Technical Considerations

Powered Mobility and Its Implications

by C. Gerald Warren

INTRODUCTION

When we examine the factors that contribute to quality of life we see a combination of no less than three: independence, vocation, and recreation. Like legs on a stool, all three need to be present, connected, and of similar length to provide stability. Among those things comprising independence, mobility and communication play the most critical roles, and are functions that are basic to the quality of a person’s life.

Homo sapiens have certainly distinguished themselves as the most mobile animals to grace the face of the Earth. For man, mobility is a fundamental part of living. Being able to move about, to explore, under one’s volitional control is a keystone of independence. The degree of mobility individuals have is directly related to their level of independence; restricted mobility significantly affects the ability to live a productive life.

Restricted mobility occurs in many forms and to many degrees. It must be looked upon as a functional limitation of an individual rather than as a state or condition related to specific diagnoses. Just as the ability to be mobile varies in able-bodied persons, it also varies among people with disabilities, even within their diagnostic categories. In providing powered mobility, the process must focus on the person, clearly defining his or her restrictions or limitations in function, and then determining how best to reduce or eliminate those restrictions by integrating powered equipment into their lives. Introducing powered mobility equipment into a disabled individual’s life can truly be liberating for that person. For those with no functional capability, it can be the difference between complete dependence and a great deal of independent mobility. For those with marginal capability, it can significantly add to their productivity and quality of their lives.

The powered wheelchair began with the application of automobile starter motors to the tubular cross frame wheelchair with power derived from an automotive battery. The developments that followed all revolved around the basic cross frame tubular chair. As time went on and innovation continued to meet the needs of severely disabled individuals, the cross frame of the wheelchair was removed and the space beneath the seat became available for a variety of equipment. Electronic control systems, communication systems, respirators, recliners, and phrenic nerve stimulators all became part of the support system that could be mounted on a powered wheelchair. By the mid-1970s, where the resources were available, severely disabled individuals were seated on a “pile of parts” which they were able to control and so achieve a significant level of independent mobility. Concurrently, the “make America accessible” plan was implemented and the domain of wheelchair users, particularly those using powered equipment, expanded dramatically.
As sophistication in the design and variety of accessories and seating systems grew, so did the pile of parts. In 1982, new concepts were brought together at the VA-sponsored workshop on special adapted wheelchairs and sports chairs, Wheelchair III (1). As a result of this conference, many recommendations were made for research and development focusing on efficiency of the equipment, noise factors, braking systems, and ride quality. In addition, a philosophy evolved regarding the esthetics or the cosmetics of a mobility system. This originated the concept of a powered chassis to which seats and accessories were added in an orderly, modular form.

In the 1980s it is not uncommon to see individuals who are completely dependent in their mobility functioning at very high levels, using an appropriate and well-integrated mobility system to independently pursue their vocational, social, and leisure goals. The key to a successful implementation of a powered mobility system does not, however, lie in the technology itself—it relies primarily on the needs and desires of the disabled individual to maintain or increase the quality of his/her life. The application of powered mobility equipment must be part of the total rehabilitation program. It must be integrated into the total plan which is directed at specific functional outcomes.

The most obvious benefactors of powered mobility are persons who are completely dependent (i.e., without the equipment they are unable to move in their environment). In some clinical settings, these are the only people who are considered as candidates for powered mobility equipment. There are, however, many manual wheelchair users and marginal walkers who can gain considerable functional benefits from the use of powered equipment. These “marginal” ambulators do move in their environments independently, but they may be greatly restricted in rate and distance due to their limited capability.

The marginal manual wheelchair user is someone whose disability includes upper body weakness and who depletes energy levels by propelling a manual wheelchair for more than very short distances (such as those with mid- to low-level quadriplegia). The resulting fatigue often compromises other aspects related to the quality of their life. This situation can occur simply because the options to be gained by using a powered system were not considered during the prescription process. While such individuals should use manual equipment for needed exercise, recreation, and as a back-up in circumstances where transportation or access is restricted, everyday mobility may be less stressful with a powered system. In some instances, the use of manual wheelchairs can be equated to use of knee-ankle orthoses by individuals with paraplegia. For some, it soon becomes apparent that they would be better off using a lightweight manual wheelchair.

