

Intensive Mobility Training for Disabled Drivers *for the Safe Use of Power Wheelchairs, Scooters & Automobiles*

(This paper intended for AT service providers and dispensers serving the disabled)

The National Institute for Rehabilitation Engineering (N.I.R.E.) is an IRS Section 501(c)3 non-profit organization which operated clinics to design, dispense and fit customized assistive equipment with user training, from 1967 to 1997. Working with disabled people's own doctors and therapists, these N.I.R.E. clinics assisted *hundreds* of people having severe and permanent motor, speech, hearing and/or vision impairments. *The N.I.R.E. pioneered the development and use of personalized high-tech self-care and mobility aids; appliance controllers; communications aids; adapted computers and office equipment; power wheelchairs (steered and controlled with inertial guidance systems or with breath controls, by people unable to use hand controls); and adapted road vehicles. Also, special vision aids for the activities of daily living and even for driving, in some instances, to help people with impaired vision*

Although the N.I.R.E. no longer operates these clinics, it is still active in dispensing "Accommodation" and "Assistive Technology" information, advice and referrals. *PERMISSION is granted for the free copying and distribution of these © papers, provided all copies are complete and unaltered.*

PURPOSE: This paper is a reference to assist doctors, therapists, mobility trainers, and mobility equipment dispensers to better understand the needs for and limitations of "**Intensive User Mobility Training**" necessary to ensure user- and public- safety. This paper especially addresses the conflicting requirements that many AT (Assistive Technology) users have. **EXAMPLES:** a severely disabled person, perhaps a spinal-injury quadriplegic or a person with advanced ALS or MS, is acquiring a power wheelchair for both indoor- and outdoor- use. Or, perhaps, such a person desires to drive an automobile or wheelchair van using special controls or assistive technology.

The basic conflict this person faces is to receive sufficient training and practice to ensure SAFETY (his own and the public's) despite his own physical endurance limitations (that may limit the time for each training or practice session.)

NEED: There has been a need for this type paper for many years, to improve safety as more and more disabled people use advanced technology vehicles and devices to improve their mobility and independence. This is a partial list of the types of technology that disabled people, some with little or no prior experience, can and must learn to use safely:

- A. To Drive on Public Roads & Highways: **hand driving controls**, when legs are impaired – and lifts or other special equipment for transferring to and from the vehicle.
- B. To Drive on Public Roads & Highways: **computerized driving controls**, with electronic command-control system, when both arms are missing or impaired. Some people have use of one or both feet although not of the arms.

- C. For Outdoor Mobility on Sidewalks, Paved Surfaces, Grass and Soil: power wheelchairs or scooters – some with **manual hand controls**; others with **computerized electronic controls**. Some controlled and steered by breaths or head, or chin movements.
- D. For Indoor Mobility in Public Buildings and in Residential Settings: power wheelchairs or scooters – some with **manual hand controls**; others with **computerized electronic controls**. Some controlled and steered by breaths or head or chin movements.

The potential hazards of driving, when the driver has special circumstances and equipment - but insufficient training and supervised practice - are real. Equally hazardous but not fully understood by many, are the hazards of human error or misuse of a power wheelchair or scooter. Our staff has learned of many incidents, over the years, wherein a handicapped personal mobility user with inadequate or no training, was unnecessarily injured or killed – a few examples:

When steering his power wheelchair or scooter on hilly grass or soil and driving across the incline rather than up or down an incline, the wheelchair or scooter is less stable side-to-side than from-to-back. It sometimes turns over, killing or seriously injuring the occupant.

Riding on a sidewalk with cracks or raised slabs that unexpectedly deflect or turn the wheel(s) that steer the wheelchair or scooter. This can result in the vehicle swerving hard to one side and going off the path or walkway, down a hill or even into water below.

Transferring in to or out of a motorized scooter, the machine can easily knock the user to the floor, turn over and fall on him ... to cause injury or death. This occurs more often with 3-wheeled scooters which are unstable side-to-side.

