wheelchair prescription and to decide how much support the wheelchair user needs.

Mat assessment - an important component of a wheelchair evaluation, specifically the seating evaluation, that is conducted on a mat table

Seat-to-back angle - determined by measuring hip flexion range of motion in supine when the pelvis rotates posteriorly

Anterior trunk support - a harness like device that pulls against the torso to stabilize it in an upright, neutral position and keep the patient from falling forward or leaning to one side

Fixed Pelvic Obliquity - indicates that the patient will be able to move the pelvis out of the posture and back to a neutral pelvis

Flexible Pelvic Obliquity - indicates that the patient will not be able to move the pelvis out of the posture and back to a neutral pelvis

Passive pressure relief - a cushion and/or related seating components that increase the surface area for weight bearing to decrease the risk of pressure sores

Dynamic pressure relief - involve a motor that pumps air or fluid through different chambers in the cushion to alter the configuration of the support surface

Force isolation - also known as offloading, it refers to another means to decrease the risk of skin breakdown in which the pressure is completely removed from an area

Interface pressure mapping - involves the measurement of interface pressure and pressure redistribution using a high-tech sensor technology to quantify and visualize the pressure between the individual and the surface

Gas struts - provide direct support for safely lifting, positioning, lowering and counterbalancing weight

Dynamic/Articulating footrests - footrests that provide elevation and articulation simultaneously

Reasonable Useful Lifetime (RUL) - refer to the time period in which Medicare will not reimburse for multiple pieces of DME that are utilized to treat the same condition. Currently, this time period is no less than five years.

ATP certification - Assistive Technology Professional

SMS certification - Seating and Mobility Specialist

Arm trough - a contoured arm support that can be attached to the armrest of the wheelchair

Indwelling catheter - refers to an internal urinary catheter that is intended for long periods of time

Prop sitters - Individuals who are unable to maintain an upright seated position in midline

Section 2: Personal Reflection Question

A mat assessment is a critical component of any wheelchair evaluation. What measurements should be recorded when the patient is in supine? Should any of these measurements be repeated when the patient is in unsupported sitting?

Section 2: Case Study

Rosa is a 65 year old woman who lives independently in a small one bedroom apartment complex. She has been diagnosed with relapsing-remitting Multiple Sclerosis and Type 2 Diabetes. She is currently using a rollator walker for community ambulation due to fatigue and is not confident with her balance on uneven surfaces. In her home, she does not need an assistive device and performs all transfers independently.

During her initial evaluation for a wheelchair prescription, Rosa is able to easily sit on the side of the treatment mat and shift weight without assistance. She does not have any sensation deficits in her upper or lower body. Her goals are to leave her apartment, do her own shopping, and go to church without depending on others to take her.

1. Which functional limitation would indicate Rosa's need for a wheelchair evaluation?
2. How would the diagnosis of Multiple Sclerosis possibly affect the wheelchair prescription?
3. Aside from the information provided, name the remaining components of a full wheelchair evaluation for Rosa.

Section 3: Wheelchair Prescription

Unless the clinician is employed within a wheelchair clinic, it is likely that the physical therapist or physical therapy assistant will be working alongside a wheelchair vendor/ specialist to produce the wheelchair prescription. While the wheelchair vendor is highly specialized and knowledgeable regarding each component of the wheelchair prescription, clinicians should have a thorough understanding and comprehension to better assist the wheelchair vendor and patient.

Armrests[9,13,14]

- There are many key features to ensure that armrests benefit the user as opposed to creating increased stress to joints and decreased functional mobility. Benefits to appropriately prescribed armrests include:
    - Armrests can optimize the patient's postural alignment and provide a place to attach an upper extremity support surface for increased functional independence and interaction with the environment.
    - Armrests allow for improved transfer ability by optimizing leverage and providing a lateral option. Pressure relief through wheelchair pushups are achieved with armrests placed at an ideal height for the individual.
    - Additionally, armrests act as a stabilizing support surface for the user to reach outside of his/her base of support to targets on the ground, the sides, or above eye-level.
- The proper height for a wheelchair armrest is determined with the patient sitting unsupported with arm by their side and elbow bent at 90 degrees.

    - Measure the distance from the seat to the patient's olecranon process and add about 1 inch plus the height of the cushion, if one is being used. The average armrest height is 9 inches.
    - It is important that the shoulders are level when the arms are relaxed on the armrests. When the armrests are too high, it can put increased stress and pressure on the shoulder joint. On the other hand, if the armrests are too low, then it can create poor posture as the patient slumps forward to reach the armrest.
- Clinicians should also consider the width of the armrests.
    - Armrests that are too wide can lead to difficulty with removal when performing transfers. Also, wider armrests can interfere with wheelchair propulsion. On the other hand, a wider armrest would be beneficial to someone who would require more assistance for core stability and may have decreased arm strength, possibly requiring the use of a powered wheelchair.
    - Armrests that are too narrow can cause the patient's arm to fall off the armrest, leading to poor posture and the need for increased assistance for trunk support. Someone who would benefit from a more narrow armrest would: (1) require excellent core strength; (2) perform slide board transfers; and (3) use the manual wheelchair as primary mode of mobility.
- The final key measurement for the armrest is the length.
    - Full-length armrests are helpful for mounting tray tables or troughs and providing better leverage for transfers. These upper extremity support surfaces help with proper positioning of the glenohumeral joint and scapula. Additionally, tray tables are used as a work surface, communication area, and feeding surface to maximize the patient's independence and quality of life.
    - Shorter armrests allow the user to utilize desks and tables for improved interaction with the environment.
- Most armrests can be removed or flipped back to allow for ease of transfers in and out for the wheelchair. Typically, there are two attachment points: one in front, and the other at the back.

- Detachable armrests are typically lightweight and have two sockets; thus, making it more difficult to manage when the patient must remove it for transfers.
- Conversely, flip back armrests are stable and lightweight with a hinge at the back for the patient to easily manage one socket to release backwards for transfers.
- One final type of armrests are tubular swing away. These armrests are extremely lightweight and allow individuals with little strength and dexterity to manage their use. Since these tubular swing away armrests are so lightweight, they are not as durable and may not be able to withstand repeated stresses.

Seat[13]

- The seat height is measured with the patient in a neutral sitting posture.
    - The height is the distance from the bottom of the heel to the popliteal fossa behind the knee, plus two inches for footrests and the height of the cushion. Because some manual wheelchair users propel the wheelchair with both lower extremities, the wheelchair may need to be lowered to allow the individual to have more efficient propulsion using bilateral lower extremities.
- Seat depth is the distance measured from back of buttocks to back of knees when the patient is in neutral sitting, minus 2 inches. It is important the depth of the seat is not too long as this creates pressure and discomfort to the back of the knee. The average seat depth is 16 inches.
- For determining appropriate hip width, have the patient in neutral sitting and measure from one side the buttocks to the other. That distance, plus 2 inches for space on both sides, is the ideal seat width. The average seat width is 18 inches.

Wheelchair Frame[6]

- Manual wheelchair frames come in various styles dependent on weight, durability, and individual need.
- Standard wheelchairs have limited personalization as they come in specific seat sizes and have no adjustability. The most common standard wheelchair frame size

is 16 inch depth, 18 inch width, 24 inch rear wheels and 8 inch front casters. As stated above, these types of wheelchairs are meant to only be used temporarily or for transportation needs.