These considerations illustrate the importance of realistically assessing the functional objectives of an individual and, when indicated, encouraging the use of powered equipment. This can provide the marginal manual wheelchair user with an appropriate rate of ambulation as well as a means of conserving his/her personal energies for activities other than mobility. The same considerations apply to the person with marginal ability to walk independently. Individuals with peripheral nerve disease, obesity, limb deficiency, or advanced age, all become candidates for a form of powered mobility when the rate and/or range of their ambulation significantly restricts the quality of their lives.

The use of powered mobility for children has become more prevalent in recent years, but not without controversy. In the early 1980s, the concept of early mobility for severely disabled children emerged and was based on the logic that the pattern of development of these individuals should approximate that of able-bodied children. The intervention was focused on reducing the limitations in the areas of social, cognitive, perceptual, and functional development that were induced by lack of mobility. Clinical application of powered mobility for very young children spurred the wheelchair industry to respond with new equipment. Research and development programs were established to provide disabled children with mobility at a time that would closely coincide with the development of mobility in able-bodied children.

There are two main concerns regarding powered equipment for young children: safety applications, and the potential adverse effects on the physical development of a child who is provided early use of powered mobility. However, from clinical experience, it is becoming clear that providing appropriate mobility to very young disabled children benefits their total development pattern and has a significant impact on their potential to be more productive individuals.
GENERAL CONSIDERATIONS IN SELECTING POWERED MOBILITY EQUIPMENT

The assessment that leads to the decision about which equipment to purchase or recommend is most important. This assessment must integrate the individual’s functional needs, life plan, and available resources. The process is similar to that of a small business deciding to purchase a new vehicle. Good decision-making would call for careful analysis of all the functions the vehicle should perform for the business. Then, depending on the needs identified by the company, attention would be focused on the type of vehicle indicated—say, a compact car or a tractor trailer. Next, it would be necessary to determine how the vehicle would fit into the company’s total business plan by balancing functions to be gained with purchase cost. Finally, it would be necessary to answer the question: can and how will this acquisition be paid for?

When applied to a recommendation for the purchase of a wheelchair, this kind of approach requires that a team of clinicians assist the client in the process of evaluation. In projecting a realistic outcome, the client must be knowledgeable about the equipment, and be able to reconcile the cost of achieving the objectives while maximizing the available resources.

Because of the expense involved, the most difficult part of the delivery process may be establishing a payment source and the needed level of funding. Third party payers often reel at the cost of providing powered mobility and its accessories. They have also historically witnessed the fact that the intended or desired outcome has frequently not been achieved. Such experience naturally leads them to be cautious, or at least conservative, in their approaches to funding powered mobility. This is a difficult position to try to reverse.

The conservative position of the third party payers has been precipitated by the fact that the market for durable medical equipment has been supply (vendor) driven. The only way to regain the confidence and support of the funding agencies is through modification of the service delivery process to make it more demand driven. This can only be done by having clients and clinicians make appropriate decisions about the equipment that is needed to realize a reasonable functional outcome.

This outcome can be achieved by clearly defining the client’s needs, being informed about and selecting the most appropriate equipment, and effectively utilizing all available technical, clinical, and financial resources.

EQUIPMENT FOR THE MARGINAL WALKER

The design of equipment used by the marginal walker is usually 3-wheeled or scooter-like. This design provides excellent mobility without the “stigma” of a wheelchair and it is easy to mount and dismount. It is often used to compensate for a person’s inability, for whatever reason, to comfortably and safely travel distances outside the home. It is not usually selected for exclusive in-home use because canes, walkers, or grab bars and rails are more suitable for moving over short distances.

The first consideration for equipment selection is whether it will be used indoors, outdoors, or both. Equipment used exclusively indoors, at home, or in institutional or vocational settings, may not need to have the stability, power, distance, or durability requirements that outdoor use demands. However, the vigor and functional needs of the users should influence the selection of indoor equipment. For example, the equipment for a geriatric individual to use going from bedroom to dining room to therapy facilities in a retirement home would differ significantly in function and cost from that used by a young person with bilateral above-knee amputation who was a shop supervisor in a large industrial setting. In some cases, a choice of low performance or high performance equipment may have to be made, or, in cases where adequate resources are available, two types of equipment may be selected. Equipment used for high performance indoors is often suitable for the low performance requirements of outdoor use (i.e., on relatively flat, uniform surfaces with moderate distance requirements).

