Abstract

Most research in the literature focuses on the development of healthcare technology for older adults, yet few studies focus on elders' use of this technology. The purpose of this literature review was to address a clear gap in the literature by determining barriers and facilitators of healthcare technology use by older adults. The Cumulative Index of the Nursing and Allied Health Literature (CINAHL), Health Source - Consumer Edition, Health Source: Nursing/Academic Edition, Library & Information Science Source, MEDLINE, Psychology and Behavioral Sciences Collection, PsycInfo, and Science & Technology Collection were searched for papers from January 2013 to November 2022. Studies that took place in the United States, consisted of a study sample aged 55 or above, and evaluated elders' use of healthcare technology were included. From 693 publications, 18 studies were selected. Six consistent themes were identified among the papers. Indications for the healthcare sector and community stakeholders are suggested.

What this paper adds

- Barriers to healthcare technology use by the elderly include lack of access to technology and the internet, health status, and negative attitudes about technology.
- There is discrepancy in the literature regarding the impact of privacy concerns on older adults' use of healthcare technology.
- Perceived needs regarding use of technology and access to education and support may facilitate older adults' adoption and use of emerging healthcare technologies.

Applications of study findings

- Older adults must be involved in the process of creation and implementation of healthcare technologies to ensure they receive the benefits the technology is meant to provide.
- Research is needed regarding racial disparities, privacy concerns, and long-term healthcare technology use to further understand older adults' ongoing use of healthcare technology.

Introduction

By 2030, all baby boomers, one of the largest generations in the United States, will be above the age of 65, and by 2034, older adults above 65 are expected to outnumber children for the first time in United States history (U.S. Census Bureau, 2019). This aging population trend is expected to continue throughout the century, with 25% of the population projected to be 65 years or older by 2060, compared to 16% of the population in 2018 (U.S. Census Bureau, 2019). The reason for this trend is not only attributed to the baby boomer generation getting older. Fertility rates have also decreased, and due to advances in medicine and technology, life expectancy in the United States has increased since the beginning of the century, yielding an increased population of older adults, and a decreased population of children to make up for the difference (U.S. Census Bureau, 2019). Due to this rapid and consistent aging of the United States population, as well as the greater prevalence of chronic health issues prevalent in older adults, our healthcare system needs to prepare to care for a predominantly elderly client population (Centers for Disease Control and Prevention, 2022).

Along with the increase of older adults in the United States, the creation of technology in the healthcare sector is increasing as well. A wide range of digital devices, including smartphone-connected devices, wearable devices, and sensors, have been developed to help

clients track their health conditions, communicate with their healthcare team, promote independence and self-management, and facilitate the use of health services (Bhavnani et. al., 2016). Moreover, with the onset of the COVID-19 pandemic in 2020, the use of digital health technologies drastically increased to keep healthcare professionals and their clients connected, and now digital healthcare delivery methods are embedded in our healthcare system (Litchfield et. al., 2021). This digitalization of healthcare delivery is intended to expand further, with the U.S. Department of Health and Human Services investing $18 million in their FY 2023 budget on the Agency for Healthcare Research and Quality (AHRQ) digital healthcare research portfolio, which will fund research studying "'what and how digital healthcare technologies work best" for patients and clinicians (U.S. Department of Health & Human Services, 2022). Additionally, it will help establish two Centers of Excellence in Telehealth Implementation, which will serve to evaluate the effects of telehealth on healthcare delivery and health outcomes, and how it can improve equity through the expanded healthcare access it offers (U.S. Department of Health & Human Services, 2022). This investment is $2 million more than what the FY 2022 budget enacted (U.S. Department of Health & Human Services, 2022). Healthcare technology will continue to expand due to increased priority at the federal level.

Usability is defined as "the effectiveness, efficiency and satisfaction with which the users can achieve tasks in a particular environment of a product" (Merriam-Webster Dictionary, n.d.). With regard to older adults, the usability of healthcare technology is important because, if the elderly are not willing or able to effectively use it, the positive health outcomes intended will simply not occur. Most research in the literature focuses on the development of healthcare technology for this population; however, few studies focus on elders' use of the technology being created for them and what promotes and inhibits their ability and willingness to use it.

(Kapadia et. al., 2015; Kadylak & Cotten, 2020). Therefore, the purpose of this literature review was to determine barriers and facilitators of healthcare technology use by the elderly.

Methods

Design

A literature review was conducted to synthesize the literature about barriers and facilitators older adults experience toward using healthcare technology.

Search Strategy and Selection Criteria

The search strategy was aimed at finding peer-reviewed academic journal articles published in English, using the following databases: Cumulative Index of the Nursing and Allied Health Literature (CINAHL) Plus with Full Text, Health Source - Consumer Edition, Health Source: Nursing/Academic Edition, Library & Information Science Source, MEDLINE, Psychology and Behavioral Sciences Collection, PsycInfo, and Science & Technology Collection. To make conclusions of relevant findings, only articles published between January 2013 and November 2022 were included. The search terms used were "elderly" and "healthcare technology use." For a study to be included in the review, it (1) had to take place in the United States, (2) consist of older adults aged 55 or above as the study sample, and (3) evaluate older adults' use of healthcare technology. In this review, 55 was the age limit selected because a large number of articles considered adults 55 or older as elderly.

Study Selection

693 articles were extracted from the search. After 139 duplicates were removed, the titles and abstracts of 554 articles were reviewed based on the inclusion criteria. 299 records were excluded due to duplicity (n = 28), not taking place in the United States (n = 218), consisting of study samples aged younger than 55 (n = 32), not being research articles (n = 9), and being

published before 2013 (n = 12). Full texts of the remaining 255 articles were screened; 223 were excluded due to not being about healthcare technology (n = 21), explaining technology created for health professionals and not the elderly (n = 26), describing devices meant for the elderly without describing their use of the technology (n = 75), analyzing technology used for, instead of by, the elderly (n = 96), or assessing the efficacy of usability scales for future studies (n = 6). Literature reviews (n = 13) were also excluded after reviewing their reference lists for additional relevant literature. Ultimately,18 articles were selected that described older adults' use of healthcare technology (Figure 1).

Quality Assessment

The studies selected for this review were assessed for quality using the Rapid Critical Appraisal checklists for descriptive, qualitative, and mixed-method studies developed by Melynk and Fineout-Overholt (2019). These checklists include questions that assess the reliability and validity of a study to determine its overall quality and strength. Both authors independently assessed the quality of each study using the same checklists, and a meeting was held to compare assessments. Most of the studies were considered low quality, yet consistency was high because similarities in findings within the articles were present.

Data Abstraction

Data from each study and review were abstracted by one reviewer and then confirmed by the other. A table of evidence including the purpose of the study, design, sample characteristics and setting, findings, level of evidence, and limitations (Table 1). Another table categorizing the papers by study type and technology type was also developed (Table 2).

Results

Study Characteristics

The characteristics of included studies are summarized in Tables 1 and 2. The 18 papers in this review were published between 2013 and 2022 (Table 1). While just about the same amount of the studies included were published from 2013-2017 (n = 10) and 2018-2022 (n = 8), over a third (n = 7) of the articles were published from 2020-2022 (Arcury et. al., 2020; Chandrasekaran et. al., 2021; Hastings et. al., 2021; Kadylak & Cotten, 2020; Lama et. al., 2022; Ramirez-Zohfeld et. al., 2020; Zhang et. al., 2020). About an even number of articles presented quantitative (n = 7), qualitative (n =6), and mixed-method (n = 5) studies (Table 2).

