



DOES A POWER ADJUSTABLE SEAT HEIGHT SYSTEM MEET THE DEFINITION OF DURABLE MEDICAL EQUIPMENT, AND IS IT MEDICALLY NECESSARY?

- WHAT DOES THE RESEARCH SAY?

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The answer to this question, based on extensive formal research, proves a resounding, yes. As the following data shows, power adjustable seat height plays a vital role in the medical device needs of those with permanent disabilities who require a complex rehabilitative power wheelchair.

42 CFR § 414.202 (The Code of Federal Regulations, Title 42 – Public Health, Chapter 4 – Centers for Medicare and Medicaid Services, Department of Health and Human Services, Subchapter B – Medicare Program, Part 414 – Payment for Part B Medical and Other Health Services, Subpart D – Payment for Durable Medical Equipment and Prosthetic and Orthotic Devices, Section 414.202 – Definitions) defines durable medical equipment as equipment, furnished by a supplier or a home health agency that meets the following conditions:

"AS THE FOLLOWING DATA SHOWS, POWER ADJUSTABLE SEAT HEIGHT PLAYS A VITAL ROLE IN THE MEDICAL DEVICE NEEDS OF THOSE WITH PERMANENT DISABILITIES WHO REQUIRE A COMPLEX REHABILITATIVE POWER WHEELCHAIR."

question, "Approximately how often do you engage the seat elevating feature to raise or lower the seat?" reported using the PASH feature more than once per day; 56 (50%) respondents indicated they use the feature "a few," "several" or "over 10" times per hour demonstrating that PASH can withstand repeated use. For example: 10 elevations/day x 365 days/year x 5 years=18,250 lifts over the five-year reasonable useful lifetime (RUL) of the power wheelchair it is used

on. This exceeds the standard 6,667 testing cycles by 11,583 cycles.

2. EFFECTIVE WITH RESPECT TO ITEMS CLASSIFIED AS DME AFTER JANUARY 1, 2012, HAS AN EXPECTED LIFE OF AT LEAST THREE YEARS.

The Food and Drug Administration (FDA) deems power wheelchairs as a Class II medical device. It is required to meet ANSI/RESNA testing standards, as verified by an independent testing facility and be code verified by the Medicare Pricing, Data Analysis and Coding (PDAC) contractor prior to entering the marketplace. A power adjustable seat height system is a FDA Class II medical device that is an accessory to a power wheelchair, which is also required to meet or exceed the minimum reasonable useful lifetime expectation of three years or greater.

3. IS PRIMARILY AND CUSTOMARILY USED TO SERVE A MEDICAL PURPOSE.

The Social Security Program Operations Manual Equipment HI 00610.200 states that "Equipment Presumptively Nonmedical... serves comfort or

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convenience functions or is primarily for the convenience of a person caring for the patient such as elevators, [and] stairway elevators ... [and] do[es] not constitute medical equipment."

A power adjustable seat height system (see Figure 1) that raises and lowers a seated individual with a permanent disability, as a component or accessory of a power wheelchair, is neither an elevator (see Figure 2) nor a stairway elevator (see Figure 3). It is recognized that elevators and stairway elevators allow an individual to move from one floor of the home to another, where the bedroom and/or bathroom is located, and may serve a medical purpose for an individual with mobility challenges. However, there is consensus among the general population that the primary and customary use of these "elevators" is non-medical and as such would not be deemed medical equipment.

In contrast, a PASH system is similar in function to the seat lift mechanism incorporated in a lift chair, which serves a medical purpose as it raises and lowers an individual with specific limitations while they are in a seated position. The primary and customary use of the chair component of a lift chair is a nonmedical one and it cannot be deemed medical equipment. Conversely, the PASH system can ONLY be used on a medically necessary power wheelchair and should be considered "Equipment Presumptively Medical" under the Social Security Act.

The Medicare National Coverage Determination (NCD) 280.4, entitled "Seat Lift" allows for coverage of a seat lift mechanism in certain situations as it states, "Reimbursement may be made for the rental or purchase of a medically necessary seat lift when prescribed by a physician for a patient with severe arthritis of the hip or knee and patients with muscular dystrophy or other neuromuscular diseases when it is determined the patient can benefit therapeutically from use of the device."

In establishing medical necessity for the seat lift, the evidence must show that the item is "included in the physician's course of treatment, that it is likely to effect improvement, or arrest or retard deterioration in the patient's condition, and the severity of the condition is such that the alternative would be bed or chair confinement."

The NCD further states, "Coverage of seat lifts is limited to those types which operate smoothly (see Figure 4), can be controlled by the patient, and effectively assist a patient in standing up and sitting down without other assistance."

The Medicare Local Coverage Determination (LCD) for Seat Lift Mechanisms (L33801) states that a seat lift mechanism is covered if the beneficiary is "completely incapable of standing up from a regular armchair or any chair in their home."

Individuals with permanent disabilities and significant medical conditions such as, but not limited to, amyotrophic lateral sclerosis (ALS), cerebral palsy (CP), cerebral vascular accident (CVA), multiple sclerosis (MS), muscular dystrophy (MD), spina bifida, spinal cord injury (SCI), or traumatic brain injury (TBI) who use a power wheelchair to ameliorate their mobility limitation may also have a need for a medical device that operates smoothly, can be controlled

FIGURE 1



Power Adjustable Seat Height

FIGURE 2



Elevator

FIGURE 3



Stair Glide

FIGURE 4



Smooth Operation of a Lift Chair

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by the patient, and effectively assists them in raising and lowering their position along the vertical continuum (see Figure 5) when prescribed by their physician to arrest or retard deterioration of their condition.

If the power wheelchair is the medically necessary item of mobility assistive equipment to replace the loss of function in the lower extremities (LEs) for ambulation, as well as the loss of function in the upper extremities (UEs) for manual wheelchair self-propulsion, then it stands to reason that the power adjustable seat height system would replace the loss of function in the LEs to transfer to/from the PWC and/or the loss of function in the UEs to reach and function to perform or participate in one's mobility related activities of daily living (MRADLs).

4. GENERALLY, IS NOT USEFUL TO AN INDIVIDUAL IN THE ABSENCE OF AN ILLNESS OR INJURY.

Comparable to a power tilt or power recline feature, the PASH feature can ONLY be used as an accessory on a medically necessary power wheelchair. As such, this component is ONLY useful to an individual with an illness or injury who also meets the coverage criteria for the PWC it will be used with.

While the power wheelchair replaces a beneficiary's loss of upper and/or lower extremity function by allowing them to move from points A – Z in a two-dimensional plane independently, safely and in a timely manner throughout the day, we live in a three-dimensional world. For an individual with a permanent disability who uses a complex rehab power wheelchair, the addition of a power adjustable seat height system may be a medically

Kiel Actively Elevating in a PASH System

FIGURE 5



necessary power seat option to replace loss of function in the vertical plane and "significantly improve the beneficiary's ability to participate in MRADLs ..." in accordance with the Power Mobility Device Local Coverage Determination.