Transferring in to or out of a power wheelchair has frequently caused injuries when the wheelchair's battery power had not been switched off. Typically, in these accidents, the user inadvertently brushed up against the drive control, activating it and sending the empty wheelchair to collide with the owner, or someone else, or other objects in the room.

Riding in a wheelchair or scooter, in a moving minivan or other motor vehicle, when the wheelchair has not been adequately and safely secured to the floor – and/or when the disabled owner is not fully, adequately secured in the wheelchair. If both are properly done: (a) the wheelchair is fully and adequately secured to the vehicle's floor, and (b) the user is fully and adequately secured to the wheelchair ... then safety is largely assured. If either of these conditions is not achieved, then an accidental collision, rolling off the road, turning over, or even making a sudden emergency stop can injure or kill the wheelchair rider. We've known of disabled people who were injured or killed in minor accidents after buying an adapted van

from an out-of-the-area company which did not provide perfectly fitted wheelchair and user restraints.

WHO ENSURES MOBILITY SAFETY for disabled AT users and public?

A & B above: Drivers, handicapped or not, of automobiles are road-tested and licensed by their state's Motor Vehicle Department. Without proper licenses, they are not permitted to drive. LOWER - RISK.

C & D above: Operators of power wheelchairs and scooters are not road-tested or licensed by any organization or agency. Therefore, safety of the operator, and of members of the public, is solely dependent on the appropriateness of the mobility device's selection, construction, and fitting. And on the thoroughness and accuracy of the operator's training. Deficiencies in these areas are often not recognized until after incidents or accidents, when it may be too late. HIGHER - RISK.

Stair-Climbing Power Wheelchairs are available for indoor use in private residences, apartment houses, etc. A number of companies have developed such wheelchairs but often do not sell them commercially because of difficulties obtaining product liability insurance to protect themselves. Every flight of stairs is different as to step heights, depths, edging, surface materials, step and debris visibility, etc. to the wheelchair user, etc. While a paralyzed engineer might more easily learn to use one of these wheelchairs with relative safety, the average non-technical user is far more likely to slip, slide and fall down an entire flight of stairs, from near the top - to the bottom. Anyone using this type wheelchair on stairs puts himself, and everyone nearby, at great risk of serious injury or death. – even with the best and most intensive on-site user training. No user license is required; there is nothing to protect disabled consumers except the manufacturers' and vendors' fear of product liability and wrongful death lawsuits. This type mobility aid is the best argument for prolonged, intensive training and user testing and licensing, with compulsory liability insurance (as if driving a car). HIGHEST - RISK

BACKGROUND: This Institute was founded by volunteers from industry, many of whom were qualified aerospace engineers. Most were not, themselves, handicapped. They knew of the necessity for intensive mobility training of disabled AT users (or anyone else) to assure the equipment user's safety, as well as the safety of the general public. These engineers and technicians were accustomed to training non-handicapped, technologically oriented and trained individuals to safely and efficiently operate high-tech mobility equipment of many different types. Many were NOT accustomed to training individuals having no previous technology interests, experience or knowledge. As a result, these wonderful high-tech N.I.R.E. volunteers developed complete programs and schedules for the mobility and/or driver training of non-technically oriented disabled people (using high-tech mobility aids). These methods worked well ... never, not once in over thirty eight years, has a N.I.R.E. client been injured (or caused injuries to others) using N.I.R.E.-dispensed mobility or driving aids. We attribute this to our policy of refusing to sell equipment by mail, and our refusal to dispense such equipment in our

own clinics, without full user training (both in our clinics and in the field where the client would continue using the equipment). *The N.I.R.E. no longer fits or dispenses equipment, and no longer trains AT users. Therefore, the information in this paper is to pass on to others what we have learned so that they can assist disabled people in their own local areas.*

Other dispensers of high-tech mobility AT equipment then included and still include: (1) commercial equipment vendors selling products by mail or freight; (2) commercial equipment manufacturers selling products through local retail dealers; and (3) some rehabilitation clinic programs such as those that offer “driver qualification and needs assessments” for paralyzed people (spinal cord injury or stroke victims) ... or for visually impaired people. AT User Mobility Training is usually handled by these “other dispensers” as described below:

