

Perkins&Will

Research Journal

2022 — Volume 14.02



03

Impact of Virtual Healthcare on an Aging Population:

Future of Care Delivery for the Elderly

Neha Rampuria, Associate AIA, LEED® Green Associate™, neha.rampuria@perkinswill.com

Abstract

This research aims to present the impact that COVID-19 had in the field of geriatrics. The article showcases challenges faced and current behavioral trends seen in the elderly population post-pandemic as it pertains to their healthcare needs. The aging population is the most vulnerable group of patients being cared for by the social care systems and healthcare providers across the world. There are three major reasons. First, the aging population is living longer than seen in the past. Recent studies suggest that in the next 10-15 years, the population of people 65 and older will outnumber the population 18 and younger, making them a majority. Secondly, as per research, 65 percent of the adults in the 65-84 age group have two or more chronic conditions. And lastly, with the increase in the use of technology to deliver healthcare, it is important to understand how the aging population will receive care while they are still adapting to new technologies.

This research on recent innovations in the environmental design and technology of the aging population was informed by a literature review and survey. This article investigates the myriad ways in which healthcare services are designed for the growing, aging population. The purpose of this study was to analyze the effects of these evolving trends on healthcare facilities and the care spaces they access and to identify new ways of designing environments. The findings highlight the urgent need to rethink the design of the built environment to make it truly inclusive and universal for the well-being of this population in the present and the future

Keywords: *elderly, virtual healthcare, COVID-19, aging, technology*

1.0 Introduction

Major demographic changes have been anticipated for the coming years due to three observed trends: the current population growing older than expected with a comparatively longer life expectancy rate; a dip in the middle-aged population due to Gen X being smaller in size compared to Millennials and the Baby boomers; and a continuous slowdown of population growth as Millennials choose to have fewer kids.

The aging population is living longer than anticipated and it is expected that in the next 10-15 years, people aged 65 and older will outnumber those aged 18 or younger. Since 1990, the Old Age Dependency Ratio (OADR) has increased across all regions in the world. As per a 2019 UN report, by 2050, the OADR is expected to reach 28 per 100 working people from 16 per 100 people in 2019.¹ As more individuals are becoming dependent on digital technologies post-pandemic and shifting



Figure 1: Demographic changes and increase in the elderly population.

towards a virtual operating world, it is uncomfortable and challenging for a high percentage of the senior population globally to adapt to this change. According to a 2021 article by The Medical Futurist, seniors are connected to the internet more than ever before because of loneliness and isolation during the pandemic.² The overall use of telemedicine services increased by 300 percent among seniors. It has increasingly become necessary for seniors to acquire technological skills, whether desired or not, to stay connected with their families and friends and catch up with this revolution.

Although, most of the user-facing applications, devices, care services, and built environments are designed by the younger population and majorly for the younger population, seniors seem to be neglected in this design process. An article by the United Nations suggests that the number of older people is projected to double by 2050.¹ As older adults become a majority population, understanding their needs is important. Based on their stage of life and abilities, they have different requirements compared to the younger population. There has been immense development in medical technology and care delivery services, after the COVID-19 pandemic, to provide care at home. The question that arises is how these care models are going to affect the elderly and the physical environment around them.

1.1 Hypothesis

COVID-19 has highlighted many of the gaps and challenges that the older population had been facing in accessing healthcare for years. A shift is being observed in the care delivery models from inpatient hospitals to outpatient and at-home services. This has also expedited the dependency on medical technology and changed the way healthcare services are being delivered. While these changes are advantageous for the users, they also bring along challenges for service providers in terms of delivering care at home. Moreover, as per an American Association of Retired Persons (AARP) Survey, 77 percent of 50 and older adults wants to remain in their home as they age.³ Having said that, the current built environment is not well-equipped and designed to accommodate these healthcare needs. Providing care at home not only requires changes in the physical environment but also in the logistical and operational work too.

Hence, working towards undertaking these challenges presents an untapped opportunity. This article will address issues and impacts of virtual care on the aging population and present some conceptual design strategies which could help in facilitating the need of receiving healthcare outside hospitals and health facilities. In the future, this will provide age-friendly care, and address the needs of elderly users while reducing the load on hospitals and service providers.

2.0 Methodology

2.1 Literature Review

A snowball sampling method was adopted to find relevant articles. This is a nonprobability sampling approach in which current research subjects recruit prospective study volunteers from their social circles. The search included keywords from the title and the potential hypothesis of the article. Multiple studies were found and selected based on their abstracts and results for further investigation.

Keywords including 'aging,' 'virtual healthcare,' 'technology,' 'elderly,' and 'COVID-19' were used to find scholarly and authentic literature, newsletters, and articles, written in 2019 or later. On review, these documents showcased the challenges faced and solutions provided to the elderly during the pandemic.

2.2 Survey

A quantitative survey was conducted to understand the perspective of care receivers, care providers, and at-home help through three groups: Physician/Academician/Field Expert/Paid Professional (anyone related to the geriatric industry), Mid-aged Adults (30-65) and Elderly/Older Population, all living in urban areas.

This segregation of user groups provided a comprehensive perspective from care providers, care receivers, and helpers. An analysis of the received responses provided an understanding of the past and present experiences of the users and informed future spatial needs of the elderly population, in terms of care at home and hospitals. Based on this data, design strategies were conceptualized and presented to provoke a discussion within the design community.

A total of 54 responses were received. These respondents included field experts including physicians, designers, medical planners, and the elderly population. Based on the data received, 61.8 percent of people who responded to the survey were mid-aged adults, 11.8 percent were field experts and 26.5 percent were the older population. 20.4 percent of the respondents were people who take care of an elderly person, out of which 81.8 percent did that in a private setting or at their homes.

As a result of this survey, a significant percentage of the elderly population believed that loneliness is one of the biggest problems in their age group and they would prefer to age in place or at home, post-pandemic. In addition, access to healthcare has also been linked to affordability issues by some people. Approximately, 61.9 percent of mid-age adult respondents were involved in their older member's healthcare routine and most of them helped them with technology, especially during virtual visits. As a result of this survey, challenges faced by these user groups were identified along with their expectations for the future of the healthcare system. In addition to the survey, insights were solicited from field experts on how the physical environment can be leveraged to address challenges faced by the aging population post-pandemic.

3.0 Virtual Healthcare and the Aging Population

The COVID-19 pandemic made it increasingly difficult to connect to people, whether it is family, work, or any other professionals. During this unprecedented shift, telehealth, and telemedicine were embraced at an unprecedented rate. A surge in medical cases forced physicians and healthcare providers to adopt a virtual approach to treatment to reach the maximum number of people without safety risks.

Virtual care has helped provide multiple services that help support an over-burdened traditional healthcare system. The ease of use for telemedicine differs across different age groups. Research suggests that senior citizens are less willing to engage with and try new technologies. This has been attributed to variability in consumer demands at different ages. Accenture's 2020 Digital Health Consumer Survey found that the younger generation has been more open to using technology and receiving virtual care compared to the older generation, especially in rural areas.⁴ Several factors which curb the use of technology as the consumer ages are discussed in this article. Section 3.2 below will discuss what factors contribute to the challenges that hinder the older generation from using technology to receive care.

3.1 The Aging Population

According to a 2021 article by WHO, aging results from the impact of the accumulation of a wide variety of molecular and cellular damage in an individual over time.⁵ This leads to gradual loss of physical and mental capacity, a higher risk of getting diseases, and finally death. An article by National Center for Chronic Disease Prevention and Health Promotion (NCCDPHP), claims by 2060, the number of older adults is expected to reach 94.7 million and will make up 25 percent of the US population.⁶ That means comparatively a higher percentage of people will be at risk of chronic diseases such as Alzheimer's, Dementia, Arthritis, Diabetes, and Cancer. These are all physical aspects of aging.