The Medicare Power Mobility Device (PMD) Local Coverage Determination (LCD) (L33789) states, "all of the following basic criteria (A–C) must be met for a power mobility device (K0800 – K0898) ... to be covered.

a) The beneficiary has a mobility limitation that significantly impairs his/her ability to participate in one or more mobility-related activities of daily living (MRADLs) such as toileting, feeding, dressing, grooming, and bathing in customary locations in the home. A mobility limitation is one that:

- i. Prevents the beneficiary from accomplishing an MRADL entirely; [independently] or
- ii. Places the beneficiary at reasonably determined heightened risk of morbidity or mortality secondary to the attempts to perform an MRADL; [safely] or
- iii. Prevents the beneficiary from completing an MRADL within a reasonable time frame [timely].

b) The beneficiary's mobility limitation cannot be sufficiently and safely resolved by the use of an appropriately fitted cane or walker.

c) The beneficiary does not have sufficient upper extremity function to self-propel an optimally-configured manual wheelchair in the home to perform MRADLs during a typical day.

- i. Limitations of strength, endurance, range of motion, or coordination, presence of pain, or deformity or absence of one or both upper extremities are relevant to the assessment of upper extremity function.
- ii. An optimally-configured manual wheelchair is one with an appropriate

wheelbase, device weight, seating options and other appropriate nonpowered accessories.”

In addition, a power wheelchair is covered if, “use of a power wheelchair will significantly improve the beneficiary’s ability to participate in MRADLs and the beneficiary will use it in the home.”

Further, the National Coverage Determination (NCD) for Mobility Assistive Equipment (MAE), 280.3 asks, “are the additional features provided by a power wheelchair needed to allow the beneficiary to participate in one or more MRADLs?” This may comprise “the ability to accommodate a variety of seating needs” including power seat functions.

The Medicare Power Mobility Device – Policy Article (A52498) defines the power options on a power wheelchair, which are covered under the durable medical equipment (DME) benefit as follows:

- a) “Single Power Option – A category of PWCs with the capability to accept and operate a power tilt or power recline or … for Group 3, 4 and 5, a power seat elevation system
- b) Multiple Power Option – A category of PWCs with the capability to accept and operate a combination power tilt and recline seating system. It may also be able to accommodate … a power seat elevator …”

Neither a power wheelchair, nor its accessories would be useful to an individual in the absence of an illness or injury. However, in the presence of an illness or injury, both the power wheelchair and the appropriate, critical components used with it, are essential to replace the loss of function individuals with permanent disabilities and complex medical needs experience.

5. IS APPROPRIATE FOR USE IN THE HOME.

In the 2016 survey conducted by Georgia Tech when respondents were asked to “estimate the relative frequency of using seat elevation in the locations listed,” 102 of 109 respondents (93.6%) indicated that they use it in the home often or sometimes.

	Often	#	Sometimes	#	Rarely	#	Never	#
At Home	78.9%	86	14.7%	16	4.6%	5	1.8%	2

A POWER ADJUSTABLE SEAT HEIGHT SYSTEM IS NOT ONLY APPROPRIATE FOR USE IN THE HOME, IT IS A MEDICALLY NECESSARY COMPONENT OF A COMPLEX REHABILITATIVE POWER WHEELCHAIR THAT MAY BE ESSENTIAL FOR THE INDIVIDUAL’S HEALTH, SAFETY, WELL-BEING AND INDEPENDENCE.

Wheelchair mobility is often only considered from the perspective of people moving from one point to another in a two-dimensional plane. Vertical movement is necessary in order for people to function and participate in a three-dimensional world. A common intervention that provides vertical mobility within a wheelchair is a seat-elevating device. (Arva, J., Schmeler, M.R., Lange, M.L., Lipka, D.D., & Rosen, L.E., 2009). Hence, the provision of a power adjustable seat height (PASH) system is medically necessary to:

1. ENABLE TRANSFERS

“Transferring from a wheelchair to other surfaces such as a bed, toilet or other surface is a necessary part of the daily routine. Transferring is a means to accomplish MRADLs (mobility related activities of daily living), and therefore it is considered a medical necessity” (Arva et al., 2009). In the survey conducted by Georgia Tech, 84 of 105 respondents (80%) indicated that they used the seat elevation feature “often” or “sometimes” during transfers to or from the wheelchair.

Wheelchair users must transfer a minimum of twice each day, yet Kim, Her and Ko (2015) found that “among the basic ADL, transfer is a task that is performed by each patient 15 – 20 times per day, on average.” Regardless of the method used, the ability to adjust the height of the seat, in conjunction with transfer training using an appropriate method and proper technique, may be an essential component for independent, safe and efficient transferring to/from the wheelchair.

SIT-PIVOT METHOD

Sitting pivot transfer (SPT) is the most common transfer method using the upper extremities (Kim et al., 2015). In fact, wheelchair users with absent or significantly impaired use of their lower extremities “must use their upper extremities for almost all activities of daily living (ADLs), such as getting in and out of bed, transferring to a shower or toilet, and transferring in and out of a car” (Tsai, et al., 2014).

[Sit-pivot] transfers are one of the most strenuous wheelchair activities performed, and incorrect transfer skills may predispose wheelchair users to developing upper limb pain and

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overuse related injuries, such as rotator cuff tears, elbow pain and carpal tunnel syndrome (Tsai et al., 2014). Kim et al. (2015) not only report “pain prevalence rates [of] 58.5% - shoulder: 71%, elbow: 35%, wrist: 53%, hand: 43%” – they also state that SPT is “the most burdensome task for the musculoskeletal system, the nervous system and the cardiovascular system among wheelchair related ADL.”

Kim et al. (2015) “compared the changes in trunk and shoulder angles and reaction forces under each hand at two different seat heights in 18 unimpaired males during independent siting pivot transfer. They found significant increases in the trunk angles of forward and lateral flexion, even though rotation decreased while transferring in the lower hand position. Increased shoulder flexion, anterior/posterior forces and reduced lateral forces were also shown. Hence, placing the hands of the supporting arms lower than the seat position during sitting pivot transfer was identified as having biomechanical advantages.” They suggest that the results of the study “can be applied as guidelines for effective and safe methods for ... spinal cord injury patients’ SPT, and can be utilized as reference data when considering the appropriate heights of aids for wheelchairs.”

Clinical evaluation and observation should take into consideration UE, core and LE strength, range of motion, muscle tone and balance when determining the difference between the seat height of the wheelchair and the height of the surface to be transferred to or from.

Tsai et al. (2014) looked at whether using proper transfer skills as measured by the Transfer Assessment Instrument (TAI) is associated with reduced loading on the upper extremities in 23 wheelchair users [that] performed transfers to a level-height bench while a series of force plates, load cells and a motion capture system recorded the biomechanics of their natural transferring techniques. While Part 1, item 5 of the TAI states, “the subject performs a level or downhill transfer, whenever possible” the study removed the height differential and had all participants perform level transfers to validate that the TAI is an effective tool for evaluating transfers on a 15-point scale. The study concluded that, “the transfer skills that can be measured by the TAI are closely associated with the magnitude and timing of joint movements. As such, the TAI may be useful for measuring the effects of a training intervention on upper limb joint loading.” This may include the recommendation of a power adjustable seat height system for power wheelchair users who must perform level or downhill transfers.

STEPHANIE

Stephanie was born with spina bifida. She does not have use of her legs and, as a person who has self-propelled a manual wheelchair her entire life, she is now experiencing pain, reduced strength, muscle fatigue and decreased function in her upper extremities such that she is now using a power wheelchair for mobility.

