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Intelligent power wheelchair use in long-term care: Potential users' experiences and perceptions

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Abstract

Purpose—Long-term care (LTC) residents with cognitive impairments frequently experience limited mobility and participation in preferred activities. Although a power wheelchair could mitigate some of these mobility and participation challenges, this technology is often not prescribed for this population due to safety concerns. An intelligent power wheelchair (IPW) system represents a potential intervention that could help to overcome these concerns. The purpose of this study was to explore a) how residents experienced an IPW that used three different modes of control and b) what perceived effect the IPW would have on their daily lives.

Materials and Methods—We interviewed 10 LTC residents with mild or moderate cognitive impairment twice, once before and once after testing the IPW. Interviews were conducted using a semi-structured interview guide, audio recorded and transcribed verbatim for thematic analyses.

Declaration of Interest: The authors report no conflicts of interest.

Results—Our analyses identified three overarching themes: (1) the difference an IPW would make, (2) the potential impact of the IPW on others, (3) IPW related concerns.

Conclusions—Findings from this study confirm the need for and potential benefits of IPW use in LTC. Future studies will involve testing IPW improvements based on feedback and insights from this study.

Keywords

power wheelchair; intelligent power wheelchair; qualitative methods; older adult; cognitive impairment; interview; long-term care

INTRODUCTION

In 2010, there were 4,822,900 adults 65 years of age and older [1]; and, in 2012, approximately 747,000 individuals living with cognitive impairment in Canada [2]. These figures are expected to rise to 9,610,500 [1] and 1,400,000 [2] respectively by 2031. Of the approximate 150,000 older adults living in long-term care (LTC) facilities in Canada currently [3], it is estimated that 60% have moderate to severe cognitive impairment [1] and 50% use a wheelchair [4]. Given our aging population, and the prevalence of cognitive impairment, it is likely that these numbers will also increase.

Limited independent mobility is a common problem among residents of LTC with cognitive impairment [5,6,7]. Mobility limitations are associated with health issues (e.g., pressure ulcers, urinary incontinence) [6], difficulty performing activities of daily living [8], and activity limitation and participation restriction [7]. Residents with cognitive impairment who use assistive mobility devices have greater mobility limitations than residents who do not [5]. Indeed, many residents who use a manual wheelchair for mobility are unable to perform fundamental wheelchair skills that are necessary for mobilizing throughout a LTC facility, such as using an elevator, going through doorways and going over a threshold [9]. Moreover, the appropriateness of manual wheelchair use for LTC residents has been questioned given their slow wheelchair propulsion [9]. These findings were supported by research reporting that wheelchair skills were significant predictors of frequency of participation and life-space mobility among LTC residents who use wheelchairs as their primary means of mobility [10].

Use of a power wheelchair, rather than a manual wheelchair, may address these aforementioned concerns and serve to enhance resident mobility. However, clinicians are often reluctant to prescribe power mobility because of safety concerns that stem from residents' physical (e.g., motor function) [11,12], visual (e.g., visual acuity) and cognitive (e.g., attention, judgment, planning, decision making) deficits [12,13]. In essence, clinicians are concerned about residents' ability to drive in a manner that is safe for both the user and others (e.g., avoiding static and dynamic obstacles).

The problems that many LTC residents with cognitive impairment experience with wheelchair use and the reluctance of clinicians to prescribe power wheelchairs to these residents may be overcome by an intelligent power wheelchair (IPW) system. IPWs are power wheelchairs that are equipped with sensors that can map the environment, detect

obstacles and provide various functionalities such as collision avoidance and autonomous driving along a line or between specified locations [14]. While numerous IPWs have been developed for users with various disabilities [14], we have developed several prototype systems (described elsewhere [15]) that are designed specifically for cognitively impaired older adults in LTC. To date, our early prototype concepts have shown promise in terms of anti-collision and navigation performance in the LTC environment [16,17]. Users performed basic driving tasks [16], perceived workload to be low (e.g., mental demand, physical demand, effort) [16,17], were assisted with wayfinding [18], reported satisfaction with the technology [16, 18] and reported a positive impact on affect and social participation [19]. Further, in comparison to use of a regular power wheelchair, users reduced the number of collisions [17,18]. Despite these positive outcomes, there were also concerns about the technology, including aesthetics [20], slow joystick response time [20], type and timing of joystick feedback [16,19,20], slow speed of the IPW [16,20] and the level/type of control (e.g., semi-autonomous versus autonomous) offered to the driver [16,18]. These concerns require resolution to ensure optimal usability of IPWs for residents with cognitive impairment.