Psychologically, aging also means retirement, value versus expendability, increasing dependency, social isolation and loneliness, loss of friends and family, challenges in adapting to change, and more.⁷ These changes are neither consistent nor straightforward and vary from person to person.

According to the Centers for Disease Control and Prevention (CDC), social isolation was associated with a 50 percent increased risk of dementia and other serious medical conditions. A report from the National Academies of Sciences, Engineering, and Medicine states that more than one-fourth of adults aged 45 and older are feeling lonely, and nearly one-fourth of adults aged 65 and older are considered socially isolated.⁸ These factors contribute to physical and mental illnesses in the older generation and further serious public health risks. Hence, at present, many organizations (as discussed in Section 3.7.1) are strategizing ways to support all age groups in society and prepare to care for an aging population.

3.2 Increasing use of Virtual Healthcare and its Challenges faced by the Aging Population

In response to COVID-19, most states in 2020 began to introduce stay-at-home policies. These policies were intended to prevent transmission of the disease to the patients within the hospital as well as control the surge. According to a research report by the Assistant Secretary of Planning and Evaluation, the number of Medicare fee-for-service (FFS) beneficiary telehealth visits increased 63-fold in 2020, from approximately 840,000 in 2019 to

nearly 52.7 million in 2020.⁹ Ninety-two percent of the beneficiaries received telehealth visits from their homes, which wasn't permitted in the pre-pandemic times. Adoption of telehealth services, pre-pandemic, was slow. A Harris Poll conducted in collaboration with American Well in early 2019, stated that 66 percent of Americans were willing to use telehealth but only 8 percent did.¹⁰ Only 10 percent silent generation, 8 percent of Baby Boomers, and 21 percent of Gen X received any kind of virtual healthcare compared to 35 percent of millennials and 38 percent of Gen-Z pre-pandemic.⁴ But surprisingly, 92 percent of people reported using virtual care for the first time during the pandemic.¹¹

Video visits and telephone visits are being adopted by many, but not all age groups see virtual care as an adequate substitute for the in-person care they received in the pre-pandemic era. As per Accenture's Digital Health Consumer Survey, pre-pandemic, only 20 percent of Baby boomers were willing to try virtual care compared to the younger population. Another October 2019 report by the University of Michigan National Poll on Healthy Aging stated more than half of the older adults who had telehealth visits indicated that in-person visits were better than telehealth visits regarding feeling cared for (56 percent), communicating with the healthcare professional (55 percent) and amount of time spent with the healthcare professional (53 percent). Moreover, 58 percent of people viewed in-person care as better in terms of overall quality of care.¹² Findings from the poll also express concerns about providers not being able to do a physical exam, privacy, feeling disconnected, difficulty using technology, and difficulty in seeing and hearing the healthcare professional. The pandemic ushered in unexpected levels of interest in virtual care. However, most people over age 57 still preferred in-person care due to the various challenges they face.¹³

Despite convenience being identified as the differentiator of virtual healthcare in geriatric care,¹⁴ it is important to understand the weaknesses that come along and the challenges they encounter. Technology is ubiquitous in almost all aspects of our daily lives; however, some barriers prevent the older population from accessing technology and ultimately virtual healthcare. Lack of instructions and guidance, lack of knowledge and confidence, health-related barriers, and cost were identified as perceived and actual barriers in a study.¹⁵ Similarly, another study reported physical barriers, lack

of access, and lack of interest as key barriers for older adults in using technology.¹⁶ Several organizations and institutions define the challenges of aging through distinct perspectives. Below are the two most important categories which encompass the factors that are holding back seniors from becoming part of the healthcare revolution.

3.3 Challenges: Physical Barriers

Cognitive abilities: As we get older, our mental functions become less nimble and flexible, and many aspects of memory worsen. This means the body parts become less efficient which makes daily life tasks difficult. In the UK, studies have shown that 45 percent of seniors have trouble using an iPad due to cognitive issues, and less than 50 percent of seniors with dementia can use technology by themselves.¹⁷ Another study reported that cognitive deficits and low self-efficacy significantly reduced participants' ability to use technology.¹⁸

Dexterity: Certain characteristics of fingers can reduce the electrical conductivity of skin such as calluses and dry skin lacking the moisture needed for the flow of electricity. Elderly people with dry and wrinkled fingertips have significant difficulty with touchscreens. Gestures like rotating and zooming in/out require the use of multiple fingers which gets challenging too. Therefore, it is difficult for them to operate devices since it gets physically impossible. 60-99 percent of the elderly population are affected by dry/leathery skin conditions and touch screens did not recognize the touch of 25-28 percent of the participants.¹⁷

Other physical impairments like multiple sclerosis, Parkinson's disease, and arthritis conditions, which are quite common in the elderly population, make it difficult and awkward for them to hold and use devices.

Vision: Decreased visual capacity sometimes prevents the elderly to access digital content or even hardware features. A study highlighted the various challenges like finding the charging connection because of concealed or hidden connections, replacing batteries, and more. This was mainly due to difficulty in seeing small symbols and visual disability.¹⁹ As a result, seniors get frustrated which leads to reluctance to use technology.

Hearing: As people age, technologies (care bots, virtual assistants, etc.) and activities (video calls, phone calls, etc.) that require voice commands become difficult to use. A study reported approximately 20 percent of older patients were not ready to use telephone health visits because of difficulty in hearing, communicating, or dementia.²⁰ Another study's results showed people with hearing loss declined the offer of telemedicine appointments, rated telemedicine outcomes significantly less positively, and had a strong preference for in-person visits. This was mainly due to hearing and related difficulties, concerns about miscommunication, lack of privacy, and associated stress and anxiety.²¹

3.4 Challenges: Emotional Barriers

Motivation: Even though telehealth might give a sense of security but learning to use a new device takes extra effort. Older people would be more open to learning new devices if the possible advantage of the new technology offsets the amount of effort involved in adapting to it. Difficulty in remembering instructions was seen as an important barrier to the use of technology amongst the older population.²² The uneasiness leads to discouragement and lessens motivation to learn new things. Computer self-efficacy has proved to be an important influence on attitude and intention to use in the case of older adults.²³ As stated in a National Institute on Aging (NIA) article, it is important to understand how people make decisions as they age.

Hesitation and Discouragement: Mastering new technology is difficult as the old population has had no experience before. It gets difficult for them to absorb new knowledge. Another article stated that users aged 65 and older are 43 percent slower at using websites compared to the younger population.²⁴ One of the main reasons is hesitation and discouragement. Forty-five percent of seniors showed behaviors that indicated discomfort in trying new things or hesitation to explore. Seniors are almost twice as likely to give up on a task and blame themselves 90 percent of the time.²⁴ One of the survey respondents stated the difficulty their parents face in using anything that requires an app or separate log-in since they do not own a laptop or a tablet. They not only face frustration but also gets agitated easily.

Mistrust/ Fear: In telemedicine, privacy and security are closely linked. According to the University of Michigan's National Poll on Healthy Aging, 49 percent of older adults reported privacy concerns.¹² Another respondent in their survey stated the need to address issues related to privacy. More reliability and power given to technology can be a deterrent to people's trust and cause people to be afraid of things that could provide great support.

