Personal Connected Health Alliance

Usability and Design Features

for the Aging Population in Connected Health

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Increasingly the aging population seeks out technology to improve and manage their health. Whether it is Google searches for symptoms or medication information, fitness trackers and smart watches to maintain wellness or smart home technology, older adults (especially Baby Boomers) break the stereotypes by becoming tech savvy consumers. Their adult children, often finding themselves in the role of caregiver, seeking technology to support the new challenges of their newly assumed roles. What kind of technology do these key stakeholders want? Do they want tech specifically designed for them or simply customized to their needs? How can app and device developers engage older adults in the design process? To address these questions, we turn toward Universal Design Principles as they apply to aging.

Principles of Universal design for aging and health technology

The principles of universal design, sometimes called human centered design, are broadly applicable to designing for aging. With age, there is no single, special requirement for health tech design. There are older adults who remain physically active and have no physical or mental limitations. In the book *Aging, Technology and Health*[1], the authors point out common challenges in aging. Physical limitations may include hearing problems, visual acuity, movement problems, and motor skills. Cognitive decline may also occur affecting the ability to actively process new or current information. In addition, there is a subset in which health literacy, numeracy and tech literacy are significant issues. So designing an app or device will depend on the particular needs of the target group using human-centered design.

What are Universal Design principles?

From the Center of Excellence in Universal Design there are seven (7) leading principles which innovation designers are encouraged to consider. These principles encourage thoughtful consideration about how the user may interact, control, and use technology. These principles include:[2]

Principle 1: Equitable Use: design is useful and marketable to people with diverse abilities

Principle 2: Flexibility in Use: accommodates a wide range of individual preferences and abilities

Principle 3: Simple and Intuitive Use: easy to understand, regardless of the user's experience

Principle 4: Perceptible Information: communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities

Principle 5: Tolerance for Error: minimizes hazards and the adverse consequences of accidental or unintended actions

Principle 6: Low Physical Effort: can be used efficiently and comfortably and with a minimum of fatigue

Principle 7: Size and Space for Approach and Use: Appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility

Of these, Principle 3 is particularly worth emphasis in health technology. If a device or app is not readily intuitive to the user, it will likely fail. Also, in general designing for health, wellness and caregiving should not add burden to the user but rather relieve burden. Treatment burden[3] for patients is a relatively new concept having to do with the amount of additional tasks required by the patient or family to perform in order to manage a condition. For instance, having multiple medications (common for many over 65) which must be taken at different times of the day, some with food, some without, adds to the complexity of care. In the technology space, remote monitoring which requires regular, active steps is contrasted with those monitoring devices which passively collect data which may reduce burden.
There are five basic steps in user-centered design:
1) Define user needs,
2) Create personas,
3) Ideate,
4) Prototype,
5) Test.

In defining user needs for health technology,[4] one should specifically consider some of the limitations mentioned above which are common in the elderly: addressing vision and visual design, hand-eye coordination and ergonomics (including grip strength and range of motion) and hearing and sound. Next, in creating personas, one should avoid stereotypical images of the elderly and instead focus on more positive portrayals. The AARP Catalyst report "Design on Aging: Connected Living" gives some excellent examples, such as, Defiant Social Butterfly, Introspective Homebody that describe personas that consider personalities and preferences when designing for older people.[5]

Ideate is the creative part of the design process but can also be the most challenging. If a startup has designers in the 20s and 30s trying to design for those over 60, there may be a failure to understand user needs. By clearly defining those needs and limitations in step 1, the designers can be better informed and technology more readily adopted.

Throughout the process, involving the users through co-design[6], can make the design process more effective. Also, in the prototype phase, having elderly users in the room with the designers is key to success. At this phase, design errors can be prevented by wireframing solutions in front of users and making modifications before the design is finalized. Finally, the testing phase includes both user testing and validation testing to achieve desired modifications prior to production.

Apps and Platforms

Next, let's look at specific design issues in mobile applications and platforms. The number of interfaces are growing including smart phones, tablets, smart watches, laptops and voice interfaces. Each of these has some pros and cons for the elderly. The smartphone is one of the most portable and common formats with easy access to standard apps (mail, browser, photos, etc.), inclusion of some health tracking and the ability to download additional health apps. However, the interface is small and standard text size is also which may be challenges for those with vision issues or eye-hand coordination. Yet there are settings which can improve accessibility, such as, closed captioning on some apps, a built-in magnifier that uses the phone's camera, boost the screen contrast or type size to make things easier to read.[7] Tablets are a larger format with similar apps, larger screen area and icons for apps but less portable yet still is preferred by many. Smart watches are readily available on the wrist, have built-in fitness tracking and pulse measurement (passive measurement) but have small formats than

smart phones therefore creating similar challenges to use. This small format may especially create challenges for those with manual dexterity or visual acuity limitations.