In the morning, she is unable to perform a sit-pivot transfer from her bed at 23 inches high to her wheelchair at 25 inches high, as it is an uphill transfer that she does not have the capacity to perform (see Figure 6). Without the ability to lower the seat to 21,” Stephanie is rendered bed-bound and subject to all the complications associated with that, such as muscle atrophy, increased risk of pressure injuries, pneumonia, bladder infections and malnutrition. By lowering the wheelchair seat height to 21,” she is able to perform an independent sit-pivot transfer, minimizing the risk for UE damage or loss of balance (see Figure 7).



FIGURE 6



FIGURE 7

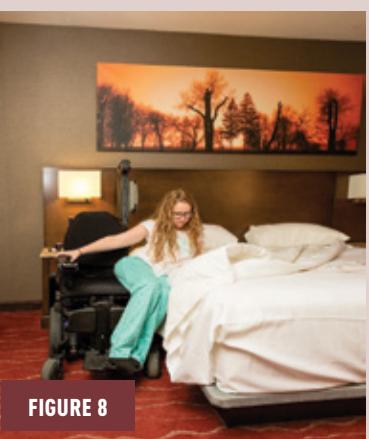


FIGURE 8



FIGURE 9

Stephanie stuck in bed

Stephanie transferring from bed to w/c

Stephanie attempting to transfer to bed

Stephanie transferring from w/c to bed

The reason the seat is at 25 inches high in the morning is because Stephanie requires that height to transfer from her wheelchair to the bed at the end of the day. With fatigue exacerbating the challenge of transferring uphill to her bed at 23 inches high from a low, static seat height of 21," Stephanie is at high-risk for an adverse occurrence from a fall in her attempts to transfer (see Figure 8). This may include, but is not limited to, fractures, dislocations, head and/or spinal injuries, lacerations and contusions, all of which increase health care costs. By adjusting the height of the wheelchair seat up to 25," she creates a 2 inches height difference between the chair and her bed for a downhill transfer (see Figure 9).

STAND-PIVOT METHOD

A sit-to-stand (STS) movement, which is defined as a movement of standing up from a chair to an upright posture, is a frequently performed activity of daily living according to Yoshioka, Nagano, Hay and Fukashiro (2014). They found that "community dwelling people stand up from a chair approximately 60 times each day." However, "many people with weakness, pain, or other disabilities of the lower extremities have difficulty rising from a standard seat height" (Burdett, Habasevich, Pisciotta & Simon, 1985).

Janssen, Bussmann & Stam (2002) performed an extensive review of literature from 1980 to 2001 (n=39) on STS movement. They report the "minimum height for successful rising ... appears to be 120% of lower leg length" and "lowering the height of the seat makes the STS movement more demanding or even unsuccessful." Hence, attempting to transfer from a seat height that is too low may be associated with an increase in fall risk.

While a minimum chair height standing (MCHS) ability test has been shown to be effective as a fall risk screening instrument for older individuals (Reider, 2012), the research has not included individuals with disabilities or those who use power wheelchairs.

Yoshioka et al. (2014) examined "the large range of seat heights on peak joint moments of the lower limbs during STS movement" using eight healthy, young subjects. They were studied standing up from seat heights of 10 cm (3.93 inches), 20 cm (7.87 inches), 30 cm (11.81 inches), 40 cm (15.7 inches), 50 cm (19.68 inches) and 60 cm (23.62 inches). The study confirmed that, "the peak mechanical load and the peak knee to hip joint movements increase inversely to seat height within the range of high to normal seat height (60 to 40 cm)." The study concludes that "the findings are useful for the design of chair [and] the improvement in the evaluation standard of minimum sit-to-stand height tests."

Nakamura, Nagasawa, Sawaki, Yokokawa & Ohira (2016) cite previous studies that report "the vastus lateralis, rectus femoris and tibialis anterior muscles showed a tendency toward higher activity levels with decreasing seat height" and indicate "standing up from a lower seat height would be more demanding." To confirm this, they examined "the effect of different seat heights on peak oxygen uptake (peak VO₂) during incremental sit-to-stand exercise" with 13 healthy young women. "The seat heights were adjusted to 100%, 80%, 120%, and 140% of knee height distance." They found that

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peak VO₂ on the incremental sit-to-stand test increased as seat height decreased." This may have significant implications for individuals who are aging with a disability, and/or exhibit respiratory compromise as a result of their diagnosis or disability.

Clinically, when evaluating stand-pivot transfers, every sit-to-stand transition can be split into four main phases: flexion (leaning forward), momentum-transfer (seat-off), extension (coming to the upright position) and stabilization (standing). This is followed by pivoting or stepping and the stand-to-sit transition. While sit-to-stand transfers have been widely studied, there is a significant lack of information concerning stand-to-sit transfers, especially at varying seat heights.

JOSH

Josh was diagnosed with limb-girdle muscular dystrophy at the age of 8. At age 25, he presents with poor strength in all four extremities and poor to fair core strength. He has poor sitting balance and does not have the ability to perform a sit-pivot or sliding board transfer. His standing balance is also poor, and he is non-ambulatory; however, by standing with his hips and knees hyperextended he is able to "lock" the joints and use the structural integrity of his ligaments to do a stand-pivot transfer independently while holding on to the armrests of the chair (see Figure 10).

With the wheelchair seat elevated to 31," Josh

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is still able to perform a stand-pivot transfer independently to and from his bed, which is also elevated to 31 inches regardless of whether he is in his own apartment or in his old room at his parent's house. At any lower seat height, he is fully dependent on a personal care attendant to transfer. In addition, Josh also remains fully independent in managing his bladder needs as he is able to stand from his wheelchair at a seat height of 31 inches to use the toilet.



FIGURE 10

Josh independently transferring using a stand-pivot method

Corey Hickey, doctor of osteopathic medicine in his fourth year of residency at the University of Pittsburgh Medical Center, completed a study entitled Seat Elevators: How to Utilize the Functional Mobility Assessment Tool to Track Function and Justify Medical Necessity, which was presented at the 32nd International Seating Symposium on March 3, 2016.

The objective of the study was to determine trends in the procurement of seat elevation (SE) and their association with function. It was a retrospective analysis of the university's client database and medical chart

review for individuals where a seat elevator (SE) was recommended from Jan. 26, 2012, to May 8, 2014, (N=61).

The measures were only calculated for individuals that had complete demographic data, procurement information, validation of the functionality of the SE, and Functional Mobility Assessment (FMA) scores at baseline and follow-up (N=22).

To assess the impact of the SE on transfers, data was analyzed for Question # 6 on the FMA which reads, "My current means of mobility allows me to transfer from one surface to another: (e.g., bed, toilet, chair)." Participants responded based on a 6-point scale where 6=completely agree, 5=mostly agree, 4=slightly agree, 3=slightly disagree, 2=mostly disagree and 1=completely disagree.

The most telling information regarding the viability of a PASH system can be found when the wheelchair user had a seat elevation feature on their previous chair and did not receive the same feature on their new chair. The baseline transfer score significantly dropped from a median of 5/6 (mostly agree) to a median of 1.5/6 (between completely disagree and mostly disagree) at follow-up (see Figure 11), which likely rendered the individual dependent in their transfers due to the loss of this feature.