- Lightweight chairs allow for slightly more adjustability compared to the standard chair. These wheelchairs are 30 to 35 pound wheelchairs are lighter and have componentry add-on options to customize to the user at an affordable cost.
- Ultra-lightweight wheelchairs offer the most customizability. This type of wheelchair frame can be more expensive, however, it provides a better long term option due to its durability and low maintenance costs. These wheelchairs are meant for self-propulsion and weigh less than 30 pounds which allows for better ease of use.

Casters[7]

Casters refer to the front wheels on manual wheelchairs. Typically, the anterior two wheels range from 3 to 8 inches. These caster wheels are connected to the frame by the caster housings, which allow for adjustability by moving the seating system forward, back, up, or down to help maximize maneuverability, increase propulsion efficiency, enhance postural alignment, and decrease the risk of injuries due to overuse.

Brakes[14]

- Brakes, also known as wheel locks, are used to help with maintaining stability of the wheelchair on various surfaces. Brakes help keep the chair from moving when performing transfers, lifting something, picking up something off the ground, or just staying in place.
- Brakes can frequently require maintenance during the wheelchair's lifespan. As the brakes become too tight, they ultimately prevent the user from locking the brakes independently. On the other hand, brakes that are too loose will not hold the tire nor prevent it from moving.
- Additionally, brakes should not be in a position where they rub on the wheel, as it will decrease the patient's wheelchair propulsion efficiency.
- Clinicians should understand that some patients may benefit from brake extenders on one, or both, sides. Brake extenders function to lengthen the lever

arm used to lock the brakes. This adjustment would be helpful to someone who has limited use of one or both upper extremities.

Footrests[9]

- Footrests provide optimal lower extremity positioning while the patient is seated in the wheelchair.
- Footrests are most beneficial for patients who are pushed in the wheelchair for transportation or users who propel their wheelchair with their upper extremities.
- Usually, they have a fixed angle usually between 60 and 90 degrees from the seat. It is more desirable to have the angle closest to 90 degrees, as long as it does not interfere with the castor wheels, since this angle minimizes the stretch and stress placed on the hamstring muscles.
- Footrests for most wheelchairs can be characterized as removable, swing away, and or flip up. Another type of foot rest is called a rigid foot support that is typically found on a rigid-frame wheelchair. These foot supports are not removable, but the height can be adjusted slightly for different leg lengths. Rigid foot supports allow the patient to have their knees at or closest to 90 degrees for optimal positioning. This type of foot support may not be optimal for a patient who performs sit to stand transfers since the foot support is not removable.
- It is possible to adjust foot rests for the individual's height. The optimal length of the foot rest is found by measuring from the popliteal fossa to the bottom of the heel. Of note, it is important to keep in mind the added height of the cushion when determining footrest length. When the foot support is too low, it can result in lower knees, creating open hip angle and possibly lead to forward pelvic sliding. When the foot support is too high, it may unload the thighs and place increased pressure on the ischial tuberosities.

Legrests[9]

- Legrests provide support to the patient's lower extremities. Some even allow for elevation, which may be useful for specific health conditions or medical needs.

- The angle can be adjusted from 70 to 180 degrees to maximize the support of the lower leg and allow for elevation, which is commonly needed for patients with edema, pain, or those with orthopedic injuries who are post-surgery. These elevating leg rests can be independent of one another, with different heights on each side. For example, the patient can raise one side to elevate the left limb while the right lower extremity is down in a comfortable position. Clinicians should be aware that elevating leg rests may not be beneficial for patients with shortened or tight hamstrings. Elevated leg rests, even in the lowest position, can place an excessive amount of stretch on tight hamstrings and, ultimately, lead to a posterior pelvic tilt.
- For standard legrests, the angle and length must be adjusted separately. Articulating legrests extend as they are elevated and would be beneficial for a patient who needs to adjust them more frequently.

Crossbars[9]

- Crossbars allow for stability and support to the backrest of sling back wheelchairs.
- The crossbar provides more stability when manual wheelchairs are pushed. In addition, they can help absorb shock over rough terrain, thus, transmitting less pressure onto the patients' spine.

Seat Belts[13]

- Seat belts help maintain good pelvic positioning to prevent hips sliding forward and maintain safety of the wheelchair user, especially during mobility.
- Typically, the angle of pull between the seating surface and seat belt should be between 45 and 60 degrees.
- Four-point belts provide multiple angles of pull, with two anchors that assist in pulling the pelvis back and two additional anchors that prevent the pelvis from shifting forward and up.

Tires/Wheels[13,14]

- Most manual wheelchairs have two larger wheels on the posterior aspect of the frame that range in size from 20 to 26 inches. These tires are connected to the central frame by metal spikes known as spoked wheels or synthetic spokes known as mag wheels.
- These back wheels are primarily used for upper extremity propulsion. Push rims or hand rims are sometimes attached to the outside of the wheels to assist with better propulsion and maneuverability. The handrims can be either metal or plastic to help patients who have decreased hand grip. Evidence has shown that the optimal push rim position allows the patient to have 100 to 120 degrees of elbow flexion as that minimizes overuse while maximizing efficiency.

- When selecting which wheels would be most beneficial to the patient, it is important to consider weight and the environment they will be most used in. In order to minimize resistance and reduce excessive energy expenditure, a patient who uses bilateral upper extremities for self propulsion should be positioned rearward with lightweight wheels.

Table 3.3 Different Types of Wheelchair Wheels

Wheel Type	Pros	Cons
Spoked wheels	• Lighter	• Require more maintenance • Not good in moist environments

Mag Wheels	• Less maintenance	• Heavier • Performance affected by extreme temperatures

Backrest height[6,9]

- Backrests provide support to maintain upright positioning, minimize trunk deviation, and maximize energy conservation during dynamic arm movements. Backrest height is measured from the bottom of the buttocks to the highest level that the patient requires, which is determined upon the amount of support that he/she needs. At a minimum, the back support goes above the posterior superior iliac crests of the pelvis in order to provide pelvic stability.
    - Patients who have functional use of their upper extremities benefit from a back support that sits below the inferior angle of the scapula. This height allows the patient to have freedom of movement of the shoulder girdle for propulsion and interaction with the environment.
    - A patient may require a higher backrest for support due to poor trunk control. A higher backrest allows for accessories, such as lateral supports or head rest, to be added for additional support.
- Backrests can be sling back, pre-fabricated, or custom made. Furthermore, they can be contoured for those who require long-term use or those with postural deformities.
    - Contoured backrests are either prefabricated based off of the average measurements or custom contoured for optimizing the patient's positioning. These are made to help support neutral alignment of the pelvis and natural curvature of the spine.
    - Sling backrests, which are most commonly seen in standard manual wheelchairs, are designed for patients who will not require long-term use

of the wheelchair. Clinicians should be forewarned that standard manual wheelchairs have non-adjustable sling backs that, over time, can lead to kyphotic posture and posterior pelvic tilt.

- Lastly, the backrest can be set at a specific angle or tilted, according to the patient's needs, cognitive function, and skin integrity.
    - People with kyphotic posture may benefit from a tilted or angled back support to assist with proper vision of the environment.
    - Wheelchairs that can tilt and recline are beneficial for those who have difficulty with performing independent pressure relief.
    - Those with poor head control may require a head and neck support in addition to a wheelchair that has the ability to tilt or recline.