These papers fall under various categories of technology types discussed, including telehealth, monitoring technologies, electronic health portals, internet, cell phones, computers, personal emergency response systems, and multiple technologies (Table 2). Within these categories, there were 6 consistent themes presented among the papers. These were identified as (1) access to technology and internet, (2) health factors, (3) privacy concerns, (4) attitudes about technology, (5) perceived need for use, and (6) need for support and education on healthcare technology use.

Access to Technology and Internet

Lack of access to technology and internet was found to be a barrier to healthcare technology use amongst older adults in 6 studies (Batsis et. al., 2019; Gordon & Hornbrook, 2016; Heart & Kalderon, 2013; Lama et. al., 2022; Latulipe, 2015; Morgenstern et. al., 2015). This barrier was especially relevant when referring to participants living in rural communities, who are less likely to have broadband access and locations with public computers (Batsis et. al., 2019; Gordon & Hornbrook, 2016; Lama et. al., 2022; Latulipe et. al., 2015). Cost and household income, which are associated with access, were directly mentioned as barriers in 4 out of the 6 studies (Heart & Kalderon, 2013; Latulipe et. al., 2015; Gordon & Hornbrook, 2016;

Morgenstern et. al., 2015). For example, in a study conducted by Gordon & Hornbrook (2016), 34.9% of participants that did not have home Internet stated it was because of the cost. However, 4 more studies that had not directly mentioned access as a barrier concluded that cost was a barrier to healthcare technology use within their participants (Parker et. al., 2013; Arcury et. al., 2020; Kadylak & Cotten, 2020; Chandrasekaran et. al., 2021).

Health Factors

Six studies identified different physical and cognitive impairments often associated with aging as another barrier (Demiris et. al., 2013; Hastings et. al., 2021; Kadylak & Cotten, 2020; Parker et. al., 2013; Ramirez-Zohfeld, 2020; Zhang et. al., 2020). Vision, motor, and hearing loss significantly challenged older adult's ability to use the healthcare technology offered to them. In their study examining older adult's acceptance of a telehealth wellness system, Demiris et. al. (2013) noted that many older adults with hearing impairments found it difficult to follow instructions and understand how to effectively use the system because they could no longer read lips to understand what they are being told like they were used to. Older adults with visual impairment consistently struggled with viewing text and digital images presented by the technologies across the studies (Demiris et. al., 2013; Parker et. al., 2013; Zhang et. al., 2020).

Cognitive impairment was an avoided factor in a few papers, with some authors excluding older adults with cognitive impairment in their studies (Demiris et. al., 2013; Morgenstern et. al., 2015; Zhang et. al., 2020). Regardless, some studies that included older adults regardless of cognitive impairment found it to be a barrier to healthcare technology use (Hastings et. al., 2021; Ramirez- Zohfeld et. al., 2020). Ramirez-Zohfeld et. al. (2020) found that participants with Alzheimer's were more likely than to have a caregiver use the patient portal studied as their proxy. Additionally, older adults with cognitive impairment found it easier, and

much preferred, to use video over other text or auditory-based technologies (Hastings et. al., 2021).

Participants' health status and levels of independence were considered. Additionally to participants with Alzheimer's, Ramirez-Zohfeld et. al., 2020 noted that the older adults with history of heart failure and coronary artery disease in the study were also more likely to have a caregiver use their online patient portal for them. Moreover, participants in Kadylak & Cotten's (2020) study that were capable of independently conducting more than one activity of daily living (ADL) were significantly more likely to be willing to use assistive robots.

Four studies encountered a positive association between self-reported health status and willingness to, or active, use of healthcare technologies (Chandrasekaran et. al., 2013; Gordon & Hornbrook, 2016; Heart & Kalderon, 2013; Kadylak & Cotten, 2020). Most of the studies measured participants' health status as a self-reported response in a questionnaire with answer choices ranging from 'excellent' to 'poor' (Chandrasekaran et. al., 2013; Gordon & Hornbrook, 2016; Kadylak & Cotten, 2020). Only one study measured health status on the basis of whether or not the participants experienced "severe health problems" (Heart & Kalderon, 2013). Across all 4 studies; however, older adults with 'better' health status were more inclined to use healthcare technology, or they were already using multiple types of technology, than their counterparts who reported 'worse' health status or severe health problems.

Privacy Concerns

Discrepancy regarding privacy concerns was noted within the articles. While 3 studies found that privacy was a major concern older adults had with regards to adopting healthcare technology, 2 claimed the opposite (Balas et. al., 2015; Batsis et. al., 2019; Demiris et. al., 2013; Latulipe et. al., 2015; Porter et. al., 2013). Demiris et. al. (2013) claimed that the participants in

their study had no privacy concerns and, on the contrary, generally wanted to share their data from a patient portal with their families and between each other. The other study that deemed privacy concerns as an insignificant contributor to healthcare technology found that some participants were concerned "but to a lesser degree" than other potential barriers encountered in the study like lack of access and perceived need (Batsis et. al., 2019).

The 3 articles that found privacy concerns as a significant barrier to the older adults using healthcare technology studied the use of an online patient portal, a monitoring technology system, and a personal emergency response device (Balas et. al., 2015; Latulipe et. al., 2015; Porter et. al., 2013). Participants in the patient portal study displayed privacy and security as the most frequent concern when considering the use of this technology (Latulipe et. al., 2015). They were worried that information about them would be discussed in the internet, they would be more susceptible to theft, and that insurance companies would have access to their information and use it to deny coverage (Latulipe et. al., 2015). Meanwhile, in the study evaluating use of monitoring technologies, many respondents used terms like "invasion" and "intrusive" when describing their concerns with the technology and why they did not want it installed in their homes (Balas et. al., 2015). Lastly, the study exploring intention to use a personal emergency response device found that participants were worried about strangers coming into their home when they activated the device, and many much preferred calling a family member or neighbor for their aid (Porter et. al., 2013).

Attitudes about Technology

Mere lack of interest toward technology and learning to use it was a defining factor towards not using healthcare technology in 3 studies, despite participants having the resources and ability to acquire and use technology (Heart & Kalderon, 2013; Latulipe et. al., 2015;

Morgenstern et. al., 2015). Many older adults in one study affirmed that they were "too old" to learn and use new technology or that the technology was '"not interesting"' (Heart & Kalderon, 2013). Latulipe et. al. (2015) found that participants were "convinced that the technology was '"too difficult"' to use, and they would not be able to learn how to use it. Participants in the study done by Morgenstern et. al. (2015) continued using the emergency department or emergency medical services like they had been before the study, even though they were provided with an emergency response device. In fact, 69% of the participants removed the device altogether (Morgenstern et. al., 2015). Meanwhile, positive attitudes towards technology were directly correlated with increased likelihood of using technology (Kadylak & Cotten, 2020). The study conducted by Kadylak & Cotten (2020) found a strong positive correlation between better attitudes towards technology and likelihood of using virtual reality technologies.