An article states this is an important issue in telemedicine adoption for an older population with concerns about their personal data being stored in a secure and immune location that prevents data breaches. Medicare fraud is an increasing issue across the country. Scams like medical billing, coercing beneficiaries to enroll in plans and programs, alluring people to sign up for services that offer free gifts, etc. are some of the common swindles. Medical professionals have encountered situations in which patients feel uncomfortable on video visits due to privacy concerns.²⁵ The Federal Trade Commission (FTC) had logged nearly 626,000 consumer complaints related to COVID-19 and stimulus payments, 73 percent involving fraud and identity theft.²⁶

Remote Monitoring is being used much more compared to the past and has become a vital component of telehealth. The surveillance nature of this process allows the caregiver to monitor activities that an elderly person does. Although, this has raised concerns about privacy in both old and young people. They perceive significant overlap between values of privacy, independence, identity, and freedom.²⁷ Therefore, perceived security is predicted to exert an important influence on older adults' acceptance of home telemedicine services.²³

3.5 Challenges: Other Barriers

Affordability: At times, when the technology is good for seniors, it is not affordable. All the 'smart' devices in the market often come with a high price tag, ruling out a big part of society including seniors.² Research conducted by a consulting firm predicted virtual health visits to reach one billion in 2020. Although this number may not include several people like the elderly population.²⁸ 87.5 percent of the elderly (65 years and above) who responded to the research survey said affordability is a concern when it comes to accessing proper healthcare. Many lower-income adults, even pre-pandemic, would not be able to

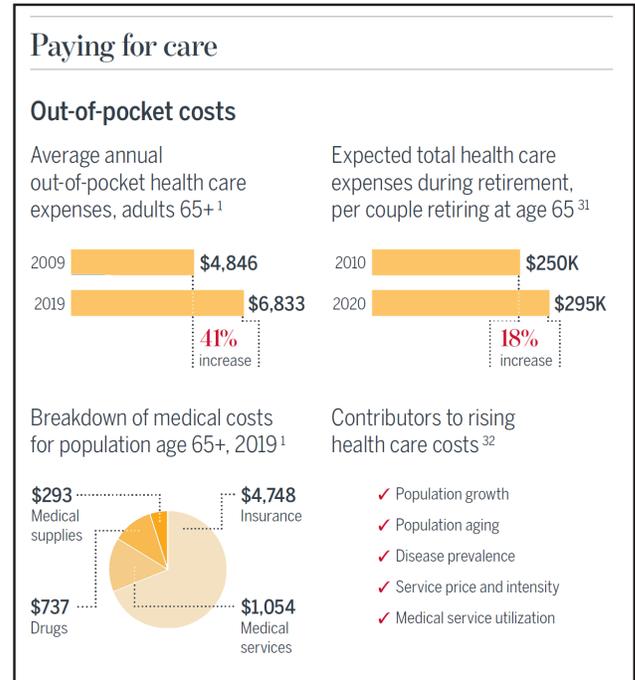


Figure 2: Change in demographics and health needs of older adults over time.²⁹

afford Medicare. Buying hardware to access telehealth becomes impossible for these people. Similarly, an analysis by Advisory Board states that when older adults move to Medical coverage, they may face difficulties with out-of-pocket costs with a fixed retirement income. Medicare actuaries project an increase in spending growth, increased use of services and intensity of care, and rising healthcare prices.²⁹ A study suggests that as telemedicine becomes global, telecommunication devices should be covered as a medical necessity, especially due to the relation between poverty and telemedicine unreadiness.²⁰

Accessibility: This can be categorized as Design Accessibility (virtual platform design) and Physical Accessibility (access to hardware, internet, etc.).

Design: Visual impairment is a very common problem while aging. Sites and apps that target seniors as end users should consider design (readability, accessibility, font size, colors, font style, etc.) to make targets and use prominent. Seniors often feel that websites are not designed with consideration for their needs and interest and digital products still discriminate against seniors.

Physical: UK Office of National Statistics reported only 50 percent ownership of smartphones in those aged 55 and above versus up to 95 percent in the 16-24 age group.³⁰ The use of internet services for communication purposes is seen as less frequent in rural areas compared to urban areas leading to disparity.³¹ Limited access to high-speed internet affects the ability of physicians and patients to effectively communicate and participate in video consultations, gather information, and monitor health.

Lack of Support: Social context affects whether a senior will use telehealth services or not. Adults surrounded by friends and family are more likely to use telehealth and adopt the practice because of the availability of support. The survey reported 19 percent of the respondents expected a great deal and 38.1 percent of people expected a moderate amount to get involved in the healthcare routine of the senior adults at their homes. When asked, most of them mentioned they help seniors with technology, driving to the hospital, coordinating care, and participating in doctor recommendations. Another study reported a better response to video visits from older adults who had social support.²⁰ Seniors aged 60 and over can struggle to set up tech devices that companies target them to use. However, the growing number of seniors who will need more care is leading to a greater market gap and interest from providers and developers to develop digital health technologies that seniors can easily use.²

3.6 Consequences of the Challenges

Virtual healthcare, with its advancement in the past few years, has had its broad reach except for the older population. This is due to their deteriorating physical and mental health, inexperience and mistrust of technology and various other reasons mentioned previously in this article. These challenges along with the pandemic have had their implications. A few of the main consequences that are essential to discuss are social isolation and loneliness, delay in care, and reduced mobility.

Human beings tend to naturally seek quality relationships for their health and well-being. Social isolation or lack of social contact with others is an underappreciated public health risk. Even though pre-pandemic this was an issue, COVID-19 and the lockdown have exacerbated the problems for the elderly. And as the world connected

more and more through technology, older adults were held back due to their physical and behavioral barriers. A report from the National Academies of Sciences, Engineering, and Medicine (NAEM) points out that 24 percent of community-dwelling Americans (65+ years) are considered socially isolated, 35 percent of adults (45+ years), and 43 percent of adults (60+ years) feel lonely.⁸ Older adults are at increased risk of facing social isolation and loneliness due to various reasons like inexperience with tech, living alone, loss of family and friends, physical impairments, and more.³² This leads to major health risks as reported in many studies. Social Isolation increases a person's risk of mortality from all causes by 29 percent, increased the risk of cancer mortality by 25 percent,³³ and increased the risk of dementia by 50 percent.³⁴ Similarly, loneliness has been associated with a 59 percent increased risk of functional decline,³⁵ and among patients with heart failure conditions, there's an increased death risk by four times, a 68 percent risk of hospitalization, and a 57 percent increased risk of Emergency Department visits.³⁶

3.6.1 Social Isolation and Loneliness

This phenomenon has also been associated with other issues relevant to demographics, planning, gender, and socio-economic status.³⁷ Migrants, especially older people who had to move to another country/city with their adult children were more likely to suffer from loneliness due to a lack of social support and companionship, declining health, language barriers, and new surroundings.³⁸ Reviews and analyses also found that higher income and more education are correlated with reduced loneliness. People with lower income and education levels might stay at locations with other social and environmental issues which reinforces loneliness.³⁹ 88.9 percent of the elderly (65 years and above) who responded to the survey said loneliness is the biggest problem for their generation. A respondent also emphasized the importance of human contact and human touch.

3.6.2 Delay in Receiving Care

Even though telehealth has been cited as a convenient way to access care, older adults with chronic conditions might not be fully satisfied, leading to delaying care to

schedule an in-person visit with the physician. Inconsistent quality of care, patient experience and engagement, loss of connection, and mistrust are four overarching themes identified in a recent article. The participants expressed concerns about the clinical effectiveness and limitations of virtual physical examinations and disparities in access, harm to the patient-clinician relationship, restricted ability to comfort patients in virtual settings, and reduced patient trust. On the other hand, many older adults are also fearful about visiting a healthcare facility and being exposed to COVID-19. According to the National Poll on Healthy Aging, the pandemic disrupted healthcare for 30 percent of older adults.⁴⁰ As per a study in 2019, 14 percent of respondents postponed or canceled, or rescheduled their visits with health providers for COVID-19-related reasons.⁴¹ 24 percent of cancer patients, 29 percent of diabetes patients, and 30 percent of people with heart conditions said they had put off at least one telehealth visit. While telehealth provides the flexibility of receiving care at home, not all people, especially older adults, are comfortable or experienced in using technology and still prefer in-person visits. Although the fear of in-person visits might not go away for some time.