Section 3: Summary

- Clinicians should have a thorough understanding and comprehension to better assist the wheelchair vendor and patient but may have opportunities to work alongside a wheelchair vendor to complete the wheelchair prescription.
- Armrests contribute to the patient's postural alignment and provide a place to attach an upper extremity support surface for increased functional independence and interaction with the environment. Additionally, they allow for improved transfer ability by optimizing leverage and providing a lateral option. Pressure relief through wheelchair pushups are achieved with armrests set at an ideal height for the patient.
- The seat of the wheelchair can be measured by its height, depth, and width.
- Wheelchair frames come in various styles dependent on weight, durability, and individual need. Examples of wheelchair frames include standard manual wheelchair, lightweight manual wheelchair, or ultra lightweight manual wheelchair.
- Casters refer to the front wheels on manual wheelchairs. They allow for adjustability by moving the seating system forward, back, up, or down to help

maximize maneuverability, increase propulsion efficiency, enhance postural alignment, and decrease the risk of injuries due to overuse.

- Brakes, also known as wheel locks, are used to help with maintaining stability of the wheelchair on various surfaces
- Footrests and leg rests provide optimal lower extremity positioning while the patient is seated in the wheelchair.
- Seat belts help maintain good pelvic positioning to prevent hips sliding forward and maintain safety of the wheelchair user, especially during mobility.
- When selecting which wheels would be most beneficial to the patient, it is important to consider weight and the environment they will be most used in. Push rims or hand rims are sometimes attached to the outside of the wheels to assist with better propulsion and maneuverability.
- The backrest of the wheelchair provides support to maintain upright positioning, minimizes trunk deviation, and maximize energy conservation during dynamic arm movements. Backrest height is measured from the bottom of the buttocks to the highest level that the patient requires, which is determined upon the amount of support that he/she needs. Backrests can be sling back, pre-fabricated, or custom made.

Section 3: Key Words

Armrest - refers to the side of the wheelchair that allows the patient to rest his/her arms. It is determined with the patient sitting unsupported with arm by their side and elbow at 90 degrees

Seat depth - refers to the distance measured from back of buttocks to back of knees when the patient is in neutral sitting, minus 2 inches.

Hip width - measurement that refers to the distance between the patient's hips and required to determine the ideal seat width

Seat width - measurement that refers to the width of the wheelchair seat and determined by measuring from one side the buttocks to the other, plus 2 inches

Casters - refer to the front wheels on manual wheelchairs

Brakes - also known as wheel locks; used to help with maintaining stability of the wheelchair on various surfaces.

Footrests - support the patient's lower extremity while the patient is seated in the wheelchair. They're ideal for patients who are pushed in the wheelchair for transportation or users who propel their wheelchair with their upper extremities.

Legrests - provide support to the patient's lower extremities when seated in the wheelchair

Crossbar - found on the back of a manual wheelchair to allow for stability and support to the backrest of sling back wheelchairs.

Sling back wheelchairs - manual wheelchair with a sling backrest

Four-point seat belts - specific type of seat belt that provides multiple angles of pull with two anchors that assist in pulling the pelvis back and two additional anchors that prevent the pelvis from shifting forward and up.

Spoked wheels - tires are connected to the central frame by metal spikes

Mag wheels - tires are connected to the central frame by synthetic spokes

Push rims - also known as hand rims; solid tube that attaches to the outside of the wheels to assist with better propulsion and maneuverability. They can be made of either metal or plastic.

Backrests - provide back support to maintain upright positioning, minimizes trunk deviation, and maximize energy conservation during dynamic use of arms. Height of the backrest is measured from the bottom of the buttocks to the highest level that the patient requires.

Section 3: Personal Reflection Question

With so many options for customization, wheelchair prescription can be overwhelming. What are some ways in which you can make the process less daunting, especially when you are practicing in a busy clinical setting?

Section 3: Case Study

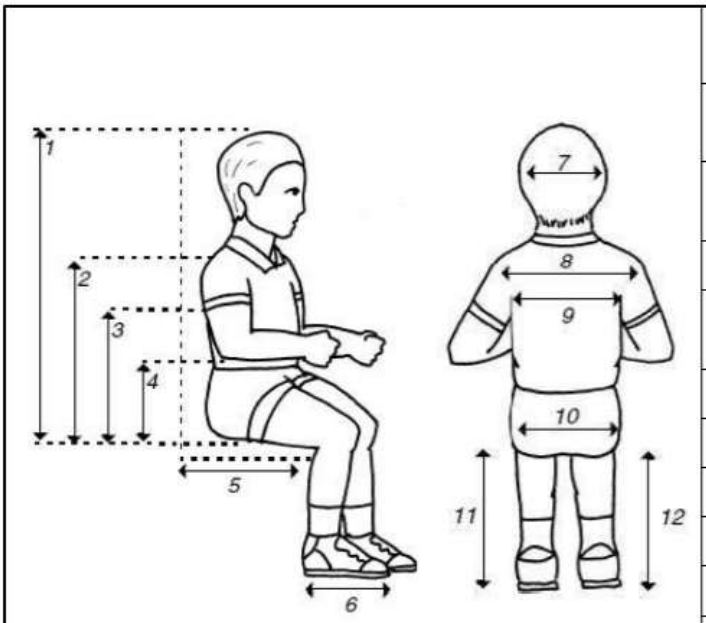
Joseph Kittle is a 47 year old male who suffered a spinal injury in a MVA that left him physically impaired. He lives with his wife in a one story home with a ramp to enter. He has 2 children, ages 12 and 10 years old, who are very active in the community. Prior to his accident, Joseph worked from home as an auditor and hopes to return to work in the next month. Joseph demonstrates good sitting balance by not needing to use his arms when sitting unsupported. He is able to perform sit-to-sit transfers with minimal-to-no assistance. He was left with very little movement in both lower extremities but has been able to regain good strength in bilateral upper extremities.

Below are findings from initial assessment and observations.

	Observation/Assessment
Head and Neck	ROM is within functional limitations
Trunk	Slightly fixed thoracic kyphosis
Pelvis	Flexible posterior pelvic tilt
Hips	• MMT 2-/5 • >90 degrees bilaterally
Knee	• MMT 2/5 • Short hamstring length, <70 degrees
Ankle and Foot	Flexible neutral
Upper Extremities	• Shoulder internal rotation • ROM within functional limits
Transfers	Independent sit pivot transfer
Propulsion	Uses bilateral upper extremities

Skin	• No current redness • At risk for skin breakdown • Able to independently perform wheelchair push-ups

Measurements taken in unsupported sitting are as follows:



1:	31	Top of head to bottom of buttocks
2:	22	Top of shoulder to bottom of buttocks
3:	19.5	Arm pit to bottom of buttocks
4:	7.5	Elbow to bottom of buttocks
5:	18	Back of buttocks to back of knee
6:	9	Foot length
7:	7	Head width
8:	17.5	Shoulder width
9:	16	Arm pit to arm pit
10:	15.5	Hip width
11:	21	Distance to bottom of left leg (popliteal to heel)
12:	21	Distance to bottom of right leg (popliteal to heel)

(Image obtained in: *Wheelchair/Scooter/Stroller Seating Assessment Form,* 2011)

1. State 2-3 seating goals for Joseph.
2. What type of wheelchair and components would be most appropriate and why? Include measurements.
3. What are the risks of an inappropriate seating system?

