Smart Homes for the Elderly of Rural Oklahoma:

A Strategy for Ethical Implementation

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Abstract

Smart homes, telemedicine, and robots are often proposed as solutions to the upcoming problem of providing care to millions of older adults. The number of elderly in need of care has risen substantially, the number of available caretakers has not kept pace with demand, and this disparity will only increase as the Baby Boomer generation ages. The care of the elderly, which results in dependency on their part, conflicts with the strong individualism of American society, sometimes causing difficulties between the patient and caretaker(s) when making care decisions. Thus, many ethical concerns have been voiced about smart home technology, from privacy issues to fears of isolation (Fritz, 2015). These concerns vary based on the cultural background of the elderly user, with upper-middle class users feeling more comfortable with the technology (Fritz, 2015). Rural users, who are most in need of the technology due to having fewer nearby healthcare providers, and dementia users, who are in need of the technology to help manage their illness during the early stages while living at home, are the ones who tend to distrust the technology the most (Fritz, 2015). Smart home implementation for the elderly has progressed rapidly in recent years, but research has fallen behind in the sense of connecting theory and practice (Berridge, 2018). As a way to address this, the author proposes a study with researchers in the Dept. of Telemedicine at the OSU Medical School in Tulsa of the rural elderly in Oklahoma, since Oklahoma has approved insurance reimbursement for telemedicine, that would be expanded to include assistive technologies for smart homes in order to try to develop a participatory model for the ethical diffusion of this technology on a mass level.

Introduction

As Katz (1996) said in Disciplining Old Age, 21st century gerontology should start undisciplining old age and invite the aged to participate as full members of society who still have important contributions to make. In the case of smart homes, on the one hand there is the danger that they will become a new and even more intrusive form of surveillance, as envisioned by Davin Heckman (2008) in *A Small World: Smart Houses and the Dream of the Perfect Day*. Heckman compared smart homes to the fantasy of novelist Ira Levin (1970) in *This Perfect Day*, in which a central computer ran a planned society that satisfied all the material desires of its populace in return for absolute loyalty and a promise to take an overdose of a tranquilizing drug at age 62 to control the population and resource expenditure. Thus, Heckman has the following conclusion with respect to smart homes for the elderly:

"In … a country where good jobs are vanishing, one would think it would be possible to arrange mutually beneficial relationships between the young and the old …. Instead, … the market suggests that we eliminate caregivers [and] substitute care with technology.... [Thus] we can watch people adhere to patterns of behavior and presume they are living well. We can offer corrections if they start acting weird. And, when they finally cross the line from … lonely depression … into full-blown dementia, we will know" (p. 144-145).

Finally, Heckman adds the following image from science fiction writer Ray Bradbury (1950) in his *There Will Come Soft Rains*, in which a smart house is dying after a nuclear holocaust has imprinted the silhouettes of two parents and their two children burned by an atomic explosion against a wall and the family dog has come home starving to die. A gust of wind breaks the kitchen window, splashing cleaning solvent against the stove, starting a fire, and

as the fire consumes the house, a tape recorder accidentally activates, playing a recitation of Sara Teasdale's (1920) poem, "There Will Come Soft Rains,"

"There will come soft rains and the smell of the ground,

And swallows circling with their shimmering sound;

And not one will know of the war, not one

Will care at last when it is done.

Not one would mind, neither bird nor tree

If mankind perished utterly;

And Spring herself, when she woke at dawn,

Would scarcely know that we were gone."

Heckman wrote *A Small World* in 2008, which was before the Baby Boomers retired en masse, so in the world of 2019, with the oldest of the Boomers at 72, there is an urgent need to transition from nursing homes to community care for this generation. However, it is incumbent upon gerontologists to put gerontology and smart homes in a social context and to ensure that the gain is greater than the loss for the elderly.

Michael Foucault, in *Discipline and Punish* (1977), holds that each new type of control engenders a new type of resistance, so we can hope that the surveillance to which the elderly will be subject in smart homes will serve some purpose of transcendence, such as allowing them to have greater independence by staying in their homes and organizing themselves better on social media as a voting block!

Review of the Literature

This review will attempt to highlight some key studies, particularly in areas in which research is currently lacking. The first section will summarize key issues that many studies

reported, and the following sections will expand on these issues with the individual study findings. At the end of the review, a proposal will be suggested for a pilot project with the elderly in a rural community to help fit technology to character in this population.

Common Issues with Smart Homes

Many of the issues and preferences concerning smart homes are shared by the elderly from various countries. The potential users indicated that cameras recording only silhouettes would be more acceptable but in general were not very accepting of camera monitors in any studies reviewed (Demiris et al., 2004; Demiris, Hensel, Skubic, and Rantz, 2008a; Townsend, Knoefel, & Goubran, 2011; Chernbumroong, Atkins, & Yu, 2010; Portet, Vacher, Golanski, Roux, & Meillon, 2013; Kirchbuchner, Hastall, Grosse, Puppendahl, and Distler, 2015; Fritz, Vandermause, Corbett, & Cook, 2015; Himmel & Ziefle, 2016). Privacy violations were a primary concern for the elderly and some caretakers, and while reasons differed for their concerns, many older adults felt uncomfortable about being constantly observed in their own home, to the point that they would not allow the cameras to be installed even for issues such as fall detection (Demiris et al., 2004; Coughlin et al., 2007; Satpathy & Mathew, 2007; Peek, Aarts, & Wouters, 2015; Kirchbuchner et al., 2015; Govercin, Meyer, Schellenbach, Steinhagen-Thiessen, Weiss, and Haesner, 2016; Demiris et al., 2008a; Fritz et al., 2015).

In general, monitoring technology like cameras were more acceptable outside the home and in public rooms like the kitchen and living room, while acceptance varied for bedrooms and was lower for bathrooms and other private areas (Fritz et al., 2015; Himmel & Ziefle, 2016). Monitoring was more acceptable if a relative was the person monitoring them (Fritz et al., 2015; Himmel & Ziefle, 2016; Pal et al., 2018). Another common concern about monitoring was data protection, as many healthcare leaders and elderly were concerned about data security and who

would see the data collected by monitors (Coughlin et al., 2007; Kirchbuchner et al., 2015; Himmel & Ziefle, 2016).

Several studies found that in order for the elderly to willingly purchase a system, the cost of the system must be low (Demiris at el., 2004; Callejas and Lopez-Cozar, 2009; Chen & Chan, 2014; Peek et al., 2015; Fritz, et al., 2015; Kirchbuchner et al., 2015; Govercin et al., 2016; Yusif et al., 2016; Pal, Funilkul, Charoenkitkarn, & Kanthamanon, 2018). There were concerns about reliability, as the system needs to reliably act as expected and last for several years even if certain functions stop working, and the elderly indicated concern in one study about a reduction in quality of life if the system fails (Satpathy & Mathew, 2007; Coughlin et al., 2007; Chen & Chan, 2014; Kirchbuchner et al., 2015; Himmel & Ziefle, 2016; Fritz et al., 2015). In order to convince the elderly to use the system, it must be easy to use, as complexity and new technology tends to concern the elderly and cause them anxiety, which is a major barrier to acceptance (Demiris et al. 2004; Satpathy & Mathew, 2007; Chen & Chan, 2014; Kirchbuchner et al., 2015; Peek et al., 2015; Yusif, Soar, & Hafeez-Baig, 2016; Pal et al., 2018). Closely related to this is training, as the elderly would prefer to be trained extensively in a method appropriate to their health and culture and would prefer that devices be simple and not have too many new features to learn (Demiris et al., 2004; Mordini et al., 2008; Oppenauer et al., 2007; Wallace, Mulvenna, Martin, Stephens, & Burns, 2010; Chen & Chan, 2014).

In terms of isolation, many elderly in a wide variety of studies expressed concern that smart homes could isolate them further by taking over human caretaker roles or by allowing relatives to monitor them without contacting or visiting them (Demiris et al., 2004; Zwijsen et al., 2011; Fritz et al., 2015; Peek et al., 2015; Marikyan, Papagiannidis, & Alamanos, 2018). Also, smart homes are perceived as threatening to their feeling of being in control, as many are

concerned that the technology could take over their homes or that the technology or people controlling it could cause them to lose autonomy by forcing them to change their daily habits (Mathew, 2005; Portet et al., 2013; Peek et al., 2015; Himmel & Ziefle, 2016; Fritz et al., 2015; Kirchbuchner et al., 2015; Yusif et al., 2016; Pal et al., 2018). Smart homes are also often considered by users as a threat in the sense of confirming their dependency, as American elderly prefer relationships where they give more than they take, are in control, and are not a burden to their family (Peek et al., 2015; Fritz et al., 2015). Perhaps because of this preference, the elderly of America and Western Europe, in contrast to those of Asia, tend to see themselves as healthier than they are, strive for an idealized version of autonomy, and tend to think that they do not need preventative health and smart home technology until they are considerably disabled (Demiris et al., 2008a; Zwijsen et al., 2011; Peek, Wouters, & van Hoof, 2014; Portet et al., 2013; Chernbumroong et al., 2010; Townsend et al., 2011; Kirchbuchner et al., 2015; Chen & Chan, 2014). Furthermore, many elderly in the West are concerned that they will be stigmatized as weak if they use the technology, and some Western caretakers also expressed concerns about stigmatization (Peek et al., 2015; Yusif et al., 2016; Zwijsen, Neimeijer, & Hertogh, 2011).

Studies of Urban America

Dewsbury (2000) came up with an early popular framework for smart home implementation. This framework emphasized determining if a smart home system would benefit the user and fit with their lifestyle, as well as determining if it was acceptable to caretakers and relatives (Dewsbury, 2000). The system should meet all of the user's needs and allow them to act with more autonomy. The user and caretaker(s) should be trained to use the system and it should be reliable, well-maintained, reasonably priced, and easy to fix (Dewsbury, 2000).

Demiris et al. (2004) worked with other researchers to conduct several early studies on smart home acceptance at TigerPlace, a retirement community for the upper-middle class. Demiris et al. (2004) conducted focus groups about potential smart home features that residents might want and found that potential users were mainly interested in prescription issue alerts, emergency alarms and aid, intruder alarms, visual and hearing aids, calendars with reminders, security cameras, other security devices, temperature monitoring and control, stove and oven monitoring and control, fall detection and prevention, health monitoring issues related to their condition, and remote control of lighting. The elderly residents were concerned that emergency alarm alerts would be ignored by emergency responders. They indicted that devices that accommodate their physical needs and devices that do not require them to interact with the technology would greatly increase their acceptance of the technology (Demiris et al., 2004).

Demiris et al. (2008a) conducted more focus groups with TigerPlace residents concerning a system they built with the following features: stove temperature detection; camera monitors; cabinet switch sensors; bed monitors that detect respiration, pulse, and movement; and a sensor mat that detects changes in how the user walks. The potential users were interested in the sensor mats but wanted to change the function of the mats to detect intruders and were primarily interested in security technology (Demiris et al., 2008a). A study conducted by Demiris, Oliver, Dickey, Skubic, and Rantz (2008b) actually implemented the technology asked about in the survey with the exception of the camera monitors and interviewed residents weekly for six months, then bi-weekly after that period. To empower the users, the residents were encouraged to report problems with the technology, such as it not being useful to them due to where the device was placed or the design of the device interfering with their daily activities, so the researchers could fix the issue (Demiris et al., 2008b). Residents reported that the technology

did not interfere with their daily activities after the modifications and that they would potentially accept different kinds of smart home devices in addition to those provided (Demiris et al., 2008b).