The selection of equipment for outdoor use is influenced most by the surfaces upon which it will operate and the distances required to travel. Climatic conditions must also be considered because performance of powered drive mechanisms are affected significantly by moisture and temperature. Other considerations for this type of equipment are:
seating for posture and trunk stability; ease of mounting and dismounting; portability in ease of assembly and disassembly; and the weight and size of individual components which may need to be lifted and stored in a car trunk.

The following case study illustrates how needs assessment and proper prescription can restore functional independence for an individual with marginal walking capabilities.

Case #1: Jackie M.

Jackie M. is a 28-year-old female, diagnosed at age 14 with Kugelberg-Welander's disease. She has a history of progressive motor weakness. At this point in her life she is able to walk short distances on smooth surfaces with the use of a cane. Jackie is a large individual whose joints are being jeopardized with ambulation and she is at high risk of fractures or joint trauma due to falling. Though weak, she has good positional control of her upper extremities and her hand dexterity is excellent. She cannot, however, stand from a seated position independently.

Jackie is employed as a clerk-typist, full-time. She is currently experiencing a number of problems at work which are directly related to her impaired mobility. She requires assistance getting in and out of the building and rising from her chair at her work station. She is reluctant to ask for assistance and therefore does not use the bathroom as often as she should. As a result she experiences periodic urinary tract problems. Jackie is unable to meet part of her job requirement—moving to various locations around the workplace. Her employer will be relocating to a carpeted facility, which will make it nearly impossible for her to walk at all.

Jackie's functional need made her an excellent candidate for a 3-wheeled mobility device with a pivoting and elevating seat. It was found that she could independently come to the standing position if the seat could be elevated to 34 inches and located adjacent to a 54-inch high solid surface for her to lean on.

Providing her with this equipment makes Jackie independent in the workplace. The installation of a 54-inch shelf in the lavatory makes it possible for her to carry out her bladder functions (which she performs standing). Now, Jackie only needs transfer assistance from her husband when entering or departing her work facility.

EQUIPMENT FOR THE MARGINAL MANUAL WHEELCHAIR USER

Many people interpret the change from a manual wheelchair to a powered wheelchair as an admission or "indictment" of greater disability rather than as an option for increased capability. It is often difficult to accurately assess or recognize the secondary functional options that are realized when a person chooses to use a more efficient and effective form of mobility. Often the perceived loss of physical prowess can be obviated by introducing the person to wheelchair sports. The questions must be asked: What else might be achieved if the form of mobility saves the wheelchair user's expense of energy? How much more work could get done? How much more "up time" could the individual have? How much more productive could that time be?

It is also important to consider the complications and expense that are introduced by incorporating powered mobility into a person's life. The cost of providing and maintaining a powered system is approximately three times that of a manual system. Some people who would like to use powered equipment do not, simply because the expense of the initial purchase combined with the need for suitable transportation far exceeds available resources.

If they do use powered equipment, marginal manual wheelchair users also need manual equipment for back-up and convenience. Some individuals use the powered equipment only in fixed locations and use the manual chair when traveling by car. Others, where resources are available, use an appropriately equipped van.

It is not uncommon to find an individual who moves from powered equipment back to manual equipment. This can occur when the gains intended by the use of a powered chair is overridden by the benefits of practicality or convenience offered by using manual equipment.

A careful assessment of the individual can result in a mobility plan that incorporates both powered and manual chairs. Based on functional needs, the powered equipment can range from light duty equipment for use in a work place to full-sized heavy duty high powered equipment for use in long range indoor and outdoor mobility.

People in this ambulation category generally have good upper extremity control and moderately
good trunk balance. They often desire high performance equipment, which is available through some of the major manufacturers, but can also be found in kits which modify a chair to provide greater acceleration and top speed.

There is a population of disabled individuals who can use a hybrid approach to their mobility needs by combining manual and powered wheelchair equipment. Selecting the appropriate types of equipment for these individuals relies heavily on insightful analysis of their functional needs, looking particularly at how the use of powered mobility will impact their total lifestyle. The key to implementing such a program for an individual lies in identifying the functional or productivity gains that can be achieved and weighing them against the costs involved in providing that equipment given the client's resources.

The case study below describes how one person combined the use of manual and powered systems in order to concentrate his energies on being productive at work, while maintaining a more independent image for leisure-time activities.

Case #2: Russell G.