Section 4: Clinical Implications for Wheelchair Management in Physical Therapy

Wheelchair Utilization Across the Continuum of Care[16]

In acute care settings, clinicians should understand that they will mostly come into contact with wheelchairs that are either manual or transport chairs. While manual wheelchairs have larger wheels and can be self-propelled, they are not feasible for every patient presentation. The transport wheelchairs are lighter than manual wheelchairs, as they are normally made out of lighter materials. They are highly foldable and considered easier to use on the part of the patient, as patients using these wheelchairs normally do not self-propel and will require assistance from another individual. Transport chairs are typically used more acutely and for short-term wheelchair use.

In inpatient rehabilitation settings, patients may require use of a variety of manual or power wheelchairs that were described in Section 1. Since clinicians are responsible for enhancing patients' functional mobility and movement, they are highly likely to come into contact with specialty chairs and will need to be familiar with their use, indications, and contraindications.

Generally, those who require long term wheelchair mobility will be using either manual or power wheelchairs for independent mobility. The decision between manual and power wheelchairs will be dependent on the ability of the individual and was discussed earlier in the course. Considerations for the patients' environment, functional capabilities, and other intrinsic/extrinsic factors pertinent to wheelchair prescription will play a large role in determining the outcome for those who require long term wheelchair mobility.

Wheelchair training

Wheelchair prescription does not end once the patient receives his or her device. Oftentimes, there is a training period in which the wheelchair user must learn new motor skills that will enhance his/her functional abilities. Physical therapists and physical therapy assistants are responsible for providing wheelchair training to encourage proper technique, safety, postural alignment, accessibility, and to decrease risk of overuse injury.

Wheelchair Propulsion Skills[4]

Training to ensure an efficient wheelchair propulsion technique is important, and the clinician should work with and observe the patient to determine the best approach for their abilities.

- The most commonly used technique for manual wheelchair propulsion requires use of the patient's bilateral upper extremities while performing a single-looping method in which the patient's hands hover above the rim between pushes.
- The most efficient wheelchair propulsion technique is the semicircular pattern. This technique is accomplished when the patient's hands hovering below the top of the rim between pushes. This decreases the frequency of pushes as well as the amount of force generated for propulsion.
- Clinicians should teach the patients to begin pushing at a "10 'o'clock" position while releasing at "2 'o'clock" to preserve the shoulder joint and utilize optimal body mechanics. Conversely, starting at "12 o'clock" and releasing at "3 'o'clock" is another commonly utilized propulsion pattern, but this technique is less efficient and more likely to cause fatigue.
- Not all patients who use manual wheelchairs are able to efficiently self propel with bilateral upper extremities and should thereby be trained on alternative methods using one or both feet.
- Clinicians should also include wheelchair propulsion training on various surfaces, both indoors and outdoors, as well as obstacle negotiation.

Transfer Training[14]

Without proper transfer skills in and out of the wheelchair, the use of a wheeled device for mobility is ineffective. Therefore, it is important to teach patients how to perform transfers in a safe and effective manner. The following three transfers can be performed independently or with a caregiver, depending on the ability of the patient who requires use of a wheelchair. Ideally, these transfers will be taught to both the wheelchair user and their caregiver.

The preferred type of transfer will depend on the patient's strength, range of motion, skin integrity, and coordination. Stand-pivot, scooting, and sliding board transfers are the most common options for patients with preserved functional capabilities. Some will use several different transfer techniques, depending on the environment. Uneven surfaces

or large gaps between surfaces may result in someone opting to use a sliding board for enhanced safety. Other patients may experience fatigue and resort to a different transfer method depending on their presentation. For example, patients with Multiple Sclerosis may perform stand-pivot transfers in the morning but rely on squat pivot techniques with assistance in the evening.

The following sections describe common transfers that may be taught to long- and short-term wheelchair users as well as their caregiver(s).

Bed to Wheelchair Sliding Board Transfer:

1. Position the chair close to the bed at a slight angle and secure both surfaces.
2. Remove the armrest and leg rest closest to the bed/mat table. In an ideal situation, the bed should be higher than the chair.
3. Place one end of the board underneath the patient's ischial tuberosity, making sure to avoid aggressive friction while placing the board.
4. Teach the patient to lean forward, push down with both arms, lift, and scoot sideways on the sliding board using several small movements. Practice this sequence from the bed to the chair.
5. Show the patient how to shift his or her weight to remove the board. Again, be sure to avoid aggressive friction and rubbing while removing the board. Over time, this can lead to skin breakdown.
6. Remember to replace the armrest and leg rest.

Standing Pivot Transfer:

1. Place both hands on the armrests and push down through the legs and with the hands.
2. Pivot using the balls of the feet until the body is positioned in front of the target surface.
3. Reach back with both hands for support and lower the body onto the target surface. Can adjust as needed.

Squat Pivot Transfer:

1. Lean the body forward and place one hand on the outside arm of the chair with the other arm on the inner arm of the wheelchair.
2. Partially extend the legs and push off with enough force to clear the seating surface.
3. Pivot on the balls of the feet towards the transfer surface.
4. Lower the hips into the seat in a controlled manner.

Curb Negotiation With a Manual Wheelchair[15]

Curb negotiation with a manual wheelchair is to be completed with the assistance of a caregiver and, under certain circumstances, may be completed with a second person in front of the wheelchair for safety. It is not recommended to negotiate a curb with a powered device.

Going up a Curb:

1. The caregiver should position the wheelchair into the full or partial wheelie position to place the casters onto the curb.
2. The caregiver rolls the chair forward until the rear wheels press firmly against the vertical face of the curb.
3. The caregiver should then ask the patient in the wheelchair to lead forward to reduce the weight on the rear wheels.
4. The caregiver then applies a forward and upward force on the push-handles or some other rigid part of the wheelchair to lift the rear wheels roll up onto the curb.
5. Once the rear wheels are on the upper level, the individual in the wheelchair sits upright again.

Going down a Curb:

1. The caregiver may slowly push the wheelchair off the upper level in the forward direction, allowing the casters to gently land on the lower level.
2. Gently follow with the rear wheels.

Management of Wheelchair Parts [14,17]

Like automobiles, wheelchair parts need to be repaired, maintained, or replaced on a regular basis. Users should be inspecting their wheelchairs regularly and, if problems are identified during the inspection, take immediate action to remedy the issue. This section will include a brief overview on parts that require special attention, as well as recommendations for a maintenance schedule.

Wheelchair maintenance has larger implications than simply taking care of one's device. Prevention of injury is one of many reasons to maintain wheelchair parts. Wheelchair related injury occurs in 5-18% of community wheelchair users, and those who do not engage in regular maintenance are 10x more likely to sustain an injury than those who keep their wheelchairs regularly maintained, repaired, or replaced.