Coughlin et al. (2007) believe smart home programs for the elderly have been delayed due to the perception that users are not receptive to the technology and that it would not be profitable to implement these systems for the elderly. They interviewed 30 leaders in healthcare services, the majority of whom expressed the feeling that the elderly would have trouble using and fixing the technology due to its complexity, that they believed the technology was really aimed more at caretakers because of its complexity, and that the elderly would not accept the technology due to the potential loss of autonomy and concerns about who would distribute the technology and control the data gathered from monitoring (Coughlin et al., 2007).

On the other hand, Callejas and Lopez-Cozar (2009) surveyed elderly users about smart home features and found that automatic lighting, temperature control, and window and blind control were popular and would be used. Music and kitchen controls were less likely to be used, though 50% of women indicated they would use the kitchen controls regularly (Callejas & Lopez-Cozar, 2009).

Peek et al. (2015) conducted a literature review and concluded that older men and people with severe limitations due to disabilities or illness place less importance on independence and thus are more accepting of smart home systems. Only three out of 31 studies were able to successfully implement smart homes to reduce length of nursing home admissions, preserve cognitive and physical health, and improve social functioning (Kelly, 2005; Tomita, Mann, Stanton, & Tomita, 2007; Bronswell, Blackburn, & Hawley, 2008). These three studies shared technology that was modified to accommodate individual circumstances and needs, as well as a

wide range of potential features and devices, from medication dispensers to monitoring technology, while the other studies had more limited technology, smaller sample sizes, and may have been poorly designed (Reeder, Meyer, & Lazar, 2013). Peek et al. (2015) note that a primary problem with current studies is that the elderly have little direct exposure to the technology, as many studies are in pre-implementation phase. Only 15.5% of potential users were willing to accept the technology immediately, but this rose to 82.4% in the scenario where they had a decline in health (Claes, Devriendt, Tournoy, & Milisen, 2014). This is a problem of perception, as most elderly delay implementation of the technology, since they think that it is aimed at people who are older and less healthy than they (Peek et al., 2014). Acceptance of the technology varies based on their generation and geographical location, which means systems must be able to adapt to a wide range of user preferences (Peek et al., 2015).

Saez, Gutierrez, and Ochoa (2015) conducted three studies with a smart home system and modified the system after each study to meet user needs better. After the final modification, the subjects liked the notification, photo, social media, energy saving, and videoconferencing features, as well as the tablet interface, and felt it was easy to use (Saez et al., 2015). To get the subjects to accept the system, modifications after each study increasingly simplified the interface, reduced interruptions to their daily routine outside of the reminder system, made the system less obtrusive, respected their privacy more, and provided services in which they expressed more interest or modified services with which they had issues but in which they would be interested without the issues (Saez et al., 2015).

Himmel and Ziefle (2016) conducted two studies on people from various age groups and found ambient position monitors were mostly acceptable to all groups and audio monitoring was relatively acceptable to most. Video monitoring acceptance decreased quite a bit between 2010

and 2015, possibly because awareness of surveillance and data security issues increased (Himmel & Ziefle, 2016). Women and older people with serious illnesses were more accepting of assistive technology, while younger people with less serious illnesses were less accepting of the technology. Younger and older people who were healthy were relatively accepting of audio monitoring and less accepting of video monitoring. Unobtrusive integration into the home and knowing the person monitoring the user were rated as less important to users than privacy and other issues, though this does not mean that the former issues were not concerning to the subjects (Himmel & Ziefle, 2016).

Overall, the studies show that American elderly users like to be in control of their situation and to be able to act independently without too much reliance on others. Unfortunately, the technology in which they show most interest, security and emergency alarms, are useful but many elderly need health monitoring, fall detection, and other features in addition to simple security systems. The preference for security systems may be partially due to their familiarity with non-smart home security and emergency alarms, their concerns about being robbed as they get older, and the perception that many other smart home features are aimed at older people with more health issues, a group of which they rarely consider themselves a part, despite many indications that they need additional help or have more severe health issues. This may be due to a deeply-ingrained attitude in American culture which pushes people to be autonomous and self-sufficient.

This is not totally realistic for most people even during their younger years, as humans are inherently a social species, and individuals are reliant on others for emotional needs, advice, income, and so on. Nevertheless, this helps to explain the reason that the technology that was

most accepted was in studies where the user was more empowered and autonomous due to having a say in how the technology was designed or modified for their needs.

Studies in Rural America

The studies in this section focus on rural American users, and unfortunately, there is a lack of studies in this area. Mathew (2005) notes that there are more rural elderly than urban elderly who need help because there are less health providers in rural areas, and many rural elderly end up institutionalized due to a lack of transportation to medical facilities. There are many special challenges that must be met to implement the technology in rural areas, including the users' lack of experience with and distrust of technology, low-income households, and sometimes a lack of features that rural elderly populations need due to the fact that most studies have focused on urban elderly populations who have somewhat different needs and desires (Mathew, 2005). Despite this, the rural elderly have shown interest in smart homes in the few studies conducted, and Mathew believes that lack of funding followed by the complexity of the systems are the main barriers to adoption.

He proposes using government subsidies or persuading insurance companies to cover purchases of smart home systems for elderly users, as well as simplifying the systems and making the interface similar to televisions, and he believes that these things are necessary to successfully implement smart homes with the elderly in rural communities. The technology must also be adapted to the user's lifestyle, not only in terms of features included and how easy it is to use, but in terms of being able to be installed in homes not set up for smart home systems, and in terms of where the devices are placed, as many rural elderly have one primary area where they stay most of the day, such as a couch. Other issues, such as the ability to easily fix small technical problems without needing technical support and the ability to purchase the systems

easily in rural areas must also be addressed to increase adoption, and one way to address some of these issues would be to install a system and allow the elderly users to get used to the system taking care of small tasks like automatic lighting in hopes of getting them to accept a more complicated system with targeted features (Mathew, 2005). Training the users with relatives or caretakers may also benefit the elderly so they are not lost when navigating the interface and trying to learn how to control various features of the system.

Satpathy and Mathew (2007) conducted a survey in a rural Mississippi town and found that many participants were aware of Internet and technology-based healthcare applications. For example, one person mentioned an older lady who used health monitoring technology and conducted telemedicine visits with a doctor in New Orleans (Satpathy & Mathew, 2007). While many elderly adults felt that they could not use the technology and their relatives also felt that their older relatives would not use the technology, many also stated that the Baby Boomer generation was much more receptive to it and would understand how to use it. Rural elderly adults also expressed the desire for the technology to be similar to their television remotes. The rural elderly were concerned about being watched even by relatives, in contrast to many urban residents who were fine with close relatives watching them, possibly because of the more traditional nature of rural elderly. Finally, the subjects expressed interest in houses designed with a system already integrated but still preferred human help (Satpathy & Mathew, 2007).

Having a large number of non-essential features, such as music controls, is not desirable to most elderly because additional features can increase the costs and make the interface more complicated. As noted, elderly Americans, and especially rural elderly, have a strong sense of independence and this may slow down smart home adoption. However, given a choice between a nursing home and having kitchen controls to prevent a house fire or health monitors to detect

health emergencies, many are likely to choose the smart home system. Nevertheless, in many cases, they seem to assume that complete independence or minimal reliance on caretakers is an option, when in reality it often is not and can cause them to have emergencies that are not dealt with swiftly due to trying to push themselves beyond their limitations. Although this perspective may be unrealistic, letting go of complete independence as an ideal that has been ingrained in them since childhood is difficult, and in many cases, caretakers may not work with them to make compromises until their condition becomes more severe, causing them to take unnecessary risks.

Foreign and Multicultural Studies

Among foreign studies, most literature reviewed was from Europe or Asia and nearby island nations. Townsend et al. (2011) conducted a literature survey on smart home studies between 2004 and 2011 and found that the users would only accept cameras if they could prevent the user from being institutionalized, if the cameras only recorded silhouettes or shadows, and if they could control the cameras. Health monitors and user-activated emergency alarms were generally acceptable, while fall detection, kitchen, and bathroom monitors were less acceptable because they were always on and recording user behavior (Townsend et al., 2011). Most elderly indicated that the majority of the devices would only be accepted if they could prevent nursing home placement (Townsend et al., 2011; Coughlin et al., 2007).

A literature review focused on studying international perspectives on smart homes was conducted by Zwijsen, Neimeijer, and Hertogh (2011), who expressed concerns about studies focusing more on advancing the technology and a few ethical issues, such as privacy, rather than focusing on ethical issues for which the elderly themselves show more concern, such as social isolation. The major privacy concerns were that some caretakers could become over-controlling and authoritarian if they had monitoring technology at their disposal, and that the elderly cannot

truly give consent to being monitored until they have used the system and understand the benefits and consequences of it (Kenner, 2008; Björneby et al., 2004).

Other studies reviewed found that there must be a demonstrated need to monitor in order to justify it to the user and that, while safety can be improved if someone is monitoring the user's activities, there are no guarantees that safety will be improved (Coughlin et al., 2007; Melander-Wikman, Jansson, Hallberg, Mortberg, & Gard, 2007). Zwijsen et al. (2011) also expressed concern that for the elderly it would be better to avoid using the system unless there was a demonstrated need, but in terms of costs, it would probably reduce cost per system if it were widely implemented in all retirement and private homes. In addition, Zwijsen et al. were concerned that the definition of independence that caretakers and elderly adults follow may slow down acceptance of smart homes. Finally, Zwijsen et al. (2011) expressed concern that there are few studies of people with special needs, such as users with dementia, and yet these groups are often considered key potential adopters by researchers.

Chernbumroong, Atkins, and Yu (2010) conducted a study in the United Kingdom at a major hospital and asked questions about a basic smart home system. Automatic lighting was once again rated as the most desirable technology and most likely to be accepted (Chernbumroong et al., 2010). Cooking monitors and controls, bed monitors, emergency alarms, and activity monitors were all considered useful but rated neutrally in terms of whether the user or caretaker would want the technology implemented in the user's home (Chernbumroong et al., 2010).

Portet et el. (2013) conducted a study in France with a small group of elderly users, their relatives, and professional caretakers who were able to interact with a smart home system with a variety of functions as well as a variety of methods of interacting with the system, such as a

tablet and voice commands. The French users had more negative reactions to smart homes than American users (Portet et al., 2013). They expressed a dislike of what they perceived as a system designed to encourage users to be lazy, a belief that monitoring cameras should only be used for those with serious disabilities, and a preference for voice commands using keywords over remotes, tablet interfaces, or more complicated voice commands (Portet et al., 2013).

Kirchbuchner et al. (2015) conducted a study in Germany and found that visibility of the system and having a system with numerous features were ranked low in importance. Females rated ease of use much more important than males and made up a majority of participants, while all participants agreed that a system that required them to change their daily habits was generally not acceptable (Kirchbuchner et al., 2015). In addition to data theft, incorrect data transmissions and data being sent to people of whom they did not approve were major concerns. Data transmission was most acceptable in cases when an emergency was detected, such as falls. Among the features asked about in the survey, the users strongly preferred emergency and intruder detection, accepted fall detection/prevention and energy savings features, and were less interested in other features. The authors concluded that privacy during embarrassing situations was the most important issue to the potential users, data transmission to a private company was not acceptable, and that participants were not willing to pay for preventative or healthcare related features because of comprehensive health insurance in Germany that typically covers medical expenses (Kirchbuchner et al., 2015).

Another study conducted in Germany by Govercin et al. (2016) implemented a smart home system in participants' homes for 45 days and found that the smart home controls and health features which included the ability to conduct telemedicine calls were the most used features of the system, followed by videoconferencing and voice calls. The assistance center,

which provided help for various technical issues, was also used frequently due to issues with videoconferencing, which was a strongly preferred feature by those between 55-64 years and males in general (Govercin et al., 2016). Participants were intolerant of technical problems, with some participants dropping out early in the study due to issues related to Internet problems, but most became accustomed to the technology after a few weeks (Govercin et al., 2016).

