Symposium: Aging and Disability

Designing Technology Solutions to Support Caregivers R. M. Mudar (Convener). *Gerontechnology 25(s)*

PARTICIPANTS E.T. Remillard (USA), L.A. Rice (USA), P. Bhowmick (USA), R.A. Mudar (USA). **ISSUE** Globally, over 100 million (29%) older adults 60 years of age or older rely on informal caregivers, often family members or friends, for assistance with daily activities [1]. These caregivers provide essential support with tasks ranging from personal care to medication management. These caregivers frequently experience high levels of stress and diminished physical, cognitive, and psychosocial well-being as the demand of caregiving grows. Advances in technology offer promising avenues to support caregivers with these everyday activities provided these technologies are carefully designed to meet the unique needs and preferences of this population. **CONTENT** Our symposium is designed to bring together speakers from the USA on the theme of using technology to support caregivers in their everyday activities. The speakers will address: 1) caregiving challenges among older adults with disabilities and implications for technology design 2) considerations for developing technology to support and better monitor their care-dependents, and 3) reduce care demands and promote well-being. **STRUCTURE** Remillard will present findings from the Aging Concerns, Challenges, and Everyday Solution Strategies (ACCESS) study, a large-scale mixed-method investigation of older adults (60+) aging with long-term sensory and mobility disabilities.

Remillard will highlight areas of unique challenges faced by caregivers who themselves have disabilities, a group often overlooked in caregiving research, and their unmet needs that create opportunities for technology innovations. Rice will discuss findings from a study examining caregiver perspectives on WheelSafe, a fall-detection system created for older adults who use wheelchairs or scooters full time. Falls pose a serious risk for this population, yet current automated detection devices often fail to accurately identify incidents. Rice will share caregivers' views on WheelSafe's usability and usefulness, discuss areas of improvements that inform design refinements to better support fall prevention. Mudar will describe a two-phase needs assessment study that informed the design of CaP-MEDSReM, a companion mobile application for caregivers of persons with cognitive impairment to monitor medication adherence. Often caregivers oversee medication management and technology solutions would allow remote medication management when care dependents are in early stages of cognitive impairment. Mudar will discuss feedback provided by caregivers on perceived usefulness and usability that guided iterative design

improvements, resulting in the development of functional prototype tailored to caregiver needs. Bhowmick will present a case study evaluating the impact of an assistive robot (Stretch mobile manipulator) on caregiver well-being and daily functioning. She will discuss the positive outcomes after a month of sustained engagement with Stretch across domains of self-care, productivity, and leisure demonstrating that assistive robotics can meaningfully support caregivers by reducing burden, improving task coordination in home environments as well as caregiver well-being. **CONCLUSION** The symposium will present interdisciplinary perspectives on developing and implementing technologies to support informal caregivers, reduce care burden, and promote autonomy and well-being for both caregivers and their care recipients.

References
1. World Health Organization. Evidence profile: caregiver support. In: Integrated care for older people: guidelines on community-level interventions to manage declines in intrinsic capacity. Geneva: World Health Organization; 2017. Available from: https://www.who.int/publications/i/item/9789241550109

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Caregivers Aging with a Disability: Challenges and Opportunities for Technology Innovation
E.T. Remillard, M. Raj, K.A. Miller, & W.A. Rogers. *Gerontechnology* 25(s*)*