The specifics regarding maintenance of a wheelchair will depend on whether the patient has a manual wheelchair or a power wheelchair. The following are a list of some items on a manual wheelchair to be inspected on a **weekly basis**:

1. Tire Deflation
    - Check to see if tires are deflated or flat. A deflated tire will be more difficult to maneuver, and propelling will take more energy than necessary.
    - To check this, the tire should not depress more than 5 millimeters under the pressure of your finger. If the tires are found to be deflated or flat, then use a bike pump, compressor, or CO2 cartridge. Typically, the amount of pressure recommended for the tire will be stated on the tire itself.
2. Seat Cushion Deterioration
    - Inspect the seat cushion to ensure it is intact and not deteriorated. Deterioration in the cushion can increase the risk of developing a pressure ulcer. While inspecting the seat cushion, look for any abnormalities such as tearing or holes in the cover, zipper malfunction, etc.

The following are list of some items on a manual wheelchair to be inspected on a **monthly basis**:

1. Nuts and Bolt Adjustment

- Ensure the nuts and bolts are properly adjusted. Nuts and bolts that are too loose will continue to loosen further and, therefore, will not hold the part properly.

2. Tire Damage or Wear and Tear

    - Check to ensure that tires are not worn down or damaged. This includes cracks, bulges, worn treads, etc., that can make the wheelchair more difficult to propel. Patients may need to contact a wheelchair maintenance expert to replace the tires if they are too worn down.

3. Damaged Bearings or Casters with a Damaged Bearing

    - Normally, the wheel bearings allow for free rotation of the wheel. Damaged bearings can cause increased rolling resistance, thus resulting in increased energy expenditure and shoulder strain during propulsion.

4. Wheels with Loose Spoke

    - The spokes should all have equal tension because when one becomes loose, damaged, or broken, it will cause the other spokes to carry more tension. Ultimately, this affects the stability of the wheel and creates a “wobbling” effect, thereby making it more difficult to propel the wheelchair. When this occurs, it is recommended to contact a wheelchair maintenance expert since the spokes must be tensioned to a specific range and a special stand is required to complete this.

5. Wheels Misalignment

    - Misalignment occurs when the rear wheels are not parallel with each other and/or the center of the wheelchair. This causes excess energy expenditure on behalf of the wheelchair user, especially during self propulsion, since he/or she must push more frequently to travel in a straight line. Over time, misaligned wheels can cause muscular strain from added efforts to propel the wheelchair itself, wasted energy, and decreased control over the wheelchair.

6. Loose Locks

    - Locks act as parking brakes and can provide stability and safety when performing transfers and various tasks such as lifting, pushing, sitting.

Loose locks can cause injury during transfers and are therefore important to maintain.

7. Loose Hand Rims or Sharp Edges on Hand Rim

    - Hand rim projections are rings that are attached to the rear wheel and are used to propel a manual wheelchair. A loose hand rim can make it difficult to grasp and propel efficiently, thus resulting in wasted energy expenditure and possible injury to the user.

On a power wheelchair, the following inspections should be performed on a **daily basis**:

1. Loose plastic covers or shrouds
2. Controls and indicators working as intended
3. Braking system intact
4. Motor failure

Energy Conservation[5]

Energy conservation is an important consideration for patients who utilize wheelchairs, especially manual wheelchairs, as a primary means of mobility. Additionally, physical therapists and physical therapy assistants can emphasize energy conservation through patient and caregiver education. Furthermore, it is important for clinicians to realize that conserving energy may help prevent future injury. The tasks that require the most energy for wheelchair users are typically getting into or out of vehicles, going up inclines, and outdoor propulsion.

During wheelchair propulsion, the total amount of energy needed throughout the day can be minimized by selecting the correct equipment, such as ensuring the wheelchair is properly sized or light in weight.

There are typically three categories of manual wheelchairs:

1. Standard frames, which are 35 lbs or greater
2. Semi adjustable standard lightweight frames, which are between 30 to 35 lbs
3. Adjustable ultra lightweight frames, which weigh less than 30 lbs

Adjustable frames typically offer more variations with regards to customization so that the most functional posture can be maintained throughout activities. A refresher on these options are included below and are thoroughly explored in Section 3:

- Seat width
- Seat depth
- Back height
- Seat height
- Adjusting the seat to back angle
- Adjusting the seat to floor height
- Placement of the rear wheels

The emphasis of customization can be viewed through an example using the positioning of the wheels on a lightweight manual wheelchair. When the rear wheels are brought forward, it can decrease shoulder strain, as well as energy expenditure, for individuals who propel themselves over various terrain. Of note, the energy it takes to propel a lightweight wheelchair is roughly 17% less than the energy required to propel a standard nonadjustable wheelchair. The difference in energy expenditure is theorized to be due to the differences in customization and the weight of the wheelchair.

Patient and caregiver education regarding ways in which to lower the frequency of transfers and how to optimize transfer mechanics can reduce strain while conserving energy. Energy conservation strategies can include:

- Using sliding board transfers or mechanical lifts as necessary
- Teaching how to perform assisted or dependent transfers that are safe for both the wheelchair user and the caregiver
- Vertical transfer distance and positioning of the wheelchair
- Teach patients that transferring to a higher surface will require greater amounts of strength from the upper extremities. Ideally, transfers should occur between parallel heights.

Another factor to consider with respect to energy conservation is the rolling resistance of the wheelchair tires in addition to the pressure by which the tires are inflated. Solid tires have greater rolling resistance when compared to pneumatic tires. Also, tire deflation is significantly correlated with higher amounts of energy consumption.

Injury Prevention[5]

- Due to the excessive amount of shoulder activity in individuals who use their arms to propel their wheelchairs, experts recommend incorporating a flexibility and resistance training program to increase shoulder function, range of motion, and endurance to prevent injury and to reduce fatigue throughout the day.
- For example, stretching the interior structures of the shoulder to counter the internally rotated and abducted posture of the shoulder is frequently recommended for the manual wheelchair user population. Unfortunately, this can lead to shoulder impingement issues which emphasizes the reason why wheelchairs should be prescribed to maintain an ideal ergonomic sitting posture. Wheelchair prescription, especially in the manual wheelchair user population, needs to optimize shoulder mechanics and thereby reduce the risk of overuse

injuries. Again, this relates to the need for education regarding proper transfer mechanics to prevent extreme shoulder positions when performing transfers.

Letters of Medical Necessity[10,15]

- Most patients will require third party funding for their wheelchair system; therefore, prescribers will need to be familiar with the rules and regulations regarding funding agencies.
    - The most common funding agencies are Medicare (on the federal level), Medicaid (on the state level), and private health insurance companies. Some patients may be eligible for benefits from the Veterans administration if the need for a wheelchair was a result of service in the armed forces. Although both Medicare and Medicaid are regulated by the Centre for Medicare and Medicaid (CMS), some states can alter Medicaid rules beyond the regulations put forth by CMS.
    - Typically, it is the occupational therapist or the physical therapist who assumes the lead position when a patient needs a wheelchair. They are responsible for working with the patient and the vendor to ensure the patient can receive their equipment in a timely manner and that the product is able to meet the patient's needs and goals as identified by the therapist's assessment. The details of the assessment will be incorporated into a letter of medical necessity which is critical when obtaining third party funding.
- The letter of medical necessity should be clear, concise, and consistent with the guidelines for coverage as specified by the third-party payer. The purpose of the letter is to provide a comprehensive picture of the patient's needs and the equipment the therapist recommends. There are many elements that are necessary in a letter of medical necessity.
    - The letter should begin by describing the patient in detail including the patient's history of presenting illness, diagnosis, limitations and impairments, prognosis, and any additional requests specific to the equipment recommended. For example, wheelchairs are expected to last a minimum of three to five years, but requests for replacing equipment may be necessary and included in the letter, along with a reasonable explanation for why the replacement will be required.