Voice interfaces (Digital Voice Assistants) including stand-alone devices (Alexa, Google Home) and those native to smart phones, do not require eye-hand coordination but do require clear speech (although these interfaces are rapidly improving via artificial intelligence). Some are even proposing a "voice first" design plan. An article by Laurie Orlov gives several reasons for a "Voice First" strategy for older adults: "Easy: Download versions and upgrades are unnecessary; Cheap: Device price war put offering within reach – but is there Wi-Fi?; Useful: Content can both surprise and impress; Smart: Last week's functionality can be forgotten; Connected: Home automation just works."[8] However, voice interfaces require the user to hear the response which can be a challenge for those elderly with hearing problems. Increasing the volume on voice devices and placing them near the user may help mitigate this.

Apps are generally designed for early adopters and not necessarily for the elderly. Well-designed apps, such as, virtual coaching for diabetes prevention or chronic conditions, are more personalized and have used a variety of personas which include the elderly. Awareness of the size of icons and the amount of detail on a screen are good universal design principles which may help. Also, seniors' abilities may change over time resulting in the need for modifications in app design or features. Gamification may be popular with a younger generation of users for health apps but may not be appropriate for older users. However, one study found that seniors may be motivated to play if the game provides socializing opportunities.[9]

Consumer devices

Commercially available health devices are widely available in drug stores and online, but how do their designs fit with the aging population? Emergency alert devices have been available the longest and are available worn on the wrist, necklaces, etc. For the elderly, there may are many considerations: what has the best value, most affordable, easiest to use, and best battery life. Some do not require a button but are voice activated. These are primarily sold as insurance against a fall at home while alone. The designs are relatively simple and intuitive, a single button to call for help. Some also provide GPS capabilities which can be helpful in monitoring those with memory loss.[10]

Fitness trackers and wearables are readily available and mostly affordable. While these may be uncommon in the older old, the Baby Boomer generation is showing a strong interest in staying healthy including the use of fitness trackers. Healthy aging includes staying fit and eating healthy so these devices provide a method for feedback on health goals. Again, the small screens and buttons on these devices may prove challenging for those with visual, fine-dexterity or hand-eye coordination issues. However, most provide single numbers on the screen and a simple tap to walk through other data. There also appear to be different user profiles, such as, short term or new adopters and long term users who tend to be more sophisticated in their use. Long term adoption "depends on recognizing the long-term benefits of tracker use, social support, and internal motivation. Nonadoption and relapse may occur because of technology's limitations and gaining awareness of one's physical activity without changing the physical activity level itself."[11]

Home monitoring systems including smart home devices are the next level in consumer health devices. Smart devices which control air conditioning and quality (such as, smart thermostats) can certainly benefit health. Smart homes have been touted as a solution for aging-in-place, however, adoption has been slow perhaps most of all due to costs. In the future, smart homes may be able to detect falls or lack of motion indicating a medical problem which would initiate a phone call or emergency response. This technology is in its early stages. It will be important to develop this with elderly focus groups to gauge interest, acceptance and future likelihood of adoption. Privacy concerns will need to be weighed against safety.[12]

Finally, assistive devices including those that assist in mobility are becoming smarter. While the basic wheelchair, walker and other manual assistive devices have been available in the marketplace, digital solutions are becoming more common. Everything from devices which respond to voice to exoskeletons are coming to market. Interest and acceptance by the elderly needs to be evaluated.

Medical-Grade devices

Remote monitoring devices have gone from awkward, complex machines with challenging connections to passive, sleek devices. Yet do they use universal design principles? Smaller devices, such as, Continuous Glucose Monitors, tend to have small interfaces. Many of these devices are 2x3.5 inches which means their screens and text are smaller yet. This can be a challenge for the visually impaired not to mention the button sizes for those with impaired

eye-hand coordination. Respiratory devices fall primarily in two categories: digital inhalers and CPAP machines. Digital inhalers are small but easily attached to an inhaler and the readout is on a mobile phone. There may be issues attaching the device to the inhaler for those with arthritis or other dexterity limitations. CPAP machines are generally compact and with a relatively small menu screen but the attachment of the air hose and water tank do not require significant dexterity. Hearing aids are in common use among the elderly and are an area of significant innovation. Again, manual dexterity may result in some challenges adjusting volume and changing batteries. New versions can be adjusted by a mobile phone and plugged-in to be recharged instead of managing small batteries on a regular basis.[13]

Concluding thoughts

Usability and design in creating connected health technology for the elderly requires application of universal design principles to the challenges of aging. Consider the common physical changes in aging including dexterity, visual changes, hearing problems, etc. Is there a role for regulatory incentives to design health technology more suitable for the aging? Applying these design principles whether one is creating apps, consumer health devices or medical-grade devices, will increase the likelihood of broad adoption.

From this review of connected health design for the aging, we have the following recommendations:

1. Understand the range of users in the aging population from those who are healthy, active and using technology to those with various limitations and health and tech literacy issues.
2. Engaging the elderly and their personal caregivers in the design process for health tech including co-design
3. Design to reduce burden and promote health. Keep it simple and effective, not complex.

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