Purpose Family caregivers (e.g., for a spouse/partner, adult child, grandchild) are often responsible for supporting their care recipient with daily tasks such as activities of daily living (e.g., bathing, dressing) and instrumental activities of daily living (e.g., transportation, medication administration). For older caregivers (i.e., age 60 and older), caregiving responsibilities can be especially challenging as they must also manage their own age-related declines (e.g., mobility, hearing, vision, cognition, strength) and health conditions. Little is known about how caregivers' functional limitations impact their ability to care for others. One particularly understudied group of older caregivers, who could benefit greatly from supportive technologies, are those who have long-term disabilities, as these individuals are likely to experience complex activity challenges [1]. The objectives of this study were to explore and compare challenges that older adults with long-term sensory and mobility disabilities face in their caregiving responsibilities. **Method** The Aging Concerns, Challenges, and Everyday Solution Strategies (ACCESS) study is a large-scale, mixed method exploration of user needs among adults aging with disability in everyday activities [2]. The ACCESS sample contains older adults (60+) with long-term (10 years+) disabilities including vision, hearing, or mobility impairments. The current analysis focused on those participants who identified 'caring for others' as one of their most difficult activities (n=85), and discussed associated challenges, as well as how they manage these challenges in-depth. We conducted a thematic analysis to assess common challenges and response strategies. **Results and Discussion** For participants with vision impairment, challenges were primarily related to the inability to read information (e.g., medicine bottles) and see environmental cues (e.g., messes, location of utensil relative to mouth for feeding assistance), transportation (e.g., not being able to drive their care recipient), and the extensive time/logistical demands required to care for someone (e.g., advanced planning). For participants with mobility impairments, physical challenges to caregiving were reported (e.g., physical stamina to clean, strength to help someone up). Some also reported emotional challenges related to their inability to care for others despite their desire to do so. For participants with hearing impairments, challenges predominately stem from communication issues with healthcare providers (e.g., access to an interpreter, speech-to-text translation) and noticing alerts (e.g., baby monitor, health monitoring devices). Though the demands and associated physical and mental impacts of caregiving are well established in the literature, the challenges of caregiving among caregivers with long-term disabilities are understudied. Findings highlight unmet needs of caregivers aging with disabilities that represent opportunities for technology innovation. Based on these challenges, the most critical opportunities include: monitoring devices with multi-modal alerts (e.g., audio, vibration, lights) for individuals with sensory impairments, tools to support physical caregiving tasks for individuals with mobility impairments (e.g., lifting heavy objects, re-positioning a care recipient), access to communication technologies for individuals with hearing impairment, and technologies to support reading and environmental awareness for individuals with vision impairment.

References
1. Rice, L. A., Mitzner, T. L., Sanford, J. A., Remillard, E. T., & Rogers, W. A. (2025). Designing for the Intersection of Aging and Disability: Application of the TechSAge Technology Intervention Model. *The Gerontologist, 65*(7), gnaf109. https://doi.org/10.1093/geront/gnaf109
2. Koon, L. M., Remillard, E. T., & Rogers, W. A. (2025). Understanding Everyday Challenges of Aging With Disability Through Lived Experiences. The *Gerontologist, 65*(7), gnaf129. https://doi.org/10.1093/geront/gnaf129

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Care Partner Preferences on the Design and Development of Fall Detection System for Older Adults who use Wheelchairs L. A. Rice, D. Peeler, A. Tangonan, S. Shi, P. Presti. *Gerontechnology* 25(s)

Purpose Falls are a concern for older adults who use wheelchairs or scooters (WC/S) full time. In the US, ~1 million older adults use a WC/S [1]. Among people who use WC/S,~60% will experience a fall [2]. After a fall, people who use WC/S spend an average of 9 minutes (range: 1-45 min) on the floor, with 80% needing assistance to recover [3,4]. Prolonged time on the ground after a fall is linked to higher risks of future injuries, long-term care admissions, and death [5]. Automated fall detection devices can provide timely assistance and reduce the severity of prolonged falls. Although widely used among ambulatory populations, existing automated fall detection devices do not accurately identify falls among people who use WC/S [6]. To address this, our team developed WheelSafe, a system designed to detect falls among older adults using WC/S and to track fall frequency and circumstances [7]. Care partners play crucial roles in fall prevention and recovery. Therefore, their input is vital to the design and development of WheelSafe. This study aims to explore care partners' preferences regarding the usability and usefulness of WheelSafe.