- (1) **Out-of-the area manufacturers or dealers who sell and ship products** to their buyers, usually offer no user training – other than, perhaps, a booklet or video. The person who acquires AT mobility equipment this way, or even as a donation or as the purchase of used equipment, is in a dilemma. If he simply uses the equipment as best he can, without professional training, there is a high likelihood of injuries occurring to himself or to some innocent passers-by. WE RECOMMEND that people who acquire AT mobility or driving aids without complete seller-provided training, arrange for professional training of themselves - where they live, travel or work. Such training is available from “Mobility Trainers” or from certain “OTR’s” (registered Occupational Therapists) who specialize in mobility training. Also, some rehabilitation clinics can arrange to provide the needed services. Where driving an automobile is involved, some of the many licensed driver training instructors have experience with and are willing to assist disabled people.
- (2) **Local retail AT dealers who sell mobility and/or driving aids** usually provide some training, especially “Care & Maintenance” instruction in order to minimize the amount of free warranty repair work that will be exacted from them. Most offer minimal “user on-the-road driver training” because the hourly costs for some would be high; because they want safety to remain a “user” liability problem, not their liability problem; and because they mostly lack staff who are qualified to administer the needed training. For all of these reasons, the N.I.R.E. recommends that mobility equipment purchases be coordinated with other local resources so that: (a) the dealer provides the equipment – to medical specifications and with a doctor’s prescription; (b) the user obtains CARE & MAINTENANCE training from the local dealer; and (c) the user obtains his on-the-road operational training from a local, qualified mobility or driving instructor.
- (3) **Rehabilitation Center Mobility Assessment & Training Clinics** in some parts of the country routinely assess and evaluate disabled individuals for driving qualifications and potentials, and then offer those who qualify the needed on-the-road training. After road-testing and licensing, using the

facility's vehicles, the patient or client is able to order his own adapted vehicle, to the clinic's tried and proven specifications. Typically, these clinics are operated for partially paralyzed people who have had strokes or spinal cord injuries. These type resources are very professional, quite economical and are highly recommended. Often, they can even qualify a client for the state-federal vocational rehabilitation programs, to pay part of all of the costs for evaluation, training and adaptive equipment.

Assistive Technology TRAINERS – their benefits and limitations

High-Tech Assistive Technology: This institute (The N.I.R.E.) custom designed, built and installed high-tech driving, steering and control systems from 1967 to 1997, for power wheelchairs, scooters and automobiles operated by severely disabled people such as quadriplegics. We also provided full, complete and intensive on-the-road driving instruction. For safety reasons, we were as thorough training our paralyzed clients to drive power wheelchairs as we were in training those who drove cars or vans. Mechanical driving controls such as used by paraplegics, were and are commonplace. But, the electronic controls needed by quadriplegics could not be mechanical and had to be electronic, almost as complex as the equipment used to steer and operate aircraft. It was this or nothing. That is why many of our clients needed to be equipped and trained by our aerospace engineers and technicians instead of by their usual occupational therapists or mobility trainers. Even though initial evaluations, fittings and training were done at the N.I.R.E. facilities, the training also involved our staff working with each client at or near his residence and, if employed, at or near the place of employment.

Trainee Endurance and Time Availability: Most of our technical and training staff workers, paid and volunteer, were from industry, were non-handicapped, and were not very familiar with the extra time and effort required for a quadriplegic to be dressed, toileted, fed and readied for each day's activities. Also, much of the training was done at the client's home, often quite far from the N.I.R.E. facility. For these reasons, and for the nature of the training, itself, our trainers often preferred two 4-hour sessions per week – as opposed to four or five 1-hour sessions per week. The longer work and supervised practice sessions often resulted in the client becoming tired and fatigued. For some clients, we were compelled to use more frequent but shorter work sessions.

Training time limitations due to trainee fatigue was a subject not well understood by our high-tech, non-medical mobility trainers. They usually looked to the client, himself, to explain what available-time he could manage for the 3 to 5 weeks typically required to complete the training. Approval for the planned training schedule was usually sought from the client's own physician. And, of course, the client's caregivers – family and/or paid aides – who made possible his availability each time, had to be consulted.

