Design of a low cost device to ease use of attendant propelled wheelchairs over difficult terrain

Summary
A need exists for low cost methods of easing travel of attendant propelled wheelchairs over difficult terrain. In this project a device was designed and trialled which went some way to meeting this need. It is hoped that with refinement, the device would be a viable aid to wheelchair users.

Aims & Objectives
The aim of the project was the design and production of a low cost, lightweight device which could be attached to an attendant propelled wheelchair, essentially making it more all-terrain friendly. Specific objectives included researching current devices and factors influencing travel over rough terrain; conception, design and manufacture of a prototype; preliminary testing; and, review of prototype performance.

Background
Design of attendant propelled wheelchairs requires consideration of both the occupant and the individual tasked with propelling them. Pushing an occupied wheelchair is not an insignificant task, often involving manoeuvring considerable weight around obstacles and over uneven surfaces. While it is essential that the occupant is transported safely and comfortably, the needs of the attendant must also be considered, that of being able to propel the chair safely with minimal strain (Cooper, 1995). Attendant propelled wheelchairs are intended to be lightweight mobility aids and are not designed for use over rough ground. If such terrains are accessed, the burden on the attendant is significantly increased. The expense and specialisation of all terrain wheelchairs tends to put them outside the reach of many individuals however there are a number of devices available to make difficult terrain more accessible to standard wheelchair users. Such devices typically utilise a large diameter wheel positioned to raise the castors off the ground. These devices appear to be geared towards more able, self-propelling users and while they are considerably cheaper than all terrain wheelchairs, they are relatively expensive when compared with standard manual wheelchairs.

In developing the design, factors which contribute to increasing the effort of propulsion were considered. A device capable of reducing rolling resistance while increasing stability and not contributing excessively to the overall mass of the wheelchair was identified. It was further established that it should be easy to use, durable, safe and reliable. A number of concepts were created and subjected to a selection process, resulting in the evolution of a single concept which best met the requirements. In the final concept, two 16” diameter mountain bike wheels were added to the chair between the rear wheels and castors. The wheels were located outside the wheelbase of the wheelchair, behind the castors. The occupant’s weight was distributed between the castors and the added wheels. The addition of mountain bike wheels reduced the overall rolling resistance of the wheelchair, making propulsion easier for the attendant.

A preliminary test run was carried out with the assistance of two able bodied volunteers. During the test, one volunteer was seated in the wheelchair while the second volunteer pushed them around a woodland park over a distance of approximately 50m. The test was then repeated with the device in place. The volunteer pushing the wheelchair found propulsion over the bumpy ground to be extremely challenging, with the occupant almost tipped out when a tree root was encountered, and significant effort was necessary to begin movement of the chair. The occupant reported that the ride was relatively comfortable although it was evident that the attendant was struggling. On addition of the device, the attendant reported that propulsion of the wheelchair around the same course was somewhat easier and she was not straining as much to start the chair moving. The occupant

reported that the ride was comparable to the previous trial although felt that it might have been marginally more comfortable with the device.

Discussion

This project was subject to a strict time constraint. If more time had been available, further testing of the device would have been carried out, encompassing a variety of terrains and test distances, before ultimately being assessed by a select number of patients and their carers. There would also have been the opportunity to refine the design between test periods, allowing any issues to be addressed as the testing progressed. In comparing the device against the specified requirements, the majority were met including the fact the device was lightweight (3.6kg) and low cost to produce (£77.30). The adaptation produced was an early prototype, but the testing performed indicated that the concept had potential. It is envisaged that a minimal amount of further work on the device would bring it from the proof of concept stage through to a viable, all terrain adaptation.

Currently there are devices available intended to make manual chairs more all-terrain friendly, however the provision of such devices is outside the scope of the NHS. While the device in this project does not totally alleviate the difficulties associated with the propulsion of an attendant propelled wheelchair over rough terrain, it does go some way towards easing the burden associated with travel over such surfaces. It is hoped that with more testing and further refinement of the design it could be a viable device, allowing users to traverse difficult terrain to do so at a fraction of the cost of devices currently on the market.

Reference

COOPER, R. A. (1995) Rehabilitation engineering applied to mobility and manipulation. CRC Press, USA.

Caroline Newe
Caroline.Newe@ggc.scot.nhs.uk