Despite suggestions that a fully autonomous IPW may be frustrating or confusing for our target population, the optimal level of control has been unexplored in the residents' natural day-to-day settings. Thus, our current IPW prototype incorporated solutions primarily to address the concerns regarding the level/type of control offered to the driver. Specifically, our prototype offered three intelligent modes with different levels/types of support [21]: (1) speed correction (i.e., the wheelchair slows down and/or stops to avoid obstacles), (2) heading and speed correction (i.e., the wheelchair steers away from obstacles and provides audio direction prompts) and (3) automatic driving (i.e., the wheelchair completes specific driving tasks without user input while avoiding obstacles). In this study, these modes were simulated by Wizard of Oz methodology, where a hidden researcher remotely modified the speed and/or direction of the wheelchair based on obstacles encountered (rather than sensor data and decision-making algorithms) thus simulating an IPW [22–25]. This methodology was also used to obtain early feedback from users while circumventing technological limitations (e.g., robustness, responsiveness) of current IPWs, which can be time and resource-intensive to overcome.

To develop an understanding of the potential impact of an IPW on residents in LTC settings who face challenges with respect to their health, activities of daily living, and participation in chosen activities, the purpose of this study was to explore a) how residents experienced an IPW that used three different modes of control and b) what perceived effect the IPW would have on their daily lives.

METHODS

Design

We conducted in-depth, semi-structured qualitative interviews as the primary method of data collection. This research was part of a larger CanWheel project (www.canwheel.ca) [21] designed to test user performance and satisfaction with a prototype IPW and gather new

design requirements. The study was approved by the Behavioral Research Ethics Board at the University of British Columbia and the test facilities.

Sites, Sample and Recruitment Procedure

We obtained a volunteer sample of 10 participants from 3 LTC facilities housing 100–200 residents each in the Lower Mainland of British Columbia, Canada. Two of the facilities were multi-floor residences, whereas one facility was a single floor residence that was built on a hill and had sloped hallways that connected different units. Individuals were eligible to participate in the study if they were at least 50 years of age, had a mild to moderate cognitive impairment as indicated by assessments conducted at the test sites (Modified Mini Mental State Exam [score between 11–26], Minimal Data Set - Cognitive Performance Scale or Montreal Cognitive Assessment [score between 10 and 26]), were able to sit in a power wheelchair for two hours per day, were able to operate a joystick and lived in one of the three participating LTC facilities. Residents with mild to moderate cognitive impairment were specifically targeted in order to obtain their distinct perspectives as a means of matching the IPW design with their wants, needs and abilities. Not only can individuals with cognitive impairment report on their unmet needs and preferences, their responses differ from proxy responses [26]. Individuals were not eligible to participate if they were unable to hear audio prompts from the IPW or were unable to communicate in English. Participants were recruited with the help of third-party collaborators at each facility who obtained permission for the study researchers to contact the potential participants. A member of the research team reviewed the consent form and the study protocol with each potential participant and obtained informed consent from those individuals willing to participate in the study.

Data Collection

Participants took part in two interviews, one before and one after testing the IPW in five driving scenarios, in each of its three intelligent driving modes (speed correction, heading and speed correction, and automatic driving). The scenarios, selected from 30 Power-mobility Indoor Driving Assessment tasks [27], included entering an elevator, turning 180 degrees and exiting the elevator, parking under a table, back-in parking, left and right turns at an intersection with an unexpected obstacle and maneuverability. These scenarios present challenges to the target population and were selected based on recommendations by the occupational therapists on the research team. The three intelligent driving modes were simulated using the Wizard of Oz methodology and all participants were informed that the IPW was controlled via tele-operation.

Interviews were conducted using semi-structured guides for the pre-driving and post-driving interviews that were developed by our research team. We incorporated a number of recommended strategies for maximizing the residents' responses [28] including conducting the interview in a quiet, safe space, developing rapport with the resident prior to and during the interview, carefully phrasing and adjusting our interview questions, conducting the interview at a slow and relaxed pace, being flexible with our question order based on the residents' responses, and using illustrative videos (described below).

The pre-driving interview was designed to explore participants' mobility experiences and activities within and outside of the LTC facility and initial perceptions regarding the IPW. To facilitate discussion regarding their initial perceptions and compensate for any lack of understanding or confusion regarding an IPW related to their cognitive impairment, participants were shown three one-minute videos that illustrated each of the three IPW modes. Sample questions included: 'What is your experience of getting around (using your manual wheelchair/power wheelchair)?', 'What activities do you do here?', 'What activities do you have trouble doing or are unable to do because of your mobility?', and 'Would you be interested in having a power wheelchair that prevented you from hitting objects? Can you describe any ideas you have about what it would look like and how would it work?'.