3.6.3 Lack of Mobility

Many seniors fear a 'Lack of Mobility' as they age. Being mobile not only means being able to walk in their surroundings but also being able to do basic quotidian activities like grocery shopping, driving a car, etc. COVID-19 and lockdown have increased these mobility restrictions. 4 in 10 seniors said they walk less than before while 3 in 10 responded vice versa.⁴² Working from home, decreased use of public transport post-pandemic, and increased time on the internet add to the problem. People get drained out too soon in these times.⁴³ A New York Times article has stated that health experts are concerned about reduced mobility and physical conditioning in older adults due to the pandemic.⁴⁴

For technology to be fully inclusive, it needs to be designed around the necessities and limitations of all user groups. Especially in the case of the elderly population, the design needs to be simple, safe, and easy to navigate. The design of the built environment also needs to be rethought and researched to make spaces adaptable to 'care-at-home' or 'hospital-at-home' concepts to meet the desires and complex care needs of the elderly population.

3.7 Trends and Technologies for Aging Well in Future

The Demand for healthcare has rapidly shifted from in-person to virtual and at present, a hybrid system exists post-pandemic. While it became convenient for younger patients to access care, older patients experienced challenges due to high vulnerability to the COVID-19 virus in hospital environments, and discomfort and inexperience while using technology. A National Poll on Healthy Aging (NPHA) showed that 1 in 3 older adults had canceled or postponed care in 2020 due to personal concerns about COVID-19 exposure in the healthcare environment.¹² As we step into the future, we are seeing value-based transformation in healthcare delivery. Value-driven care strives to improve access to healthcare, improve patient experience and quality of care, and moderate healthcare costs.⁴⁵ Innovative products, programs, and care models are being developed to deal with the desires and complex needs of the aging population from hospitals to outpatient settings. And more recently, we are also seeing care options expanding within a household setting—from products to the design of the built environment itself.

3.7.1 Technologies

Interest in technology among older adults has continued to expand, especially after the COVID-19 pandemic. As many of the seniors are catching up with the current technology, many others are awaiting new advances. 64 percent of 50 and older adults are interested in at least one type of upcoming advancement. Older adults are continuing to spend time on technology. By 2030, the 50+ market is expected to spend 108 billion dollars on average, annually on tech products.⁴⁶

Several age-tech companies are utilizing Virtual and Augmented Reality solutions that provide an immersive experience. Embodied Labs offer immersive caregiver training, XR Health offers rehabilitation, and Rendeever and Silver Adventures offer virtual experiences to improve the well-being of the elderly population.⁴⁷

Recently Google introduced 'Project Starline'—a video-conferencing technology project that enables friends, families, and coworkers to feel together even when they're cities apart. Through this tech, one can see the other person's life-size in three dimensions. Google has been conducting demos with healthcare and media partners

to get early feedback.⁴⁸ This can improve telehealth experience and patient experience, especially for older adults who still prefer in-person visits. Alexa, Amazon's smart-voice assistant, also made their way into the senior living communities during the pandemic. It became easy for older adults to use the multiple features and gain the ability to manage their living environment and stay connected with their families. Senior living providers are seeing promise in voice technology and strong results from pilot programs.⁴⁹

Robotics and its implementation into facility operations have taken a rise due to staffing pressure, especially post-pandemic. Robotic assistants might routinely feature in older people's homes, helping them with self-care, providing emotional support, and allowing virtual access to doctors and nurses. In retirement homes, they could be helpful for entertainment or cleaning while in hospitals they are already doing basic tasks to free up nurses to focus on patient care.⁵⁰ With this increasing demand for healthcare workers for future and current shortages, medical scientists and experts are looking at robotics to mitigate this demand-supply issue. The home eldercare market, driven by expanding elderly population, is anticipated to increase to \$224 billion by 2024 from \$100 billion in 2016.⁵¹ Social robots, service robots, autonomous mobile robots, surgical-assistance robots, and modular robots are a few categories seen within the medical field.⁵² Robotics in the healthcare industry is beneficial as it enables high levels of patient care, efficiency, and accuracy and saves work environments for caregivers and patients.

3.7.2 Hospital at Home:

The preference to 'age in place rather than in any kind of facility' is widely recognized in the elderly population post-pandemic. As per a National Poll on Healthy Aging (NPHA) article, 'Aging in place refers to living independently, safely, and comfortably in one's home for as long as possible. There have been many advantages of care at a home model decrease in mortality, better functional outcomes for patients, reduced risk of hospital-associated infections (HAIs), shorter hospital stays, cost-effectiveness, more physical activity, and better sleep for patients.⁵³ Studies found that the average cost of care for patients at home was 52 percent less than in-hospital care.⁵⁴ Moreover, healthcare at home may also reduce

the burden of overloaded health facilities and systems.

However, it can become challenging for older adults to safely remain in homes without certain modifications and additional support from others. Many older adults are not prepared to age-in place. They either do not have common accessibility features or haven't given much thought to what modifications might be needed.⁵⁵ Moreover, the successful implementation of home care also requires adequate social support. Hence, soon, residents will need to employ a Human-centered design in its true sense.

The Center for Health Design released a white paper that presented research strategies that facilitate healthcare at home. These findings included considerations for building and room configuration, patient handling equipment, furniture, accessibility fixtures, storage, waste disposal, flooring, lighting, technology, and home aesthetics.⁵³ Residential designs are mostly oriented towards young, healthy, and abled individuals and do not support accessibility needs or healthcare services. Hence, homes need to be universally designed for aging in place which would include not only patients' needs but also the care provider's physical and psychosocial needs. 'Telemedicine: Where We Are and Why the Built Environment Matter,' a Center of Health Design webinar, talks about video etiquette and how location is considered an examination room despite its intended use. The room should be sufficient in size, safe, lit with minimum external noise (audio and visual privacy), have comfortable seats, and be able to accommodate posture and movement visualization. Therefore, home renovations and new models of acute care in the home are growing all around the country. Moreover, Medicare Advantage Plans may cover home modifications and other benefits.⁵⁶

Research shows that home-based primary care has been shown to improve the quality of life of home-limited patients and their caregivers with reduced healthcare costs. Home-based primary care resurgence is occurring fast with time due to factors like an aging society, improved technology, increased emphasis on home and community services, and cost savings.⁵⁷ The article suggests an expansion of the home-based workforce to support home-based services for better healthcare delivery in the future. The hospital-at-home care model is particularly good for patients with well-defined treatment protocols such as pneumonia, congestive