Russell G. is a 20-year-old male with complete quadriplegia at C 6-7. He completed a comprehensive rehabilitation program and had been discharged ambulating with a lightweight wheelchair equipped with pegged hand rims. He wanted to use the manual wheelchair in order to maintain and improve his upper extremity condition. Russell independently transferred in and out of an automobile, laboriously loading and unloading the wheelchair.

Eighteen months after discharge he was sponsored by the Division of Vocational Rehabilitation to attend a computer training program specifically for disabled individuals. The demands of the program began to take a toll on his stamina, and during the course he would on occasion allow an ambulating student to give him a push from his car into the facility and/or to and from the lunch room (over low pile carpet).

Suggestions that he consider using a powered wheelchair continued to be rejected because Russell perceived that using a powered wheelchair would be an admission of greater disability. Then, on field trips to potential employers he began to realize the impracticality of pushing the distances required to get from the parking facility into the building and to his workplace. There were also considerable distances to be travelled within the building, such as to meetings and to the lunchroom. To efficiently accomplish these tasks (related solely to his mobility and not to his job function) it would require excessive effort in his manual chair.

He eventually engaged in planning the move into a powered wheelchair system. Russell relocated his residence close to a wheelchair-accessible bus line that connected with his employment location. He now uses his electric wheelchair to go to and from work. But he continues to use his manual wheelchair for all other social and recreational activities. The manual wheelchair also serves as a backup when he encounters difficulties and/or breakdown with his electric wheelchair.

EQUIPMENT FOR THE SEVERELY DISABLED INDIVIDUAL

People in this category are unable to independently transfer and/or are severely limited in their ability to control mobility equipment. They must rely completely on their equipment for any level of independent mobility. With the proper equipment, it is possible for someone capable of only one or two body motions to control a wheelchair. The use of pneumatic switches makes it possible for a person with only control of pressure in the oral cavity to operate powered equipment with a sip and puff control. Once fitted with the appropriate system, many people can have sufficient mobility to achieve high levels of independence. It is not uncommon now to find people in the workplace who have little more than breath or head control. These people can be assisted into their wheelchair in the morning, provided with minimal assistance throughout the day with feeding or leg bag evacuation, and at the end of a very productive day can be assisted from the wheelchair to their bed. Many such individuals are engaged in activities related to their education, vocation, and social leisure time.

Providing equipment for these individuals requires a highly integrated approach taking into consideration the physical requirements of the person's environment, the seating and positioning of the individual, the selection of the optimal control method, and the integration of accessories and associated equipment. Determination of a mobility
system for an individual in this category is, as in all other wheelchair prescription cases, based on the anticipated functional needs and life objectives that will be pursued. The first step in the process is to select the basic powered base. The characteristics of additional powered equipment—such as recliners, communication, and/or life support systems—must also be considered. This places further requirements on the mobility system for both power and the space to accommodate this equipment.

The next consideration is seating. The individual must be provided with a seating system that will both position him/her for optimal control of the equipment and also maximize the length of time the person is able to remain seated in the wheelchair, which involves the factors of fatigue and tissue protection. Determining the best positioning and posture of the individual in the wheelchair is a highly specialized process that requires a well coordinated team approach. Proper seating is often fundamental to an individual’s ability to operate the control system. This is particularly true for individuals who are cerebral palsied or head injured for which the processes of seating and control must be performed together.

The factors in seating a severely disabled person to maximize “up time” are tissue protection, lower extremity circulation, and threshold of fatigue. Tissue protection in persons with insensitive tissue requires a seating surface that provides optimal distribution of the pressures. However, the redistribution or unweighting of the load-bearing surfaces is an effective complementary method of assuring maximum protection.

For the individual who is unable to perform reliable pressure relief manually, powered reclining or tilting of the seat may be necessary. Powered reclining mechanisms allows the individual to independently redistribute or decrease the pressure on the weight-bearing surfaces and to rest residual trunk and respiratory musculature. The recline function is often combined with elevating legrests and can assist in control of lower extremity fluid pooling. Many such users have demonstrated a secondary function of the recliner: using the motion to reposition themselves in space in a limited form of body language.

People who use reclining equipment have frequently complained that repeated reclining shifts their bodies out of the normal stable position, causing a loss of sitting balance and poor positioning. Sliding or stretching during the recline can also cause unwanted spasticity and repeated reclining can wrinkle and bunch clothing, which of itself can cause uneven pressure distribution.