The post-driving interview was designed to explore participants' experiences with driving the IPW in the three modes and their perceptions regarding the potential impact of the IPW on their lives and those of others around them (e.g., other residents, staff, family, friends). To compensate for memory deficits and facilitate discussion during the post-driving interview, participants were shown three one-minute videos of themselves using the IPW in each driving mode. Sample questions included: 'How would this wheelchair feature affect your ability to get around?', 'Where would you go/what would you do using this wheelchair feature?', and 'What did you like most/least about this wheelchair feature?'. Interview questions were open-ended primarily and had a variety of probes. In addition to the qualitative interviews, we collected demographic (e.g., age), clinical (e.g., diagnosis), and wheelchair (e.g., prior wheelchair training) data.

The first two authors, who are occupational therapists and experienced qualitative researchers, conducted the interviews. For consistency, the same investigator interviewed each participant, except for one participant for whom the original interviewer was unavailable for the second interview. All interviews were audio recorded and transcribed verbatim.

Data Analyses

A thematic analysis approach was used to analyze the data [29]. Preliminary data analyses were conducted by both interviewers throughout the data collection process, which involved identification and summary of important patterns and ideas within the data. This method allowed for modification of the interview guides to capture emerging themes. Upon completion of the interviews, more in-depth thematic analyses were conducted [29], whereby both interviewers independently coded and categorized the data, then reviewed each other's codes and categories, and finally collaboratively identified the overarching themes. Further refinement of the themes was conducted through review by all authors.

Trustworthiness strategies were incorporated into our study procedures. First, post-interview debriefing sessions were conducted by four of the authors. These meetings provided a forum for reflective commentaries that facilitated refinement of interview techniques, discussion of initial impressions of the data, and identification of areas requiring further investigation. Second, the diverse professional backgrounds of the investigators (i.e., three occupational therapists, one epidemiologist/occupational therapist, one social scientist, and one computer

scientist) enhanced the credibility of our data collection, data analyses, and ultimate theme development.

RESULTS

Participants

The participants' (n=10) demographic and wheelchair data are shown in table 1, Pseudonyms were used to protect participants' anonymity. The participants' age ranged from 62–98, over half (n=6) were female and most (n=7) used a manual wheelchair as their primary mobility device. The pre-driving and post-driving interviews combined took on average 38 minutes (range: 20–75 minutes).

Themes

Our analyses identified three overarching themes that were generally consistent between the pre- and post- IPW trials. (1) 'The difference an IPW would make' theme explored the potential impact of an IPW on residents' day-to-day lives and included three sub-themes of increased participation, improved safety and enhanced feelings of well-being. (2) 'The potential impact of the IPW on others' theme explained residents' perceptions of how the IPW would affect the LTC facility staff, other residents and friends and family. (3) The 'IPW related concerns' theme portrayed residents' apprehensions regarding the IPW use in the LTC setting and included two sub-themes of technological concerns and personal concerns. In relation to the three themes, the residents spoke mostly about the IPW as whole, rather than mode-specific details. However, when asked specifically about their preferred mode; three participants could not choose between modes, as they felt they would use them all equally depending on the situation; one preferred the speed correction mode; one preferred the heading and speed correction mode; four preferred the automatic driving feature; and one did not feel as though he would use any features and, thus, had no preference.

The Difference an IPW Would Make—All 10 participants described ways in which the IPW would positively impact their day-to-day lives in their LTC facilities. Specifically, our analyses suggested that use of an IPW would lead to increased participation, increased safety, and enhanced feelings of well-being.

Increased participation: Six of the ten participants believed that use of an IPW would facilitate participation in activities within the LTC facility including attending facility-based activities (e.g., exercise class, music class, art class, physiotherapy appointments, bingo, swimming in the pool), visiting friends within the facility, going to the cafeteria and eating meals in the common dining room. Seven of the ten participants believed that the IPW would facilitate participation in activities outside of the LTC facility such as shopping, visiting friends and family, and banking. For five of the ten participants, use of an IPW would enable engagement in activities that they are not able to do in their current wheelchair. For the other half, the participants would continue to engage in the same activities using an IPW but would be able to do so more easily, frequently and independently.