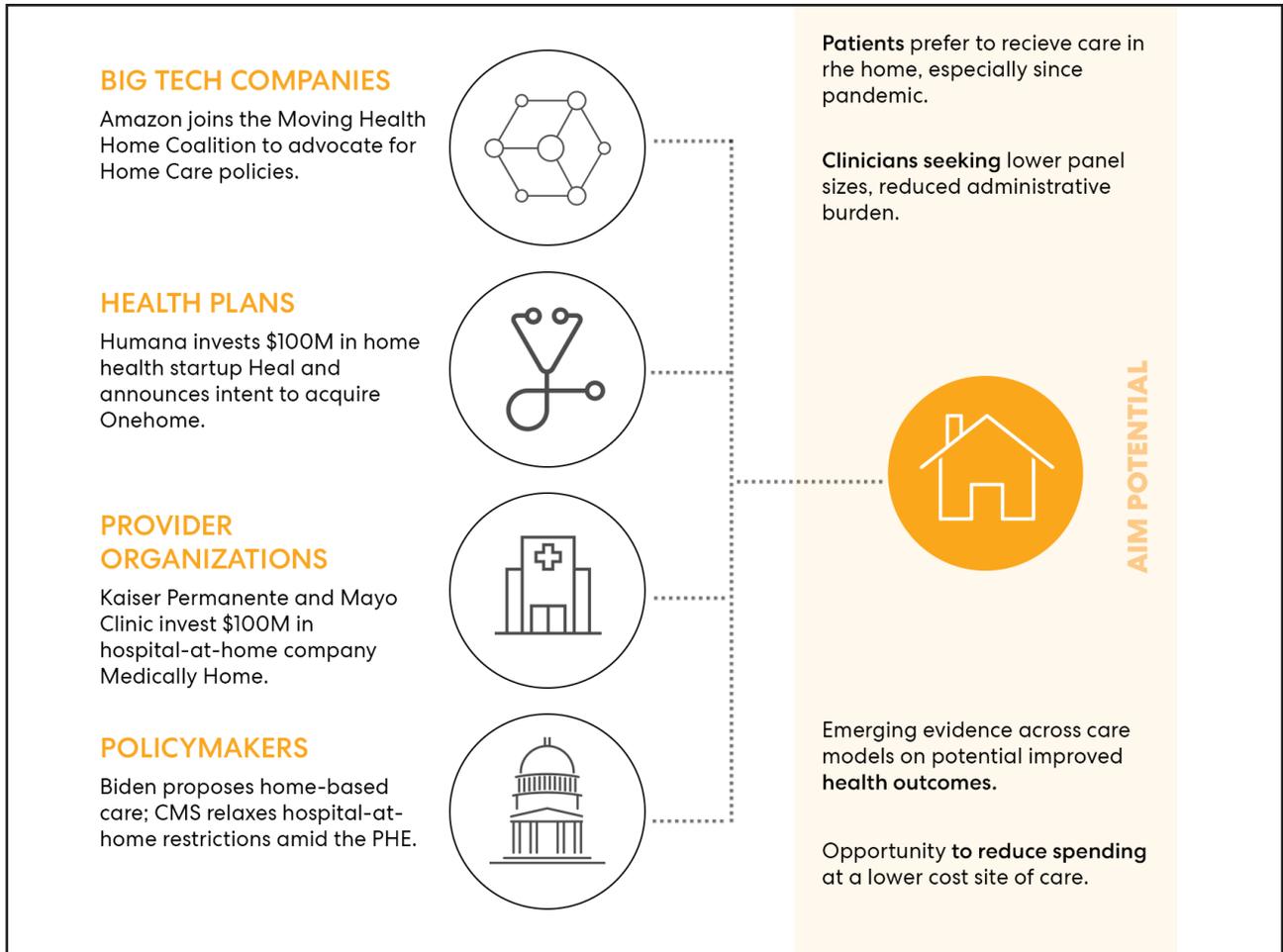


Figure 3: Home-based care and key stakeholders. (Courtesy – Women in Healthcare National Webinar: State of Healthcare Market in 2022 presented by Advisory Board).

heart failure, diabetes, COPD, etc. Mount Sinai’s at-home program provides services for acutely ill patients who would otherwise require hospitalization. The hospital reported increased patient satisfaction and lower cost of care.⁵⁸ Current Health, being acquired by Best Buy, is a leading care platform that provides remote patient monitoring, telehealth, and patient engagement in a single solution for healthcare organizations.⁵⁹

The Care at Home model has the potential to innovate how and where hospitals provide care. Home is identified as the best location to receive care, and by leveraging technology, hospitals can add value, reduce the cost of care, and keep their patients in a safe environment.

3.7.3 Other Care Models

Healthcare systems are well prepared to develop and evaluate ways to identify social isolation and loneliness among the elderly in clinical settings.⁸ Doctors can assess the risk of loneliness and social isolation and can connect older adults to community resources that offer help.³² AARP, Area Agencies on Aging, Eldercare Locator, National Council on Aging, and National Institute on Aging (NIA) are a few examples of organizations that promote social connections and healthy habits for the elderly population. Companies like ‘Papa’ helps health plans and employers connect members and their families to real people for help with companionship, everyday tasks, transportation, and more.

3.7.4 The Post-pandemic Urban Environment

In addition, Innovative Programs such as Case-Finding for Complex Chronic Conditions in Seniors 75+ and Geriatric Patients-Aligned Care Teams highlight the evolving and enhanced healthcare delivery models that target multidisciplinary interventions to maintain the health and well-being of an individual.⁶⁰ Research by HealthTech points out senior care trends to watch out for in 2022. It states, with increasing ownership of technology and increasing burden on the independent facility staff, organizations are creating tech concierge roles for assistance.⁶¹

4.0 Results

4.1. Population Preferences

The responses received from the survey helped in strengthening the arguments and backing up the referenced data in the paper. Five main topics, answered by all groups, were identified, interpreted, and summarized in the form of a table.

1. Adapting to virtual healthcare has been most challenging for people who lack social support or who are not tech-savvy. Because of the circumstances and the need to access care providers, most of the elderly were forced to use telehealth.
2. The choice between in-person care, virtual care, and hybrid care is highly based on convenience. If the health issue is less critical, young, or old, people prefer the virtual option since it saves time. Hence, it's a need-based choice.
3. Although the most common challenge people faced as elderly was to gain the same experience as in-person like lack of human touch, complications with technology, and clarity.
4. Given a choice, people express interest in devices that provide safety more than extra care or help.
5. Expectations from healthcare providers vary with different age groups. Mid-aged adults expect more access to quality care, faster service, convenience, and transparency and older adults expect simpler designs and the ability to age well. The survey reported responses to people's expectations from

the healthcare system like the availability of remote monitoring, access to Electronic Medical Records and communication with clinicians, better management of fragile and brittle conditions, and better quality of life for aging.

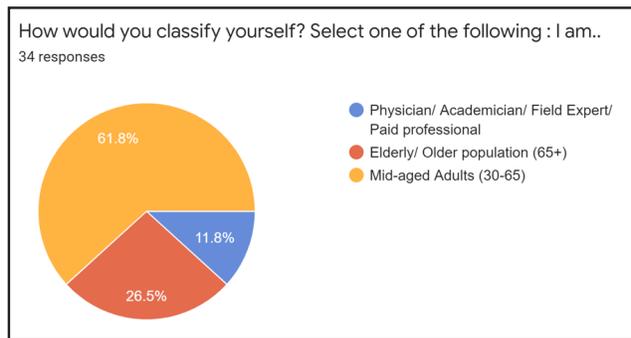


Figure 4: Diversity of people who responded to the research survey.

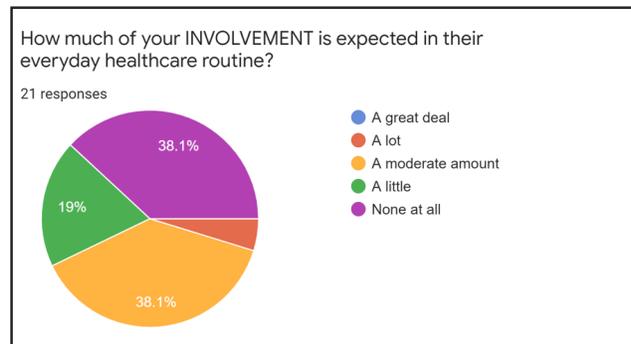


Figure 5: Response by mid-aged adults (30-65) to the research survey.