Methods Care partners of older adults who use WC/S were recruited to participate in a focus group to give feedback on the initial WheelSafe design. Participants watched a brief video explaining WheelSafe and engaged in a semi-structured interview to provide feedback on general design, notification methods, data access, and the perceived benefits of the system. Three researchers with backgrounds in rehabilitation science, disability studies and industrial design conducted a thematic analysis of participant responses [8].

Results and Discussion Ten care partners who provided care to older adults who use WC/S for at least one year participated. Three main themes emerged: Usability, Usefulness, and Areas for Refinement. Regarding usability, participants appreciated the system's design but felt that the amount of information required to input after a fall could be overwhelming, suggesting fewer questions and more intuitive input methods such as voice-to-text. Access to the data was considered essential, with strong interest in detailed fall histories, including causes, locations, and contextual notes. In terms of usefulness, care partners viewed the system as innovative and believed it could significantly enhance safety and support aging in place. They emphasized that care partners should be able to add details about fall circumstances and potentially edit responses provided by the end-user. Lastly, participants proposed areas for improvement, including leveraging the phone's features to support tracking, using sensors to detect risky movements before a fall, and recording features such as voice and video to capture richer details. Care partners see high potential for WheelSafe to improve the support they provide to older adults and to serve as a valuable tool for promoting aging in place.

References

1. Nie Q, Rice LA, Sosnoff JJ, Shen S, Rogers WA. Understanding Wheelchair Use in Older Adults From the National Health and Aging Trends Study. Archives of Physical Medicine and Rehabilitation. 2024;105(3):514-24.
2. Kirby RL, Ackroyd-Stolarz SA, Brown MG, Kirkland SA, MacLeod DA. Wheelchair-related accidents caused by tips and falls among noninstitutionalized users of manually propelled wheelchairs in Nova Scotia. American Journal of Physical Medicine & Rehabilitation. 1994;73(5):319-30.
3. Rice LA, Peters J, Sung J, Bartlo WD, Sosnoff JJ. Perceptions of Fall Circumstances, Recovery Methods, and Community Participation in Manual Wheelchair Users. Am J Phys Med Rehabil. 2019;98(8):649-56.
4. Rice LA, Sung J, Peters J, Bartlo WD, Sosnoff JJ. Perceptions of fall circumstances, injuries and recovery techniques among power wheelchair users: a qualitative study. Clin Rehabil. 2018;32(7):985-93.
5. Bisson EJ, Peterson EW, Finlayson M. Delayed initial recovery and long lie after a fall among middle-aged and older people with multiple sclerosis. Arch Phys Med Rehabil. 2015;96(8):1499-505.
6. Abou L, Fliflet A, Hawari L, Presti P, Sosnoff JJ, Mahajan HP, et al. Sensitivity of Apple Watch fall detection feature among wheelchair users. Assist Technol. 2022;34(5):619-25.
7. Abou L, Fliflet A, Presti P, Sosnoff JJ, Mahajan HP, Frechette ML, et al. Fall detection from a manual wheelchair: preliminary findings based on accelerometers using machine learning techniques. Assistive Technology. 2023:1-9.
8. Braun V, Clarke V. Using thematic analysis in psychology. Qualitative research in psychology. 2006;3(2):77-101.

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User-Centered Needs Assessment for Designing and Refining the Care Partner Medication Education, Decision Support, Reminding, and Monitoring (CaP-MEDSReM) System J. Shim, R. Bhadrachalam, S. Nippani, C. Smith, O. Boamah, R. A. Mudar. *Gerontechnology* 25(s)