Yusif et al. (2016) conducted a survey of Danish smart home literature and found that uncertainty about the technology, where and how to get smart home systems, how to use them, and a lack of information about the technology from healthcare providers and caretakers are major obstacles to adoption. Concerns about influence by organizations or social networks and a challenging physical environment for their health level influenced their willingness to adopt the technology, but in general, those who were familiar with the technology and its benefits had a more positive outlook on adoption and thought that the technology could improve their quality of life, help them meet their goals and participate in activities, increase autonomy, increase security and awareness of their surroundings, and allow them to practice self-care longer (Yusif et al., 2016).

The first Asian study reviewed was conducted by Chen and Chan (2014) in Hong Kong, China, and a key cultural difference between Asia and the rest of the world was noted concerning smart homes in that there was an acceptance of using the system to aid those who only needed a little assistance. There was more willingness to use basic health monitoring technology as soon as health began to decline and all of the system features as physical abilities began to decline more (Chen & Chan, 2014). Males were more likely to adopt the technology, unlike in the United States, where females were more likely to adopt it, but all economic and social groups wanted access to it and indicated an equal likelihood of using it. Chen and Chan (2014) believe

that small-group training sessions would be more effective for solving anxiety in Asia than an individual approach like the one used by the United States because it can provide careful guidance, allow participants to see other users with the same problems, and allow them to form social bonds as they learn, all of which can help overcome embarrassment in that culture.

Pal et al. (2018) conducted an online survey in India, Malaysia, Thailand, and Indonesia. They screened participants with no knowledge of smart homes and found the factors that most influenced acceptance were obvious benefits of the system such as increases in autonomy and recommendations by a primary healthcare provider (Pal et al., 2018). According to the users, acceptance was not affected by family member, nurse, or non-medical caretaker recommendations, nor by whether the technology was made and supported by a private company or the government. The authors concluded that data collection aimed at analyzing and providing valuable health information to users would increase acceptance (Pal et al., 2018).

Older people in a wide variety of cultures have similar issues with smart homes, such as complexity and high cost, and similar solutions have been tried in a number of these countries. Methods of implementation may differ, such as training people from the Asian countries in groups rather than individually as in Europe and the United States, but reducing the complexity of the technology and decreasing the cost of the system through widespread use and government support are core issues that may represent similar solutions in many countries. However, a key area that differs is overall acceptance by the elderly of the different regions. Many in Asian countries are more accepting of the technology, perhaps because of familial expectations and obligations in those countries. In the United States and some European countries, and particularly in rural America, perceived family expectations creates the opposite effect, as many users are worried that accepting the system could put a burden on their family because of

concerns about over-committing their relatives' time and money. This may be due to differing value systems between Eastern and Western countries.

Heuristic Studies

In addition, these foreign studies can shed light on other key issues relating to smart homes and telemedicine and user concerns versus the concerns of others. Many smart home systems tested contained elements of telemedicine, such as the ability to conduct video conferencing with doctors. The most valuable system to users in rural America and with dementia may be a system that can comprehensively help them address healthcare needs by allowing their health to be checked regularly and giving them access to high-quality medical staff when they need help or check-ups. However, ironically, the groups that are most in need of smart homes are the most resistant, especially when it comes to prevention.

Fritz et al. (2015) focused on the idea of patient-centered care to reduce costs and improve care quality, as well as self-identified cultural values rather than generally associated cultural values based on race, gender, religion, and other values. Participants varied in terms of what type of privacy was considered most important (Fritz et al., 2015). Some were more concerned with modesty or privacy when conducting activities in various states of undress, such as bathing or undressing (Fritz et al., 2015). Others were more concerned about natural privacy or privacy in one's home (Fritz et al., 2015). Some were concerned with privacy from government and Big Brother (Fritz et al., 2015). Norm privacy, or what one would be expected to do or not do in one's home, was also a concern for many (Fritz et al., 2015).

Privacy lost may not be worth the independence gained depending on how severe the intrusions are, and after a certain point, smart home privacy intrusions are not considered worth it, with a few subjects stating that they would not allow any type of camera or sensor monitor to

be installed (Fritz et al., 2015). However, in general, participants prefer the smaller loss of privacy associated with smart homes when compared to the greater loss of independence of nursing homes (Fritz et al., 2015).

Most users would not seek out a system without relatives persuading them, and they were less trusting of the system if it was not recommended by relatives (Fritz et al., 2015). They also felt that smart homes should complement their human caretaker(s), not replace them, and that robot caretakers helping with physical tasks, such as dressing and feeding, would be alienating and unacceptable (Fritz et al., 2015). Safety and health monitoring, on the other hand, were generally viewed positively if they didn't involve cameras, as they could increase quality of life (Fritz et al., 2015). Comfort, convenience, and quality of life were all important features because they increased safety, as safety concerns were a key theme and issue for this group (Fritz et al., 2015). As for implementation, most users wanted to use the system earlier to learn how to use it as soon as possible but expressed contradictory feelings by stating that they would only adopt the system if necessary, implying a delay in implementation (Fritz et al., 2015). Most subjects thought the upper-middle class and women would be more accepting of help, the former due to their income (Fritz et al., 2015). Also, education of users is needed to address distrust about real versus unreal issues (Fritz et al., 2015).

Mortenson, Sixsmith, and Woolrych (2015) were concerned that researchers rarely explore the effects of surveillance technology holistically, and as noted before, privacy concerns in some studies tend to be limited to data protection and sharing rather than addressing concerns that the elderly express about being observed in embarrassing or private situations. No studies have been conducted on how monitoring may change a person’s daily life and behavior or their social and caring relationships (Sixsmith, 2013). Mortenson, Sixsmith, and Beringer (2016) note

that in a 1995 reprint of Bentham's work on the panoptican from 1791, he proposed a prison where individuals could be observed from a central location but would not know if they were being watched. Foucault (1977) adopted this metaphor when discussing how surveillance or potential surveillance may be able to change thinking and behavior of people who think that they might be observed at any time. As monitoring technology begins to extend into private homes and invade norm privacy, users expect to be judged on social norms, express concern about this, and may react by altering their behavior to match social norms (Fritz, 2015; Foucault, 1973).

Marikyan et al. (2018) felt that current studies they reviewed had three key weaknesses, a focus on only users as opposed to caretakers and medical providers, a focus on only the structure and function of the devices, or a focus on only the potential benefits rather than the issues with smart homes. Users varied in terms of reasons why they would accept a smart home, from convenience, to health, to energy and cost saving measures, the latter of which was particularly influential for rural and international users (Marikyan et al., 2018). Many researchers believe that smart homes can reduce isolation and increase socialization, but studies show that many users will not use the technology due to concerns about stigmatization or that in-person communication could be reduced or replaced entirely (Damodaran & Olphert, 2010; Demiris et al., 2004). Marikyan et al. (2018) believe that studies should implement a whole system rather than a few features and that data on healthcare workers and caretakers is lacking. Furthermore, they believe there is little evidence that smart homes will be accepted and that legal policies, psychological resistance, and individual and financial circumstances will have effects on acceptance and have not been studied adequately (Marikyan et al., 2018). Ethical and acceptance issues are compounded for patients with dementia, whose needs are even more specific than other groups.

Bennett et al. (2017) discussed several human rights issues related to assistive technology that concerned the World Health Organization. These rights include the moral obligation of researchers to develop assistive technology that allows those with mental or physical disabilities to live more independently. In addition to this primary rule, they add that patients, including those with dementia, should have equal rights under law, be allowed to choose their place of residence, be allowed to participate in the community to the best of their ability, and have access to the best available healthcare and technology. Bennett et al. conclude that it will be necessary to develop national laws to balance the needs of dementia patients and their right to privacy and independence. Furthermore, they add that the end goal of assistive technology should be to aid people with dementia in increasing their independence by helping them function well enough to maintain involvement in their financial and care decisions alongside their caretakers (Bennett et al., 2017).

Novitzky et al. (2015) conducted a literature survey of studies from several countries, including the United States, dating back to 1990, to determine if smart homes would be useful to users with dementia. Once the users are part of a study, they want to be included in the development process of the technology and are more likely to stop using the technology if they are not included (Wallace, Mulvenna, Martin, Stephens, & Burns, 2010; Francis, Balbo, & Firth, 2009). User needs may be poorly understood by the often much younger developers, with the result of needs not being met even after implementation and testing (Panek & Zagler, 2008; Lauriks et al., 2007). Cultural differences and motivation play important roles in terms of how accepting users are of the technology, and with motivation in particular, designers have more trouble than relatives in motivating the patient to use the technology (Duquenoy & Whitehouse, 2006; Gaul & Ziefle, 2009; Grönvall & Kyng, 2012; Holzinger, Schaupp, & Eder-Halbedl, 2008;

Remmers, 2010; Salces, Baskett, Llewellyn-Jones, & England, 2006; van Hoof, Kort, Rutten, & Dujinstee, 2011; Zaad & Allouch, 2008; Wallace et al., 2010; Sponselee, Schouten, Bouwhuis, & Willems, 2008). Special training methods in the use of simplified systems is particularly important for users with dementia to learn how to use the technology (Mordini et al., 2008; Oppenauer et al., 2007; Wallace et al., 2010). Finally, some studies found that elderly users strongly preferred voice controls over touch screens but other studies found that they had no preference for one over the other (Portet, Vacher, Golanski, Roux, Meillon, 2011; Wallace et al., 2010).

The authors note that in addition to ethical issues, interface and hardware problems, screen size and mobility of devices, and intolerance of devices that do not meet their specific needs all contribute to the problem of implementing a widespread smart home system (Novitzky et al., 2015). For example, they note that fall detection systems, one of the widely advertised smart home features in systems aimed at the elderly, often do not provide greater security or protection than a wearable one-button alarm and may only be pushed due to designers' and caretakers' preferences for more complex, flashy systems and the ability to observe the user to ease caretaker anxiety (Novitzky et al., 2015).

To develop a smart home system capable of addressing dementia users' specific needs, Raei and Bouchachia (2016) note user-centered design is necessary, but many authors expressed concern about the anxiety a failure of a system prototype could create in users with dementia, and others believed users with dementia should only be involved in the final phase when the system is fully developed (Poulson, Ashby, & Richardson, 1996; Björneby, Topo, & Holthe, 1999; Orpwood, Gibbs, Adlam, Faulkner, & Meegahawatte, 2005). An alternative route is to have caregivers of patients with dementia help develop early prototypes, but many are

technophobes and believe time spent on other activities reduces the quality of care they can provide to their relative or patient (Amiribesheli & Bouchachia, 2015; Sponselee, Schouten, Bouwhuis, & Willems, 2008; Raappana, Rauma, & Melkas, 2007). It is hypothesized that a theoretical adaptive system model for users with dementia would need to have personas, or fictional characters, used as a substitute for real people, which can interact with scenarios, or the environment, and have use-cases, or cases that show actions and reactions based on the combination of personas and scenarios, and that are played out so the system can learn approximately how to react based on the actions of real people (Casas et al., 2008; Aoyama, 2005; Raei & Bouchachia, 2016).