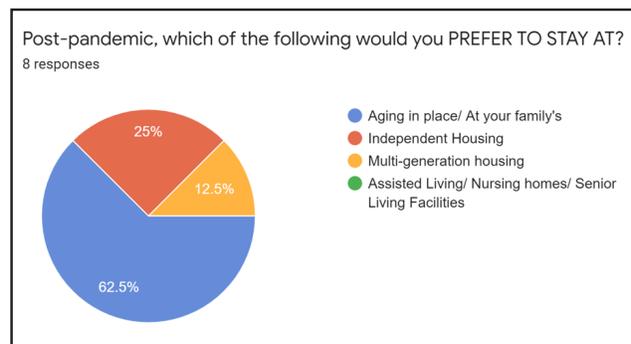


Figure 6: Response by elderly/older population on their preference to stay (65+ years).

Impact of Virtual Healthcare on an Aging Population

People Perspective				
	Mid-aged Adults (30-65 years)	Elderly/ older population (65+ years)	Physicians/ academicians/ field experts/ paid professionals	Inferences
Convenience in adapting to change in Healthcare Delivery Systems	Most common response stated adapting to new technology becomes difficult for seniors and it also depends on the cognitive abilities of the person	22.2% - Very convenient, 55.6% - Somewhat convenient, 22.2% - Neutral	Overall participants felt it was easy for tech savvy elders to adapt to the change and with a speedy adoption, they did better than expected.	Overall, seniors adapted well, (even though it seemed forceful) to the virtual system, especially the tech savvy individuals.
Preference for Elderly: In-person versus Virtual visits versus Hybrid visits	<ul style="list-style-type: none"> 63.1% responders preferred hybrid option as it depends on the care required. 21.0% people preferred in-person visits because of real-time experience of challenges faced by older adults. 15.7% people preferred virtual visits as it's a more convenient option 	N/A	While 50% people chose Hybrid visits, rest 50% chose in-person visits backed up by reasons like more personal interactions and familiarity.	Based on the needs, all groups prefer the most convenient option. Care-at home model can consider parameters for less critical issues in patients/ in-person visit by the doctor.
Challenges and positive outcomes faced by elderly to access Telehealth or Virtual Healthcare	<ul style="list-style-type: none"> Accessibility and ability to navigate through portals and apps is seen as the most common response Cognitive abilities defines the level of challenge. For e.g., people with dementia gets really confused. Complicated paperwork Videocalls helped people with mental health. 	<ul style="list-style-type: none"> Longer wait time No Dental care or eye exams for long time Lack of human touch and contact Less flexible automated systems 	<ul style="list-style-type: none"> All (100%) of the responders thought access to technology was one of the main challenges followed by access to internet, disability, and improper physical environment (75%). Some also considered absence of human assistance and comfort with technology as challenges. 	Common challenges like in-person experience and lack of human touch and complications with technology are identified by all groups.
Technologies looking forward to: Carebots, Robotic arms, VR Tech for Immersive Experiences, Wireless Motion sensors and AI monitoring solutions	First choice for 52.4% of the participants was Wireless motion sensors and AI monitoring solutions while 19% of the people chose carebots and VR Technology for immersive experience	First choice for 55.6% of the participants was Wireless motion sensors and AI monitoring solutions while 44.4% people chose VR Technology for immersive experience	N/A	Wireless motion sensors and AI monitoring solutions are first choices. Safety > Support/ Extra care
Future expectations and preferences regarding care delivery models	<ul style="list-style-type: none"> Remote monitoring, access to Electronic Medical Records, more transparency Access to specialists and MDs, beyond local hospitals and clinics Better quality of life for aging Online portals and automatic check-ins On-demand care, quick turn arounds, home visits In-home diagnostic interface Clear communication, Simple terminology 	<ul style="list-style-type: none"> 62.5% people prefer to Age-in place or stay at their family's post pandemic, 25% people prefers Independent housing while 12.5% preferred Multi-generational housing 32.5% participants responded that the future of healthcare is not being designed keeping seniors in mind while the rest disagreed. Human connection, complex navigation, flexibility were identified as some of the stated issues. 	<ul style="list-style-type: none"> Older adults expect a simpler design of apps, patient portals or any web-based site and larger graphics for readability for seamless use, reduced noise levels and increased access to outdoors. Caregiving services like physical and occupational therapy, hospice services, monitoring and help with everyday activities, tech training sessions and on-call doctor or nurse service might be beneficial in future. Flexible, mobility friendly and intuitive built environment 	While the mid-aged adults (next set of older population) expect more accessibility to quality care, faster service, convenience and transparency, the older people only want to age well and need simpler designs in the present,

Figure 7: Summary of responses from the research survey.

4.2 Promoting Healthy Aging

As we move forward with these upcoming trends and technologies, below are some recommendations for the design industry to promote healthy aging.

4.2.1 Universal Design and Aging in Place

Residential designs, whether single-family homes or apartments, are mostly oriented toward young, healthy, and abled individuals and do not support accessibility and future healthcare needs. Hence, homes need to be creative and universally designed for all people regardless of their age, gender, or abilities. This also makes the space adaptable for future use. To design a space for aging in place, it should not only include patients' needs but also care providers' physical and psychosocial requirements like accessibility features, type of fixtures, patient handling, and monitoring equipment requirements, etc. Common diagnostic spaces or exam-like rooms can also be included.

With the advent of hospital-at-home care models, infection control methods, temperature check machines, equipment storage requirements, and accessibility are important considerations. Evidence-based design and research for healthcare at home are emerging. As designers, one needs to explore ways to facilitate 'care at home without making the physical environment too institutionalized and uninviting. Architects, designers, and healthcare professionals must consider this opportunity to design 'Healthcare at Home. Even though the design of a residential environment with clinical requirements might seem like a difficult union, there is a growing need for support. With its potential benefits, it is important to explore ways in which every home can support healthcare and older people's everyday needs.

Flexible and Multi-generational living options in any housing can help them get integrated into the communities through design and can help reduce loneliness and social isolation. Participation in communal events helps in keeping seniors active.

4.2.2 Decentralized Care

Decentralization in healthcare delivery is gaining pace as consumers continue to demand affordable and personalized healthcare. Healthcare facilities would

need to incorporate telemedicine space for consulting within hospitals and introduce decentralized, outpatient care locations which are safe for people who still prefer in-person care. The distributed network of healthcare facilities not only facilitates easy access but is less likely to be affected in case of another crisis. This model can connect the healthcare system closely with the community to provide personal and responsive care as per the need.

4.2.3 Digital Detox

As we introduce and use more and more technology, a large portion of the day is spent staring at screens, either for work or entertainment. The use of streaming devices, social media platforms, and wearables all day has made people feel the need for some 'no-tech' time. In the case of the elderly, post-pandemic, as people are learning to use technology, most of their time is spent on devices which has resulted in a reduced number of physical activities. Designing environments, indoors or outdoors, where people could get 'unplugged' and connect with others around them can immensely help in overall well-being.

4.2.4 Design for Healthy Aging

As we design our urban spaces, we need to begin thinking of creative, flexible, and inclusive solutions to create an ecosystem for aging well in a community and promote a socially interactive lifestyle. Biophilia, indoor environmental quality, and opportunities for social interaction play a major role as design elements to age well. For older adults, giving them the ability to exert control over their environment can support healthy aging.⁶² A 2021 article by UC Davis informs developers, planners, home builders, and other key stakeholders of the need and ways to create innovative, healthy aging communities through strong and consistent evidence.⁶³ Land-use planning and design can improve health and well-being, and this is the perfect opportunity for designers to rethink the design of our urban environment to support healthy aging.

5.0 Conclusion

Aging with integrity is important. With the growing percentage of the elderly population in the world, healthcare does not just need to be brought 'at home' but should be considered for all spaces that an older person could use or access. COVID-19 has highlighted various questions that were very prevalent in the past but are more severe now. The study has shown considerable influence on the elderly population due to the changing trends.