For individuals who did not have a SE at base line and then received one on their new chair, their pre-intervention transfer score improved from a median of 3.5/6 (between slightly disagree and slightly agree and mostly agree) (see Figure 12). The individual is now able to move toward a response of "completely agree" as they become more proficient with the new feature and possibly a new transfer technique.

SE at baseline, did not receive a SE with new PWC

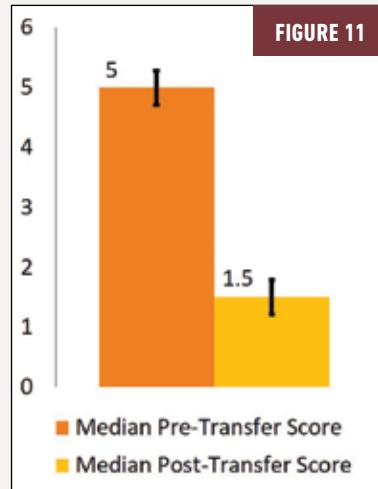


FIGURE 11

No SE at baseline, received SE on new PWC

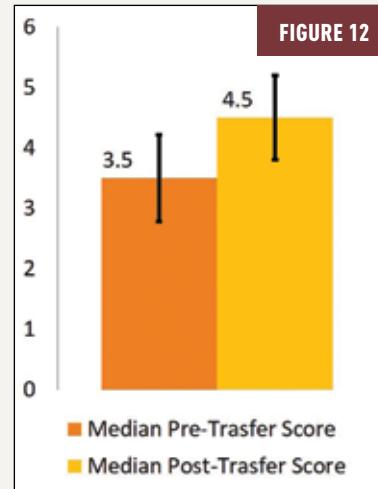


FIGURE 12

2. FACILITATE REACH

Item number 12 of 30 on the power wheelchair skills test (WST) is "reaches high object." As stated in the Wheelchair Skills Training Manual, "skill in wheelchair use is not an end itself, it is a means to an end." The manual further asserts, "the characteristics of the wheelchair, its features, fit and setup can have

	Often	#	Sometimes	#	Rarely	#	Never	#
To help reach things	81.9%	86	13.3%	14	3.8%	4	1%	1
While dressing	16.3%	17	26%	27	17.3%	18	40.4%	42
While grooming (brushing teeth, combing hair, etc.)	39.4%	41	23.1%	24	16.3%	17	21.2%	22
While eating or preparing a meal	59.2%	61	24.3%	25	6.8%	7	9.7%	10
During toileting activities	27.2%	28	17.5%	18	22.3%	23	33%	34
During bathing activities	21%	22	10.5%	11	17.1%	18	51.4%	54

major effects on skill performance.” It should be noted that “the skills chosen for inclusion in the Wheelchair Skills Program are intended to be representative of the range of skills that wheelchair users and/or caregivers may need to regularly perform,” such as reaching.

Reaching a high object is included in the WST because “a combination of upward and sideways or forward reaching is often needed when reaching for a light switch, elevator button or cupboard.” The target for the test is 2.5 cm (1 inches) in diameter and 1.5 m (60 inches) from the floor. To pass the test “the subject reaches up under control, touches the target and then resumes the normal sitting position.” Chair height, and the ability to reposition the seat height, can have an impact on the wheelchair user’s ability to touch the target. Passing the reach test is only the first step in assessing whether an individual can actually reach to perform or participate in their ADLs from the wheelchair.

In the survey conducted by Georgia Tech (2017), 100 of 105 (95.2%) respondents indicated that they use their seat elevating feature “often” or “sometimes” to help reach things. However, the activities in which they are engaged in while elevated, such as dressing, grooming, eating/meal preparation, toileting and bathing, differ. The survey did not obtain information as to why the results differ, but seat elevation does reduce the effect of environmental barriers to the vertical space.

Access to the vertical environment is essential for a wheelchair user to perform or participate in their ADLs. Either by building code or convention the standard height of objects an individual must interact with on a daily basis are as follows:

Kitchen counter top height = 36 inches

Kitchen upper cabinet height = 54 inches at the bottom, 84 inches at the top

Freezer height = 50 inches – 72 inches

Stove top height = 36 inches

Over stove microwave height = 50 inches – 54 inches at the bottom, 66 inches at the top

Height for a closet rod = 66 inches, top shelf = 80 inches

Washer/Dryer height = 36 inches, stacked = 75 inches

Height of a light switch = 48 inches

Height for a thermostat = 60 inches

Fire alarm pull height = 42 inches – 54 inches

When compared to the mean shoulder height in sitting for women (n=2208) at 21.87 inches and men (n=1774) at 23.53 inches (Gordon, C.C., Churchill, T., Clauser, C.E., Bradtmiller, B., McConville, J.T., Tebbetts, I & Walker, R.A., 1988), it is clear seated individuals must reach above shoulder height to access any of these areas of the home. Anthropometric measurements also show that the mean vertical grip reach in sitting for the same women is 47.73 inches (43.01– 52.32 inches) and 51.57 inches (46.36 – 56.38 inches) for men, which fall short of the heights needed to safely perform or participate in ADLs, even at the top range of the reach. This places seated individuals, such as power wheelchair users, as substantial risk for injury and increased health care costs from adverse occurrences in their quest for independence.

HOWEVER, THE ACTIVITIES IN WHICH THEY ARE ENGAGED IN WHILE ELEVATED, SUCH AS DRESSING, GROOMING, EATING/MEAL PREPARATION, TOILETING AND BATHING, DIFFER. THE SURVEY DID NOT OBTAIN INFORMATION AS TO WHY THE RESULTS DIFFER, BUT SEAT ELEVATION DOES REDUCE THE EFFECT OF ENVIRONMENTAL BARRIERS TO THE VERTICAL SPACE.

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MADONNA

Madonna sustained an incomplete spinal cord injury (SCI) at the T10 level at age 18. She used a manual wheelchair for 35 years but at 53, as she ages with a disability, she is experiencing significant pain and strength limitations in her neck, shoulders and upper back from overuse injuries. As a single parent, she found herself reaching overhead hundreds of times each day to cook, clean and do laundry from a low, static seat height, exacerbating her pain (see Figure 13). In addition, she sustained third-degree burns twice while removing a hot, cooked item from the stove due to the poor biomechanical position of her upper extremities from a low seat height. Medical care for Madonna may have been prevented by adjusting her wheelchair seat to the appropriate height for the task she was performing, thereby saving thousands of dollars for each occasion.

Requejo, P.S., Mulroy, S.J., Haubert, L.L., Newsam, C.J., Gronley, J.K., & Perry, J. (2008) assert that it is imperative for wheelchair users to “minimize extreme or potentially injurious positions at the shoulder by avoiding extreme positions such as hand over the shoulder.” They indicate “based on ergonomics literature, there is a strong association between working above overhead height and shoulder pain in the work environment” and that “use of a wheelchair increases a person’s need for overhead activity to access the environment.”