There are four areas in which dementia users differ greatly from other subgroups, and thus, four areas that require them to have special components added to their smart home system that other elderly users generally do not need. Dementia users tend to have repetitive language, which worsens as dementia progresses; a tendency to forget how or when to accomplish tasks; dehydration due to forgetting to drink water; and a tendency to wander at night (Amiribesheli & Bouchachia, 2015). To deal with these issues, Amiribesheli and Bouchachia (2015) proposed and developed an early prototype that can detect repetitive language and the degree of repetitiveness with recording equipment, as well as night wandering and drinking (or lack of) with motion sensors that are set up to take several actions, including alerting caretakers when there are urgent issues, such as the patient trying to leave the house at night; trying to calm the patient; and locking the doors of the house if necessary. They propose that the features should be optional by enabling the features to be turned on or off and that all system components must resemble familiar objects, such as radios or televisions, to avoid stimulating paranoid reactions. In a later study, Amiribesheli and Bouchachia (2018) found that many caretakers and specialists

they interviewed were in favor of using speech analyzers, sensors to monitor water intake, and sensors to monitor and help with daily tasks. Specialists felt the system was more reliable than manual recordings, while caretakers felt the system freed them to focus on improving the patient's well-being in other ways (Amiribesheli & Bouchachia, 2018). A continuing study expands on these ideas to develop a system that may be able detect urinary tract infections early, to which dementia patients are prone due to dehydration (Hughes, 2018a). Around 400 patients were evaluated and early results show a decrease in irritability, agitation, depression, and anxiety (Hughes, 2018a). However, some were also concerned that elderly users, particularly those with dementia, could be easily persuaded to use tracking and monitoring devices despite their discomfort (Zwijsen et al., 2011). It could be argued that using tracking devices and other smart home safety features could be less disturbing to users with dementia than being placed in a nursing home, but studies need to be conducted to see if smart homes are an acceptable alternative to nursing home placement, as many dementia sufferers also have extreme distrust due to their condition.

In addition, society sometimes has unrealistic expectations of the responsibility and kindness of caretakers. It seems to expect the elderly to continue to have the same levels of interaction or increased interaction with smart homes when many elderly only have irregular access to a paid caretaker or visiting relative, and once the caretaker or relative can check on them or interact with them through the technology without traveling to their home, they sometimes take the path of convenience. It is not necessarily a malicious action, but rather it is human nature to reduce time commitments if possible. The users, perhaps due to their age and experience, understand this better than others involved in the creation and dissemination of smart home systems.

Another type of heuristic study is gamification. Gamification in the learning environment concerns converting otherwise tedious learning tasks into games to improve the rate and ease of learning and has been proposed as a solution to help the elderly learn how to use basic smart home technology. Anderson and Rainie (2012) interviewed technology stakeholders to identify key beliefs about the potential of gamification. Over half believed it would be implemented in many jobs and communication networks because of the social rewards and competitive and enjoyable aspects of games increasing the speed of learning (Anderson & Rainie, 2012). Others believed it would not be as widespread because of its potential to distract and to lead to over-competitiveness. Some participants were concerned the manipulative, competitive, and addictive aspects of gaming could lead to information breaches or leaks, increased social manipulation at a societal scale, resistance from employees who dislike competitive or manipulative scenarios, workers that compete rather than cooperate, "leaderboard fatigue," and other issues. Others felt it could instead increase cooperation and passion (Anderson & Rainie, 2012).

A study on gamification of telemedicine systems was conducted by Vette, Tabak, Weering, and Vollenbroek-Hutten (2015) which proposed creating a framework of elderly gaming archetypes, or player personalities, and reasons for playing, as they believe gamification could aid in teaching them how to use various systems. The elderly are likely to fall into a couple of different archetypes from Bartle's classification of players, such as socializers, who focus on forming social connections through the game; achievers, who focuses on objectives, or in this case, learning how to use the technology; and a variant on the explorer archetype, such as those who simply like to play the games (Vette et al., 2015). Their reasons for playing may be initially to learn about the technology, but if the games were similar enough to their preferred games

from childhood, whether that be crossword puzzles, regular puzzles, older video games, or something else familiar to them, they might be able to enjoy the games and learn more about the technology by willingly interacting with it (Vette et al., 2015).

McCallum (2012) studied how games designed for health could potentially benefit the elderly. There are two types of games, general outcome games with a broad scope, such as exercise games generally designed to improve fitness, and specific outcome games with a specific target, such as rehabilitation games (McCallum, 2012). Among health-related games, there are physical fitness games aimed at improving physical fitness; cognitive health games that improve strategic and analytical thinking abilities, such as chess and "Brain Age;" and social and emotional health games, which provide shared experiences with relatives and friends, cooperative or competitive gameplay, and discussion. The latter type has been proven to decrease depression in teenagers. McCallum's case study created a design for the MasterQuiz game for elderly patients that would need minimal input from nurses and run on a tablet without an Internet connection. Reminiscing has shown to be beneficial for the elderly and so the game is designed to encourage the user to think about their past. The game was tested in six cycles and included text instructions and automatic progression. The game asks questions and allows the user to answer until they get the correct one. It scores the users based on how few guesses they needed to get the answer, and most users did not need assistance to play. McCallum believes voluntary participation, game quality, understanding and following the rules to obtain the benefits of the game, and intrinsic motivation are key to success, but also that certain processes, such as taking medications, should not be gamified because it might encourage users to take the task less seriously. To rapidly disseminate games to the elderly, McCallum (2012) concludes the

process for game approval needs to be streamlined and updates should be allowed to be disseminated without pre-approval.

Lithoxoidou et al. (2018) believes gamification should support education, socialization treatment adherence, monitoring, and non-pharmacological interventions. Lithoxoidou et al. (2018) proposed an engine should be developed for health games that allows the games to be used on various platforms, set the game rules, leaderboards, types of games, and awards for winning or completing tasks. The games themselves should allow the users to advance levels upon completion of certain requirements, reward users for certain accomplishments, and add quests with rewards to motivate users. The engine should have three variations of users, administrators who create and edit games, game masters who create gamification proposals, and users who play and progress in the game. Textual descriptions should be provided and follow Game Definition Language, which provides general guidelines for the language structure of game text. Lithoxoidou et al. (2018) state users should be awarded with badges or similar prizes upon reaching a certain percentage of completion or completing certain tasks.

In terms of other technology currently aimed at elderly users that has not been discussed in current research, mass-market smartwatches and tablets are currently leading technology in new developments that could potentially benefit the elderly. There are a few peer-reviewed studies of mass-market smartwatches and tablets. Lu, Fu, Ma, Fang, and Turner (2016) conducted an early literature survey of smartwatches of various brands. Most studies reviewed were inconclusive at this point about whether smartwatches could help with disease detection or ongoing health issues, or were still ongoing (Lu et al., 2016). One study found seizure detection disappointing, while another found that using a smartwatch accelerometer to provide feedback when administering CPR increased chest compression rate and depth, but did not necessarily

increase the overall quality of the CPR (Patterson et al., 2015; Gruenerbl, Pirkl, Monger, Gobbi, & Lukowicz, 2015). Hughes (2018b) reviewed an ongoing study on IBM's and Karantis 360's tablet that can be used to run a cloud-based living system by working with Internet-enabled sensors. The tablet and sensors can monitor behavior, learn the user's behavior patterns, note unusual activities, and detect emergency situations (Hughes, 2018b).

Smartwatches have increasingly implemented fitness and health tracking features in an attempt to entice users to adopt the technology. Apple's Smartwatch Series 4 seems to be specifically targeting the elderly with new developments. The smartwatch supports fall detection, was tested on 2,500 users, can supposedly detect the differences between falling and tripping, and can send an alert to emergency services and contacts with the user's location if the user does not dismiss the notification asking if the user is alright in a certain amount of time or is immobile (Regan, 2018; Liedtke, 2018). Fall detection is automatically enabled for users over 65 years old (Baig, 2018).

The smartwatch also has the first electrocardiogram (ECG) sensor offered directly to consumers, which is typically only available at a doctor's office (Regan, 2018; Liedtke, 2018). The smartwatch can send the data from the ECG, including whether atrial fibrillation, or irregular heartbeat, is detected, to a doctor via PDF (Liedtke, 2018). The smartwatch also features previous health and fitness apps present in Apple's other smartwatches and iPhones (Liedtke, 2018; Baig, 2018). However, the Apple smartwatches have multiple disadvantages for the elderly, including requiring an iPhone for some features, the expense of both the phone and smartwatch for those who want all features, and a small screen that may be difficult to navigate for those with little technical experience or with physical disabilities (Regan, 2018; Orlov, 2018). Smartwatch sales are expected to jump by 15% in 2019 among those 55 and older, and

smartwatches might be subsidized by some types of insurance or Medicaid in some states, but the patient may have to share health tracking information (Baig, 2018; Pressman, 2018). Due to all of these factors, adoption would probably primarily be those under 65 and urban middle and upper class users over 65 who are more familiar with technology.

An early ongoing study of the smartwatch funded partially by Apple and conducted by Turakhia et al. (2018) tested whether the smartwatch could detect atrial fibrillation accurately and consistently in 400,000 volunteers of various age groups, excluding those under 22. Volunteers were given an irregular pulse notification if one was detected and given 30 days to contact a physician available to participants for the study (Turakhia et al., 2018). The physician discussed symptoms with the patient and determined what actions should be taken, such as whether the patient should visit the emergency room. Patients were asked in a follow-up survey 90 days later if they had contacted a healthcare provider besides the study's physician and what the outcome was, such as the results of hospital tests and treatments chosen by their provider based on their symptoms. Patients who had issues with atrial fibrillation were provided with ECG patch monitors that recorded tachograms and pulse for seven days, and it was found that the smartwatch had similar results as the patch 97.5% of the time. The study is ongoing, and researchers are seeking more participants over 65 for the second phase (Turakhia et al., 2018).

Practical Implementation and Medicaid

Berridge (2018) states that Medicaid is beginning to reimburse purchases of smart home technology in some states, but purchases by the states that reimburse for cameras, tracking devices, and monitors may not even be tracked, depending on the state (Berridge, 2018). To effectively implement a program, the cost-effectiveness of smart homes, the type of information users want to share and with whom they want to share it, and how to make fair, ethical decisions

for users with cognitive impairment must be researched and discussed with policy makers when implementing programs (Berridge, 2018). Finally, she emphasizes a key problem, which is a lack of recent studies that address gaps in current research, such as long-term implementation studies, in order to better understand the practical problems of implementing the systems (Berridge, 2018).

States vary widely in terms of coverage of assistive technology, with some having Medicaid waivers for almost anyone who may need assistance. However, state waivers tend to be vague on whether smart home technology is covered under assistive technology outside of personal emergency response systems, or PERS, which are devices that have a button the user can push to call emergency services, and may or may not be wearable. Some waivers seem to use assistive technology to refer to technology that can assist in breathing, movement, or other basic functions rather than smart homes. Several states do not cover assistive technology with waivers and whether the patient can obtain the technology may depend on how they present their request for a waiver. In terms of states that have specific coverage for the aged, 27 provide either PERS and/or assistive technology, with most providing PERS and not other assistive technology. Other states may cover the aged providing they meet certain requirements, such as a proven disability. All states that mention assistive technology in one or more waiver are detailed in Appendix A.

