Universal design as an approach to sustainable gerontechnology

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Purpose Toileting and bathing have long been associated with successful aging at home (e.g., Harris, et al., 2015; Yang and Sanford, 2012). The majority of assistive technologies to support self-care activities among older adults, such as grab bars, commode chairs and tub benches, are specialized devices that are typically non-residential in character and fixed in place or difficult to adjust. This approach to integrating non-adaptable specialized technologies into existing living environments has implications not only for adoption and acceptance, but also for disuse, abandonment, and replacement as individuals' functional abilities may vary unpredictably and decline over time. In contrast, universal design, which is everyday design, presents an approach to the development of more sustainable technologies that are not only compatible with residential environments, but are useful and usable across the lifespan of both an individual and the product. This paper will contrast universal design to traditional specialized design of gerontechnologies, highlighting examples from 3 ongoing self-care projects in the Rehabilitation Engineering Research Center TechSAge to develop user-controlled, adjustable, and repositionable toilet and bathing technologies that can be seamlessly integrated into bathroom environments. **Method** Voice-controlled adjustable technologies with embedded force and pressure sensors for data collection, including a toilet/grab bar to aid transfers and a repositionable bathtub/grab bar system that enables transfers to the tub or converts to a curbless shower to enable use of a shower chair, have been constructed and installed in the Georgia Tech AwareHome. In addition, a plug-and-play, camera-based soft robotic shower head on a flexible hose that will enable voice-controlled or automatic hands-free washing, is in the modeling phase prior to installation at the University of Illinois LIFE Home. The three projects use repeated measures designs of simulated use to demonstrate usability and usefulness of prototype technologies. To date, repeated trials have been conducted in which 15 ambulatory older adults with mobility limitations transfer to/from the toilet system using the minimum U.S. code-based configuration (17"/43.18 cm toilet height and 33"/83.82cm grab bar height) and up to three user-adjusted configurations to identify the user-preferred configuration. **Results and Discussion** Balance and stability can be determined by the distribution of body weight on the seat as measured by the mean area of pressure in the seat (Palmer, Knight, & Perring, 2010), where the smaller area of pressure indicated greater stability and balance. Using the embedded sensors to measure and analyze the area of the ellipse generated by the change in center of pressure or movement of users on the seat (Silva et al., 2017), preliminary analyses indicate that higher seat and grab bar height in the preferred configuration had a smaller mean area of pressure (0.0671) than the standard configuration (0.0771). Although not statistically different, the trend suggests that seat and grab bars located at heights greater than the standard code configuration may lead to better stability during toilet transfer and sitting. Whereas the preliminary analysis examined mean area of pressure from initial seat contact to offloading, we expect to find significant results when data are analyzed at each distinct transfer stage, lowering (i.e., initial contact), stationary sitting, and rising (final contact). Current assistive technologies that are fixed in place or difficult to adjust may not effectively accommodate unpredictable fluctuations in functional abilities of older adults. In contrast, universal design user-controlled adjustable technologies present a more sustainable approach as they not only have the potential to be seamlessly integrated into any bathroom environment, but also have the potential to be useable and useful for any user at any point in time.

References

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