The collision avoidance assistance offered by all three driving modes was considered by all participants to be instrumental in facilitating participation in activities. Specifically, participants reported that the IPW would be beneficial in navigating specific static (e.g., entering/exiting an elevator, parking at a dining room table, ramps) and dynamic (e.g., other wheelchair users and staff in the LTC facility and people on sidewalks and in stores) environmental challenges. The automatic driving mode was also felt to be advantageous in relation to participation in activities, in particular for those residents who have difficulty remembering/finding their way around the facility. As expressed by one participant, John, 'Some residents can't even find their own rooms, especially at night'. According to this participant, an IPW would be of assistance.

Strategic use of the IPW modes was highlighted when John spoke about using the features at various times, such as at the end of the day or at the end of an activity when fatigued or, alternatively, to get to an activity in order to save energy for the activity itself. The value of the dependability of the IPW in relation to residents' decision-making about whether or not to participate in an activity was also illustrated by John when he said, '... I would be assured that I can come back by myself [with an IPW]... because sometimes it's not easy to get someone to help you get back to the room with a manual wheelchair.'

Improved safety: Nine of the ten participants described how the collision avoidance assistance of the three IPW modes would improve safety. For example, Steve stated, 'It [use of the IPW] would be great. I wouldn't hit things. I wouldn't be hit. I could go places and do things.' Betty captured the improved safety for staff when she said, 'I wouldn't be endangering them anymore.' John expressed how being able to move quickly is one of his biggest challenges and, thus, an IPW would be essential in avoiding collisions when he said, 'I wouldn't have to worry so much about hitting any objects... sometimes things appear in short notice.' The IPW would also be good for avoiding collisions in crowds as illustrated by Freda when she said, '... it [the IPW] would help with the traffic jams in the hallways and especially in the dining room! You know, at mealtimes... I have to just wait and you have to look really hard to see an opening to get in so that you're not going to bump into other people...' The collision avoidance was also considered to be important in improving safety outside of the LTC facility such as on busy sidewalks and stores.

Enhanced feelings of well-being: All but one participant described positive feelings associated with the use of the IPW and its potential impact on their day-to-day lives. Jack, whose responses indicated an indifference to the IPW use, was very independent and content with his functional ability in his current power wheelchair. Examples of positive feelings included happiness, amazement, pride, confidence, power, and decreased anxiety. For example, Freda said, 'I think it would make you a lot happier... to have the extra freedom.' and 'I was just a little amazed at myself that I could do that... I've never driven, tried to drive anything...' John articulated, 'I feel proud in the wheelchair [IPW], to move alone without needing anything... I was showing off to the people around me.' and 'It [IPW] would allow me to go anywhere with a lot of confidence.' Betty conveyed, 'I would feel powerful being seen in the IPW.' Linda expressed, 'When it [the IPW] was driving for me,

that was a chance to relax... it made my anxiety go away...' Thus, the majority of participants felt positively toward the IPW.

The Potential Impact of the IPW on Others—Participants varied regarding the extent to which they felt the IPW would impact others. Three participants commented that they felt that the IPW would not impact others at all, while five others described how it would decrease required assistance, worry and frustration. In terms of decreased assistance provision, three participants commented that the staff in their LTC facility were very busy and that use of an IPW would be helpful in that staff would no longer need to assist them with getting to and from their activities and destinations such as art class, the pool, and the cafeteria. Florence described how if she were to use an IPW her family and friends would worry less when she said, 'I think they [participant's family] would be happy that I have it [the IPW]... they wouldn't worry about me... they worry about me now.' Linda discussed how people become impatient and annoyed when they have to wait for a power wheelchair user to move around when she commented, 'They would get all upset... when there's nothing to be upset about... there are some people that are extremely impatient.' She felt that these situations could be eliminated with use of an IPW.

IPW related concerns—Participants also voiced concerns related to using the IPW in LTC facilities, although less so relative to the positive discussions described above. These concerns were of both a technological and personal nature.

Technological concerns: Although all participants could see the benefit of the collision avoidance feature, concerns regarding drawbacks were also voiced. Steve felt that this feature would not be of benefit in all situations. In particular, he explained that the use of collision avoidance in crowded, busy areas of the LTC facility, such as the dining room, would be problematic because '... it [the IPW] stopped everywhere... it would be a rat race... oh, it would be terrible, we're all going somewhere, and you wanna get there, and we wouldn't get to go!' Harold voiced his angst about the IPW not allowing the user to get close enough to objects to perform functional tasks, such as eating at a table, when he stated, 'What if I wanted to put something on the table?' and 'If I wanted to get close to something, maybe the wheelchair would stop me.' Susan expressed her concern over the use of the automatic driving mode outside of the LTC facility when she said, '... too dangerous, it should be used in the building.' Linda was concerned about the IPW malfunctioning, and three participants expressed the importance of the user having the opportunity to choose and override modes as desired.

