Functional Changes in Older Adults: Impact on Home Technology Design

Victor A. Hirth, MD, MHA, FACP[1]

[1]University of South Carolina / Palmetto Health Geriatrics, Columbia, SC, USA

Abstract: The aging demographic being experienced by all western countries has significant impact on health care utilization as well as the ability to remain in independent living situations. Chronic medical conditions and functional disability impair older adults' ability to remain independent. Ambient assisted living technologies may help less the burden of disability and increase the likelihood of older adults remaining independent into their later years.

1 Introduction

As people get older the number of diseases and conditions they may accumulate increases. Diseases such as hypertension, arthritis, diabetes, Alzheimer's disease and osteoporosis are very common in the older population. Along with this functional disabilities such impaired mobility, falls, memory loss and weakness become more common as well.

Consequently, these diseases are also associated with leading causes of death. In the US, the leading causes of death are heart disease, cancer, stroke and lung disease. Alzheimer's disease was the 5th leading cause of death in 2004 (most recent data), up from number 7 just a year earlier[1]. Similarly, in England and Wales the leading causes of death were heart disease, stroke, cancer and dementia[2]. High income countries in Europe had similar results with heart disease, stroke and dementia as the top 3 leading causes of death, respectively.

2 Common Medical Conditions: Dementia

Given the increasing frequency of death caused by dementia it is important to understand what this term means. Dementia is an umbrella term for memory loss plus loss of one other cognitive function. These other functions include executive function, that is the ability to recognize a problem, formulate solutions and test the strategies, language difficulty in either understanding or expressing words or phrases and orientation to person, place or time. Of the types of dementia, Alzheimer's disease is the most common.

Practical points to remember about Alzheimer's disease include its generally slow and progressive nature, though this can be highly variable, the fact that the prodrome is usually quite long and that the first deficits to appear are usually not necessarily memory related. It is not unusual to find that hobbies or other outside activities, the ability to pay bills in an organized and timely manner and social

interactions are the first things to decline. Only later is overt memory loss noted by family members or others.

Items of interest as they relate to the Smart Home include the opportunity for intervention with cognitively impaired persons from early to late, as well as the fact that cognitive training works in early as well as late stage demented persons. Physical activity is one aspect that should not be overlooked as benefiting brain health in both healthy and cognitively impaired individuals.

3 Visual Problems as a Contributor to Disability

Other problems that are common but less often realized as contributing to physical dependence include eye diseases such as macular degeneration, glaucoma and cataracts as well as hearing loss and diminished taste. Advanced glaucoma impairs vision by reducing peripheral vision such that only central vision remains intact. Macular degeneration has the opposite effect with sparing of peripheral vision by loss of the high acuity central vision that is necessary for viewing fine detail. Cataracts, depending on their location in the lens of the eye can obstruct central or peripheral vision and most notably can cause significant glare especially at night. Other issues and concerns regarding older adults include geriatric syndromes such as falls and instability, immobility, incontinence, confusion, polypharmacy, malnutrition and failure to thrive also called frailty.

4 What Physicians Would Like to Know

Physicians would be interested to know what is happening to their patients in the home environment, however, the background and training of the type of physician will impact what type of information he or she might want. Geriatric doctors would want to know about falls, changes in eating or drinking, alterations in sleep patterns, social withdrawal or reduction in interactions, medications and their side-effects and well as the person's social support network. Other health care providers might be satisfied to know vital signs and weight changes which typically are late indicators of disease states, presence or absence of injury, medication and what is the chief complaint, i.e. "what's wrong."

5 Case Discussion of an Older Person and what "Smart" Technology May Offer

Case: An 82 year old woman, widowed for the past 10 years lives in her own home with her cat. Her vision is poor due to macular degeneration and consequently she has difficulty reading the labels on her medication bottles. She has diabetes that she manages with insulin and her daughter prepares her syringes for her. She doesn't drive, is homebound and recently has lost 5 kg in the past month. She does not want to move to another living situation. Yesterday she had her first fall going to the bathroom and skinned her elbow. She was able to get up with great difficulty. Her daughter is very concerned and wants her to move to a more supervised living setting.

Evaluation and management of this situation involves recognizing and categorizing her problems. Her problems include social isolation, poor vision, challenges with diabetes management, poor mobility, weight loss and her recent fall.

The assessment of these problems would include for the social isolation, interviews of both her and her family as well as social contacts she may have. The vision problems would be assessed by a visit to the eye doctor testing her functional vision and looking at the r home for adequacy of lighting, contrast between surfaces and colors. Her diabetes would be evaluated by blood testing and reviewing her blood sugar monitor use. Mobility would be assessed by watching her walk, testing her strength and asking her what types of activities give her the most difficulty. Weight loss would be evaluated by ruling out medical disease, asking about her diet and shopping habits as well as inquiring as to the difficulty in obtaining foods and if foods taste good or not. The fall also would be evaluated to ensure that no acute medical condition had caused the fall as well as performing mobility and strength evaluation and a home environment assessment and reviewing potential contributing factors.

     Potential solutions to these problems include a home health aid, senior volunteer or offering transportation to local church or senior activity group activities. The vision problems could be addressed by having her medications prepared in advance and ensuring that her home is safe to walk about given her vision difficulties. Diabetes management would include obtaining a glucose monitor that provide audio read out of blood sugar results and continued insulin preparation by her daughter. Mobility and physical function would be remedies by physical therapy for gait and strengthening as well as enrollment in an ongoing physical activity program. Weight loss would be tracked and monitored in addition to finding opportunities to increase calorie intake. Her recent fall treatment would include the physical therapy treatment as above as well as evaluating and treating the precipitating conditions such as in this case a urinary tract infection.

     What might the Smart Home do? Addressing social isolation would still be a potentially complex problem probably not remedied by a robotic dog or access to chat rooms. Vision deficits could be ameliorated by contrast enhanced lighting in addition to lighting that followed the person, like on a stage as well as audio controls for common household items such as the stove or heat which typically require fine vision to see the settings. A system for optimal diabetes management might be like the following example. "Your blood sugar was 165 mg/dl, you should take 6 units of regular insulin, and your insulin syringe will be prepared for you in the refrigerator in 30 seconds." In regard to poor mobility, the Smart Home designers should exhibit caution. The opportunity to worsen physical function by replacing or assisting physical function that otherwise might occur should be avoided. Perhaps the system would provide mobility reminders such as, "Get up and sit down 10 times." And, if the system detects low or incomplete effort it might say, "You're not trying." For her weight loss, the system might monitor food and liquid intake and provide reminders to increase calorie intake as well as calorie tracking. For the prevention of falls, the system might track changes in gait or mobility and have safety interventions such as fall notification or fall prevention systems that it could implement.

     Smart Home goals should include different optimization for different populations. For healthy residents a system that encourages optimal physical activity, social engagement and a reasonable diet might be sufficient. For older adults with frail health and conditioning modalities would be helpful. The potential for Smart Home technologies to improve the health and well being of older adults as well as potentially

save millions of expenditures by avoided hospitalization and institutionalization is tremendous.

References:

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