Conclusion

The present author proposes doing a study in a rural area of Oklahoma with users of telemedicine that would be expanded to include attitudes toward the assistive technologies of smart homes. It is expected that these users will want, or will accept, if provided for minimal to no expense, security features, health monitors and sensors that are not image-based, and other

health features such as medication dispensers, stove monitors and controls, and emergency fall buttons they can wear. It is expected that they will reject features such as automatic lighting and window control, social media and communication features, and intrusive technology such as cameras, since the rural elderly seem to share traits with international European users, who view traditional smart home technology as aimed at lazy people. Ideally, different methods of training should be used, such as in-person instructors and gamification, and different interface types should be tested, such as voice commands versus basic remote controls, to encourage users to become familiar with the technology and to encourage them to express preferences about what they need to learn to use the system consistently. Privacy preferences need to be discussed in-depth with the users to determine privacy guidelines, as rural users are often more distrustful of technology and may want to institute certain limitations that will determine the level to which they accept the technology. Finally, isolation issues should be addressed, preferably by determining what features lead to the issue and removing or changing the features. Berridge (2018) states that Medicaid support coordinators in states such as Washington, with a few exceptions, are currently setting up smart home pilot projects without sufficient guidance, since these same officials have asked for more research on user experiences, ethical issues, and efficacy. Thus, our study of the rural elderly could be done with researchers in the Dept. of Telemedicine at the OSU Medical School in Tulsa, since Oklahoma has approved insurance reimbursement for telemedicine, and could be expanded to include assistive technologies for smart homes. The study would use archetypes, or typical personality traits, of this population combined with a participatory model to try to help in the ethical diffusion of smart home technology at a mass level.

In the proposed study, ethical issues related to privacy, fears that the technology will be substituted for human contact, and how the surveillance affects the users' self-identity should be explored. Although many books, both fiction and non-fiction, have discussed a dystopian future in which people are under constant surveillance and their actions are judged by the government, this has not truly been possible until recently. In China, many large cities now have cameras on every street corner, and these cameras are used along with artificial intelligence and human operators to analyze and judge actions based on a point system. Jaywalking, buying certain products, committing crimes, acting rebelliously toward the government, helping others, as well as who is related to or knows the subject, are judged and scored by the social credit system (Carney, 2018). Good citizens receive benefits such as not needing to put a deposit down when renting a home, hotel room, or car, while bad citizens may be less able to travel, unable to get government jobs, and unable to get credit (Carney, 2018).

The United States may never develop such a system, as its surveillance activities are more limited and its society is more democratic. However, the issue with the elderly who need smart homes is that caretakers or relatives could sometimes place them in a dystopian situation. Many relatives and caretakers may care for their patient, but they could use a system with high-quality surveillance cameras in an over-controlling manner and could put the user at risk. Over-concerned relatives or caretakers may observe the user and try to alter behavior of which they disapprove. This could easily be extended too far. In conclusion, upcoming smart home systems must take into account not only the physical and mental weaknesses of the users but also concerns about the asymmetrical power dynamics in the caretaker-user relationships. Finally, while we have not yet reached Foucault's panoptican society where we are always under surveillance, smart homes are an approximation to this when they include monitoring

technology, albeit for a constructive purpose, so we must emphasize protecting the elderly users from both obvious and non-obvious dangers so that the gain is truly greater than the sacrifice.

References

Alabama Waiver Factsheet. (n.d.). Retrieved March 8, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/AL-Waiver-Factsheet.html#AL0241

Alaska Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/AK-Waiver-Factsheet.html#AK0261

Amiribesheli, M., & Bouchachia, A. (2015). Smart home design for people with dementia. *IEEE 2015 International Conference on Intelligent Environments* (pp. 1-4). Prague: IEEE. Retrieved March 9, 2019, from https://www.researchgate.net/publication/281204549_Smart_Homes_Design_for_People_with_Dementia

Amiribesheli, M., & Bouchachia, H. (2018). A tailored smart home for dementia care. *Journal of Ambient Intelligence and Humanized Computing, 9*(2), 1755-1782. Retrieved March 10, 2019, from https://www.researchgate.net/publication/321334911_A_Tailored_Smart_Home_for_Dementia_Care

Anderson, J., & Rainie, L. (2012). *The Future of Gamification.* Washington, D.C.: Pew Research Center. Retrieved March 12, 2019, from https://www.pewinternet.org/2012/05/18/the-future-of-gamification/

Aoyama, M. (2005). Persona-and-scenario based requirements engineering for software embedded in digital consumer products. *Proceedings of the 13th IEEE International*

Conference on Requirements Engineering (pp. 85-94). Paris: IEEE. Retrieved March 9, 2019, from https://ieeexplore.ieee.org/document/1531030

Arizona Demonstration Fact Sheet. (2018). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Waivers/1115/downloads/az/az-hccc-fs.pdf

Arkansas Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/AR-Waiver-Factsheet.html#AR0195

Baig, E. C. (2018). Apple Watch Heart Monitoring and Fall Detection: Are They Lifesavers? *USA Today*, p. 1. Retrieved March 18, 2019, from https://www.kgw.com/article/news/nation-now/apple-watch-heart-monitoring-and-fall-detection-are-they-lifesavers/465-a1f7e551-6f79-4e34-a28e-f3e10fb8f8ee

Bennett, B., McDonald, F., Beattie, E., Carney, T., Freckelton, I., White, B., & Willmott, L. (2017). Assistive technologies for people with dementia: Ethical considerations. *Bulletin of World Health Organization, 95*, 749-755. Retrieved March 6, 2019, from https://www.who.int/bulletin/online_first/BLT.16.187484.pdf?ua=1

Berridge, C. (2018). Medicaid becomes the first third-party payer to cover passive remote monitoring for home care: Policy analysis. *Journal of Medical Internet Research, 20*(2), e66. Retrieved November 25, 2018, from https://www.jmir.org/2018/2/e66/

Björneby, S., Topo, P., & Holthe, T. (1999). *Technology, ethics and dementia: A guidebook on how to apply technology in dementia care.* Norway: Norwegian Centre for Dementia Research. Retrieved March 8, 2019

Björneby, S., Topo, P., Cahill, S. M., Begley, E., Jones, K., Hagen, I., . . . Holthe, T. (2004). Ethical Considerations in the ENABLE project. *Dementia, 3*, 297. Retrieved November 11, 2018, from https://www.researchgate.net/publication/254085006_Ethical_considerations_in_the_ENABLE_project

Bradbury, R. (1950). *There will come soft rains.* New York City: Collier's.

Brownsell, S., Blackburn, S., & Hawley, M. S. (2008). An evaluation of second and third generation telecare services in older people's housing. *Journal of Telemedicine and Telecare, 14*(1), 8-12. Retrieved November 21, 2018, from https://journals-sagepub-com.argo.library.okstate.edu/doi/abs/10.1258/jtt.2007.070410

California Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/CA-Waiver-Factsheet.html#CA0336

Callejas, Z., & Lopez-Cozar, R. (2009). Designing smart home interfaces for the elderly. *ACM SIGACCESS Assessibility and Computing, 95*, 10-16. Retrieved October 11, 2018, from https://dl.acm.org/citation.cfm?id=1651261

Carney, M. (2018). Leave No Dark Corner. *ABC News*. Retrieved November 23, 2018, from https://www.abc.net.au/news/2018-09-18/china-social-credit-a-model-citizen-in-a-digital-dictatorship/10200278

Casas, R., Marin, B. R., Robinet, A., Delgado, A. R., Yarza, A. R., McGinn, J., . . . Grout, V. (2008). User modeling in ambient intelligence for elderly and disabled people. *Proceedings of the International Conference on Computers for Handicapped Persons*

(pp. 114-122). Berlin: Springer. Retrieved March 9, 2019, from https://link.springer.com/chapter/10.1007/978-3-540-70540-6_15

Chen, K., & Chan, A. H. (2014). Gerontechnology acceptance by elderly Hong Kong Chinese: A senior technology acceptance model (STAM). *Ergonomics*, 635-652. Retrieved October 20, 2018, from https://www-tandfonline-com.argo.library.okstate.edu/doi/abs/10.1080/00140139.2014.895855

Chernbumroong, S., Atkins, A. S., & Yu, H. (2010). Perception of smart home technologies to assist elderly people. *The Fourth International Conference on Software, Knowledge and Information Management and Applications Towards Happiness and Sustainable Development* (pp. 90-98). Paro: Chiang Mai University. Retrieved October 5, 2018, from http://www.camt.cmu.ac.th/skima2010/

Claes, V., Devriendt, E., Tournoy, J., & Milisen, K. (2015). Attitudes and perceptions of adults of 60 years and older towards in-home monitoring of the activities of daily living with contactless sensors: An explorative study. *International Journal of Nursing Studies, 52*(1), 134-148. Retrieved November 21, 2018, from https://www-sciencedirect-com.argo.library.okstate.edu/search/advanced?docId=10.1016/j.ijnurstu.2014.05.010

Colorado Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/CO-Waiver-Factsheet.html#CO0288

Connecticut Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/CT-Waiver-Factsheet.html#CT0302

Coughlin, J. F., D'Ambrosio, L. A., Reimer, B., & Pratt, M. R. (2007). Older adult perceptions of smart home technologies: Implications for research, policy & market innovations in healthcare. *Porceedings if the 29th Annual International Conference of the IEEE EMBS* (pp. 1810-1815). Lyon: IEEE. Retrieved October 5, 2018, from https://ieeexplore.ieee.org/abstract/document/4352665

Damodaran, L., & Olphert, W. (2010). User responses to assisted living technologies (Alts) - A review of the literature. *International Journal of Integrated Care, 18*(2), 25-32. Retrieved November 14, 2018, from https://www.emeraldinsight.com/doi/abs/10.5042/jic.2010.0133?journalCode=jica

Delaware Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/DE-Waiver-Factsheet.html#DE0009

Demiris, G., Hensel, B. K., Skubic, M., & Rantz, M. (2008). Senior residents' perceived need of and preferences for "smart home" sensor techologies. *International Journal of Technology Assessment in Health Care, 24*(1), 120-124. Retrieved October 5, 2018, from https://www.ncbi.nlm.nih.gov/pubmed/18218177

Demiris, G., Oliver, D. P., Dickey, G., Skubic, M., & Rantz, M. (2008). Findings from a participatory evaluation of a smart home application for older adults. *Technology & Health Care, 16*(2), 111-118. Retrieved October 5, 2018, from https://www.ncbi.nlm.nih.gov/pubmed/18487857

Demiris, G., Rantz, M. J., Aud, M. A., Marek, K. D., Tyrer, H. W., Skubic, M., & Hussam, A. A. (2004). Older adults' attitudes towards and perceptions of 'smart home' technologies: A

pilot study. *Medical Informatics & the Internet in Medicine, 29*(2), 87-94. Retrieved October 5, 2018, from https://www.ncbi.nlm.nih.gov/pubmed/15370989

Dewsbury, G. (2000). The social and psychological apects of smart home technology within the care sector. *New Technology in the Human Services, 14*, 9-17. Retrieved September 31, 2018, from https://www.researchgate.net/publication/238353008_The_Social_and_Psychological_Aspects_of_Smart_Home_Technology_within_the_Care_Sector

District of Columbia Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/DC-Waiver-Factsheet.html#DC0334

Duquenoy, P., & Whitehouse, D. (2006). A 21st century ethical debate: Pursuing perspectives on ambient intelligence. In C. Zielinski, P. Duquenoy, & K. Kimppa (Ed.), *The Information Society: Emerging Landscapes. IFIP International Conference on Landscapes of ICT and Social Accountability* (pp. 293-314). New York: Centre for Pervasive Computing. Retrieved November 12, 2018, from https://link.springer.com/book/10.1007%2F0-387-31168-8

Florida Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/FL-Waiver-Factsheet.html#FL0194

Foucault, M. (1963). *The birth of the clinic: An archaeology of medical perception.* (S. Smith, Trans.) London, England: Tavistock.

Foucault, M. (1977). *Discipline and punish: The birth of the prison.* London, England: Penguin Books.