Personal concerns: There were also IPW related concerns that were more personal in nature. Specifically, there were a variety of concerns related to the IPW controlling the user's mobility. Three participants did not feel comfortable with giving up control, as highlighted by Steve who said, 'I wanted to be in charge' and Rose who stated, 'I like steering on my own.' Harold was concerned about the IPW reacting to the environment unexpectedly or in a way that may be incongruent with how he might respond as indicated by these comments, 'It [the IPW] may do more than I'd expect it to... it might come as a surprise... the wheelchair would be more cautious than I would be, or would need to be...'

Harold also expressed feelings of inferiority related to the intelligence of the wheelchair in comparison to his own impaired cognition, as indicated in this statement, 'In some respects, you would think that the wheelchair is smarter than I am.' Further, two participants did not want to be reminded of their own personal deficits in relation to the IPW's intelligence and control, as highlighted by Freda, 'I know that it's slowing down and I know I'm turning... I don't have to have it tell me I'm doing that. I don't like that. I don't want to be told by this voice that I almost hit somebody.' Finally, Freda was also concerned that the IPW would be an 'attention grabber' and that it would make her feel self-conscious, and Harold felt that others may laugh at him for needing such assistance.

DISCUSSION

This study is the first of its kind to explore the perceptions of LTC residents who have cognitive impairment and use a manual or power wheelchair, regarding a prototype IPW before and after trialing the technology. We were able to explore residents' experiences and perceptions regarding the impact an IPW could have on their daily lives in their LTC setting on a general level. However, apart from obtaining preferences regarding modes, we were less successful in obtaining mode-specific data from this group of participants. This is because participants tended to speak about the IPW in general rather than specific modes. The variety of opinions regarding preferred modes was a noteworthy finding that highlights the importance of customizing the IPW options according to user-specific needs and preferences.

That participants felt an IPW would improve their participation in chosen activities is also an important finding that echoed that of community-dwelling power wheelchair users who provided their perspective of the potential impact of an IPW on social participation based on viewing an illustrative video [30]. Interestingly, participation in LTC activities themselves seemed not to be the challenge, a notion congruent with the fact that activities offered in LTC settings are typically designed to accommodate older adults with motor and cognitive deficits. The difficulty, rather, was getting to and from the activity. In that sense, participants were describing mobility itself as a pre-requisite for participation in activities, a requirement that the IPW would facilitate. The mobility difficulties described by our participants are consistent with Smith and Kirby's report that manual wheelchair using LTC residents in their study were unable to perform the wheelchair skills necessary to travel to and from activities (e.g., going through doorways and over thresholds) and that their participants' propulsion speed was too slow to be an efficient means of mobility [9]. Enabling participation in chosen activities would be a beneficial outcome of IPW use, especially given the positive impact of personal control and choice on quality of life, such as that which accompanies a decision to independently mobilize to a desired activity [31]. Indeed, residents who are not independent for their mobility often have little control over where they are taken and how long they are left there, a consequence of low staff to resident ratios [32].

The power wheelchair safety concerns identified by participants in this study were in keeping with those previously identified by prescribers [12,30,33], wheelchair users [30,33] and caregivers [30,33]. For example, the challenge of managing a power wheelchair in crowded areas and its associated safety risks is a common theme. It is important to note,

however, that LTC residents may not have the option of avoiding crowds, a strategy often implemented by community-dwelling power wheelchair users [30]. In contrast, as a consequence of living in an environment with a regimented routine, residents encounter crowds daily at mealtime, as described in this study and others [33, 34]. Minimizing the discrepancy between residents' abilities and environmental demands, through the collision avoidance offered by all three intelligent modes, would likely decrease the daily frustrations of enduring this situation and have a positive effect on their well-being. The enhanced feelings of well-being described by participants in this study, especially those related to decreased anxiety, provide support for this point.