Their study compared the frequency and duration of overhead arm activity between wheelchair users and occupationally matched non-wheelchair users during an eight-



FIGURE 13

Madonna in her kitchen elevating to mitigate the number of times she must reach overhead.

hour workday. They found that non-wheelchair users performed an average of **53** (9 – 88) episodes of overhead arm activity while wheelchair users performed an average of **297** (44 – 798) episodes of arm activity during the same time period. The total time spent in an overhead position was five times greater for wheelchair users (mean = 34.6 minute, range = 7.9 to 106.6 minute) as compared to standing adults (mean = 6.6 minute, range = .4 – 15.5 minute).

Extrapolated out, a wheelchair user that reaches overhead 297 times/day x 365 days/year will reach overhead **542,025** (80,300 – 1,456,350) times during the five-year reasonable useful lifetime of the power wheelchair. During the same five years a person at standing height that reaches overhead 53 times/day x 365 days/year will only reach overhead **96,725** (7,300 – 160,600) times. The researchers concluded the increased overhead use documented in the study “may contribute to the development of shoulder pathology” and “individuals with SCI should avoid extreme shoulder positions, particularly overhead arm activities.”

It is likely that a PWC user in a chair with a low, static seat height will need to reach overhead as many times as a manual wheelchair (MWC) user, but will have a much more difficult time executing it. In evaluating beneficiaries with disabilities for the appropriate mobility base, if a manual wheelchair is reasonable and necessary, the expectation is that the individual has sufficient balance, strength, range of motion, coordination, endurance and UE function to self-propel and perform or participate in their MRADLs, including the ability to reach overhead as many times per day as necessary.

Sabari, J., Shea, M., Chen, L., Laurenceau, A., & Leung, E. (2016) declare that “the upper limb and neck are common sites for the development of repetitive strain injuries (RSI)” and hypothesized that “the addition of a seat elevation device may alleviate the risk factors that lead to the development of RSI.” They observed 60 ambulatory adults age 18 – 65, seated symmetrically in a power wheelchair, who were asked to perform a functional vision task and a functional reach task. Each task was performed at the minimum wheelchair seat height and the maximum seat height.

Results “revealed a statistically significant difference between AROM required for shoulder abduction to complete the reaching task, when comparing performance with the wheelchair at minimum seat height and at maximum seat height.” They contend “the power seat elevator at its maximum height may allow wheelchair users to perform functional tasks without excessive AROM at the shoulders, thereby decreasing their risk for developing RSI.” While “further



FIGURE 14

Kiel is able to reach the thermostat and see what temperature he is adjusting it to.

investigation would need to test a sample population of long-term wheelchair users,” they conclude that their “findings provide preliminary support for considering [seat elevation] as a medical necessity for wheelchair users who are at risk of developing chronic pain syndromes associated with the shoulder girdle and/or cervical spine.”

KIEL

Kiel sustained an incomplete SCI at the C5/6 level. In addition to an increased risk for shoulder and neck RSI, Kiel has a critical use for his power seat elevation system as he reaches and adjusts the thermostat in his home. Kiel experiences thermoregulatory dysfunction secondary to his SCI. Thermoregulation is the process that allows the human body to maintain its core temperature. Thermoregulatory dysfunction in individuals with SCI refers to the fact that their body cannot perform this function properly. As a result, Kiel needs to be able to adjust the thermostat independently for his health and safety.

While he can reach the thermostat at a height of 48 inches from a low, static seat height, he is unable to see what temperature he has adjusted it to without the capability of adjusting the height of his wheelchair seat. Vertical adjustment (see Figure 14) provides him the visual access he needs to support this reaching activity, independently manage this condition and not incur additional personal care assistance (PCA) hours or medical costs from an adverse occurrence.

In 2016, Vince Schiappa, a graduate student researcher at the University of Pittsburgh in the School of Health and Rehabilitation Sciences conducted a study entitled “Functional Satisfaction with Power Seat Elevators,” which was

presented at the 33rd International Seating Symposium on March 2, 2017. The study was designed to assess the difference in satisfaction of function while using seat elevators on power wheelchairs among individuals with disabilities through a retrospective analysis of two databases that included time one and time two Functional Mobility Assessment (FMA) scores. To assess satisfaction with reach, FMA Question # 5 was used which reads, “my current means of mobility allows me to reach and carry out tasks at different surface heights as independently, safely and efficiently as possible (e.g., table, counters, floors, shelves, etc.) (see Figure 15). It should be noted that the sample size in this presentation (n=139) was larger than the sample size (n=123) reported in his master’s thesis defended on March 21, 2016, and the median FMA scores differ, although the direction of change in scores for the task is consistent.

For participants that had a SE on their previous chair and did not receive one on their new chair, the reach score dropped from a median 5/6 (mostly agree) to 3.5/6 (between slightly agree and slightly disagree) with the larger (n=139) sample size. For the smaller sample size (n=123), the median FMA reach score dropped to 2.5/6 (between mostly disagree and slightly disagree) when a SE was not provided on the new PWC.

For participants who did not have a SE at base line and then received one on their new chair, the pre-intervention reach score improved from a median of 4/6 (slightly agree) to a post intervention median score of 6/6 (completely agree). This likely improved the person’s ability to perform or participate in their activities of daily living; however, verification of this was outside the scope of the study. A SE may also

DOES A POWER ADJUSTABLE SEAT ...
(CONTINUED FROM PAGE 41)

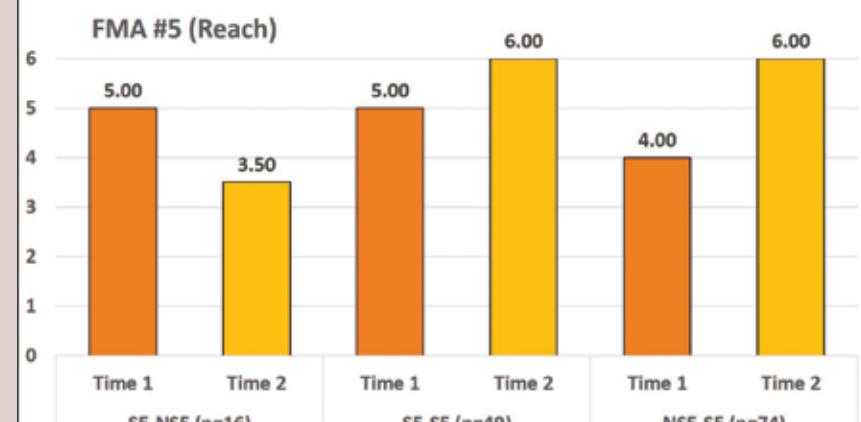
significantly reduce the risk for an adverse occurrence during attempts to engage in reaching activities.

Nutrition and hydration are both medically necessary to sustain life. “Feeding” as a mobility related activity of daily living is far more than getting to the table where a prepared meal is placed before the beneficiary to eat, followed by them moving away from the table so someone can clean up. Stephanie can be fully independent in all aspects of “feeding” as she prepares herself a grilled cheese sandwich and tomato soup (see Figures 17, 19 & 21). However, in her attempts to do so from a low, static seat height, she is at very high risk for injury secondary to a fall, burns, lacerations, contusions, etc. (see Figures 16, 18 & 20).