Perceived Need for Use

Perceived need for use was one of the most clear and common themes amongst the selected studies, with almost half (n = 8) of the articles discussing it (Balas et. al., 2015; Batsis et. al., 2019; Demiris et. al., 2013; Latulipe et. al., 2015; Park et. al., 2017; Parker et. al., 2013; Porter et. al., 2013; Zhang et. al., 2020). Demiris et. al. (2013) found that because many of their participants found the telehealth kiosk to be useful during the study, they were more interested in continuing to use it. In a study conducted by Porter et. al. (2013), more elderly women were motivated to use their personal emergency response device after reflecting of their ability to reach for help quickly (RHQ). Realizing that they might need to reach for help quickly at unpredictable times, and that the people that they would reach out to in an emergency may not be available to help them, increased participants' willingness to use the device consistently. Batsis et. al. (2019) noted that participants gained motivation to use healthcare technology after

noticing improvement in their habits. Park et. al. (2017) demonstrate a similar situation with different outcomes, with many participants reporting low levels of perceived usefulness after training on a smartphone medication reminder app. From these results, the authors suggested that emphasizing the real-world utility of the app can help target usefulness and increase the use of the technology. (Park et. al., 2017). Overall, if the healthcare technology proved to support an older adults' need, they are more willing to accept and use it in their daily lives.

Zhang et. al. (2020) expose a discrepancy between older adults having healthcare technology but not using it for its intended purpose. On average, participants wore the Fitbit studied on 93.9% of the required days, but 80% of the participants reported that the Fitbit was not helpful in promoting physical activity and rarely checked it (Zhang et. al., 2020). These results reveal that older adults must sense a need or utility for a healthcare technology in order for them to engage with it as intended and get something out of it.

Need for Support and Education (13)

Lastly, the most popular theme across all the studies is older adults' need for support and education to use healthcare technology. 12 out of 18 articles called for this particular facilitator of healthcare technology (Balas et. al., 2015; Chandrasekaran et. al., 2021; Demiris et. al., 2013; Gordon & Hornbrook, 2016; Hastings et. al., 2021; Heart & Kalderon, 2013; Latulipe et. al., 2015; Lenstra, 2017; Park et. al., 2017; Parker et. al., 2013; Porter et. al., 2013; Zhang et. al., 2020).

Lack of familiarity or exposure and deficient knowledge on how to use the healthcare technologies studied were common barriers older adults faced when trying to use healthcare technologies in these studies; conversely, those who already had experience using devices and had higher levels of technology self-efficacy were noted to have a greater likelihood of wanting

to use the healthcare technologies studied (Balas et. al., 2015; Chandrasekaran et. al., 2021; Hastings et. al., 2021; Latulipe et. al., 2015; Parker et. al., 2013, Porter et. al., 2013; Zhang et. al., 2020). According to Park et. al. (2017), training older adults on a certain healthcare technology significantly helped them view the technology as easier to use, and they tended to have greater intention to use it. These finding yielded the authors of these studies claim a need for training and education services on technology for older adults (Balas et. al., 2015; Chandrasekaran et. al., 2021; Hastings et. al., 2021; Latulipe et. al., 2015; Park et. al., 2017; Parker et. al., 2013; Porter et. al., 2013; Zhang et. al., 2020)

Support is a relevant facilitator towards using healthcare technology amongst older adults as well. The technical difficulties that come with healthcare technology make it frustrating and discouraging for older adults attempting to adopt this technology, and oftentimes they wished there was a way within the technology to reach out for technical assistance (Demiris et. al., 2013; Latulipe et. al., 2015). In a couple of the studies, participants who had support resources, such as family members, a partner, or community resources, tended to be more likely to use or want to use healthcare technologies (Balas et. al., 2015; Heart & Kalderon, 2013; Latulipe et. al., 2015; Lenstra, 2017). Moreover, older adults were shown to seek out support if they did not have it at home. Demiris et. al. (2013) found that older adults preferred going to community settings instead of staying at home to use technology because there are often staff on site to support them when they need help. In order to increase access to this much needed support, public community settings where older adults can not only learn how to use technology but also receive support during this experience are highly advised (Demiris et. al., 2013; Heart & Kalderon, 2013; Latulipe et. al., 2015; Lenstra, 2017).

Discussion

Implications

Based on this literature review, it is clear that older adults in the United States face barriers to using healthcare technology. These may include lack of access to technology and the internet, poor health status, and negative attitudes towards technology. Facilitators to healthcare technology use by elderly, however, include perceiving a need to use a certain technology, education and training on technology use, and support from their family or community.

Education and support were very highly recommended by the authors of the studies reviewed with regards to promoting use of healthcare technology by the elderly (Balas et. al., 2015; Chandrasekaran et. al., 2021; Demiris et. al., 2013; Gordon & Hornbrook, 2016; Hastings et. al., 2021; Heart & Kalderon, 2013; Latulipe et. al., 2015; Lenstra, 2017; Park et. al., 2017; Parker et. al., 2013; Porter et. al., 2013; Zhang et. al., 2020). Moreover, perceived need for a technology was noted to be a crucial factor towards use of different healthcare technologies by elderly (Balas et. al., 2015; Batsis et. al., 2019; Demiris et. al., 2013; Latulipe et. al., 2015; Park et. al., 2017; Parker et. al., 2013; Porter et. al., 2013; Zhang et. al., 2020). Application of these findings can be initiated by clinicians. As the personnel that help manage older adults' health and are often the ones recommending healthcare technologies to their patients. Clinicians should promote the use of the healthcare technology they want their patients to use by explaining to them why they want them to use the technology, how it is intended to benefit their health and wellness, and how to use it considering their specific needs and health conditions that impact sensory perception, cognition, and other body functions. This way, patients will be encouraged to engage with the device as intended because they know how to use it and how it can help them. Education alone can, realistically, help reduce the effects of some of the barriers encountered in

the studies, such as health factors, privacy concerns, and negative attitudes about technology, because they would be actively addressed by an individual's healthcare team.

Additionally, community programs to provide education about technology and support older adults can extremely help them adopt different healthcare technologies (Demiris et. al., 2013; Heart & Kalderon, 2013; Latulipe et. al., 2015; Lenstra, 2017). The literature shows that older adults who have a support system to use technology at home or have access to community infrastructure that can offer them support are more likely to adopt, or be willing to adopt, healthcare technology in their daily lives (Balas et. al., 2015; Heart & Kalderon, 2013; Latulipe et. al., 2015; Lenstra, 2017). Moreover, when older adults decide to use technology, they are going to experience more difficulties the more time they spend using certain technology (Tsai et. al., 2019). Support when using healthcare technology is going to be needed during and beyond the process of implementation in older adults' daily lives. As a result, incorporating public resources, such as libraries and senior centers, can not only expand access to technology and internet but also increase the likelihood of older adults to have adequate training on technology usage and support if difficulties arise, all of which, in turn, lead to increased use of healthcare technology by the elderly.

Lastly, healthcare technology developers must include older adults when creating technology for them. As mentioned before, older adults face a variety of barriers to using healthcare technologies, and in some studies, older adults mentioned specific features they wished the healthcare technology examined had to make it more user friendly and beneficial to their health and wellbeing (Batsis et. al., 2019; Demiris et. al., 2013; Latulipe et. al., 2015; Park et. al., 2017; Parker et. al., 2013). Incorporating older adults in the development of new and

upcoming healthcare technologies meant for this population can help address their concerns, limitations, and guarantee that they will actually use the technology.