Often, the intensive, rigorous and full (to achieve ongoing safety) training program was completed without the client taking dangerous shortcuts even though sometimes tiring or even exhausting to the client trainee. This was and is as it should be. In some cases, the client found the training dull, repetitive, boring and tiring – and tried to skip parts of it, to

take shortcuts, and even to terminate the lessons before completing them. With computer guided automobiles, due to the high speeds used and the resulting dangers, to do this was a major threat to the public safety – much more so than if a power wheelchair were being used. To prevent this, the N.I.R.E. required its clients to sign written forms agreeing to fully complete their training, before the special equipment was installed. In several cases, when work was completed, clients simply decided to take their cars and leave, and not complete their training. In several instances, when we knew this was to occur, we impounded the vehicle and gave the client a choice: (1) complete the training and then take the car; or (2) have us remove the special equipment we had installed and then take the car, without it.

DRIVING CONTROL DESIGN CHOICES exist and should be carefully considered, especially for all drivers of automobiles ... and for slower-reacting drivers of power wheelchairs and scooters. When choosing an electric, electronic or computerized steering and control system, potential users will find two broad categories are available: **(1) simple open-loop-control systems** which cost less to buy, are simpler to maintain, and may be more reliable; AND **(2) complex control systems with closed-loop servo-system feedback.** For low-speed wheelchairs and scooters, the performance differences between (1) and (2) are not of major significance. However, for people who steer and drive automobiles using electronic breath, head-movement, mouth, foot or finger controls, the differences are very significant. Those who drive using mechanical (paraplegic hand) driving controls are generally stabilized by the car's own power steering system which has its own travel-speed sensors and steering position feedback system. However, the added servo motors used to steer, accelerate and brake a car under electric, electronic or computer control do not use the car's built-in feedback and control systems. This breaks down to each method having its own performance advantages and disadvantages. These can be summarized as follows:

(1) Open-Loop Control Systems	(2) Closed-Loop Control Systems
+ Lower costs to buy and maintain	- Higher costs to buy and maintain
+ Simpler system easier to maintain	- Complex and difficult to maintain
- Requires constant attention driving because human brain must constantly process visual feedback and driver must constantly make tiny adjustments.	+ Requires less attention while driving because system processes servo feedback signals automatically. Is safer.
- Less safe to drive & requires constant attention by driver who must constantly make minute adjustments.	+ Safer to drive – if maintained properly by service professionals with periodic checkups.
- Requires much more training & practice.	+ Requires less training & practice.

The N.I.R.E. did, over a thirty-year period, dispense both types of control systems, always with intensive user training. For power wheelchairs and scooters, there was not much difference in safety. However, with automobiles, there were significant differences in safety and also with regard to the driver's maximum safe driving time before becoming fatigued. Our conclusions were, in general, that the complex, closed-loop systems were and are preferable to the simpler open-loop systems for reasons relating to overall safety

and less user fatigue. But, in cases where a person lives in an isolated area and cannot obtain professional maintenance service, that person may be safer with the simpler, less service-needy open-loop control system.

DRIVING TRAINEES with Impaired Vision did then, and even now, require intense, special training. Some states categorically prohibit visually impaired people from driving, with or without special equipment and training. Other states do permit these people to drive and to be licensed – but only after they are trained, road-tested under varying conditions, and found to be consistently safe drivers. For driving automobiles and minivans, these methods work well protecting the driver and members of the public, and the intensive, thorough on-the-road training is the key to safety. Unfortunately, people can buy and use, in public areas, any type of power wheelchair or scooter without any compulsory training, testing or licensing. This has resulted in many preventable deaths and injuries.

INJURY and DEATH REPORTS for accidents involving power wheelchairs and scooters are very consistent. The reports show that disabled individuals injured or killed are mostly people with non-technical occupational backgrounds who had received no training or just minimal training. Disabled equipment users with the lowest rates of injury or death were and are individuals who had received intensive user training, or people who hadn't received such training but had, themselves, occupational backgrounds of a technical nature.