The reason for these difficulties arises from the early design of the wheelchair, which used a simple hinge joint to attach the chair back to the frame. In reclining a wheelchair with a standard hinge the person tends to slide down the back of the seat. During elevation of the chair back, shear forces between the person and the back usually prevent the person from sliding back up to the original seating position. The sliding occurs because the location of the pivot points of the chair differ from the axis of rotation of the person’s body during the recline (2).

Many manufacturers now incorporate mechanisms into the recline system of wheelchair mechanisms that are designed to eliminate sliding either by allowing the chair back to slide with the person by tilting the entire seat, or by using mechanisms that cause the chair back to follow the path of the person. Studies have shown that the average displacement during recline is 11 centimeters. Chairbacks that provide a non-shear feature must accommodate displacement of approximately this magnitude as the chair back goes through the recline cycle (Figures 1a and 1b).

A similar displacement problem can exist at the knee because the axis of rotation of the chair and the knee joint may not coincide. The problem here is less severe, however, because the low mass of the legs lets them slide without difficulty. A more common problem is encountered with the incorrect length of the legrests. If they are too short, excessive pressure can be applied on the bottom of the feet when the legrest is elevated. Pressure on the feet and accommodations made by adjusting the length of the legrest on the chair should always be checked when using a system for reclining or elevating the legs.

The use of non-shear reclining systems can significantly increase the up time of an individual and make it feasible and safe for that person to spend an entire functional day in a powered wheelchair.

Control of a powered wheelchair can be achieved by harnessing any reliable motion an individual may have. Motion in a plane can be used...
to control a joystick and provide proportional control. Limited unidirectional motion can activate single switches which can be electronically interpreted to perform a variety of functions. It is possible to drive a wheelchair, slowly, with the use of a single switch. Voice recognition, whereby a person speaks commands to control the chair, has been used; however, this approach has not been widely accepted due to cost, complexity, and reliability of operation.

The numerous sites that can be used for wheelchair control are shown in Figure 2. Proportional control can be achieved using conventional joysticks when gross hand motion is available. When motion is limited, “short throw” joysticks needing only 3/16 of an inch displacement of the sticks still result in full amplitude signal from the wheelchair controller. This approach can make fingertip control, chin control, and, in some cases, lip or tongue control possible.

Switching control of the wheelchair is made feasible by the use of acceleration control circuitry. A sip and puff regimen uses a hard puff or sip on a straw connected to pneumatic switches to control the chair’s forward and reverse and stopping functions. A soft sip or puff on the same straw activates switches that control the turning rate. Single-switch control of a chair is also possible, whereby the functions are scanned and selected with a single switch (Figures 3a and 3b). Such operation is necessarily slow, but it does provide independent mobility for the severely disabled individual who may have no other alternative.

Recently, microprocessors have been integrated into wheelchair control systems that allow the custom programming of performance features. Once a person’s motor capabilities have been analyzed with regard to rate and degree of control and a physical interface defined (i.e., the method by which the person will activate the system), the control features can be custom-tailored to make the machine respond appropriately.

When a severely disabled individual begins daily activities there are many accessories on board the

![Figure 1a](image-url)


![Figure 1b](image-url)

Figure 2.
Wheelchair control system. By positioning a switch or sensing device at some anatomical location, signals can be derived which might be employed to operate a wheelchair. This listing represents potential control sources; controllers have been implemented to use many of these sites:

A. Chin control. Worn as a collar, device requires very small travel (1/4 inch or less) to produce proportional control.

B. Headrest control. By pushing straight back against the headrest, a forward signal is produced. By rocking the head to the left or right against the headrest, turn signals are generated. A separate switch needs to be activated to reverse the sense for backward motion.

C. Joystick. This operates using standard joystick format.

D. Arm/elbow control. Movement of the elbow outward and/or sliding of the arm forward and backward might be used for activation of switches or proportional signals.

E. Head control. Direct use of forward/backward and left/right movement of the head is employed.

F. Shoulder position. Elevation and depression (or slump) provide forward/backward signals while protraction/retraction of the shoulder provide the left/right signals.

G. 1) Pneumatic (puff/sip) control. This system uses hard puffs and sips to control forward and backward velocities, while soft puffs and sips introduce proportional turns; 2) Spoken control. A computer can analyze the words spoken and use them to “drive” the wheelchair; 3) Mouth, tongue, lip control. A head-mounted chin-controller element can make use of small movements to provide proportional control.