Research Gaps

Over the last decade, a relatively small number of 18 articles were published addressing older adults' use of healthcare technology. As a result, a few gaps in the research were noticed during the review. Most of the studies did not have a very diverse sample size, and only 4 discussed differences in healthcare technology use between racial groups (Arcury et. al., 2020; Chandrasekaran et. al., 2021; Gordon & Hornbrook, 2016; Lama et. al., 2022). African American, Latino, and Filipino individuals were found to have significantly lower rates of healthcare technology use than their White counterparts, yet there were no potential explanations for these disparities sought for in any of the studies (Arcury et. al., 2020; Chandrasekaran et. al., 2021; Gordon & Hornbrook, 2016; Lama et. al., 2022). Therefore, further research is needed with regards to social determinants of health and how they may impact use of healthcare technology by elderly in minority groups.

Additionally, discrepancy was noted between some articles regarding privacy concerns and its contribution healthcare technology use. Some claimed the privacy was a major concern among older adults, while others stated that it was an irrelevant factor (Balas et. al., 2015; Batsis et. al., 2019; Demiris et. al., 2013; Latulipe et. al., 2015; Porter et. al., 2013). Since the articles that included privacy as a major concern were published in 2013 and 2019, and the articles that claimed the opposite were published in 2013 and 2015, it is likely that, due to recent technological or social advances, privacy while using technology is a reemerging concern. However, there are simply not enough studies that discuss privacy to make a conclusion. More research targeted at privacy concerns and healthcare technology use must be conducted to solve

this discrepancy and ensure the role of this potential barrier is known and can be properly addressed.

Finally, many articles claimed that older adults were willing to use healthcare technology based on certain barriers and facilitators. However, none of the studies conducted follow-up assessments on their participants after the initial intervention, so it is not known whether or not individuals that stated they were willing to use healthcare technology actually ended up using the technology in the long run. Follow-up studies of the studies in this review and longitudinal studies that can evaluate healthcare technology use by elderly over time need to be conducted.

Strengths and Limitations

The main limitation of this review is that the only search terms used to find articles for this review were "elderly" and "healthcare technology use". While this may have limited our initial search for articles, however, the limitation was mitigated by searching the reference lists of literature reviews that followed our criteria for inclusion to ensure we missed the least number of relevant articles possible. Moreover, the research gaps mentioned earlier limit this review from being relevant to older adults in minority groups and evaluating long-term impact of interventions like training and community support.

Strengths of this review include the multiple databased used to find articles, which gave us a wider scope of the literature published about this topic. Additionally, although only 18 articles were selected, we still had a diverse set of technology types within the studies, making the review impartial to one type of technology alone. Furthermore, since the 18 articles were scattered over the past 10 years fairly evenly, the review adequately reflects barriers to healthcare technology use over the course of the intended time frame. Lastly, barriers and facilitators discussed in this paper were notable across multiple technology types and years of

study publications, so the themes discussed not skewed to just a few technologies or a certain time.

Conclusion

All in all, older adults are limited to using healthcare technology due to lack of access to technology and the internet, health factors, and negative attitudes about technology. These barriers can be mitigated if clinicians can encourage older adults by explaining that healthcare technology is necessary and can have a purpose in their daily lives, community programs are implemented to promote the use of healthcare technology, and technology must consider the needs and interest of older adults when developing healthcare technologies meant for them to address the barriers found in this review up front. The same barriers and facilitators to healthcare technology use have been relevant amongst elders over the last decade. As Demiris et. al. (2013) suggest, "...successfully designing and implementing this technology will require careful evaluation of obtrusiveness and human factors and ergonomics principles that are centered on end-user needs."

References

Arcury, T. A., Sandberg, J. C., Melius, K. P., Quandt, S. A., Leng, X., Latulipe, C., Miller, D. P., Jr., Smith, D. A., & Bertoni, A. G. (2020). Older adult internet use and eHealth literacy. *Journal of Applied Gerontology, 39*(2), 141-150. https://doi.org/10.1177/0733464818807468

Balas, M. C., Bonasera, S. J., Cohen, M. Z., Hertzog, M., Sisson, J. H., Potter, J. F., Fitch, A., & Burke, W. J. (2015). Measuring functional recovery in older patients discharged from intensive care units: Is advanced technology an option? *Journal of Applied Gerontology, 34*(3), NP22-NP40. https://doi.org/10.1177/0733464813480267

Batsis, J. A., Naslund, J. A., Zagaria, A. B., Kotz, D., Dokko, R., Bartels, S. J., & Carpenter-Song, E. (2019). Technology for behavioral change in rural older adults with obesity. *Journal of Nutrition in Gerontology and Geriatrics, 38*(2), 130-148. https://doi.org/10.1080/21551197.2019.1600097

Bhavnani, S. P., Narula, J., & Sengupta, P. P. (2016). Mobile technology and the digitalization of healthcare. *European Heart Journal, 37*(18), 1428-1438. https://doi:10.1093/eurheartj/ehv770

Centers for Disease Control and Prevention. (2022). Promoting Health for Older Adults. *U.S. Department of Health & Human Services.* https://www.cdc.gov/chronicdisease/resources/publications/factsheets/promoting-health-for-older-adults.htm#print

Chandrasekaran, R., Katthula, V., & Moustakas, E. (2021). Too old for technology? Use of wearable healthcare devices by older adults and their willingness to share health data

with providers. *Health Informatics Journal, 27*(4), Article 14604582211058073. https://doi.org/10.1177/14604582211058073

Demiris, G., Thompson, H., Boquet, J., Le, T., Chadhuri, S., & Chung, J. (2013). Older adult's acceptance of a community-based telehealth wellness system. *Informatics for Health and Social Care, 38*(1), 27-36. https://doi.org/10.3109/17538157.2011.647938

Gordon, N. P., & Hornbrook, M. C. (2016). Differences in access to and preferences for using patient portals and other eHealth technologies based on race, ethnicity, and age: A database and survey study of seniors in a large health plan. *Journal of Medical Internet Research, 18*(3), Article e50. https://doi.org/10.2196/jmir.5105

Hastings, S. N., Mahanna, E. P., Berkowitz, T. S. Z., Smith, V. A., Choate, A. L., Hughes, J. M., Pavon, J., Robinson, K., Hendrix, C., Van Houtven, C., Gentry, P., Rose, C., Plassman, B. L., Potter, G., & Oddone, E. (2021). Video-enhanced care management for medically complex older adults with cognitive impairment. *Journal of the American Geriatrics Society, 69*(1), 77-84. https://doi.org/10.1111/jgs.16819

Heart, T., & Kalderon, E. (2013). Older adults: Are they ready to adopt health-related ICT? *International Journal of Medical Informatics, 82*(11), Article e209-31. https://doi.org/10.1016/j.ijmedinf.2011.03.002

Kadylak, T., & Cotten, S. R. (2020). United States older adults' willingness to use emerging technologies. *Information, Communication and Society, 23*(5), 736-750. https://doi.org/10.1080/1369118X.2020.1713848

Kapadia, V., Ariani, A., Li, J., & Ray, P. K. (2015). Emerging ICT implementation issues in aged care. *International Journal of Medical Informatics, 84*(11), 892-900. https://doi.org/10.1016/j.ijmedinf.2015.07.002

Lama. Y., Davidoff, A.J., Vanderpool R.C., & Jensen, R.E. (2022). Telehealth availability and use of related technologies among medicare-enrolled cancer survivors: Cross-sectional findings from the onset of the COVID-19 pandemic. *Journal of Medical Internet Research, 24*(1), Article e34616.