3. SUPPORT PSYCHOLOGICAL AND PHYSIOLOGICAL HEALTH, SAFETY AND WELL-BEING.

Wu, Y., Lie, H., Kelleher, A., Pearlman, J., Ding, D. & Cooper, R.A. (2017) assert that “wheelchair discomfort is a very common problem for wheelchair users” and suggest that “increasing the frequency of using PSFs (power seat functions) may decrease wheelchair discomfort.” The chairs used in the study were outfitted with encoders “to record angle changes for tilt, recline, legrests and seat elevation.” The 13 individuals with disabilities that completed the eight-week study in their home and community filled out the Tool for Assessing Wheelchair discomfort (TAWC) each day. The results showed that “wheelchair discomfort intensity is correlated with the frequency of using tilt, recline and legrest functions” and the frequency of using these functions “were not correlated with each other.” While the study does not discuss what impact

FIGURE 15



FMA Reach.



FIGURE 16



FIGURE 17

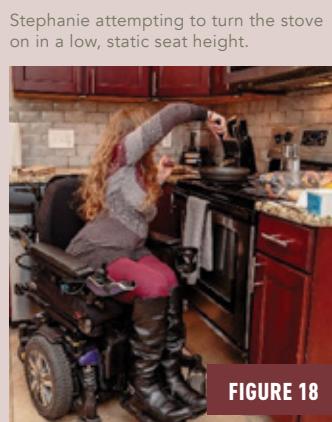


FIGURE 18



FIGURE 19

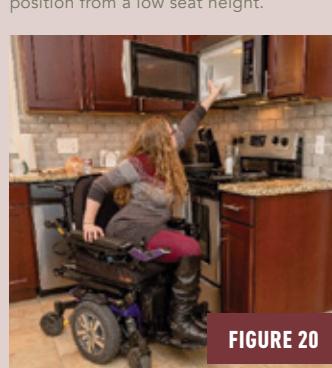
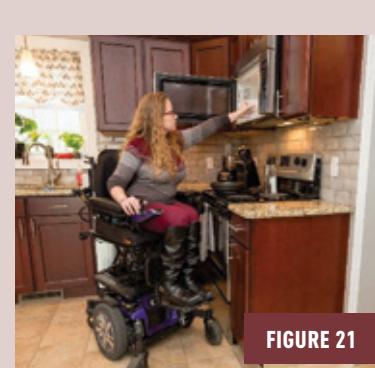


FIGURE 20



Stephanie attempting to retrieve hot tomato soup from the microwave in a low seat height.

Stephanie safely accessing the microwave in an elevated seat position.



FIGURE 22A

Kiel experiences significant pain and fatigue in his neck following his C5/6 SCI, especially when attempting to speak with an average height standing male.

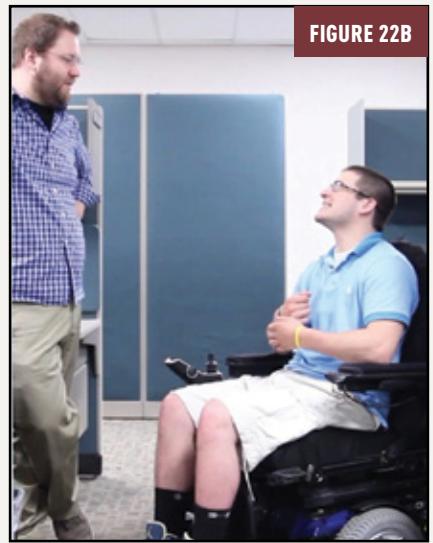


FIGURE 22B

Kiel's neck position in a low seat

wheelchair design" (see Figure 22a and 22b).

Sabari, et al. (2016) suggest "frequent hyperextended cervical positions are likely to lead to fatigue of the soft tissue structures of the cervical region, and significant discomfort can be expected when these positions are sustained." Results of their study "reveal a statistically significant difference between AROM requirements for cervical extension to complete the computer viewing tasks, when comparing performance with the wheelchair at minimum seat height and at maximum seat height." They state that their study findings "provide support for the potential benefit of a seat elevation feature in reducing the arcs of motion required to extend the neck, and thereby minimizing the risk for RSI at the neck." Their data supports

power seat elevation may have on discomfort, it does state "wheelchair discomfort might result from other medical or physiological factors and the maximal improvement of wheelchair comfort that PSFs can achieve should be further investigated."

Clinical observation of wheelchair users sitting at a low seat height highlights the fact that they are forced to extend the cervical spine to levels that contribute to pain when interacting with other people or objects in their environment. Kirby, R.L., Fahie, C.L., Smith, C., Chester, E.L., & Macleod, D.A. (2004) studied 20 wheelchair users who assumed and maintained four neck positions for five minutes each to determine if they experienced more discomfort in an extended or rotated position as compared to their self-selected most comfortable position (MCP). "The MCP for wheelchair users is straight ahead with the neck slightly flexed." However, to make eye contact with the average height seated male, the wheelchair user had to extend their cervical spine 11°. Cervical extension increased to 27° when looking up at an average height standing male. They conclude "sustained extension and rotation of the neck, alone or in combination, increase the neck discomfort of wheelchair users" and contend "these findings have implications for

"previous recommendations that wheelchair users of all physical statures may benefit from the various advantages of a power seat elevation device, especially in minimizing the risk for the development of pain in the neck and secondary complications" such as cervical myelopathy.

One additional, adverse implication of neck hyperextension that may be observed in individuals who look up from a low seat height is the elicitation of the symmetric tonic neck reflex (STNR). The STNR is triggered by flexion or extension of the neck. When the neck flexes, the arms flex and the legs extend; conversely when the neck extends, the arms go into extension and the hips and legs flex. This may result in a loss of seated position, and discomfort in individuals with cerebral palsy who have retained the STNR, or in individuals that have suffered a stroke or traumatic brain injury where the STNR has re-emerged. Unfortunately, there is no research that has looked at the effect a symmetric tonic neck reflex has on seated position, discomfort in the seated position as a result of an STNR, or whether the application of a power seat elevation system minimizes the effect of an STNR on posture by maintaining a neutral neck position. However, observing and detailing the impact of seat elevation for the one person (n=1) being evaluated for a power wheelchair is what is ultimately required to establish the medical need for the feature.

CONTINUED ON PAGE 44

**RESULTS OF THEIR STUDY
“REVEAL A STATISTICALLY
SIGNIFICANT DIFFERENCE
BETWEEN AROM
REQUIREMENTS FOR CERVICAL
EXTENSION TO COMPLETE
THE COMPUTER VIEWING
TASKS, WHEN COMPARING
PERFORMANCE WITH THE
WHEELCHAIR AT MINIMUM
SEAT HEIGHT AND AT
MAXIMUM SEAT HEIGHT.”**

DOES A POWER ADJUSTABLE SEAT ...
(CONTINUED FROM PAGE 43)



FIGURE 23

Mark exhibiting a symmetric tonic neck reflex when extending his neck.

MARK

Mark (see Figure 23) was born with cerebral palsy. He is fully independent in all his activities of daily living at the wheelchair level even though he presents with spasticity in all four extremities. When Mark looks up from a low seated position, he elicits a significant STNR that triggers spasticity and involuntary movement that results in him flexing his legs (right greater than left) and extending his arms (left greater than right). This causes him to lose his positioning in the wheelchair and appropriate contact with his cushion and back, which can result in injuries, especially on the seated surface, due to shearing forces. In addition to the discomfort it causes him, this reflexive response also negatively impacts his ability to reach and function to perform his ADLs throughout the day.