H. Foot control. A rocker plate could yield all four signals for wheelchair direction, or “gas pedal” type controls might be used.

I. Knee control. Thrusting the knee inward or outward can provide control signals.

(Courtesy of DU-IT Control Systems Group, Inc., Shreve, OH 44676)
wheelchair that may require control. Accessories may include headlights, flashing lights, horns, alarms, tape recorders, fans, recline functions, telephone, and remote control actuators. The variety of functions on the chair are selected through a switch that controls a scanning display of the functions available. A second set of switches or a joystick is then used to select a desired function. Since most individuals who use this type of equipment are not capable of operating more than one control mechanism at a time, the functions are usually performed in serial.

Besides operating the wheelchair accessory equipment, the control systems also incorporate remote control communication with environmental systems through radio frequency or infrared beams. Usually, the individual operates the features of an environmental control system through the same control mechanism that is used for all other features of the wheelchair. Such a system enables the person to have remote control of anything switchable in his or her environment, such as the telephone, intercom, door latches, lights, AC receptacles, radios, television, and computer (Figure 4).

The survival rate of spinal cord injured people who are respirator dependent has increased markedly because of the improved evacuation procedures at accident sites and the specialized care now provided for severely disabled individuals. Those who require life support systems, such as respirators and/or phrenic nerve stimulators, now can have them mounted on board their wheelchairs. The critical nature of these life support systems requires that they be coupled to an emergency alarm system that can sense difficulty or malfunction and summon assistance if needed. Commercial paging technology can be applied, where a simple sensor detects the malfunction and a paging system transmits a signal to a receiving station to summon assistance.
This type of equipment requires lift-equipped vehicles for transportation. The most critical issue in transporting such individuals is adequate hold-down mechanisms in the vehicle. These mechanisms must securely hold the wheelchair frame to the vehicle, and the individual must be secured to the wheelchair. It is essential to remain aware of the fact that the wheelchair itself can constitute a mass 2 to 3 times that of a person, and thus on impact it can become a formidable missile inside a vehicle.

The following case study demonstrates how a person with a progressively disabling condition has been able to continue his daily activities through the use of a specially-equipped powered mobility system.

Case #3: Bill T.

Bill T. is a 39-year-old male, diagnosed with Charcot-Marie-Tooth disease, a progressive hereditary neuropathy. The disease had progressed to the point where he was using a standard powered wheelchair with a low back, swing-away legrests, and detachable desk arms. He used a lift-equipped van with a translating driver’s seat to which he transferred from the powered wheelchair.

Bill was employed full-time by a state agency as an administrator of a major social service program. This position required him to spend a significant amount of time in and out of his office, driving 15,000 miles a year.

Deterioration of his condition led to a more generalized weakness, which in turn affected his posture, his ability to do pressure-reliefs, and in particular his transfer abilities. He began experiencing persistent welling in his lower extremities. His level of fatigue became extremely high. By the end of the day an independent transfer could take him up to 5 minutes. He found it necessary to retire immediately after his evening meal. His general health and well-being were deteriorating to the point where he began to miss work.

A request to the Division of Vocational Rehabilitation for post-employment services resulted in an evaluation focused on his mobility and transportation system. It was recommended that he use a powered reclining wheelchair with elevating legrests.
and non-shear hinge mechanism operated through a wheelchair accessory control system. This system also allows Bill to mount on the wheelchair a tape recording system for dictation and note-taking. The powered recline system allows him to sit in a relaxed posture and perform pressure reliefs while in meetings and at his desk talking on his speaker phone. Bill now has a great deal of flexibility finding ways to rest during the work day. The elevating legrests significantly improved the pooling of fluids in his lower extremities.

In addition, the van was modified to include a drop pan and hold-down system in the driver's position so that he could operate his vehicle from his wheelchair. This eliminates what had been a very difficult transfer activity. It also adds to his safety since his wheelchair is now secured whereas in the past it had simply been parked with brakes on while the van was in motion.

This implementation not only significantly improves Bill's effectiveness in the workplace but also has had a tremendously positive impact on the quality of his life by increasing his daily up time by 3 and a half to 4 hours.