Latulipe, C., Gatto, A., Nguyen, H. T., Miller, D. P., Quandt, S. A., Bertoni, A. G., Smith, A., & Arcury, T. A. (2015). Design considerations for patient portal adoption by low-income, older adults. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. CHI Conference, 2015,* 3859-3868. https://doi.org/10.1145/2702123.2702392

Lenstra, N. (2017). The informatics lifecourse: Studying the experiences of older adults learning technology in senior centers. *Proceedings of the Association for Information Science and Technology, 54*(1), 736-738. https://doi.org/10.1002/pra2.2017.14505401137

Litchfield, I., Shukla, D., & Greenfield, S. (2021). Impact of COVID-19 on the digital divide: a rapid review. *BMJ Open, 11*(10), Article e053440. https://doi.org/10.1136/bmjopen-2021-053440

Melnyk, B. M., & Fineout-Overholt, E. (2019). Making the case for evidence-based practice and cultivating a spirit of inquiry. In B. M. Melnyk & E. Fineout-Overholt (Eds.), *Evidence-based practice in nursing & healthcare: A guide to best practice,* 4th ed. Philadelphia, PA: Wolters Kluwer.

Merriam-Webster Dictionary. (n.d). Usability. http://www.webster-dictionary.org/definition/usability

Morgenstern, L. B., Adelman, E. E., Hughes, R., Wing, J. J., & Lisabeth, L. D. (2015). The women independently living alone with a medical alert device (WILMA) trial. *Translational Stroke Research, 6*(5), 355-360. https://doi.org/10.1007/s12975-015-0411-0

Park, D. Y., Goering, E. M., Head, K. J., & Barlett Ellis, R. J. (2017). Implications for training on smartphone medication reminder app use by adults with chronic conditions: Pilot study applying the technology acceptance model. *Journal of Medical Internet Research, 1*(1), Article e5. https://doi.org/10.2196/formative.8027

Parker, S. J., Jessel, S., Richardson, J. E., & Reid, M. C. (2013). Older adults are mobile too! Identifying the barriers and facilitators to older adults' use of mHealth for pain management. *BMC Geriatrics, 13*, Article 43. https://doi.org/10.1186/1471-2318-13-43

Porter, E. J., Ganong, L. H., & Matsuda, S. (2013). Intentions of older homebound women with regard to reaching help quickly. *Western Journal of Nursing Research, 35*(1), 6-23. https://doi.org/10.1177/0193945911428482

Ramirez-Zohfeld, V., Seltzer, A., Xiong, L., Morse, L., & Lindquist, L. A. (2020). Use of electronic health records by older adults, 85 years and older, and their caregivers. *Journal of the American Geriatrics Society, 68*(5), 1078-1082. https://doi.org/10.1111/jgs.16393

Tsai, H. S., Rikard, R. V., Cotten, S. R., & Shillair, R. (2019). Senior technology exploration, learning, and acceptance (STELA) model: From exploration to use - a longitudinal randomized controlled trial. *Educational Gerontology, 45*(12), 728-743. https://doi.org/10.1080/03601277.2019.1690802

U.S. Census Bureau. (2019). 2020 Census Will Help Policymakers Prepare for the Incoming Wave of Aging Boomers. *U.S. Department of Commerce.* https://www.census.gov/library/stories/2019/12/by-2030-all-baby-boomers-will-be-age-65-or-older.html

U.S. Department of Health & Human Services. (2022). Fiscal Year 2023 Budget in Brief. https://www.hhs.gov/sites/default/files/fy-2023-budget-in-brief.pdf

Zhang, Z., Giordani, B., & Chen, W. (2020). Fidelity and feasibility of a multicomponent physical activity intervention in a retirement community. *Geriatric Nursing, 41*(4), 394-399. https://doi.org/10.1016/j.gerinurse.2019.12.002