- The tests and outcome measures being used in the assessment should also be included in the letter. These include but are not limited to: the patient's functional status, range of motion, strength, neurological status, and abnormal tone or reflexes.

- The seating and mobility assessment should have revealed problems with different bodily systems, and it is important for the clinicians to explain the relationship between the impairments and limitations of the patient identified in the assessment and with the seating and mobility interventions that are being recommended. Each additional part of the wheelchair should be specified and accompanied with a justification to support the need for that specific part. Third party payers may also require justification to explain why lower costs options are not suitable for this specific patient.

- Lastly, a summary of the patient's information, as well as the contact information for the primary therapist and the prescribing doctor, should be included at the end of the letter so that the third-party payer can contact any of these individuals if any questions should arise throughout the process. It is important to be meticulous when drafting the letter of medical necessity since that can mean the difference between a long drawn on review process and the efficient delivery of the wheelchair.

- An individual's functional abilities help to determine what type of wheeled mobility device that insurance will cover. The following descriptions may assist in determining reimbursement coverage:

  Manual wheelchair - the individual is unable to safely ambulate with a cane or walker but has the upper body strength to self propel, or has a caregiver who is able to assist.

  Power-operated vehicle/scooter - the individual does not qualify for a manual wheelchair but is able to safely get in and out of the device and operate the controls. The individual must also have adequate postural support to maintain an upright position.

  Power wheelchair - if the individual cannot safely operate a manual wheelchair or power operated vehicle/scooter, then this may be the best option. If patients are unable to operate a standard joystick, then they may qualify for alternative control devices.

- Tips for writing letters of medical necessity to avoid funding denials:
    - The primary reason for the physical therapy evaluation must be “Mobility Evaluation.”
    - Use standard note format, rather than supplier provided forms.
    - Clearly convey that “Medical Necessity” is based solely on in-home use.
    - Write using terms with clear functional boundaries, such as “nonfunctional ambulation” rather than “difficulty walking.”

Working with Vendors[6,9]

- Once funding for the wheelchair has been approved, the vendor will order the equipment and assemble the wheelchair according to these specifications prescribed by the therapist.
- Then, the vendor will notify the therapist that the wheelchair is ready for delivery, and the patient will return to the clinic for fitting and training. Vendors may also provide small adjustments to the wheelchair during the training period.

  As discussed earlier in the course, wheelchair training will include teaching the patient, as well as caregivers, various topics such as:

    - How to use the wheelchair
    - How and when to inspect the wheelchair
    - How to maintain, repair, or replace parts as necessary

  If possible, these instructions should be provided in different ways (i.e., verbally, in writing, demonstrating to the patient/caregiver, etc) to optimize learning and retention.
- It is standard for the delivery of the wheelchair to take several months following the initial assessment unless a basic, standard wheelchair without customization was prescribed. It is important that, during this time, the therapist keeps track of the patient's status and ensures that the patient's needs have not changed since the initial assessment. Once the wheelchair has been delivered, the patient should have the opportunity to use the wheelchair to ensure that his or her needs are met as established during the initial wheelchair prescription assessments.

Section 4: Summary

- Since clinicians are responsible for enhancing patients' functional mobility and movement, they are highly likely to come into contact with various types of wheeled mobility and will need to be familiar with their use, indications, and contraindications. This holds true for every clinician, regardless of practice setting. Further, physical therapists and physical therapy assistants are responsible for providing wheelchair training, in addition to the wheelchair prescription, to encourage proper technique, safety, postural alignment, accessibility, and to decrease risk of overuse injury.
- Teaching wheelchair propulsion includes educating the patient on efficient propulsion techniques, hand placement and positioning, obstacle negotiation, and ways to conserve energy during mobility.
- Without proper transfer skills in and out of the wheelchair, the use of a wheeled device for mobility is ineffective. Therefore, it is important to teach patients how to perform transfers in a safe and effective manner. The preferred type of transfer will depend on the patient's strength, range of motion, skin integrity, and coordination.
- Curb negotiation with a manual wheelchair is to be completed with the assistance of a caregiver and, under certain circumstances, may be completed with a second person in front of the wheelchair for safety. It is not recommended to negotiate a curb with a powered device.
- Wheelchairs will require their parts to be repaired, maintained, or replaced on a regular basis. Users should be inspecting their wheelchairs regularly and, if problems are identified during the inspection, then action should be taken to address the issue. Those who do not engage in regular maintenance are 10x more likely to sustain an injury than those who keep their wheelchairs regularly maintained, repaired, or replaced.
- The tasks that require the most energy for wheelchair users are typically getting into or out of vehicles, going up inclines, and outdoor propulsion. Therefore, energy conservation is an important consideration for patients who utilize wheelchairs, especially manual wheelchairs, as a primary means of mobility.
- Experts recommend incorporating a flexibility and resistance training program to increase shoulder function, range of motion, and endurance to prevent injury and

to reduce fatigue due to the excessive amount of shoulder activity in individuals who use their arms to propel their wheelchairs.

- A letter of medical necessity may be critical when obtaining third party funding. It should be written in a clear, concise manner that is consistent with the guidelines for coverage as specified by the third-party payer. The purpose of the letter is to present a comprehensive depiction of the individual and their need for the highly specialized equipment. Clinicians should include the following details when drafting letters of medical necessity:
    - Patient's abilities and needs
    - Current equipment and limitations
    - Goals for requested equipment
    - Recommendations and justification
    - Information ruling out lesser equipment/devices

Section 4: Key Words

Single-looping method - method to describe wheelchair propulsion using both upper extremities

Semicircular pattern - method to describe wheelchair propulsion using both upper extremities

Stand-pivot transfers - method used to describe the way in which a patient can move from one surface to another by standing and pivoting on one or both lower extremities

Scooting transfers - method used to describe the way in which a patient can move from one surface to another by scooting while in a seated position. This may or may not require the use of a sliding board.

Sliding board transfers - method used to describe the way in which a patient can move from one surface to another by using a slick board placed strategically between the two surfaces

Energy conservation - an important consideration for patients who utilize wheelchairs, especially manual wheelchairs, as a primary means of mobility

Letter of medical necessity - a comprehensive depiction of the individual and their need for highly specialized wheeled mobility and related equipment.

Section 4: Personal Reflection Question

Have you ever had to write a letter of medical necessity? What resources are available to you, should you unexpectedly need to write one? How can you organize the letter to minimize the risk of denial?

Section 4: Case Study

Lisa is a 17-year-old high school senior with an incomplete traumatic spinal cord injury (SCI) as a result of a waterboarding accident. As a result, Lisa is expected to be a long-term wheelchair user. She was intrigued to learn about competitive wheelchair sports but is inexperienced with independent mobility.

1. To encourage independence with functional mobility, which transfer technique would be most appropriate to teach Lisa?
2. What are three items that may be worth inspecting monthly on her future manual wheelchair?
3. What strategies would you review with Lisa in regards to energy conservation when she receives her wheelchair?
4. When creating a letter of medical necessity to justify a request for a manual wheelchair, name three necessary components that should be included to avoid denial.