Foucault, M. (1984). *The Foucault reader.* (P. Rabinow, Ed.) New York City: Pantheon. Retrieved February 16, 2019

Foucault, M. (2003). *The essential Foucault: Selections from the essential works of Foucault.* (P. Rabinow, & N. Rose, Eds.) New York City: The New Press. Retrieved February 16, 2019

Francis, P., Balbo, S., & Firth, L. (2009). Towards co-design with users who have autism spectrum disorders. *Universal Access in the Information Society, 8*(3), 123-135. Retrieved November 8, 2018, from https://search-proquest-com.argo.library.okstate.edu/docview/201545714?rfr_id=info%3Axri%2Fsid%3Aprimo

Fritz, R. L., Vandermause, R., Corbett, C., & Cook, D. J. (2015). The influence of culture in older adults' adoption of smart home monitoring. *Gerontechnology, 14*(3), 146-156. Retrieved November 14, 2018, from https://www.researchgate.net/publication/284448049_The_Influence_of_Culture_on_Older_Adults'_Adoption_of_Smart_Home_Monitoring

Gaul, S., & Ziefle, M. (2009). Smart home technologies: Insights into generation-specific acceptance motives. In A. Holzinger, & K. Miesenberger (Ed.), *HCI and Usability for e-Inclusion. 5th Symposium of the Workgroup Human-Computer Interaction and Usability Engineering of the Austrian Computer Society, USAB 2009* (pp. 312-332). Berlin: Springer. Retrieved November 14, 2018, from https://link.springer.com/book/10.1007%2F978-3-642-10308-7

Georgia Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/GA-Waiver-Factsheet.html#GA0112

Giddens, A. (1971). *Capitalism and modern social theory.* Cambridge: Cambridge University Press. Retrieved January 13, 2019

Govercin, M., Meyer, S., Schellenbach, M., Steinhagen-Thiessen, E., Weiss, B., & Haesner, M. (2016). SmartSenior@home: Acceptance of an integrated ambient assisted living system. Results of a clinical trial in 35 households. *Informatics for Health and Social Care, 41*(4), 430447. Retrieved October 20, 2018, from http://web.a.ebscohost.com.argo.library.okstate.edu/ehost/detail/detail?vid=0&sid=a05e9082-933f-4672-b24d-66e7ee992c8e%40sdc-v-sessmgr06&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=116238173&db=aph

Grönvall, E., & Kyng, M. (2012). On participatory design of home-based healthcare. *Cognition, Technology & Work, 15*(4), 389-401. Retrieved November 16, 2018, from https://link.springer.com/article/10.1007/s10111-012-0226-7

Gruenerbl, A., Pirkl, G., Monger, E., Gobbi, M., & Lukowicz, P. (2015). Smart-watch life saver: Smart-watch interactive-feedback system for improving bystander CPR. *Proceedings of the 2015 ACM International Symposium on Wearable Computers* (pp. 19-26). Osaka: ACM. Retrieved March 19, 2019, from https://dl.acm.org/citation.cfm?id=2802086

Hawaii Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/HI-Waiver-Factsheet.html#HI0013

Heckman, D. (2008). *A small world: Smart houses and the dream of the perfect day.* Durham: Duke University Press. Retrieved February 2, 2019

Himmel, S., & Ziefle, M. (2016). Smart home medical technologies: Users' requirements for conditional acceptance. *i-com, 15*(1), 39-50. Retrieved October 10, 2018, from https://www.degruyter.com/view/j/icom.2016.15.issue-1/icom-2016-0007/icom-2016-0007.xml

Holzinger, A., Schaupp, K., & Eder-Halbedl, W. (2008). An investigation on acceptance of ubiquitous devices for the elderly in a geriatric hospital environment: Using the example of person tracking. *Computers helping people with special needs. 11th International Conference, ICCHP 2008* (pp. 22-29). Berlin: Springer-Verlag. Retrieved November 17, 2018, from https://link.springer.com/book/10.1007%2F978-3-540-70540-6

Hughes, O. (2018a). Surrey Trust Awarded Additional £1m Funding for 'Pioneering' IoT Dementia Study. *Digital Health*, p. 1. Retrieved March 11, 2019, from https://www.digitalhealth.net/2018/09/surrey-trust-awarded-extra-1m-funding/

Hughes, O. (2018b). IBM and Karantus360 Team up for IoT Assisted Living System. *Digitla Health*, p. 1. Retrieved March 7, 2019, from https://www.digitalhealth.net/2018/06/ibm-and-karantis-team-up-for-iot-assisted-living-system/

Idaho Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/ID-Waiver-Factsheet.html#ID0076

Illinois Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/IL-Waiver-Factsheet.html#IL0326

Indiana Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/IN-Waiver-Factsheet.html#IN4197

Iowa Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/IA-Waiver-Factsheet.html#IA4111

Kansas Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/KS-Waiver-Factsheet.html#KS4165

Katz, S. (1996). *Disciplining old age: The formation of gerontological knowledge.* Charlottesville: University of Virginia Press. Retrieved January 21, 2019

Kelly, D. (2005). Smart support at home: The integration of telecare technology with primary and community care systems. *British Journal of Healthcare Computing and Information Management, 22*(3), 19-21. Retrieved November 20, 2018, from https://www.tib.eu/en/search/id/BLSE%3ARN166582190/Smart-support-at-home-the-integration-of-telecare/

Kenner, A. M. (2008). Securing the elderly body: Dementia, surveillance, and the politics of "aging in place". (Monahan, & Fisher, Eds.) *Surveillance & Society, 5*(3), 252-269.

Retrieved November 9, 2018, from https://pdfs.semanticscholar.org/814b/2e87380f29d9ae4612a62aff67fab5244d07.pdf

Kentucky Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/KY-Waiver-Factsheet.html#KY0144

Kirchbuchner, F., Hastall, M. R., Grosse-Puppendahl, T., & Distler, M. (2015). Ambient intelligence from senior citizens' perspectives: Understanding privacy concerns, technology acceptance, and expectations. *European Conference on Ambient Intelligence* (pp. 48-59). Springer. Retrieved October 21, 2018, from https://www.researchgate.net/publication/283722542_Ambient_Intelligence_from_Senior_Citizens'_Perspectives_Understanding_Privacy_Concerns_Technology_Acceptance_and_Expectations

Lauriks, S., Reinersmann, A., Roest, H. G., Meiland, F. J., Davies, R. J., . . . Droes, R. (2007). Review of ICT-based services for identified unmet needs in people with dementia. *Ageing Research Reviews, 6*, 223-246. Retrieved November 15, 2018, from https://www.sciencedirect.com/search/advanced?docId=10.1016/j.arr.2007.07.002

Levin, R. (1970). *This Perfect Day* (Book Club ed.). London: Michael Joseph Penguin Books. Retrieved February 17, 2019

Liedtke, M. (2018). Apple's Updated Smartwatch Adds Heart Readings. *American Association of Retired Persons*, p. 1. Retrieved March 18, 2019, from https://www.aarp.org/home-family/personal-technology/info-2018/updated-apple-watch-features.html

Lithoxoudou, E. E., Paliokas, I., Gotsos, I., Krinidis, S., Tsakiris, A., Votis, K., & Tzovaras, D. (2018). A gamification engine architecture for enhancing behavioral change support systems. *The 11th Pervasive Technologies Related to Assistive Environments Conference* (pp. 482-489). Corfu: ACM. Retrieved March 17, 2019, from https://www.researchgate.net/publication/326021420_A_Gamification_Engine_Architecture_for_Enhancing_Behavioral_Change_Support_Systems

Louisiana Waiver Factsheet. (n.d.). Retrieved March 9, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/LA-Waiver-Factsheet.html#LA0866

Lu, T.-C., Fu, C.-M., Ma, M. H.-M., Fang, C.-C., & Turner, A. M. (2016). Healthcare applications of smart watches: A systematic review. *Applied Clinical Information, 7*(3), 850-869. Retrieved March 17, 2019, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5052554/

Maine Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/ME-Waiver-Factsheet.html#ME0276

Marikyan, D., Papagiannidis, S., & Alamanos, E. (2018). A systematic review of the smart home literature: A user perspective. *Technological Forecasting and Social Change, 2*(1), 1-16. Retrieved November 2, 2018, from https://www-sciencedirect-com.argo.library.okstate.edu/search/advanced?docId=10.1016/j.techfore.2018.08.015

Maryland Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/MD-Waiver-Factsheet.html#MD0023

Massachusetts Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/MA-Waiver-Factsheet.html#MA40701

Mathew, A. (2005). Smart homes for the rural population: New challenges and opportunities. *Proceedings of the 2005 Annual Conference of the Association for Computer Aided Design in Architecture* (pp. 24-35). Ataman: Osman. Retrieved November 9, 2018, from http://papers.cumincad.org/data/works/att/acadia05_024.content.pdf

McCallum, S. (2012). Gamification and serious games for personalized health. *Studies in Health and Informatics, 177*, 85-96. Retrieved March 12, 2019, from https://www.researchgate.net/publication/230783925_Gamification_and_serious_games_for_personalized_health

Melander-Wikman, A., Jansson, M., Hallberg, J., Mortberg, C., & Gard, G. (2007). The lighthouse alarm and locator trial- A pilot study. *Technology and Health Care, 15*, 203-212. Retrieved November 10, 2018, from http://lnu.diva-portal.org/smash/get/diva2:501698/FULLTEXT01.pdf

Michigan Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/MI-Waiver-Factsheet.html#MI0233

Minnesota Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/MN-Waiver-Factsheet.html#MN0025

Mississippi Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/MS-Waiver-Factsheet.html#MS0255

Missouri Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/MO-Waiver-Factsheet.html#MO0197

Montana Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/MT-Waiver-Factsheet.html#MT0148

Mordini, E., Wright, D., Wadhwa, K., Hert, P. D., Mantovani, E., Thestrup, J., . . . Vater, I. (2009). Senior citizens and the ethics of e-inclusion. *Ethics and Information Technology, 11*(3), 203-220. Retrieved November 13, 2018, from https://link.springer.com/article/10.1007/s10676-009-9189-7

Mortenson, B., Sixsmith, A., & Woolrych, R. (2015). The power(s) of observation: Theoretical perpsectives on surveillance technologies and older people. *JournalAgeing and Society, 35*(3), 512-530. Retrieved November 25, 2018, from https://www-cambridge-org.argo.library.okstate.edu/core/journals/ageing-and-society/article/powers-of-observation-theoretical-perspectives-on-surveillance-technologies-and-older-people/666B8A344D0303219D859459C368F0D9

Mortenson, W. B., Sixsmith, A., & Beringer, R. (2016). No place like home? Surveillance and what home means in old age. *Canadian Journal on Aging, 35*(1), 103-114. Retrieved November 24, 2018, from https://www-cambridge-org.argo.library.okstate.edu/core/journals/canadian-journal-on-aging-la-revue-canadienne-du-vieillissement/article/no-place-like-home-surveillance-and-what-home-means-in-old-age/5F151C6277A0A045CE856A60CE5B6D42#

Nebraska Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/NE-Waiver-Factsheet.html#NE4154

Nevada Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/NV-Waiver-Factsheet.html#NV4150

New Hampshire Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/NH-Waiver-Factsheet.html#NH0053

New Jersey Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/NJ-Waiver-Factsheet.html#NJ4133

New Mexico Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/NM-Waiver-Factsheet.html#NM0173

New York Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/NY-Waiver-Factsheet.html#NY4125

North Carolina Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/Nc-Waiver-Factsheet.html#NC0662

North Dakota Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/ND-Waiver-Factsheet.html#ND0273

Novitzky, P., Smeaton, A. F., Chen, C., Irving, K., Jacquemard, T., O'Brolchain, F., . . . Gordijn, B. (2015). A review of contemporary work on the ethics of ambient assisted living technologies for people with dementia. *Science and Engineering Ethics, 21*(3), 707-765. Retrieved October 29, 2018, from https://link.springer.com/article/10.1007%2Fs11948-014-9552-x