Figure 1

PRISMA Diagram: Older Adults' Use of Healthcare Technology

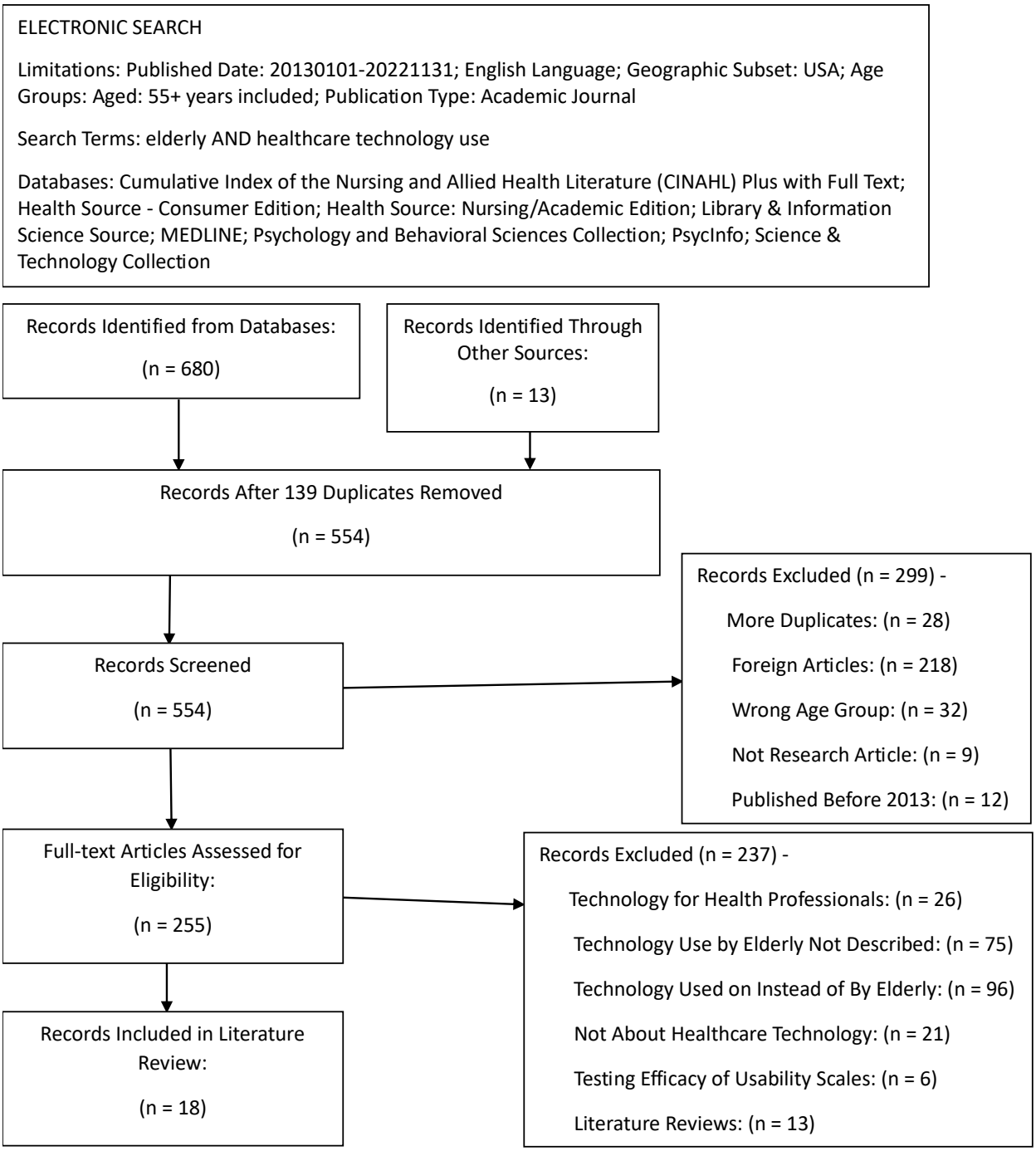

Table 1

Table of Evidence: Older Adults' Use of Healthcare Technology

Citation	Purpose of Study	Design/Method	Sample/Setting	Related Findings	LOE, Limitations, Strengths
Demiris et. al., 2013	Evaluate the perceived usability and effectiveness of a tele-health wellness kiosk in an independent retirement community as well as privacy considerations.	Qualitative study, focus groups.	Retirement community in Seattle, WA; n = 12 (6 in each focus group), mean age 79.3; 8 female, 4 male. Attrition rate below 5%.	**Purpose** - All appreciated ability to capture physiological parameters and be notified of wellbeing; if already self-assessed did not see added value. **Usability** - (4/12) kiosk not always registering weight and oxygen, wanted interpretations of results, (5/12) needed assistance taking vital signs, (6/12) frustrated at computer mouse, challenging for those with hearing aids – can no longer read lips, arthritis problems; "frustrated feeling." **Feedback** - Printouts useful, health-related decision making enhanced, little interest in educational videos.; want more feedback. **Setting** - Community settings preferred, want staff on site for assistance. **Privacy** - No privacy concerns, (3/12) want to share data with others.	Level VI Limitations – study carried out in a single facility. Strength – low attrition rate
Heart & Kalderon, 2013	Assess use by older adults of technology in general and ICT in particular, in order to evaluate their readiness to adopt health-related ICT.	Quantitative descriptive study, questionnaire and survey.	63 participants from 4 nursing homes in Texas; mean age 80.2, 70% female.	Main source of support children and family among users and nonusers. 65% relied on themselves or partner for **support**, 2% nonusers. 33% that use PC often use it at **home**, friends, workplace, and relatives less often (100%, 97%, 90% respectively). PC use 6.6 times greater if living with **partner** than alone. **Ages** 70-79 (90%), 80-89 (85%), >90 (93%) lower than 60-69. Higher **education** 3.1 times more likely than lower education. **Health** 80-89 years 4.4 times more likely than unhealthy. Reasons for **NOT** using – no need (37%), not interesting (21%), too old (18%), do not know how (5%), too difficult (5%), no access (13%), too expensive (16%), medical problem (3%), do not like (3%).	Level VI Limitations – small sample size, sample of convenience
Parker et. al., 2013	Examine the willingness of older adults with CP to adopt mHealth technologies and identify participants' perceived barriers and facilitators to adopting mHealth technologies.	Qualitative study, focus groups with semi-structured interviews.	Three sites in New York; n = 41, 6 focus groups; mean age 76.2, 56% non-Hispanic white, 34% African American, 78% female.	**Concerns** – reluctance to rely on machine (19.5%), "don't need it" (17.3%), concerned if healthcare provider receives information (14.6%). **Ways mHealth devices might be used** – help reach healthcare provider faster (26.8%), monitor over 24-hour period (24.4%), monitor falls and other adverse events at home (14.6%), two-way communication channel between physician and patient (14.6%), easier information sharing (7.3%), supervision and security (9.8%). **Barriers** – concern about battery dying (48.8%), cost (41.5%), lack of familiarity with technology (31.7%), forgetfulness/memory problems (29.3%), privacy concerns (19.5%), unwilling to wear monitor (9.8%), functional limitations (9.8%), concern about learning to use technology (7.3%), concern about device malfunction or incorrect use (7.3%). **Facilitators** – training on use (61.1%), tailor equipment to functional abilities (34.1%), employ support staff (24.4%), evidence that device leads to improved pain outcomes (4.9%), wearable monitors preferred (4.9%).	Level VI Limitations – convenience samples, small sample size, total number of adults coming to senior centers each day not recorded, urban older adults only, no non-English speaking participants included or cultural groups besides African American and White, no control for average pain level or years of pain.

Porter et. al., 2013	Describe intentions of older women to reaching help quickly (RHQ), place intentions in personal–social context and compare intentions of subscribers to personal emergency response system (PERS) and nonsubscribers.	Qualitative study, semi-structured interviews, each women averaged 3 interviews.	n = 40, women, living alone, aged 85 and older, mean age 89.6 years, 21 PERS subscribers, 19 nonsubscribers; 23 (56%) finished study.	24/40 encouraged to get RHQ device or use it more effectively by **family, friends, or healthcare providers.** Realizing that **need** of RHQ might be **unpredictable** encourages use (n = 12 subscribers). Varying beliefs about whether they would have **time** to RHQ. **Telephone preferred** PERS amongst subscribers and nonsubscribers – want to hear a voice. Interacting with dispatchers **over time** enhanced frequency participants mentioned PERS as way to request help. Nonsubscriber concerns - **strangers** in the house, deficient **knowledge** about PERS - assumed dispatchers would leave their desks and come help, **how quickly** help would come, if dispatchers were **competent.** Inconsistency with use because they "**don't need it today**"	Level VI Limitations – attrition rate 44%, Strengths – participants interviewed by more than one person.
Balas et. al, 2015	Determine if older patients discharged from intensive care units (ICU) would be willing to use mobile phone and sensor technology (mobile monitoring) to measure their functional recovery in the posthospitalization period.	Qualitative study, descriptive design, semi-structured interviews.	Large medical center in Midwest; n = 15 patients, aged 65+, admitted to ICU, managed by medical or surgical critical care service, had English-speaking surrogate who spent least 4 hours with subject over 5 years; excluded if within 1 year of CNS injury, history of psychotic disorders, blind or deaf, non-English speaking, undergoing cardiothoracic surgery, 22/43 enrolled.	**Perceived Beneficial Aspects** - Check on personal progress and needs, realistic, believed additional knowledge about technology would help them. **Perceived Negative Aspects** - Do not care to learn, lack of ability to use technology, inconvenient, privacy concerns.	Level VI Limitations – inclusion of convenience sample, mainly Caucasian participants, recruited from single institution, low interview participation rate.
Latulipe et. al., 2015	Understand IT environment among low-income, older adults living in urban and rural communities, the information seeking behaviors of patients, their access and abilities, their knowledge, perceptions and use of network technology, eHealth and patient portals.	Qualitative study, interviews.	Four counties in North Carolina; n = 36 patients, white, African American, American Indian, Mixed, Hispanic, aged 55+, recruited based on recommendations from clinic partners, compensated.	**Patient Portal Benefits** - 5 patients already using more likely to mention specific benefits, nonusers could only guess and repeat back what interviewer said. - Digital archiving and analysis and neutral communication medium deemed useful. **Patient Portal Concerns and Barriers** - Privacy and security main concern – information about them discussed on another device, lack of understanding of security features noted, used by insurance to deny coverage, theft. - Fear of loss of face-to-face time with provider. - Lack of interest (15/36 patients). - Lack of access to technology – cost and interest main barrier. - Usability issues and intimidating medical language. **Desired Features** - Complete medical records. - Contextualized medical advice. - Technical assistance.	Level VI Limitations – participants not random, recruited based on recommendations from clinic partners. Strengths – diverse group of participants, collected data from participants in multiple counties.