Our findings suggest that use of an IPW among LTC residents could have an equally positive impact on facility staff, other residents, and family and friends. For example, a number of studies report that workload is a key factor leading to job dissatisfaction among nursing staff in LTC [35–37]. The decreased demands required for assisting residents with their mobility may improve job satisfaction and, in turn, improve the care provider-resident relationship as a result of decreased wait times for other care needs [38]. Further, participants' descriptions regarding the usefulness of an IPW in LTC related to improved safety for other residents and staff confirms similar findings by Wang et al [39] who interviewed LTC staff and residents as part of a study designed to evaluate a contact sensor skirt for an anti-collision power wheelchair.

The technological concerns expressed by our participants provide insights to allow us to further refine our IPW. The need for context awareness in relation to collision avoidance, such as allowing users to get close enough to static objects for functional purposes (e.g., parking at a table for meals), has been feedback proposed in a previous IPW study [33]. However, the comments regarding the potential 'constant stopping' in crowded areas provided a new insight. It highlights a challenge that may be unique to LTC settings, where there is the potential for many IPW users in confined spaces with few, if any, options for alternate routes. Participants' remarks related to concerns around control, reminders of their own deficits and the perspectives of others indicate that there may be an adjustment period related to use of an IPW. This notion is akin to that of transitioning into a regular power wheelchair, as found by Stenberg et al [40]. The transition to an IPW, however, may be even more challenging, given its increased control over the users' mobility.

There were several limitations to this study. First, participants included a small sample of individuals from only three facilities and, thus, our results are not generalizable to all LTC facilities. Second, the demographic data were collected via self-report and, therefore, the information may not be completely accurate. Third, the participants trialed the IPW under supervision, for specific tasks, and did not have the opportunity to use it independently in their daily lives. While this procedure may have limited participants' abilities to project the potential impact of the IPW, all residents were able to describe personal situations that would be improved through use of the IPW. Fourth, the fact that the participants were supervised while using the IPW may have led to feelings of either enhanced safety or, in contrast, performance anxiety. Unsupervised use of the IPW should be tested in future studies (after ensuring all safety risks have been addressed). Finally, conducting qualitative interviews with individuals who have mild to moderate cognitive impairment can be

challenging given their changes in memory, language abilities (e.g., word finding or comprehension difficulties) and abstract thinking [41]. However, we found that using strategies for maximizing the residents' responses and, in particular, showing the residents videos of themselves using the IPW in the post-driving interview seemed to be a good means of enabling recall and discussion. Nevertheless, the videos seemed to be most effective at facilitating discussion regarding the IPW in general, rather than generating mode-specific information. The videos were also most effective at promoting discussion specific to the impact of the IPW on themselves, rather than its potential impact on others. Regardless, we felt that obtaining the perceptions of LTC residents with cognitive impairment, as the end users of the IPW technology, outweighed the challenges or limitations, given that this population is normally excluded from research studies. Interviews with nursing staff of LTC facilities, as well as residents' friends and families, may provide further insights regarding this IPW prototype and its use among LTC residents with cognitive impairment.

CONCLUSION

In this study, 10 LTC residents identified enhanced participation, improved safety and feelings of well-being as potential benefits of an IPW in their LTC setting. Positive impacts on others were identified as decreased need for assistance, worry and frustrations. Equally valuable were the residents' insights regarding possible challenges of the IPW in a LTC setting, as they provide us the opportunity to continue to improve our IPW design. Findings from our study confirm the need for and potential benefits of IPW use in LTC. Future studies will involve testing improvements to our IPW prototype based on feedback and insights from this study with the ultimate goal of enhancing mobility and quality of life of LTC residents with cognitive challenges.

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Abbreviations

IPW	intelligent power wheelchair
LTC	long-term care

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Implications for Rehabilitation

- Intelligent power wheelchairs may enhance participation and improve safety and feelings of well-being for long-term care residents with cognitive impairments.
- Intelligent power wheelchairs could potentially have an equally positive impact on facility staff, other residents, and family and friends by decreasing workload and increasing safety.

Table 1

Participants' demographic and wheelchair-use characteristics

Subject Pseudonym	Age (years)	Sex	Education	Primary mobility device	Years using primary mobility device
John	65	Male	U	MWC	2
Freda	79	Female	HS	MWC	Unknown
Florence	84	Female	HS	PWC	2
Jack	66	Male	U	PWC	2
Susan	70	Female	U	PWC	2
Linda	98	Female	HS	MWC	2
Betty	62	Female	HS	MWC	8
Harold	64	Male	HS	MWC	14
Steve	63	Male	>HS	MWC	3
Rose	68	Female	HS	MWC	5

U=university; HS=high school; MWC=manual wheelchair; PWC=power wheelchair