Purpose Medication adherence for chronic, asymptomatic conditions such as hypertension is a persistent challenge among persons with mild cognitive issues (PwCI), which increases their risk of accelerated cognitive decline [1,2]. Informal caregivers (e.g., spouses, adult children), often assume responsibility for supporting medication management [3]. Caregivers support adherence both directly and indirectly. Initially, their role may be observational, including tracking medication intake, noting missed doses, providing reminders, or identifying confusion with complex regimens as needed. As cognitive impairment progresses or fluctuates, their involvement typically increases, shifting from passive reminders to more hands-on management. One promising strategy to support medication adherence in PwCI is leveraging mobile health (mHealth) technology for self-management and unobtrusive caregiver monitoring. We are currently testing the efficacy of an mHealth tool called Medication Education, Decision Support, Reminding, and Monitoring-Memory (MEDSReM-M) system, designed to support hypertension medication self-management in PwCI, in a clinical trial. The goal of this study was to understand caregivers' needs and preferences to design a companion mHealth tool for caregivers, called Care Partner Medication Education, Decision Support, Reminding, and Monitoring (CaP-MEDSReM) to facilitate shared medication management. **Method** Based on input from subject matter experts and a literature review on caregiver roles, challenges, and technology preferences, we created mockups of the proposed application (app) and a demonstration to gather feedback during the first round of needs assessment. These mockups illustrated the app workflow, including onboarding, features such as nudges and tracking, and educational materials. In the first iteration, six remote semi-structured interviews were conducted with caregivers of PwCI (average age: 63.6 ± 3.88 years). After viewing a demonstration of the app, caregivers provided feedback on perceived usefulness and usability. Interview data were analyzed to identify facilitators and barriers to app use and assess needs and preferences. Based on this feedback, the team refined the app to better address user needs and developed a new prototype. A second iteration of interviews was conducted with five caregivers (average age: 44 ± 17.31 years) using the refined prototype. These interviews obtained detailed feedback, including user-driven design modifications for specific features. **Results and Discussion** In the first round of needs assessment, caregivers reported high usability and perceived the app as a supportive companion tool. Core functions including onboarding, caregiver notifications, and medication tracking received the highest ratings for usefulness and ease of navigation. Monitoring, encouragement, and the learning module scored slightly lower, with participants noting a need for greater personalization to align with diverse caregiving roles. In the second round, caregivers again rated the updated app as highly intuitive, citing improved interaction design and workflow efficiency. They valued features such as nudges/reminders, medication intake tracking, and refill alerts, and highlighted the app's clean visual layout and customizable settings, including reminder preferences and access to educational content. Feedback emphasized the importance of adaptive design, with suggestions for offline functionality, smart device integration, and accessibility enhancements for users with physical limitations, elements currently under consideration to optimize inclusivity and universal usability. Overall, results indicate strong perceived utility of CaP-MEDSReM in supporting medication adherence for PwCI, with caregivers recognizing its potential to reduce cognitive and operational burden in medication management.

References
1. Campbell NL, Zhan J, Tu W, Weber Z, Ambeuhl R, McKay C, McElwee N. Self-reported medication adherence barriers among ambulatory older adults with mild cognitive impairment. Pharmacotherapy. 2016;36(2):196-202. doi:10.1002/phar.1702.
2. Cheng YW, Chiu MJ, Chen YF, Cheng TW, Lai YM, Chen TF. The contribution of vascular risk factors in neurodegenerative disorders: from mild cognitive impairment to Alzheimer's disease. Alzheimer's Res Ther. 2020;12(1):91. doi:10.1186/s13195-020-00658-7.
3. Gillespie R, Mullan J, Harrison L. Managing medications: the role of informal caregivers of older adults and people living with dementia. A review of the literature. J Clin Nurs. 2014;23(23-24):3296-3308. doi:10.1111/jocn.12519.

