Wheelchair transit: an unresolved challenge in a maturing technology

Wheelchair developments have been taking place at an amazing rate, particularly over the past decade. Manual wheelchairs have experienced an explosion of design improvements, mainly focused around the lightweight designs, initially for use by active spinal cord injured users and now by many others. New materials, alternate frame configurations, suspension systems, adjustable features, wheel improvements, and more esthetic designs have all contributed to these improvements. New manual mobility bases for specialized seating and mobility applications have experienced a similar evolution, mainly for younger populations of users. Wheelchairs with standing features are also now common in the marketplace.

Powered wheelchair designs have similarly undergone a significant transformation in terms of powered base and scooter technology, advanced microprocessor-based control options, improved drive trains, new suspension designs, expanded seating options and significant advancements in overall appearance and performance.

A 22-part series of national wheelchair testing standards is essentially in place, providing manufacturers a means of testing the performance of products and then disclosing test information in ways essential for accurate product comparisons (1).

Much still remains to be done. Research is now underway that will lead to the next generation of wheelchair improvements. Studies on biomechanics of wheelchair propulsion (2–6), improvements to control, and guidance systems of, powered chairs (7–11), investigation of secondary injuries due to prolonged manual propulsion, accident prevention (12,13), improvements in battery technology (13,14), and improved evaluation tools and methodologies for selecting appropriate manual and powered products are all on the horizon. Alternate designs for recreation and sports applications (15) and access to recreation environments for wheelchair users (16) are also moving into the mainstream of serious research investigation.

One user-environment that has been largely ignored by researchers and the wheelchair industry is the transportation of wheelchairs in both private and public motor vehicles. The two main unresolved issues are independent access to the vehicles and safety of persons using wheelchairs and other passengers (17,18). The industry standard for securing wheelchair passengers in motor vehicles is the four-belt tie-down system with either integrated or independent occupant restraints. Wheelchair seated drivers are most often secured by floor-mounted docking devices. Belt technology severely limits the independent use of public vehicles, such as transit buses or paratransit vans, since an attendant or operator is required to fasten and disengage the belts. Docking technology, as currently designed, can only work in personal vehicle applications, where mating parts can be added to both the wheelchair and the vehicle. And finally, most wheelchairs were never designed to provide safe seats in the event of
a vehicle collision (19), in spite of the reality that there are rapidly increasing numbers of transit vehicle users as a result of legislation, such as ADA, IDEA, and other positive outcomes of the universal consumer movement.

Research into wheelchair crash analysis leading to improved designs for transit applications is urgently needed (20,21). Methods for expanding the use of securement-docking technology for universal use in both private and public vehicles must lay the foundation for enhanced independence and transit vehicle accessibility (22). Demonstration of practical methods of providing on-wheelchair options for occupant restraints, thereby freeing users from inappropriate vehicle-mounted devices, remains to be done. And finally, forums must be created and nurtured that will bring together the responsible industries (wheelchair, securement, and vehicle) with users and researchers so that common issues can be addressed and national standards of wheelchair transit practice evolved (23).

The foundation work on behalf of wheelchair users and the technology upon which they depend for safe transit has only just begun. Interested parties are strongly urged to join and support this important effort, as we strive to fulfill a remaining void in a rapidly maturing rehabilitation technology.

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REFERENCES