Ohio Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/OH-Waiver-Factsheet.html#OH0337

Oklahoma Waiver Factsheet. (n.d.). Retrieved March 10, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/OK-Waiver-Factsheet.html#OK0179

Oppenauer, C., Preschl, B., KalteisI, K., & Kryspin-Exner, l. (2007). Technology in old age from a psychological point of view. In A. Holzinger (Ed.), *HCI and Usability for Medicine and*

Health Care. Symposium of the Austrian HCI and Usability Engineering Group (pp. 133-142). Graz: Springer. Retrieved November 21, 2018, from https://link-springer-com.argo.library.okstate.edu/chapter/10.1007%2F978-3-540-76805-0_11

Oregon Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/OR-Waiver-Factsheet.html#OR0565

Orlov, L. (2018). The Apple Watch and Fall Detection- What's It Mean? *Aging in Place Technology Watch*, p. 1. Retrieved March 18, 2019, from https://www.ageinplacetech.com/blog/apple-watch-and-fall-detection-what-s-it-mean

Orpwood, R., Gibbs, C., Adlam, T. D., Faulkner, R., & Meegahawatte, D. (2005). The design of smart homes for people with dementia- User-interface aspects. *Universal Access in the Information Society, 4*(2), 156-164. Retrieved March 8, 2019, from https://www.researchgate.net/publication/220606600_The_design_of_smart_homes_for_people_with_dementia_-_User-interface_aspects

Pal, D., Funilkul, S., Charoenkitkarn, N., & Kanthamanon, P. (2018). Internet-of-things and smart homes for elderly healthcare: An end user perspective. *IEEE Access, 6*, 10483-10496. Retrieved October 11, 2018, from https://ieeexplore.ieee.org/document/8300511

Panek, P., & Zagler, W. (2008). Computers helping people with special needs: A living lab for ambient assisted living in the municipality of Schwechat. *11th International Conference, ICCHP 2008* (pp. 1008-1015). Linz: Springer-Verlag. Retrieved November 7, 2018, from https://www.researchgate.net/publication/227285145_A_Living_Lab_for_Ambient_Assisted_Living_in_the_Municipality_of_Schwechat

Patterson, A. L., Mudigoudar, B., Fulton, S., McGregor, A., Poppel, K. V., Wheless, M. C., . . . Wheless, J. W. (2015). SmartWatch by SmartMonitor: Assessment of seizure detection efficacy for various seizure types in children, a large prospective single-center study. *Pediatric Neurology, 53*(4), 309-311. Retrieved March 18, 2019, from https://www.researchgate.net/publication/281083777_SmartWatch_by_SmartMonitor_Assessment_of_Seizure_Detection_Efficacy_for_Various_Seizure_Types_in_Children_A_Large_Prospective_Single-Center_Study

Peek, S. T., Aarts, S., & Wouters, E. J. (2015). Can smart home technology deliver on the promise of independent living? A critical reflection based on the perspectives of older adults. *Handbook of Smart Homes, Health Care and Well-Being*, 203-214. Retrieved October 10, 2018, from https://www.researchgate.net/publication/272796934_Can_Smart_Home_Technology_Deliver_on_the_Promise_of_Independent_Living_A_Critical_Reflection_Based_on_the_Perspectives_of_Older_Adults

Peek, S. T., Wouters, E. J., van Hoof, J., Luijkx, K. G., Boeije, H. R., & Vrijhoef, H. J. (2014). Factors influencing acceptance of technology for aging in place: A systematic review. *International Journal of Medical Informatics, 83*(4), 235-248. Retrieved November 13, 2018, from https://www-sciencedirect-com.argo.library.okstate.edu/search/advanced?docId=10.1016/j.ijmedinf.2014.01.004

Pennsylvania Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/PA-Waiver-Factsheet.html#PA0354

Portet, F., Vacher, M., Golanski, C., Roux, C., & Meillon, B. (2011). Design and evaluation of a smart home voice interface for the elderly: Acceptability and objection aspects. *Personal and Ubiquitous Computing, 17*(1), 127–144. Retrieved November 21, 2018, from https://link-springer-com.argo.library.okstate.edu/article/10.1007%2Fs00779-011-0470-5

Portet, F., Vacher, M., Golanski, C., Roux, C., & Meillon, B. (2013). Design and evaluation of a smart home voice interface for the elderly: acceptability and objection aspects. *Pers Ubiquit Comput, 17*, 127-144. Retrieved October 21, 2018, from https://link-springer-com.argo.library.okstate.edu/article/10.1007/s00779-011-0470-5

Poulson, D., Ashby, M., & Richardson, S. (1996). *A practical handbook on user-centered design for assistive technology.* Brussels: European Commission, TIDE. Retrieved March 8, 2019

Pressman, A. (2018). Smartwatch Sales Could Get a Lift Next Year from an Unexpected Age Group. *Yahoo*, p. 1. Retrieved March 18, 2019, from https://finance.yahoo.com/news/smartwatch-sales-could-lift-next-110058203.html

Raappana, A., Rauma, M., & Melkas, H. (2007). Impact of safety alarm systems on care personnel. *Gerontechnology, 6*(2), 112-117. Retrieved March 8, 2019, from https://www.researchgate.net/profile/Helinae_Melkas/publication/276999414_Impact_of_safety_alarm_systems_on_care_personnel/links/58199d0f08ae50812f5e04e2/Impact-of-safety-alarm-systems-on-care-personnel.pdf

Raei, P., & Bouchachia, A. (2016). A literature review on the design if smart homes for people with dementia using a user-centered design approach. *BCS Human Computer Interaction Conference 2016* (pp. 1-8). Bournemouth: BCS Learning and Development Ltd.

Retrieved March 6, 2019, from https://www.researchgate.net/publication/310622083_A_Literature_Review_on_the_Design_of_Smart_Homes_for_People_with_Dementia_Using_a_User-Centred_Design_Approach

Reeder, B., Meyer, E., Lazar, A., Chaudhuri, S., Thompson, H. J., & Demiris, G. (2013). Framing the evidence for health smart homes and home-based consumer health technologies as a public health intervention for independent aging: A systematic review. *International Journal of Medical Informatics, 82*(7), 565-579. Retrieved November 19, 2018, from https://www-sciencedirect-com.argo.library.okstate.edu/search/advanced?docId=10.1016/j.ijmedinf.2013.03.007

Regan, T. (2018). Apple Makes Play for Seniors with New Smartwatch Features. *Senior Housing News*, p. 1. Retrieved March 18, 2019, from https://seniorhousingnews.com/2018/09/12/apple-makes-play-seniors-new-smartwatch-features/

Remmers, H. (2010). Environments for ageing, assistive technology and self-determination: ethical perspectives. *Informatics for Health & Social Care, 35*(3), 200-210. Retrieved November 18, 2018, from http://web.a.ebscohost.com.argo.library.okstate.edu/ehost/detail/detail?vid=0&sid=03215dc0-39f6-4958-94fe-94bb2a10261c%40sessionmgr4006&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=aph&AN=55614857

Rhode Island Comprehensive Section 1115 Demonstration Fact Sheet. (2018). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Waivers/1115/downloads/ri/ri-global-consumer-choice-compact-fs.pdf

Saez, D. F., Gutierrez, F. J., & Ochoa, S. F. (2015). Introducing ambient assisted living technology at the home of the elderly: Challenges and lessons learned. *Ambient Assisted-Living. ICT-based Solutions in Real Life Situations: 7th International Work-Conference* (pp. 125-136). Puerto Varas: ResearchGate. Retrieved November 1, 2018, from https://www.researchgate.net/publication/300223759_Introducing_Ambient_Assisted_Living_Technology_at_the_Home_of_the_Elderly_Challenges_and_Lessons_Learned

Salces, F., Baskett, M., Llewellyn-Jones, D., & & England, D. (2006). Ambient interfaces for elderly people at home. *In Ambient intelligence in everyday life*, 256–284. Retrieved November 20, 2018, from https://link.springer.com/chapter/10.1007/11825890_13

Satpathy, L. a. (2007). "Smart" housing for the elderly: Understanding perceptions and biases of rural America. *Proceedings of the 2007 Annual Conference of the Association for Computer Aided Design In Architectqaure (ACADIA), Dalhousie University School of Architecture and NSCAD University* (pp. 1-11). Halifax: ACADIA. Retrieved November 23, 2018, from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.130.1653&rep=rep1&type=pdf

Sixsmith, A. (2013). Technology and the challenge of aging. In A. Sixsmith, & G. Gutman (Eds.), *Technologies for Active Aging* (pp. 1-25). Vancouver: Springer. Retrieved November 25, 2018, from file:///C:/Users/Rachel/Downloads/9781441983473-c1.pdf

South Carolina Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/SC-Waiver-Factsheet.html#SC0676

South Dakota Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/SD-Waiver-Factsheet.html#SD0189

Sponselee, A.-m., Schouten, B. A., Bouwhuis, D., & Willems, C. (2008). Smart home technology for the elderly: Perceptions of multidisciplinary stakeholders. *European Conference on Ambient Intelligence, AmI'07* (pp. 314-326). Berlin: Springer. Retrieved November 20, 2018, from https://surfsharekit.nl/publiek/fontys/843b11ac-6276-4a79-85a8-183bdd7d28c4

Teasdale, S. (1920). There will come soft rains. *In Flame and Shadow.* Macmillan: Harper's.

Tennessee Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/TN-Waiver-Factsheet.html#TN0357

Texas Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/TX-Waiver-Factsheet.html#TX0181

Tomita, M. R., Mann, W. C., Stanton, K., & Tomita, A. D. (2007). Use of currently available smart home technology by frail elders process and outcomes. *Topics in Geriatric Rehabilitation, 23*(1), 24-34. Retrieved November 21, 2018, from

https://www.researchgate.net/publication/297303624_Use_of_currently_available_smart_home_technology_by_frail_elders_process_and_outcomes

Townsend, D., Knoefel, F., & Goubran, R. (2011). Privacy versus autonomy: A tradeoff model for smart home monitoring technologies. *33rd Annual International Conference of the IEEE EMBS* (pp. 4749-4752). Boston: IEEE. Retrieved October 11, 2018, from https://www.ncbi.nlm.nih.gov/pubmed/22255399

Turakhia, M. P., Desai, M., Hedlin, H., Rajimane, A., Talati, N., Ferris, T., . . . Perez, M. V. (2018). Rationale and design of a large-scale, app-based study to indentify cardiac arrhythmias using a smartwatch: The Apple heart study. *American Heart Journal, 207*, 66-75. Retrieved March 19, 2019, from https://www.researchgate.net/publication/327533402_Rationale_and_design_of_a_large-scale_app-based_study_to_identify_cardiac_arrhythmias_using_a_smartwatch_The_Apple_Heart_Study

Utah Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/UT-Waiver-Factsheet.html#UT40183

van Hoof, J., Kort, H. S., Rutten, P. G., & Duijnstee, M. S. (2011). Ageing-in-place with the use of ambient intelligence technology: Perspectives of older users. *International Journal of Medical Informatics, 80*(5), 310-331. Retrieved November 20, 2018, from https://www-sciencedirect-com.argo.library.okstate.edu/science/article/pii/S1386505611000566?via%3Dihub

Vermont Global Commitment to Health Section 1115 Demonstration Fact Sheet. (2018). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/Medicaid-CHIP-Program-Information/By-Topics/Waivers/1115/downloads/vt/vt-global-commitment-to-health-fs.pdf

Vette, F. D., Tabak, M., Weering, M. D., & Vollenbroek-Hutten, M. (2015). Engaging elderly people in telemedicine through gamification. (G. Eysenbach, Ed.) *JMIR Serious Games, 3*(2e9), 1-23. Retrieved November 11, 2018, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4704903/?report=printable