Morgenstern et. al., 2015	Examine the benefit of wearing medical alert devices to activate emergency medical systems for elderly women living alone.	Quantitative study, randomized controlled pilot trial.	Ann Arbor, Michigan; n = 265, treatment n = 133, control n = 132. Aged 60+ years, women, at least 1 stroke risk factor, not using medical alert device/service, phone compatible with monitoring service, plans to stay in current residence, living alone; excluded if cognitive impairment, living with someone, residing in emergent care; living 1+ hour from Ann Arbor; having caregiver that helps > 3 hours/day. Planned sample size of 320 not achieved.	Lack of participation mainly attributed to lack of **land-line** telephone. 9/10 women who purposefully used device went to **emergency room** or **emergency medical services** without device. 50% women wore device all the time, 12% never wore it, 69% **removed** it. 53% would want to keep if **cost** not an issue, 17% if they had to pay for it.	Level II Limitations – greater follow-up loss among intervention group than control group, unblinded study, failed to achieve planned sample size. Strengths – even number of participants in control and intervention groups.
Gordon & Hornbrook, 2016	(1) Identify race/ethnic and age disparities among seniors in use of patient portal. (2) Determine whether race/ethnic and age disparities exist in access to digital devices and preferences for using email- and web-based modalities to interact with health care system. (3) Assess whether observed disparities are due to barriers to access and inability to use Internet. (4) Learn whether older adults not using patient portal or website have potential interest in doing so and what kind of support might be suited to help.	Quantitative, two studies. (1) Collected administrative data about patient portal account status and utilization. (2) Collected data from mailed survey with stratified random sample of population.	California; members of the Kaiser Permanente Northern California health plan, ages 65-79, English-speaking. (1) non-Hispanic white (n=183,565), black (n=16,898), Latino(n=12,409), Filipino (n=11,896), Chinese (n=6314) (2) non-Hispanic white (n= 849), black (n = 567), Latino (n = 653), Filipino (n = 219), Chinese (n = 314)	The **older** the less likely to own devices, register and use portal to send messages, view lab results, or order refills (P<.01); video visits (P<.001). **Chinese** and **White** more likely than Black, Latino, and Filipino to register, own devices, use internet and email, do video visits, be willing to use digital technology for health tasks (P<.001). 81% owned electronic devices, 47.2% **able** to send and receive messages. **Cost** race differences significant between Black, Latino, and Filipino vs. Chinese and White (P<.001). Most White (83.9%) and Chinese (79.2%) able to use internet alone or with some help, Black (58.2%), Latino (64.4%), Filipino (53.2%). Healthcare benefit information preferred by email – by White and Chinese (P<.05) and younger old people (P<.01). **Educational attainment**, good **health** more likely in White and Chinese than other groups (P<.001) Opinions on effect of technology on ease of healthcare communication and education: Black, Latino, Filipino more likely to say **harder** (P<.05). When adjusting for **use ability**, race differences gone but still age differences present.	Level VI Limitations – did not have information for full study population about internet access practices, education, and income, unable to determine if need for laboratory test results or prescription refills occurred before or after members created account, low response rates among minority groups, no validated measures of health literacy. Strengths – large and diverse cohort, restricted comparisons of portal use for viewing of laboratory results and ordering of prescription refills to seniors who had cause to perform these tasks.

Lenstra, 2017	Analyze experiences of older adults learning technology in senior centers.	Qualitative, ethnographic, year-long study; interviews, observations.	Three senior centers in Midwestern American urban area; n = 54, regularly participate in technology learning spaces.	Results explained with **"informatics lifecourse"**. Factors in informatics lifecourse – helpers and **spaces for learning**, **changing** technologies, ageism, **lifelong** learning, struggle of individual and community. Barrier – **support** sources/volunteers not always present at senior center.	Level IV Limitations – researchers joined and helped support services offered, so participants may have adapted their actions because they sought services.
Park et. al., 2017	(1) Assess feasibility of Smartphone Medication Reminder App (SMRA) to increase patients' intention to use app. (2) Understand ways to improve design and implementation of training session in hospital setting.	Mixed method, pilot study, two-group design.	Rural Midwest; n = 11, median age 58, taking 3+ prescriptions, managing chronic condition for least 3 months before study, use smartphone, no experience of SMRA use, training (n = 5) and non-training (n = 6) group; excluded if hospitalized, limited English, unable to travel to study location.	Perceived **ease of use** (P=.13) and the level of **intention** to use an SMRA (P=.33) higher in the training group than non-training group. Perceived **usefulness** (U=4.50, Z=−1.99, P=.05) and level of **positive subjective norm** (P=.25) lower in training group than non-training group. Focus groups – would find useful if app… - addressed **specific** struggles in medication adherence. - family and providers viewed app use positively.	Level III Limitations – contradicting results regarding perceived usefulness between training and non-training group, small sample size. Strengths – inclusion of control group.
Batsis et. al., 2019	Evaluate perceptions of how technology can improve health in rural older adults with obesity.	Convergent parallel mixed-method study. Semi-structure interviews, focus groups, and self-reported questionnaire.	Private rural clinic in Lebanon, NH; n = 29, mean age 72.9 years, English-speaking, BMI ≥30kg/m2 or waist circumference ≥88cm in females or ≥102cm in, compensated.	Older adults overall **open** to use technology, felt it had potential to **help** improve health – provides insight, motivation, and accountability, helps gain knowledge. mHealth devices would require individual **personalization** for best results. Barriers – **rural** residence, lack of **access** and **skills.**	Level VI Limitations – small group chosen in convenience manner, much data self-reported, lack of racial diversity, high level of education, participants had prior exposure to technology.
Arcury et. al., 2020	Examine Internet use and eHealth literacy among older adults who were patients at clinics for low-income populations.	Quantitative study, questionnaire via interview.	One urban and two rural low-income clinics members in North Carolina; n = 200, white (n = 80) and minority (n = 120), aged 55+, treated for chronic diseases, spoke English or Spanish, able to give informed consent and interview.	Factors Associated with Internet Use - **White** (67.5%), minority (43.3%) – no difference between African American and Latino. - > **High School** (75.7%), High School or less (40.8%). - **Income** greater than 200% of poverty (75%), lower income (50.6%). - 2+ **e-devices** (82.1%), 1 (25.5%), no home device (1.8%). - **Married** (64.3%), not married (44.8%). - Inadequate general **health literacy** (42.6%), adequate health literacy (83%). Factors Associated with eHealth Literacy - 2+ devices, 46.7% had high eHealth literacy; 1, 33.3% literacy, no e-device, 0%.	Level VI Limitations – participation rate limited due to drawing sample from three clinics. Strengths – large, racially diverse, low-income sample with urban and rural representation, widely used measure of eHealth literacy (eHEALS).