PEDIATRIC POWERED MOBILITY

In recent years increased attention has been paid to the mobility needs of motor-impaired children (3,4). Proponents of powered vehicles for very young people present strong reasons for introducing powered mobility to children at a time in their developmental pattern that coincides as closely as possible to when they would have begun independent mobility as an able-bodied child. The application of powered mobility can be as young as 24 months.

This is a marked departure from the previously held concept that powered mobility should only be provided to adults because the value of providing this equipment to children was offset by issues of safety and physical development. Moreover, it is certainly true that with powered systems there are higher costs, transportation problems, and accessibility issues. However, recent research clearly points to the advances that can be achieved in social, cognitive, perceptual, and functional developments of the child when early mobility is achieved.

Introducing powered mobility equipment for use by a child must be done through a comprehensive evaluation of the child and family that is performed by clinicians who understand how to maximize the potential benefits of the equipment to the child's life. There is a variety of equipment with many options now on the market, such as 3-wheeled vehicles, carts and buggies, and a miniature version of the standard powered wheelchair.

Many systems are available for the child with limited functional control. Selecting and interfacing the control system with the child's abilities is one of the most crucial aspects, and should be done in conjunction with choosing the proper seating system. Proper positioning of the child is critical in achieving both operational success and safety.

All aspects of the child's growth and development need to be considered and incorporated into the process. The evaluation must also consider the devices that will be used in conjunction with the mobility system, such as augmentative communication, environmental control, and computers used in the educational process. Of particular importance is integrating the control of each piece of equipment to assure that it can be effectively operated with as few restrictions as possible. As with any child, there is the ever-present concern for safety as independent mobility is explored. The disabled child learning to use powered mobility just presents a different set of circumstances.

ELEVATING AND STANDING MOBILITY DEVICES

In some vocational, educational, or perhaps even domestic settings, an individual might benefit from either elevating himself to various heights or moving around in a vertical position. For example, an individual may have to perform desk or keyboard activities on the job and may also have to perform customer service related activities at a 42-inch counter. An elevating wheelchair seat will facilitate these tasks.

There also is equipment on the market that will enable a person to be restrained in a standing position and use a joystick to drive the powered platform upon which he/she stands. One such piece of equipment also allows the individual to bend at
the waist and/or to move from standing to a nearly prone position. Such equipment, however, is not for everyone. But, it is appropriate in circumstances where a needed function demands a capability that can only be provided by such equipment.

RECREATIONAL EQUIPMENT

There are many types of all-terrain vehicles that are hand-controlled or that are easily adaptable to hand controls. These vehicles can provide a tremendous social leisure outlet for many disabled individuals. Such vehicles have also been used in vocational settings to move individuals through terrain completely non-negotiable by standard powered mobility equipment. This kind of equipment can provide opportunities for activities ranging from competing on semi-professional race track circuits to hiking, hunting, fishing, or just taking a leisurely “walk in the woods.”

Organized competitive activities for powered wheelchair users have been conducted on an ad hoc basis in many parts of the country, usually in conjunction with a sports wheelchair event. As interest in powered wheelchair competitive events increases, it is hoped it will precipitate the type of design development that occurred with manual wheelchairs and the resulting growth of sports and recreational activities.

CONCLUSION

The goal and responsibility of the prescriber of a wheelchair must be to restore to the greatest degree possible the individual’s ability to pursue the three quality of life factors: independence, vocation, and recreation. In some instances, this is best accomplished by providing the option of using both a manual and a powered wheelchair. Giving a person the advantage of both options may make the difference between self-reliance and dependence on others. It can determine whether or not a person is able to travel between home and work or school without the assistance of others. It can greatly affect the quality and degree of participation in many leisure activities, such as going out for a “walk” to the grocery store or just around the neighborhood. Distances that seem short or a bit of brisk exercise to an able-bodied walker may cause total fatigue to those who must push themselves in a manual wheelchair. These are considerations that should not be overlooked by the prescriber.

Clearly, the powered wheelchair is not a symbol of further disability but a means to move about freely while preserving vital energies for productive pursuits. This message must be conveyed to everyone whose disability requires the use of a wheelchair to carry out all or some of the everyday functions of living. However, the attitude that powered mobility is only for those with severe disability is a concept widely held by both disabled individuals and the general public. It need not be and should not be. Clinicians and other professionals who prescribe wheelchairs have an opportunity to dispel this myth and, at the same time, improve the quality of life for many wheelchair users.

REFERENCES