Section 5: Case Studies Revisited

Section 1: Case Study Prompt/Responses

As the director of an inpatient rehabilitation unit, you have been tasked with creating an equipment list to be submitted for the department's annual capital budget. Your therapists have been requesting several different types of wheelchairs, and you have allocated a specific amount of funds to be used for this purpose.

As part of your budget proposal, you are required to justify the request for each item and indicate its clinical purpose. For the following wheelchairs, please write 2-3 sentences describing its purpose, clinical utility, and benefit.

1. **Tilt-in-space (TIS) manual dependent wheelchair[2]**

   TIS wheelchairs allow the seating system to be tilted forward or backward while the seat-to-back angle remains constant. TIS wheelchairs are commonly prescribed by physical and occupational therapists to help posture, reduce the risk of skin breakdown, and improve comfort. These chairs are frequently purchased in inpatient rehabilitation facilities to accommodate low physical function and/or cognitive impairments that may prevent or significantly impact patients' ability to maintain upright posture, shift weight, or communicate discomfort.

2. **Standard manual wheelchair**

   Standard wheelchairs are an optimal choice for medical facilities due to their heavy and sturdy frames that have the capability to accommodate various body shapes and sizes. Additionally, they are ideal for short-term use, like for patients who require short-term seated mobility needs after lower extremity surgery or procedures that require non-weight bearing for a brief period of time. It should be known that standard manual wheelchairs are not recommended for patients who require special seating systems or those who self-propel.

3. **Ultra lightweight manual wheelchair**

   Ultralight wheelchairs are generally the best style of wheelchair for individuals who self propel full-time due to their ability to improve push speeds, distance of propulsion, and decrease energy expenditure compared with standard wheelchairs. These wheelchairs are the lightest in weight and have the greatest amount of adjustability to customize the wheelchair to meet the needs of the individual. Ultra lightweight manual wheelchairs are typically prescribed to active wheelchair users who plan to use their wheelchairs as a primary means of mobility based upon their physical characteristics and anticipated intensity of use. Typically, these wheelchairs are prescribed according to individuals' function as opposed to their medical diagnoses. While these types of chairs are typically highly customized to the individual, it may benefit a specialized rehabilitation unit, such as a Spinal Cord Rehabilitation Center, to purchase one or two ultra lightweight manual wheelchairs to trial for patients prior to purchasing.

4. **Power wheelchair with mid-wheel drive**

   Power wheelchairs are categorized by their base unit which, in this case, is a mid-wheel drive configuration. These types of power wheelchairs are frequently recommended for patients with environmental restrictions that require small turning radii to accommodate small spaces. Depending upon the location of the inpatient rehabilitation system, it's likely that patients who reside in small residential homes would benefit from prescription of a mid-wheel drive power wheelchair.

5. **Power wheelchair with secondary attendant controls**

   For patients with excessive fatigue, sundowning, or other progressive pathologies, secondary attendant controls can be included for caregivers. This allows the therapist or caregiver to operate the chair while walking behind the wheelchair. Ideally, secondary attendant controls may also be desired when teaching patients to use their power wheelchairs for the first time.

Section 2: Case Study Prompt/Responses

Rosa is a 65 year old woman who lives independently in a small one bedroom apartment complex. She has been diagnosed with relapsing-remitting Multiple Sclerosis and Type 2 Diabetes. She is currently using a rollator walker for community ambulation due to fatigue and is not confident with her balance on uneven surfaces. In her home, she does not need an assistive device and performs all transfers independently.

During her initial evaluation for a wheelchair prescription, Rosa is able to easily sit on the side of the treatment mat and shift weight without assistance. She does not have any sensation deficits in her upper or lower body. Her goals are to leave her apartment, do her own shopping, and go to church without depending on others to take her.

1. **Which functional limitation would indicate Rosa's need for a wheelchair evaluation?**

   Rosa falls under the criteria for "Limited mobility range" as defined by her difficulty with community ambulation and risk for falls. Additionally, she also qualifies for wheeled mobility due to the fact that she suffers from a progressive neurological condition and will eventually require increased amounts of assistance to perform functional tasks.

2. **How would the diagnosis of Multiple Sclerosis possibly affect the wheelchair prescription?**

   The quality of wheelchairs that are usually recommended for individuals with MS is typically inferior (i.e. less adjustable for the user) to that of devices issued to patients with other qualifying conditions, like spinal cord injury. One reason why individuals with MS may be issued a poorer quality manual wheelchair is because clinicians may anticipate a slower progression of MS. This can lead some clinicians to view a manual wheelchair as an intermediate step in the disease progression, which is going to be followed by an increased reliance on a power device for mobility. Lastly, many individuals with MS will use a manual wheelchair to alleviate some of their daily fatigue. Since they may not initially use a wheelchair as their primary means of mobility, patients may be issued a wheelchair with standard options. Ironically, these wheelchairs are generally not customizable in which self propulsion can cause an increase in fatigue-like symptoms. This is counterintuitive since most patients are attempting to overcome MS-induced fatigue.

3. **Aside from the information provided, name the remaining components of a full wheelchair evaluation for Rosa.**

   A wheelchair evaluation for this patient presentation should include a review of systems, range of motion and strength values of hips, knees, and upper extremities, vision testing, and a cognitive assessment with an emphasis on judgment and problem-solving skills.

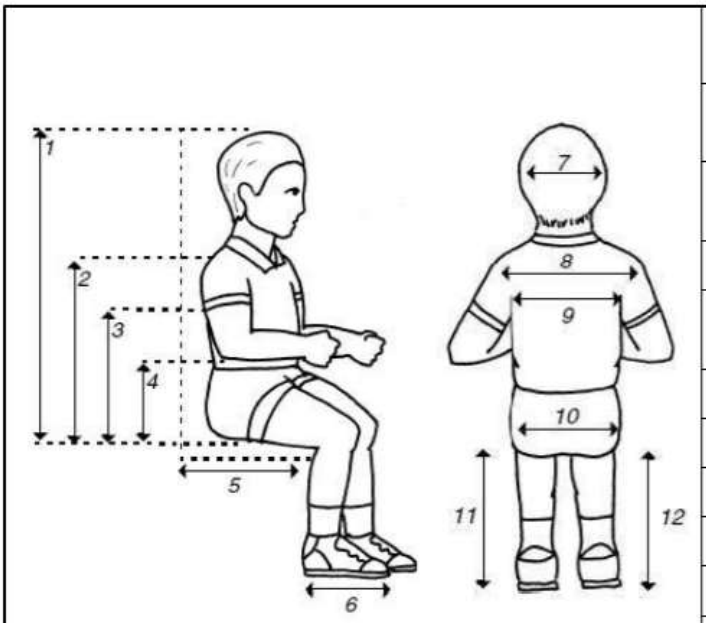
Section 3: Case Study Prompt/Responses

Joseph Kittle is a 47 year old male who suffered a spinal injury in a MVA that left him physically impaired. He lives with his wife in a one story home with a ramp to enter. He has 2 children, ages 12 and 10 years old, who are very active in the community. Prior to his accident, Joseph worked from home as an auditor and hopes to return to work in the next month. Joseph demonstrates good sitting balance by not needing to use his arms when sitting unsupported. He is able to perform sit-to-sit transfers with minimal-to-no assistance. He was left with very little movement in both lower extremities but has been able to regain good strength in bilateral upper extremities.

Below are findings from initial assessment and observations.