CONCLUSION

The position taken by the Centers for Medicare & Medicaid Services (CMS)

that seat elevation does not primarily serve a medical purpose is inconsistent with coverage policy on Mobility Assistance Equipment and ignores the fact that individuals with permanent disabilities use seat elevation to replace a loss of function, perform MRADLs, mitigate deterioration of their health and function and minimize the risk of preventable adverse occurrence.

A PASH system is an accessory to a power wheelchair and is integral to its function for a person who needs to adjust their vertical seat position to achieve the full therapeutic benefit of the power wheelchair.

In 1996, Health and Human Services (HHS) stated that accessories to wheelchairs are part of the DME benefit in its HCFA Ruling 96-1 which states, “to the extent that a wheelchair seating system or other equipment may or may not function properly or not achieve its full ‘therapeutic benefit’ without attached components supporting or restricting motion in a body part, the attachments are appropriately viewed as a necessary accessory that is an integral part of the durable medical equipment and is, accordingly, payable as durable medical equipment, provided that the other prerequisites for classification as durable medical equipment are met.”

The research presented continues to support RESNA’s position that seat elevators are often medically necessary for wheelchair users by enabling them to reach, improving MRADL abilities, facilitating or enabling transfers, providing peer height at different ages, enhancing independence and productivity, and delaying or preventing pain and secondary complications of the upper extremities established in 2009 by Arva et al. It clearly meets the definition of DME as required by 42 CFR § 414.202 and should be considered as a reasonable and necessary accessory to a complex rehab power wheelchair as a replacement of loss of function for persons with disabilities and complex medical needs.

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REFERENCES:

1. ARVA, J., SCHMELER, M.R., LANGE, M.L., LIPKA, D.D., & ROSEN, L.E., (2009). RESNA POSITION ON THE APPLICATION OF SEAT-ELEVATING DEVICES FOR WHEELCHAIR USERS. *ASSISTIVE TECHNOLOGY*, 21(2), 69-72. <HTTP://DOI:10.1080/10400430902945587>.
2. BURDETT, R.G., HABASEVICH, R., PISCIOTTA, J., & SIMON, S., (1985). BIOMECHANICAL COMPARISON OF RISING FROM TWO TYPES OF CHAIRS, *PHYSICAL THERAPY*, 65(8), 1177-1183
3. CMS, (2005). 280.3 NATIONAL COVERAGE DETERMINATION MOBILITY ASSISTIVE EQUIPMENT (MAE), (EFFECTIVE 05/05/05), RETRIEVED ON 12/21/17 FROM <HTTPS://WWW.CMS.GOV/MEDICARE-COVERAGE-DATABASE/DETAILS/NCD-DETAILS.ASPX?NCDID=219&NCDVER=2&BC=AAAAGAAAAAA&>
4. CMS, (1989). 280.4 NATIONAL COVERAGE DETERMINATION SEAT LIFT MECHANISM, (EFFECTIVE 5/1/89), RETRIEVED ON 12/21/17 FROM <HTTPS://WWW.CMS.GOV/MEDICARE-COVERAGE-DATABASE/DETAILS/NCD-DETAILS.ASPX?NCDID=221&VER=1>
5. H.S. (1996) HCFA RULING NO. 96-1 RETRIEVED ON 12/21/17 FROM <HTTPS://WWW.CMS.GOV/REGULATIONS-AND-GUIDANCE/GUIDANCE/RULINGS/DOWNLOADS/HCFAR961.PDF>
6. H.R. 705 – ENSURING ASSESS TO QUALITY COMPLEX REHABILITATION TECHNOLOGY ACT OF 2017, INTRODUCED 1/30/17, RETRIEVED ON 12/21/17 FROM <HTTPS://WWW.CONGRESS.GOV/BILL/115TH-CONGRESS-HOUSE-BILL/750?Q=%7B%22SEARCH%22%3A%5B%22HR+750%22%5D%7D&R=1>
7. FEDERAL REGISTER 42 CFR 414.202, RETRIEVED ON 12/21/17 FROM <HTTPS://W.GPO.GOV/FDSYS/PKG/CFR-2016-TITLE42-VOL3/PDF/CFR-2016-TITLE42-VOL3-SEC414-202.PDF>