Virginia Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/VA-Waiver-Factsheet.html#VA0372

Wallace, J., Mulvenna, M. D., Martin, S., Stephens, S., & Burns, W. (2010). ICT interface design for ageing people. In C. N. M.D. Mulvenna (Ed.), *Supporting People with Dementia Using Pervasive Health Technologies. Advanced Information and Knowledge Processing* (pp. 165-188). London: Springer_Verlag. Retrieved November 13, 2018, from https://pdfs.semanticscholar.org/ada4/ef9fca8bd1e1fa0ab311724c5ded7271eea3.pdf

Washington Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/WA-Waiver-Factsheet.html#WA40669

West Virginia Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/WV-Waiver-Factsheet.html#WV0134

Wisconsin Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/WI-Waiver-Factsheet.html#WI0414

Wyoming Waiver Factsheet. (n.d.). Retrieved March 11, 2019, from Medicaid.gov: https://www.medicaid.gov/medicaid/section-1115-demo/demonstration-and-waiver-list/Waiver-Descript-Factsheet/WY-Waiver-Factsheet.html#WY0236

Yusif, S., Soar, J., & Hafeez-Baig, A. (2016). Older people, assistive technologies, and the barriers to adoption: A systematic review. *International Journal of Medical Informatics, 94*, 112-116. Retrieved October 20, 2018, from https://www-sciencedirect-com.argo.library.okstate.edu/search/advanced?docId=10.1016/j.ijmedinf.2016.07.004

Zaad, L., & Allouch, S. B. (2008). The influence of control on the acceptance of ambient intelligence by elderly people: An explorative study. In E. Aarts, J. L. Crowley, B. d. Ruyter, H. Gerhäuser, A. Pflaum, J. Schmidt, & R. Wichert (Ed.), *Ambient Intelligence European Conference, AmI 2008* (pp. 58-74). Berlin: Springer. Retrieved November 20, 2018, from https://link.springer.com/book/10.1007%2F978-3-540-89617-3

Zwijsen, S. A., Niemeijer, A. R., & Hertogh, C. M. (2011). Ethics of using assistive technology in the care for community-dwelling eldery people: An overview of the literature. *Aging & Mental Health, 15*(4), 419-427. Retrieved October 11, 2018, from https://www-tandfonline-com.argo.library.okstate.edu/doi/abs/10.1080/13607863.2010.543662

Appendix A

- Alaska, Arizona, Arkansas. Kentucky, Mississippi, Oregon, Puerto Rico, Rhode Island, Texas, West Virginia do not mention assistive technology or PERS in their waivers ("Alaska Waiver Factsheet", n.d.; "Arizona Demonstration Factsheet", 2018; "Arkansas Waiver Factsheet", n.d.; "Kentucky Waiver Factsheet", n.d.; "Mississippi Waiver Factsheet", n.d.; "Oregon Waiver Factsheet", n.d.; "Rhode Island Comprehensive Section 1115 Demonstration Fact Sheet", n.d.; "Texas Waiver Factsheet", n.d.; "West Virginia Waiver Factsheet", n.d.).
- Alabama provides services to adults 18 years or older who are disabled or have long-term illnesses and need assistive services to live independently ("Alabama Waiver Factsheet", n.d.). It also has a waiver targeting those who would like to move out of institutions into their own homes and those who need additional financial help because the other waivers for which they qualify are not meeting their needs ("Alabama Waiver Factsheet", n.d.).
- California provides personal emergency response systems to all qualified disabled or aged individuals from ages zero and up ("California Waiver Factsheet", n.d.).
- Colorado provides assistive technology to people zero and up with disabilities ("Colorado Waiver Factsheet", n.d). Other waivers provide PERS to the aged or people with brain injuries, spinal cord injuries, blindness, mental health issues, or disabilities ("Colorado Waiver Factsheet", n.d.).
- Connecticut provides personal emergency response systems to most aged and disabled groups ("Connecticut Waiver Factsheet", n.d.). Other waivers provide assistive

technology for people of various age groups who have difficulty living on their own due to age and/or disabilities (“Connecticut Waiver Factsheet”, n.d.).

- Delaware covers assistive technology for non-Medicaid individuals 12 and up with disabilities (“Delaware Waiver Factsheet”, n.d.).
- District of Columbia provides personal emergency response systems to those 65 and up, as well those ages 18-64 with physical disabilities (“District of Columbia Waiver Factsheet”, n.d.). The Persons with Intellectual and Developmental Disabilities waiver provides assistive technology to disabled individuals 18 and up (“District of Columbia Waiver Factsheet”, n.d.).
- Florida waivers provide PERS for those with disabilities, as well as adults with cystic fibrosis, those in need of long-term care, and the elderly (“Florida Waiver Factsheet”, n.d.). The Model Waiver and Traumatic Brain and Spinal Cord Injury waiver provide assistive technology (“Florida Waiver Factsheet”, n.d.). The Model Waiver is aimed at children 20 years or younger who have medical issues that require assistance to continue living in the home (“Florida Waiver Factsheet”, n.d.).
- Georgia provides PERS to individuals with physical disabilities ages 21-64 (“Georgia Waiver Factsheet”, n.d.).
- Hawaii provides assistive technology to people with developmental disabilities of any age (“Hawaii Waiver Factsheet”, n.d.).
- Idaho waivers provide PERS to the aged and those with disabilities (“Idaho Waiver Factsheet”, n.d.).

- Illinois provides PERS to people with brain injuries, HIV/AIDS, and disabilities ("Illinois Waiver Factsheet", n.d.). Assistive technology can also be obtained for children ages 3-21 with developmental disabilities ("Illinois Waiver Factsheet", n.d.).
- Indiana waivers cover PERS for those with disabilities, the elderly, and those with autism or traumatic brain injuries ("Indiana Waiver Factsheet", n.d.).
- Iowa waivers cover PERS for people with disabilities, brain injuries, and the aged ("Iowa Waiver Factsheet", n.d.). The HCBS Elderly Waiver covers assistive devices for those 65 and up ("Iowa Waiver Factsheet", n.d.).
- Kansas provides assistive technology to those ages 0-21 and 65 and up who are frail and need assistance to live independently ("Kansas Waiver Factsheet", n.d.). Additionally, waivers cover PERS for the aged and people with brain injuries and physical disabilities ("Kansas Waiver Factsheet", n.d.).
- Louisiana waivers cover PERS for those with autism, disabilities, and the aged ("Louisiana Waiver Factsheet", n.d.).
- Maine waivers cover assistive technology and PERS for people with disabilities, autism, and the aged ("Maine Waiver Factsheet", n.d.).
- Maryland waivers cover assistive technology for people with disabilities ("Maryland Waiver Factsheet", n.d.). The Living at Home waiver covers PERS for adults 18-64 with physical disabilities ("Maryland Waiver Factsheet", n.d.).
- Massachusetts waivers cover assistive technology for individuals with autism ages 0-8 and individuals with intellectual disabilities ages 22 and up ("Massachusetts Waiver Factsheet", n.d.). PERS are covered for those ages 65 and up, and those ages 60-64 with physical disabilities ("Massachusetts Waiver Factsheet", n.d.).

- Michigan covers assistive technology and PERS for those ages 21-64 with physical disabilities, those ages 65 and up, and those of any age with developmental disabilities ("Michigan Waiver Factsheet", n.d.).
- Minnesota waivers cover assistive technology for individuals with intellectual or developmental disabilities ("Minnesota Waiver Factsheet", n.d.).
- Missouri waivers cover assistive technology for people with autism or with intellectual or developmental disabilities ("Missouri Waiver Factsheet", n.d.).
- Montana waivers cover PERS for those with disabilities or those with mental illnesses who are age 18 and up ("Montana Waiver Factsheet", n.d.).
- Nebraska waivers cover assistive technology and PERS for the aged and individuals with autism or disabilities ("Nebraska Waiver Factsheet", n.d.).
- Nevada waivers cover PERS for individuals with physical disabilities and the aged ("Nevada Waiver Factsheet", n.d.).
- New Hampshire waivers cover assistive technology support services for people with autism, those with brain injuries who are ages 22 or older, or those who have developmental or intellectual disabilities ("New Hampshire Waiver Factsheet", n.d.). PERS are covered for the aged and those with physical disabilities ages 18-64 ("New Hampshire Waiver Factsheet", n.d.).
- New Jersey covers assistive technology and PERS for individuals ages 21 and up with autism or those with intellectual and developmental disabilities ("New Jersey Waiver Factsheet", n.d.).
- New Mexico covers assistive technology for individuals with intellectual or developmental disabilities or autism ("New Mexico Waiver Factsheet", n.d.).

- New York waivers cover assistive technology for those with autism or disabilities and the aged ("New York Waiver Factsheet", n.d.).
- North Carolina covers assistive technology for the aged and people with disabilities from ages 18-64, those with brain injuries from ages 22 and up, and children ages 0-20 who are medically fragile ("North Carolina Waiver Factsheet", n.d.). PERS are covered for those with any disability or autism of any age and the aged ("North Carolina Waiver Factsheet", n.d.).
- North Dakota covers assistive technology for those with autism from ages 0-11 ("North Dakota Waiver Factsheet", n.d.).
- Ohio waivers cover assistive technology and/or assistive technology services for those with disabilities and autism, as well as the aged ("Ohio Waiver Factsheet", n.d.). PERS are covered for the aged ("Ohio Waiver Factsheet", n.d.).
- Oklahoma provides assistive technology for those with intellectual disabilities and those with physical disabilities ages 20-64 ("Oklahoma Waiver Factsheet", n.d.). PERS are covered for most adults with disabilities and the aged ("Oklahoma Waiver Factsheet", n.d.).
- Pennsylvania waivers cover assistive technology for individuals with autism, intellectual disabilities, developmental disabilities from ages 0-8, physical disabilities from ages 21-64, and the aged ("Pennsylvania Waiver Factsheet", n.d.). PERS are covered for the aged and those with physical disabilities from ages 18-64 ("Pennsylvania Waiver Factsheet", n.d.).
- South Carolina covers assistive technology and PERS for those with disabilities, as well as PERS for the aged ("South Carolina Waiver Factsheet", n.d.).

- South Dakota waivers cover PERS for the aged and those with physical disabilities ages 18-64 (“South Dakota Waiver Factsheet”, n.d.).
- Tennessee covers assistive technology and PERS for individuals with intellectual disabilities of all ages and developmental disabilities from ages 0-5 (“Tennessee Waiver Factsheet”, n.d.).
- Utah waivers cover assistive technology and PERS for individuals with brain injuries from ages 18 and up, the aged, those with autism, those with intellectual or developmental disabilities, and those with physical disabilities from ages 18-64 (“Utah Waiver Factsheet”, n.d.).
- Vermont covers assistive technology for those with brain injuries (“Vermont Global Commitment to Health Section 1115 Demonstration Fact Sheet”, n.d.).
- Virginia waivers cover assistive technology and PERS for individuals with developmental or intellectual disabilities, autism, individuals ages 0-64 with physical disabilities, and the aged (“Virginia Waiver Factsheet”, n.d.).
- Washington covers assistive technology for individuals with developmental disabilities ages 3 and up, and those with intellectual disabilities or autism from ages 8-20 (“Washington Waiver Factsheet”, n.d.).
- Wisconsin covers assistive technology and PERS for the aged, people with disabilities, and children ages 0-21 with autism or serious emotional disturbance (“Wisconsin Waiver Factsheet”, n.d.).
- Wyoming covers PERS for the aged and individuals with physical disabilities from ages 18-64 who need long-term care (“Wyoming Waiver Factsheet”, n.d.).