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Beyond the 'Primary User': A Caregiver–Centered Case Study of Stretch Robot in Home Care

P. Bhowmick, S. A. Olatunji, V. Nguyen, R. A. Mudar, J. Evans, W. A. Rogers. *Gerontechnology* 25(s)

Purpose Care partners play a critical yet often invisible role in long-term home-based caregiving. Robotics research commonly focuses on the primary user while overlooking the lived experiences, identities, and occupational needs of their care partners. We report a case study of an older adult full-time caregiver, Mrs. E., caring for her husband, who is non-speaking with quadriplegia. Mrs. E's identity is frequently collapsed into a single caregiving role despite her additional roles as an individual, spouse, mother, grandmother, and friend. We evaluate how an assistive robot (a Stretch mobile manipulator, designed by Hello Robot™) can support her daily life activities, enabling autonomy, reducing care demands and creating opportunities for meaningful engagement. We assessed whether using Stretch affected her performance and satisfaction across tasks. **Method** We used the Canadian Occupational Performance Measure (COPM) [1] to obtain ratings of performance and satisfaction for tasks identified by Mrs. E. as important. This 1–10 scale is traditionally used by occupational therapists with patients, but we found it valuable for a caregiver-centered evaluation. Through qualitative interviews and COPM ratings, we identified tasks Jane wanted, needed, or was expected to perform but could not do or was dissatisfied with, prior to robotic support. The assessment focused on key domains of self-care (personal care, functional mobility, community engagement), productivity (paid and unpaid work, household management), and leisure (quiet and active recreation, socialization). Jane completed baseline COPM ratings and a second assessment, a month later, after sustained interaction with Stretch. Differences in performance and satisfaction were analyzed to understand the robot's impact on caregiver well-being and daily functioning. **Results and Discussion** We observed substantial gains across nearly all domains, demonstrating that assistive robots can meaningfully support care partners, not only care recipients. Stretch's ability to autonomously retrieve, carry, position, and stabilize objects reduced Jane's physical and time-critical caregiving demands, enabling not just task relief but the restoration of personally meaningful activities. We categorized these improvements into four areas. 1) <u>Self-care</u>: Before Stretch, Jane rated her opportunity to exercise, a top personal priority, as 1 in both performance and satisfaction. After the intervention, these ratings rose to 10. Stretch acted as an exercise coach and motivator. Jane emphasized that the robot's countdowns, tactile cues, and interactive pacing transformed exercise from something she avoided into something she looked forward to, describing Stretch as a "motivating factor". Stretch's autonomous item retrieval substantially reduced her physical workload. 2) <u>Household management</u>: Tasks such as transporting laundry, previously rated 5, increased to 10 because Stretch could carry several items across the house, replacing multiple trips Jane formerly had to make. She appreciated Stretch's ability to carry items from the kitchen during meal preparation, noting that the robot consistently assisted in ways that were reliable, safe, and predictable. 3) <u>Socialization</u>: With Stretch present, Mrs. E's husband could independently participate in activities such as playing cards, playing on "his own team", allowing her to engage in conversation, maintain social connections, and experience meaningful interactions beyond her role as caregiver. With reduced physical and cognitive load, Mrs. E regained access to restorative leisure activities. 4) <u>Reading</u>: This was initially rated 1 but increased to 10 after interaction with Stretch. Even though Stretch was not directly involved in the reading task, its support in other areas enabled Mrs. E to engage in something she enjoyed, which she seldom had time for. This reflected renewed time, energy, and emotional bandwidth for quiet recreation. Overall, this case study illustrated how robotics interventions can substantially enhance care partner well-being, autonomy, and task coordination. It highlighted transferable insights for designers and researchers working on assistive robots in home care contexts. It shows, evaluating robots solely on task completion underestimates their real-world impact. Additionally, meaningful caregiver outcomes often arose indirectly, through enabling care recipient autonomy or freeing time for activities unrelated to the robot itself, pointing to the need for evaluation frameworks that capture second order and systemic effects. By foregrounding the care partner's experiences, this work highlights the need to expand human–robot interaction research beyond care recipients to include care partners as central beneficiaries of assistive robotic systems. This holistic approach can advance design and acceptance of robots designed for home environments.

References

1. Law M, Baptiste S, Carswell A, McColl MA, Polatajko H, Pollock N. *Canadian Occupational Performance Measure*. 5th ed, revised. Ottawa: COPM Inc; 2019.

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