8. GORDON, C.C., CHURCHILL, T., CLAUSER, C.E., BRADTMILLER, B., MC CONVILLE, J.T., TEBBETTS, I & WALKER, R.A., (1988). ANTHROPOMETRIC SURVEY OF U.S. PERSONNEL: SUMMARY STATISTICS INTERIM REPORT, RETRIEVED ON 12/21/17 FROM [HTTPS://MULTISITE.EOS.NCSU.EDU/WWW-ERGOCENTER-NCSU-EDU/WP-CONTENT/UPLOADES/SITES/18/2016/06/ANTHROPOMETRIC-DETAILED-DATA-TABLES.PDF](https://MULTISITE.EOS.NCSU.EDU/WWW-ERGOCENTER-NCSU-EDU/WP-CONTENT/UPLOADES/SITES/18/2016/06/ANTHROPOMETRIC-DETAILED-DATA-TABLES.PDF)
9. HICKEY, COREY, (2016). SEAT ELEVATORS: HOW TO UTILIZE THE FUNCTIONAL MOBILITY ASSESSMENT (FMA) TO TRACK FUNCTION AND JUSTIFY MEDICAL NECESSITY, 32ND INTERNATIONAL SEATING SYMPOSIUM PAPER PRESENTATION MARCH 3, 2016
10. JANSEN, W.G.M., BUSSMANN, H.B.J., & STAM, H.J, (2002). DETERMINANTS OF THE SIT-TO-STAND MOVEMENT: A REVIEW, PHYSICAL THERAPY, 82(9) 866-879
11. KIM, S.S., HER, J.G., & KO, T.S., (2015). EFFECT OF DIFFERENT HAND POSITIONS ON TRUNK AND SHOULDER KINEMATICS AND REACTION FORCES IN SITTING PIVOT TRANSFER, JOURNAL OF PHYSICAL THERAPY SCIENCE, 27 (7): 2307 – 2311
12. KIRBY, R.L., FAHIE, C.L., SMITH, C., CHESTER, E.L., & MACLEOD, D.A., (2004). NECK DISCOMFORT OF WHEELCHAIR USERS: EFFECT OF NECK POSITION, DISABILITY & REHABILITATION, 26(1): 9 – 15. [HTTPS://DOI.ORG/10.1080/09638280310001621451](https://DOI.ORG/10.1080/09638280310001621451)
13. KIRBY, R.L., SMITH, C., PARKER, K., MC CALLISTER, M., BOYCE, J., RUSHTON, P.W., ROUTHIER, F., BEST, K.L., MACKENZIE, D., MORTENSON, B., BRANDT, A., (2016). THE WHEELCHAIR SKILLS PROGRAM MANUAL, PUBLISHED ELECTRONICALLY AT DALHOUSIE UNIVERSITY, HALIFAX, NOVA SCOTIA, CANADA. [WWW.WHEELCHAIRSKILLSPROGRAM.CA/ENG/MANUAL.PHP](http://WHEELCHAIRSKILLSPROGRAM.CA/ENG/MANUAL.PHP)
14. REHABILITATION ENGINEERING & APPLIED RESEARCH LAB; GEORGIA INSTITUTE OF TECHNOLOGY, (2017). SURVEY OF USERS OF WHEELCHAIR SEAT ELEVATORS. RETRIEVED FROM <HTTP://HDL.HANDLE.NET/1853/59106>
15. NAKAMURA, K., NAGASAWA, Y., SAWAKI, S., YOKOKAWA, Y., & OHIRA, M., (2016). EFFECT OF DIFFERENT SEAT HEIGHTS DURING AN INCREMENTAL SIT-TO-STAND EXERCISE TEST OF PEAK OXYGEN UPTAKE IN YOUNG, HEALTHY WOMEN, JOURNAL OF SPORTS AND SCIENCE MEDICINE, 15, 410-416
16. NORIDIAN HEALTHCARE SOLUTIONS, LLC (2017). LCD FOR SEAT LIFT MECHANISMS (L33801), EFFECTIVE 01/01/17, RETRIEVED ON 12/21/17 FROM <HTTPS://MED.NORIDIANMEDICARE.COM/DOCUMENTS/2230703/7218263/SEAT+LIFT+MECHANISMS+LCD/9DB611FB-CFD9-4162-8EC6-BB4AFB237BE7>
17. NORIDIAN HEALTHCARE SOLUTIONS, LLC (2017). LCD FOR POWER MOBILITY DEVICES (L33789), EFFECTIVE 01/01/17, RETRIEVED ON 12/21/17 FROM <HTTPS://MED.NORIDIANMEDICARE.COM/DOCUMENTS/2230703/7218263/POWER+MOBILITY+DEVICES/18B2DB50-5276-44D0-8424-0596DCC01976>
18. NORIDIAN HEALTHCARE SOLUTIONS, LLC (2017). LCD FOR POWER MOBILITY DEVICES – POLICY ARTICLE (A52498), EFFECTIVE 01/01/17, RETRIEVED ON 12/21/17 FROM <HTTPS://MED.NORIDIANMEDICARE.COM/DOCUMENTS/2230703/7218263/POWER+MOBILITY+DEVICES/18B2DB50-5276-44D0-8424-0596DCC01976>
19. NORIDIAN HEALTHCARE SOLUTIONS, LLC (2018). LCD FOR WHEELCHAIR OPTIONS/ACCESSORIES, EFFECTIVE 01/01/18, RETRIEVED ON 01/10/17 FROM <HTTPS://MED.NORIDIANMEDICARE.COM/DOCUMENTS/2230703/7218263/WHEELCHAIR+OPTIONS+ACCESSORIES+LCD/AF84D4D7-2912-453F-8E94-AB45C5C433EC>
20. REQUEJO, P.S., MULROY, S.J., HAUBERT, L.L., NEWSOM, C.J., GRONLEY, J.K., & PERRY, J., (2008). EVIDENCE-BASED STRATEGIES TO PRESERVE SHOULDER FUNCTION IN MANUAL WHEELCHAIR USERS WITH SPINAL CORD INJURY, TOPICS IN SPINAL CORD INJURY REHABILITATION, 13(4): 86 – 119 <HTTP://DOI:10.1310/SCI1304-86>
21. REIDER, N. (2012). MINIMAL CHAIR HEIGHT STANDING TEST PERFORMANCE IS INDEPENDENTLY ASSOCIATED WITH FALLS IN A POPULATION OF CANADIAN OLDER ADULTS, MASTER'S THESIS, UNIVERSITY OF VICTORIA (UNPUBLISHED), RETRIEVED ON 12/21/17 FROM [HTTP://DSPACE LIBRARY.UVIC.CA/BITSTREAM/HANDLE/1828/4374/REIDER_NADIA_MSC_2012.PDF?SEQUENCE=1&ISALLOWED=Y](HTTPS://DSPACE LIBRARY.UVIC.CA/BITSTREAM/HANDLE/1828/4374/REIDER_NADIA_MSC_2012.PDF?SEQUENCE=1&ISALLOWED=Y)
22. SABARI, J., SHEA, M., CHEN, L., LAURENCEAU, A., & LEUNG, E., (2016). IMPACT OF WHEELCHAIR SEAT HEIGHT ON NECK AND SHOULDER RANGE OF MOTION DURING FUNCTIONAL TASK PERFORMANCE. ASSISTIVE TECHNOLOGY, 28(3), 183-189 <HTTP://DOI:10.1080/10400435.2016.1140692>
23. SCHIAPPA, VINCE, (2016). ASSESSMENT OF POWER WHEELCHAIR USER SATISFACTION USING SEAT ELEVATORS, MASTER'S THESIS, UNIVERSITY OF PITTSBURGH (UNPUBLISHED), RETRIEVED ON 12/21/17 FROM <HTTP://D-SCHOLARSHIP.PITT.EDU/27312/>
24. SCHIAPPA, V., DICIANNO, B., SCHMELER, M., SCHEIN, R., SAPTONO, A., HENDERSON, G. & HICKEY, C., (2017). ASSESSMENT OF SEAT ELEVATOR USER SATISFACTION, 33RD INTERNATIONAL SEATING SYMPOSIUM 2017 PAPER PRESENTATION MARCH 2, 2017
25. SSA (2014) PROGRAM OPERATIONS MANUAL SYSTEMS, HI 00610.200, DEFINITION OF DURABLE MEDICAL EQUIPMENT EFFECTIVE 5/23/14, RETRIEVED ON 12/21/17 FROM <HTTPS://SECURE.SSA.GOV/POMS.NSF/LNX/0600610200>
26. TSAI, C., HOGABOOM, N.S., BONINGER, M.L., & KOONTZ, A.M., (2014). THE RELATIONSHIP BETWEEN INDEPENDENT TRANSFER SKILLS AND UPPER LIMB KINEMATICS IN WHEELCHAIR USERS, BIOMEDICAL RESEARCH INTERNATIONAL, VOLUME 2014, ARTICLE ID 984526 <HTTP://DX.DOI.ORG/10.1155/2014/984526>
27. WU, Y., LIU, H., KELLEHER, A., PEARLMAN, J., DING, D., & COOPER, R.A., (2017). POWER SEAT FUNCTION USAGE AND WHEELCHAIR DISCOMFORT FOR POWER WHEELCHAIR USERS, THE JOURNAL OF SPINAL CORD MEDICINE, 40(1) 62 – 69, <HTTP://DX.DOI.ORG/10.1080/10790268.2016.1192360>
28. YOSHIKA, S., NAGANO, A., HAY, D.C., & FUKASHIRO, S., (2014). PEAK HIP AND KNEE JOINT MOVEMENTS DURING A SIT-TO-STAND MOVEMENT ARE INVARIANT TO THE CHANGE OF SEAT HEIGHT WITHIN THE RANGE OF LOW TO NORMAL SEAT HEIGHT, BIOMEDICAL ENGINEERING ONLINE, 13:27 <HTTP://WWW.BIOMEDICAL-ENGINEERING-ONLINE.COM/CONTENT/13/1/27>

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