	Observation/Assessment
Head and Neck	ROM is within functional limitations
Trunk	Slightly fixed thoracic kyphosis
Pelvis	Flexible posterior pelvic tilt
Hips	• MMT 2-/5 • >90 degrees bilaterally
Knee	• MMT 2/5 • Short hamstring length, <70 degrees
Ankle and Foot	Flexible neutral
Upper Extremities	• Shoulder internal rotation • ROM within functional limits
Transfers	Independent sit pivot transfer
Propulsion	Uses bilateral upper extremities
Skin	• No current redness • At risk for skin breakdown • Able to independently perform wheelchair push-ups

Measurements taken in unsupported sitting are as follows:



1:	31	Top of head to bottom of buttocks
2:	22	Top of shoulder to bottom of buttocks
3:	19.5	Arm pit to bottom of buttocks
4:	7.5	Elbow to bottom of buttocks
5:	18	Back of buttocks to back of knee
6:	9	Foot length
7:	7	Head width
8:	17.5	Shoulder width
9:	16	Arm pit to arm pit
10:	15.5	Hip width
11:	21	Distance to bottom of left leg (popliteal to heel)
12:	21	Distance to bottom of right leg (popliteal to heel)

(*Wheelchair/Scooter/Stroller Seating Assessment Form,* 2011)

1. **State 2-3 seating goals for Joseph.**

   Goals can include:

   a. Maximizing function and independence to propel household and community distances, perform uneven transfers, and work from home

   b. Ensure pressure care needs are met for him to perform pressure relief independently

   c. Minimize risk of developing any postural abnormalities while accommodating current postures including posterior pelvic tilt, short hamstrings, rounded shoulders

   d. Ensuring comfort and decreasing pain

2. **What type of wheelchair and components would be most appropriate and why? Include measurements.**

    a. Frame: Ultra light wheelchair as he will be using the chair for increased time during the day and for long-term use.

    b. Seat: Measurements: 18 inches width, 16 inches depth, and height from the ground 23 inches. Flat or slightly angled backwards seat for support to pelvis. Contoured gel cushion 2 inches thick for even distribution of weight.

    c. Armrests: 10.5 inch height armrest to account for the 2-inch cushion. The armrest should be padded, adjustable, and swing-back would provide the most ease for transfers, while providing durability for pressure relief push-ups. Average armrests width would be most beneficial for performing transfers and wheelchair push-ups for pressure relief. Joseph would benefit from shorter length arm rest to be able to pull up fully to desk when he returns to work at home.

    d. Backrest: Back height: 15.5 inches which represents 4 inches below the axilla. Posterior pelvic stabilization contouring. Joseph demonstrates good sitting balance and does not require any lateral supports or head support.

    e. Wheels: 22-26 inch height spoked wheels that are lightweight to allow Joseph to continue to be involved in the community and busy with his children. Hand or push rims would help with propulsion efficiency and energy consumption.

    f. Castors: 6-8 inches to make the front of the chair slightly higher than the back to create posteriorly tilted seat to maximize wheelchair propulsion with upper extremities

    g. Brakes: Regular length brakes, demonstrates good sitting balance and use of bilateral upper extremities

    h. Footpetals: Rigid foot support or footrest angled 70-90 degrees down from full extension due to short hamstring length. Neutral foot plate due to flexible foot and ankle with no contractures. Joseph may benefit from posterior heel loops or stop to maintain proper foot positioning on the plate.

i. Crossbars: Not needed due to the contoured seat with cushion and contoured backrest.

j. Seatbelts: Not needed due to no sliding was noted and Joseph is able to reposition independently.

3. **What are the risks of an inappropriate seating system?**

- Skin breakdown
- Contractures
- Pain and discomfort
- Psychological factors such as depression, anxiety
- Decreased independence
- Falls
- Limited mobility
- Injuries such as rotator cuff tears, impingement
- Decreased social interaction and integration
- Decreased quality of life

Section 4: Case Study Prompt/Responses

Lisa is a 17-year-old high school senior with an incomplete traumatic spinal cord injury (SCI) as a result of a waterboarding accident. As a result, Lisa is expected to be a long-term wheelchair user. She was intrigued to learn about competitive wheelchair sports but is inexperienced with independent mobility.

1. **To encourage independence with functional mobility, which transfer technique would be most appropriate to teach Lisa?**

   Depending on her level of injury and functional capabilities, a sliding board transfer and/or stand/squat-pivot transfers would be appropriate to encourage independence with functional mobility. There is a strong possibility that she would benefit from learning all three transfers.

2. **What are three items that may be worth inspecting monthly on her future manual wheelchair?**

    - Nuts and bolts adjustment
    - Tire damage or wear and tear
    - Damaged bearings or casters with a damaged bearing
    - Loose spokes on wheels
    - Wheel misalignment
    - Loose locks
    - Loose hand rims or sharp edges on the hand rim

3. **What strategies would you review with Lisa in regards to energy conservation when she receives her wheelchair?**

    - Decreasing frequency of transfers from bed to chair, chair to shower, chair to couch, etc.
    - Teaching optimal transfer mechanics, such as positioning of the wheelchair and sliding board, transferring to/from equal surface heights, avoiding transferring to a higher surface, selection of transfers when fatigue
    - Using sliding board transfers or mechanical lifts as necessary
    - Showing her assisted or dependent transfers that are safe for both Lisa and her caregiver
    - Vertical transfer distance and positioning of the wheelchair relative to the target (lower surface will cause less strain on her upper extremity)
    - Wheelchair maintenance, specifically regarding wheelchair wheels, to limit resistance of tires against ground
    - Wheelchair propulsion training

4. **When creating a letter of medical necessity to justify a request for a manual wheelchair, name three necessary components that should be included to avoid denial.**

A letter of medical necessity may be critical when obtaining third party funding. It should be written in a clear, concise manner that is consistent with the guidelines for coverage as specified by the third-party payer. The purpose of the letter is to present a comprehensive depiction of the individual and their need for the highly specialized equipment. At minimum, clinicians should include the following details when drafting letters of medical necessity:

- Patient's abilities, current presentation, and anticipated future needs
- Current equipment and limitations, including tests and measures or results from functional outcome measures
- Goals for requested equipment
- Recommendations and justification of customized equipment, especially advanced dynamic seating options or custom interfaces
- Information ruling out lesser equipment/devices

Conclusion

Options for wheeled mobility have significantly evolved over the past few decades and include a variety of manual and powered wheelchairs styles to meet the needs of patients with disabilities. When prescribed appropriately, wheelchairs have the potential to maximize function, decrease participation restrictions, and lessen the effects of disability without sacrificing other aspects of daily living. Consequently, clinicians should have a thorough understanding of the ways in which the wheelchair prescription is created and recommended. Key components of any wheelchair evaluation include a mat assessment, tests and measures of range of motion, strength, and tone, functional outcomes, and a postural assessment in sitting. In addition, clinicians should be knowledgeable about the various components of the wheelchair itself and how they impact postural alignment, comfort, skin integrity, mobility, participation, and attentiveness in the user. However, clinicians have responsibilities that extend beyond the wheelchair evaluation. Wheelchair training is an integral part of rehabilitation for wheelchair users and, as such, clinicians should familiarize themselves with various skills and interventions to reduce disability and improve mobility, access, and participation. Clinical implications may further affect patients' long term health as well as functional outcomes.

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