Kadylak & Cotten, 2020	What factors predict US older adults' willingness to use specific emerging technologies (autonomous vehicles, assistive robots, Internet connected home appliances, Internet connected cameras for home monitoring, a smart home with a built-in personal digital assistant, and virtual reality)?	Quantitative study, internet-based survey, descriptive statistics and series of binary logistic regression models.	n = 1148, aged 65+, internet users at time of data collection, U.S. residents from across U.S.	24% willing to use assistive robots, 37% Internet-connected home appliances, 48% home monitoring, 29% smart home with digital assistant, 15% virtual reality. Assistive Robots - Independent activities of daily living (**IADLs**) (P = .02), SRHS (P= .02), **attitude** towards new technology (P< .001), **educational** attainment (P= .005). Home Appliances - **Online habit** (P = .003), **attitude** (P < .001), **race** (African American: P = .05), annual **income** (P= .02). Home Monitoring - **Online habit** (P < .001), **attitude** (P < .001), **race** (African American: P = .001; Asian: P = .01), annual **income** (P = .01), **household size** (P = .02). Smart home - **Online habit** (P = .03), **attitude** (P< .001), annual **income** (P = .04). Virtual reality - **hours online**/day (P = .004), **attitude** (P < .001), **age** (65–74: P = .01), **gender** (female: P = .002), **household size** (P = .05), **marital** status (married: P = .01).	Level VI Limitations – skewed towards older adults that are internet-savvy, Strengths – largest study examining diverse range of emerging technologies among U.S. older adults at the time.
Ramirez-Zohfeld et. al., 2020	Characterize content and frequency of use of PP messaging tethered to EHRs by older adults, aged 85 years and older.	Mixed methods study, retrospective chart review.	n = 791 patients, aged 85+, receiving care at outpatient internal medicine and geriatric clinics at large urban, academic health center.	Most common uses: **clinical** issues (25%), **scheduling** (18.7%), **medications**/vaccines (14.9%), medication refills (10.5%), **laboratory** orders/results (10.5%). Patients initiated messages more for **scheduling** (P = .04) and **medication** refills (P = .04) than caregivers. Patients with **Congestive Heart Failure**, **Coronary Arterial Disease**, or **Alzheimer's** disease had caregiver-initiated messages more frequently (30.7%) than rest (21.6%; P = .01).	Level VI Limitations – may not be representative of older adults who do not have limited access and literacy, more racially diverse sample needed.
Zhang et. al., 2020	Examine fidelity and feasibility of multicomponent physical activity intervention in retirement community.	Mixed methods study, non-randomized design.	Southeast Michigan; n=18, aged 65+, mean age 85.9 years, all white, can walk 10 feet without human assistance, speak and read English fluently, signed consent form; excluded if cognitive impairment, health conditions that limit exercise ability.	Participants wore Fitbit average 93.9% of required days. 20% liked using Fitbit, 80% reported it was **not helpful**. Barriers – not **understanding** information shown on Fitbit, not knowing norms of daily steps, poor **vision.**	Level VI Limitations – small sample size from one community, all white sample, only 2 male patients, self-selection bias, interviews did not include participants that dropped out of study, mainly targeted individual-level factors.
Chandrasekaran et. al., 2021	Examine predictors related to health conditions of older adults and their associations with use of wearable healthcare devices.	Quantitative, pilot study, data from national U.S. survey.	n = 1481, non-users (n = 1222) and users (n = 259), racially diverse, aged 65+ who answered question about use of electronic healthcare device in past 12 months.	Use **Men** less likely than women (OR =0.62, 95% CI 0.36–1.04). More than **High School** 5-9 times more likely. **Asian** 2 times more likely than white (OR = 2.60, 95% CI 0.89–7.64). Strong positive association **income** and use of wearable devices. **Healthy** twice more than poor health (OR = 1.98, 95% CI 1.37-2.87). **Electronic communication** with doctors (OR = 1.86, 95% CI 1.16–2.97), health information **online** (OR =1.79, 95% CI 1.03–3.10) more likely. Share **Asian** less than white (OR = 0.08; 95% CI 0.02–0.37). Greater technology **self-efficacy** more likely (OR = 2.41, 95% CI 0.86–6.70).	Level VI Limitations – constrained by use of secondary data, self-reported data. Strength – large sample, racially diverse.

Hastings et. al., 2021	Assess feasibility of video-enhanced care management for complex older veterans with suspected mild cognitive impairment (CI) and their care partners compared with telephone delivery.	Mixed methods, pilot study, randomized controlled trial.	Care from Durham VA HCS-affiliated primary care clinic, n = 40 patients, aged 65+, veterans, men complex medical conditions, suspected mild cognitive impairment; excluded if previous cognitive impairment, no decision-making capacity, no available care partner, serious mental illness, active substance abuse, current hospitalization or residence in nursing home, hospice eligible, unable to communicate on phone.	Usability of the video telehealth platform higher for those already **familiar** with technology (mean (SD) System Usability Scale scores: 65.0 (17.0) vs 55.6 (19.6)). 35.5% video arm participants reported likely (score 4-5) to communicate with provider by video if option offered - **convenience**/access, feeling **comfortable**/familiar with technology, appreciating **learning** opportunity. 55% unlikely (score 1-2) - **not comfortable** with technology, preferred in-person. Themes from qualitative data: perceived **value** of delivery mode, **usefulness** for managing chronic conditions, **satisfaction** with care management intervention, usefulness of care partner participation.	Level II Limitations – virtual care management evolved since beginning of study, more interviews with participants in video arm, small sample size from simple VA HCS clinic, low racial diversity, just men. Strengths – randomized sample.
Lama et. al., 2022	Identify sociodemographic associations with technology ownership, internet access and use of communication, and telehealth availability in population-based sample of Medicare-enrolled cancer survivors.	Quantitative study, data from Medicare Current Beneficiary Survey COVID-19 Summer 2020 Supplement.	n = 2044, Medicare beneficiaries (aged 65+, disabled, or have end-stage renal disease (ESRD)) who reported prior nonskin cancer diagnosis and usual source of care, non-Hispanic white (n = 1638).	53% used internet for communication, 62% usual provider had telehealth available. Communication less frequent in **rural** than urban (28% vs. 46%, $P < .001$), **Hispanic** and **Black** than white (29%, 31% and 44%, $P < .01$). Rural lower telehealth **availability** (53% vs. 63%, $P < .001$).	Level VI Limitations – cross-sectional data June-July 2020, do not reflect telehealth experience during COVID-19 pandemic, self-reported data, disabled and ESRD patients < 65 years. Strengths – large, population-based sample, address use early into pandemic.

Table 2

Papers by Technology and Study Type: Older Adults' Use of Technology

	Quantitative	Qualitative	Mixed-Methods	Total
Telehealth	(n = 1) Lama et. al., 2022	(n = 2) Demiris et. al., 2013 Parker et. al., 2013	(n = 1) Hastings et. al., 2020	n = 4
Monitoring Technologies	(n = 1) Chandrasekaran et. al., 2021	(n = 1) Balas et. al., 2015	(n = 1) Zhang et. al., 2020	n = 3
Electronic Health Portals	(n = 1) Gordon & Hornbrook, 2016	(n = 1) Latulipe et. al., 2015	(n = 1) Ramirez-Zohfeld et. al., 2020	n = 3
Personal Emergency Response Systems (PERS)	(n = 1) Morgenstern et. al., 2015	(n = 1) Porter et. al., 2013	(n = 0)	n = 2
Computers	(n = 0)	(n = 1) Lenstra, 2017	(n = 0)	n = 1
Cell Phones	(n = 0)	(n = 0)	(n = 1) Park et. al., 2017	n = 1
Internet	(n = 1) Arcury et. al., 2020	(n = 0)	(n = 0)	n = 1
Multiple Technologies	(n = 2) Heart & Kalderon, 2013 Kadylak & Cotten, 2020	(n = 0)	(n = 1) Batsis et. al., 2019	n = 3
Total	n = 7	n = 6	n = 5	n = 18