New models and technologies are beneficial, but only to those who can access them. The physical environment needs to be modified to deliver care at home. This study is only a first step to investigating opportunities that are brought along with the positive or negative trends for the aging population. By analyzing the effects of this evolution in healthcare facilities and care spaces, designers must identify new ways of planning environments that are not only tech friendly, but also elderly-friendly.

Acknowledgments

I would like to express my gratitude to Tina Giorgadze, Kalpana Kuttaiah, and Tim Pettigrew who constantly supported my research and helped me in moving forward with their advice. Also, special thanks to the Los Angeles Studio, all Survey respondents, and the E. Todd Wheeler Health Fellowship at Perkins&Will which made this research possible.

References

- [1] Department of Economic and Social Affairs, Population Division, United Nations, (2019). World Population Ageing, Report, Retrieved on 10/2021 from <https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf>
- [2] The Medical Futurist (2021), "How Seniors Got Lost in The Digital Health Revolution", *The Medical Futurist*, October 2021.

- [3] Davis, M. R. (2021). New AARP survey reveals older adults want to age in place. AARP. Retrieved May 10, 2022, from <https://www.aarp.org/home-family/your-home/info-2021/home-and-community-preferences-survey.html>

- [4] Accenture, (2020). How Can Leaders Make Recent Digital Health Gains Last, Report, Retrieved on 10/2021 from https://www.accenture.com/_acnmedia/PDF-130/Accenture-2020-Digital-Health-Consumer-Survey-US.pdf

- [5] World Health Organization. (2021). Aging and Health. Retrieved October 2021, from <https://www.who.int/news-room/fact-sheets/detail/aging-and-health>

- [6] Centers for Disease Control and Prevention. (2022). Promoting health for older adults. Promoting Health for Older Adults. Retrieved October 15, 2022, from <https://www.cdc.gov/chronicdisease/resources/publications/factsheets/promoting-health-for-older-adults.htm>

- [7] Flett, G. L., & Heisel, M. J. (2021). Aging and Feeling Valued Versus Expendable During the COVID-19 Pandemic and Beyond: A Review and Commentary of Why Mattering is Fundamental to the Health and Well-Being of Older Adults. *International Journal of Mental Health and Addiction*, 19(6), 2443-2469.

- [8] National Academies of Sciences, Engineering, and Medicine. (2020). Social Isolation and Loneliness in Older Adults: Opportunities for the Health Care System. Washington, DC: The National Academies Press.

- [9] Samson, L.W., Tarazi, W., Turrini, G., Sheingold, S., (2021). Medicare Beneficiaries' Use of Telehealth in 2020: Trends by Beneficiary Characteristics and Location, Report, Retrieved on December 13, 2021, Issue Brief No. HP-202127.

- [10] The Harris Poll, (2020). Telehealth: The Coming 'New Normal' for Healthcare, Report, Retrieved on January 12, 2022, from <https://theharrispoll.com/briefs/telehealth-new-normal-healthcare/>

- [11] Perna, G. (2021). Data Dive: Digital Health making a surprising impact for older patients. Consumerism. Retrieved on December 15, 2021, from <https://www.healthevolution.com/insider/data-dive-digital-health-making-a-surprising-impact-for-older-patients/>

- [12] Kurlander, J., Kullgren, J., Singer, D., Solway, E., Malani, P., Kirch, M., Saini, S., Virtual Visits: Telehealth and Older Adults. University of Michigan National Poll on Healthy Aging (2019). Retrieved from <http://hdl.handle.net/2027.42/151376>.
- [13] Jercich, K. (2021). Post-pandemic, majority of patients say they prefer in-person care, survey finds. *Healthcare IT News*. Retrieved on October 24, 2021, from <https://www.healthcareitnews.com/news/post-pandemic-majority-patients-say-they-prefer-person-care-survey-finds>
- [14] Doraiswamy, S., Jithesh, A., Mamtani, R., Abraham, A., Cheema S. (2021). Telehealth Use in Geriatrics Care during the COVID-19 Pandemic—A Scoping Review and Evidence Synthesis. 18(4), 1755.
- [15] Vaportzis, E., Giatsi Clausen, M., & Gow, A. J. (2017). Older Adults Perceptions of Technology and Barriers to Interacting with Tablet Computers: A Focus Group Study. 8(1687).
- [16] Haase, K. R., Cosco, T., Kervin, L., Riadi, I., & O'Connell, M. E. (2021). Older Adults' Experiences With Using Technology for Socialization During the COVID-19 Pandemic: Cross-sectional Survey Study. 4(2), e28010.
- [17] No Isolation, (2021). Digital Exclusion: New research reveals how touchscreens leaves 5.6 million elderly behind, Report, Retrieved on 01/2022 from <https://www.noisolation.com/research/digital-exclusion-report>
- [18] Alvseike, H., & Brønneck, K. (2012). Feasibility of the iPad as a hub for smart house technology in the elderly; effects of cognition, self-efficacy, and technology experience. 5, 299.
- [19] Wang, S., Bolling, K., Mao, W., Reichstadt, J., Jeste, D., Kim, H. C., & Nebeker, C. (2019). Technology to Support Aging in Place: Older Adults' Perspectives. 7(2), 60.
- [20] Lam, K., Lu, A. D., Shi, Y., & Covinsky, K. E. (2020). Assessing Telemedicine Unreadiness Among Older Adults in the United States During the COVID-19 Pandemic. *JAMA Intern Med*, 180(10), 1389-1391.
- [21] Saunders, G. H., Oliver, F. J. T., & e-Health. (2022). Impact of Hearing Loss on Communication During Remote Health Care Encounters. Mary Ann Liebert, Inc. Publishers, 28.
- [22] Raja, M., Bjerkan, J., Kymre, I. G., Galvin, K. T., & Uhrenfeldt, L. (2021). Telehealth and digital developments in society that persons 75 years and older in European countries have been part of: a scoping review. *BMC Health Services Research*, 21(1), 1157.
- [23] Cimperman, M., Brenčič, M. M., Trkman, P., & Stanonik, M. d. L. (2013). Older adults' perceptions of home telehealth services. *Telemedicine Journal and E-health: The Official Journal of the American Telemedicine Association*, 19(10), 786-790.
- [24] Nielsen, J. (2013). Usability for Senior Citizens: Improved, But Still Lacking.
- [25] Boyd-Barrett, C. (2020). For seniors, another COVID-19 hazard: Scammers. California Health Report. Retrieved on June 18, 2020, from <https://www.calhealthreport.org/2020/05/29/for-seniors-another-covid-19-hazard-scammers/>
- [26] Tyler, B. (2021). COVID-19 Brings New Scams for Senior Citizens. News Release. Retrieved from <https://dhhs.ne.gov/Pages/COVID-19-Brings-New-Scams-for-Senior-Citizens.aspx>
- [27] Berridge, C., & Wetle, T. F. (2019). Why Older Adults and Their Children Disagree About In-Home Surveillance Technology, Sensors, and Tracking. *The Gerontologist*, 60(5), 926-934.
- [28] Forrester. (2020). US Virtual Care Visits to Soar To More Than 1 Billion. Retrieved on February 2, 2022, from <https://www.forrester.com/press-newsroom/us-virtual-care-visits-to-soar-to-more-than-1-billion/>
- [29] Egan, Y., & Sznycer-Taub, M. (2022). Caring for an aging population: Past, present, future. The Advisory Board. Retrieved February 2022, from https://www.advisory.com/topics/strategy-planning-and-growth/2022/03/caring-for-an-aging-population-infographic?utm_source=member_blog&utm_medium=email&utm_campaign=2022Apr07&utm_content=ATH_x_x_x_x_secondcta&elq_cid=4801117&#paying-for-care
- [30] Ezzat, A., Sood, H., Holt, J., Ahmed, H., & Komorowski, M. (2021). COVID-19: are the elderly prepared for virtual healthcare? *BMJ Health & Care Informatics*, 28(1), e100334.