RECOMMENDATIONS for ensuring that severely disabled individuals receive safe-driving mobility and driver training:

1. Be sure the engineers or technicians who train disabled drivers are, themselves trained to understand the disabilities, discomforts and physical limitations of their trainees. This may require special training of the trainers by a physician, occupational therapist or nurse.
2. Require all clients to sign a written agreement, before receiving special equipment, that they will complete the training and testing that results in certification as a safe driver or power wheelchair (or scooter) operator. The agreement should authorize removal of the special equipment if these terms are not met.
3. Follow through with equipment removal if the training is not successfully completed. This is necessary to protect the disabled driver and the public. It may also protect the dispensers and trainers, and their organizations or sponsors, from subsequent injury and/or damage claims by a driver, his family, or his accident victims.

4. Always, be open to restarting and completing any training programs that were not completed. Always try to help the disabled client so long as you maintain and meet all necessary and appropriate safety needs.
5. Drivers of automobiles are always tested and licensed by the state. Make certain, however, that the state knows the driver's disability diagnosis and prognosis. Some drivers with progressive disabilities should be required to present to the DMV, new medical reports once a year - and some drivers may need to be retested once a year by the DMV. Both the driver and the DMV should know up front about such needs so they can be noted and scheduled. Drivers whose disabilities and health conditions are not progressive may safely have 2, 4 or 5 year renewal periods, as do non-handicapped drivers. ***We recommend that all disabled drivers have their vehicles serviced regularly to lessen the likelihood of unexpected breakdowns, and that they always have cell phones with them.***
6. Drivers of power wheelchairs and scooters are NOT tested by the state or anyone else – unless they choose to make their own arrangements. We urge that all users of power mobility devices arrange to be tested and retested regularly, also as to vision, reaction times, physical condition and driving skills. Those having progressive conditions need to have this done more often – typically, once every six months. Those with non-progressive conditions should have these reviews once each year, or once in two years. **We recommend that all users of power mobility devices be taught how to examine them each day, before using same ... and how to more rigorously examine and test their machines once a week. All power mobility aids need to be professionally serviced immediately, when repairs are known to be necessary. In addition, each power mobility device should be professionally inspected (preferably by the selling dealer or an agent of the manufacturer) once every three to four months.**

RECOMMENDED READING (related N.I.R.E. papers):

The N.I.R.E.'s Assistive Technology Papers are listed on the internet's ABLEDATA website. Readers may go to the webpage url shown below for selecting, viewing, printing and downloading the N.I.R.E. papers listed on the webpage, at the bottom. Each paper is available in any of three formats on this webpage.

<http://www.abledata.com/abledata.cfm?pageid=89079§ionid=19326>

Mobility Training Safety Papers: *This paper* is intended as a reference for those who prescribe, recommend or dispense mobility equipment, and/or train disabled people to use powered mobility equipment ... including wheelchairs, scooters and automobiles.

**Another, separate paper*, is available that explains in more detail, for disabled consumers, the dangers of, and the training needed by them, for safely using powered mobility devices such as wheelchairs and scooters. This paper is available from the ABLEDATA website - or it can be requested from the N.I.R.E. by e-mail, telephone or regular mail. We recommend both wheelchair mobility training papers, plus other selected papers from the listing below:

* **“Mobility Training for User- and Public- Safety ... with Motorized Scooters and Wheelchairs”** is intended for people using, or planning to use manual or power wheelchairs or scooters. The wheelchair user who understands the various safety issues enjoys more, better and safer mobility. Related N.I.R.E. papers – available on request:

“Motorized Scooters and User Safety”

“Powered Wheelchairs and Residential Fire Safety”

“Powered Wheelchairs and User Safety”

“Public Transportation, Mobility Aids and Passenger Safety”

“Residential and Workplace Accommodations for Quadriplegics”

“Assistive Technology for Quadriplegics”

“Assistive Technology for People with Low-Vision or Reduced Visual Acuity”

“Impaired Night Vision and Night Blindness”

Intensive Mobility Training Saves Lives!

For additional information or free technical support, please email: NIRE@warwick.net
or contact us by regular mail or telephone.

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