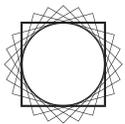
- [31] Lama, Y., Davidoff, A. J., Vanderpool, R. C., & Jensen, R. E. (2022). Telehealth Availability and Use of Related Technologies Among Medicare-Enrolled Cancer Survivors: Cross-sectional Findings From the Onset of the COVID-19 Pandemic. *J Med Internet Res*, 24(1), e34616.
- [32] Centers for Disease Control and Prevention. (2021). Loneliness and social isolation linked to serious health conditions. Alzheimer's Disease and Health Aging. Retrieved on August 10, 2021, from <https://www.cdc.gov/aging/publications/features/lonely-older-adults.html#:~:text=Older%20adults%20are%20at%20increased,chronic%20illness%2C%20and%20hearing%20loss>
- [33] Fleisch Marcus, A., Illescas, A. H., Hohl, B. C., & Llanos, A. A. J. P. O. (2017). Relationships between social isolation, neighborhood poverty, and cancer mortality in a population-based study of US adults. 12(3), e0173370.
- [34] Kuiper, J. S., Zuidersma, M., Voshaar, R. C., Zuidema, S. U., van den Heuvel, E. R., Stolk, R. P., & Smidt, N. J. (2015). Social relationships and risk of dementia: A systematic review and meta-analysis of longitudinal cohort studies. 22, 39-57.
- [35] Perissinotto, C. M., Cenzer, I. S., & Covinsky, K. E. (2012). Loneliness in older persons: a predictor of functional decline and death. 172(14), 1078-1084.
- [36] Manemann, S. M., Chamberlain, A. M., Roger, V. L., Griffin, J. M., Boyd, C. M., Cudjoe, T. K., Jiang, R. J (2018). Perceived social isolation and outcomes in patients with heart failure. 7(11), e008069.
- [37] Lyu, Y., & Forsyth, A. (2022). Planning, Aging, and Loneliness: Reviewing Evidence About Built Environment Effects. 37(1), 28-48
- [38] Syed, M. A., McDonald, L., Smirle, C., Lau, K., Mirza, R. M., & Hitzig, S. L. (2017). Social isolation in Chinese older adults: Scoping review for age-friendly community planning. 36(2), 223-245.
- [39] Chen, Y., Hicks, A., While, A. E. (2014). Loneliness and social support of older people in China: a systematic literature review. 22(2), 113-123.
- [40] Ladin, K., Porteny, T., Perugini, J. M., Gonzales, K. M., Aufort, K. E., Levine, S., Weiner, D. E. (2021). Perceptions of Telehealth vs In-Person Visits Among Older Adults with Advanced Kidney Disease, Care Partners, and Clinicians. *JAMA Network Open*, 4(12), e2137193-e2137193
- [41] Kullgren, J., Malani, P., (2022). Pandemic disruptions mean many older adults still haven't gotten needed care, Report, Retrieved on 02/2022 from <https://www.healthyagingpoll.org/reports-more/poll-extras/pandemic-disruptions-mean-many-older-adults-still-havent-gotten-needed>
- [42] Rinderud, P. (2021). Seniors and technology during Covid-19: the latest insights. Retrieved February 2022, from <https://www.ericsson.com/en/blog/2021/1/seniors-and-technology-during-covid>
- [43] Linkage Connect, (2021). 2021 Technology Study Older Adults Age 55-100, Report, Retrieved on 02/2022 from <https://www.linkageconnect.com/wp-content/uploads/2021-Technology-Study-Report.pdf>
- [44] Span, P. (2022). The pandemic has made many seniors less active. The Pandemic Has Made Many Seniors Less Active. Retrieved November 23, 2022, from <https://www.nytimes.com/2022/02/05/health/covid-elderly-mobility.html>
- [45] Powers, J. S. (2019). The Importance of Geriatric Care Models. 4(1), 5.
- [46] Kakulla, B. (2021). 2022 Tech Trends and the 50-Plus. Retrieved from <https://doi.org/10.26419/res.00493.001>
- [47] Etkin, K. (2021). What is Metaverse and what could it mean for the future of Aging. Retrieved from <https://www.thegerontechnologist.com/what-is-the-metaverse-and-what-could-it-mean-for-the-future-of-aging/>
- [48] Bavor, C. (2021). Project Starline: Feel like you're there, together. Research. Retrieved from <https://blog.google/technology/research/project-starline>
- [49] Mullaney, T. (2021). Amazon Introduces Alexa for Senior Living Enterprise Use, Atria Bringing to Related JV Properties. Retrieved from <https://seniorhousingnews.com/2021/10/25/amazon-introduces-alexa-for-senior-living-enterprise-use-atria-bringing-to-related-jv-properties/>
- [50] Savage, N. (2022). Robots rise to meet the challenge of caring for old people. *Nature*, 601(7893), S8-s10.

- [51] Link, B. (2020). Emerging Robotic Technology for Home Healthcare. Ideas in Motion. Retrieved from <https://info.designatronics.com/blog/emerging-robotic-technology-for-home-healthcare>
- [52] Intel (2022). Robots in Healthcare: The future of Robots in Medicine. *Health and Life Sciences*. Retrieved from <https://www.intel.com/content/www/us/en/healthcare-it/robotics-in-healthcare.html>
- [53] Piatkowski, M. A., Addie Taylor, Ellen. (2019). Healthcare at Home: A White Paper Supporting The Center for Health Design Interactive Diagrams. The Center for Health Design.
- [54] Levine, D. M., Ouchi, K., Blanchfield, B., Diamond, K., Licurse, A., Pu, C. T., & Schnipper, J. L. (2018). Hospital-Level Care at Home for Acutely Ill Adults: a Pilot Randomized Controlled Trial. *Journal of General Internal Medicine*, 33(5), 729-736.
- [55] Malani, P., Kullgren, J., Solway, E., Robinson-Lane, S., Singer, D., Kirch, M., & Smith, E. (2022). National Poll on Healthy Aging: Older Adults' Preparedness to Age in Place.
- [56] Span, P. (2018). Medicare advantage is about to change. here's what you should know. *The New York Times*. Retrieved on March 2022, from <https://www.nytimes.com/2018/07/20/health/medicare-advantage-benefits.html>
- [57] Schuchman, M., Fain, M., & Cornwell, T. (2018). The Resurgence of Home-Based Primary Care Models in the United States. 3(3), 41.
- [58] American Hospital Association (2020). Issue Brief: Creating Value by bringing Hospital Care Home. The Value Initiative. Retrieved from https://www.aha.org/system/files/media/file/2020/12/issue-brief-creating-value-by-bringing-hospital-care-home_0.pdf
- [59] Best Buy (2021). Best buy to acquire current health to help make home the center of health. Best Buy Corporate News and Information. Retrieved on March 2022, from <https://corporate.bestbuy.com/best-buy-to-acquire-current-health-to-help-make-home-the-center-of-health/>
- [60] Powers, J. S. (2021). Geriatric Care Models. 6(1), 6.
- [61] Scott, J. (2021). 3 Senior Care Tech Trends to Watch in 2022. *HealthTech Management*. Retrieved on March 2022, from <https://healthtechmagazine.net/article/2021/12/3-senior-care-tech-trends-watch-2022>
- [62] Engelen, L., Rahmann, M., & de Jong, E. (2022). Design for healthy ageing—the relationship between design, well-being, and quality of life: a review. *Building Research & Information*, 50(1-2), 19-35.
- [63] Melnikow, J., Ritley, D., Miller, M., Loureiro, S., Kohatsu, N., Backman, D., Owens, C. (2021). Planning Healthy Aging Communities. UC Davis Center for Healthcare Policy and Research.

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