

The Impact of COVID-19 on California's Plans for Caring for its Aging Population

Bruce Pickering \ Berkeley Roundtable on the International Economy \ nbpickering@gmail.com □

David Lindeman \ Center for Information Technology Research in the Interest of Society and the Banatao Institute (CITRIS) \ dlindeman@citris-uc.org

Allyson Tang \ Berkeley Roundtable on the International Economy \ atang@berkeley.edu

Berlin, February 2024

ISSN 2748-5587 \ DOI [10.34669/WI.WS/33](https://doi.org/10.34669/WI.WS/33)

EDITORS: The Managing Board members of the Weizenbaum-Institut e.V.
Prof. Dr. Sascha Friesike
Prof. Dr. Martin Krzywdzinski
Prof. Dr. Christoph Neuberger
Dr. Ricarda Opitz

Hardenbergstraße 32 \ 10623 Berlin \ Tel.: +49 30 700141-001
info@weizenbaum-institut.de \ www.weizenbaum-institut.de

EDITORIAL MANAGER: Dr. Moritz Buchner

TYPESETTING: Luisa Le van, M.A., Atelier Hurra

This publication is available open access and is licensed under Creative Commons Attribution 4.0 (CC BY 4.0): <https://creativecommons.org/licenses/by/4.0/>

The Weizenbaum Institute is a joint project funded by the Federal Ministry of Education and Research (BMBF) and the State of Berlin. It conducts interdisciplinary and basic research on the digital transformation of society and provides evidence- and value-based options for action in order to shape digitization in a sustainable, self-determined and responsible manner.

This work has been funded by the Federal Ministry of Education and Research of Germany (BMBF) (grant no.: 16DII136, 16DII131, 16DII137 – “Deutsches Internet-Institut”).

Abstract

Older adults have traditionally been the age cohort most resistant to the adoption of technology, making aging in place difficult and frequently expensive. But recent advances in technology – and those just on the horizon – have the potential to transform the ability to age in place by making senior healthcare both safer and more connected. Such technology can enable healthcare professionals to monitor their charges in real time, respond quickly to healthcare emergencies, make healthcare consultations safer and less onerous for both patients and healthcare workers, assist elders with physical therapy, connect older adults to family and friends, and provide entertainment and learning opportunities

for seniors. It is now even possible for older adults in rural areas to receive remote surgery from world class surgeons.

The arrival of COVID-19 forced older adults into isolation, severely limiting contact with healthcare providers, family and friends. But COVID-19 also accelerated the adoption of many of the trends already extant, incentivizing older adults and healthcare providers to adopt new technologies much more rapidly than ever before. The Welbeheath Program of All-inclusive Care for the Elderly (PACE) in California's Central Valley, may provide a model of flexible, responsive and adaptive care.

TABLE OF CONTENTS

1	Introduction	5
2	Aging in place and the use of technology	5
2.1	Factors driving technology adoption by older adults	6
2.2	Primary uses of technology to support healthy aging-in-place	7
2.2.1	Cognition and independent living	8
2.2.2	Communication and social connectivity	8
2.2.3	Personal mobility	8
2.2.4	Transportation	9
2.2.5	Access to healthcare	9
2.2.6	Additional technology considerations	10
2.3	Key emergent technologies and potential barriers to acceptance	11
2.4	Additional potential barriers to technology adoption	16
2.5	The State of California's pre-COVID-19 plans for its aging population	17
2.5.1	Key elements of California's Master Plan for Aging	17
2.6	Aging populations and workforce considerations	18
3	The impact of COVID-19 and the acceleration of ongoing trends	19
3.1	Overall impact of COVID-19 on California's economy	19
3.2	Changes in technology due to COVID-19	20
3.3	The impact of COVID-19 on technology adoption by older adults	21
3.4	The impact of COVID-19 on the healthcare workforce	22
3.5	Acceptance of new technologies by workforce and family caregivers	23

4	The WelbeHealth case study and the potential adaptability of hybrid systems	24
4.1	The traditional CASE model	25
4.2	WelbeHealth – A case study of one PACE provider	27
4.3	Conclusions from the WelbeHealth case	30
5	References	32

1 Introduction

This paper will explore how COVID-19 has influenced California's efforts to create a healthy environment for the state's aging population, particularly the large percentage of older adults who wish to "age in place," that is, staying in their homes as they grow older rather than moving into specialized senior communities. In California, the California Department of Aging and public and private care organizations have consistently been in the forefront of developing and utilizing technology as a means of supporting its senior population, particularly in support of more efficient delivery systems and a more efficient healthcare workforce. The impact of COVID-19 is clearly significant, and this paper will explore the impact on both the senior population and the workforce.

Starting with an overview of technologies coming online to make aging in place more practicable, Section 2 will provide a brief overview of those technologies, barriers to adoption, the State

of California's pre-COVID-19 planning, and examine employment trends within that portion of the workforce working with aging seniors. Section 3 of the paper will consider how COVID-19 altered California's approach to healthcare for senior populations, including employment and the acceptance of various technologies – particularly the digital and broadband based technologies important for supporting healthy aging. It will then consider the impact of COVID-19 on the implementation of technologies, their acceptance by older adults and their application in the work processes of the healthcare workforce. Finally, the paper concludes with a case study incorporating the adaptations of WelbeHealth, a California PACE (Program of All-Inclusive Care for the Elderly) provider, to the COVID-19 pandemic – an example which offers one possible path forward for other such organizations and likely has applicability to the larger healthcare system for older adults.

2 Aging in place and the use of technology

As with much of the developed world, California has faced an increase in its aging population, and for many of the same reasons: low birthrates, longer lifespans and low immigration. The state's population aged 60 years and over is expected to grow more than three times as fast as the total population and this growth varies by region. By 2030, one-quarter of the state's population of 40 million will be an older adult. If unaddressed, the state could easily find itself in the difficult situation of trying to care for an older population while still needing to meet the needs of the current and future workforce.

Most older adults prefer remaining in their own homes, and indeed, such aging in place is generally seen as a net positive for both seniors and the healthcare industry, reducing overall healthcare costs, and making older adults more comfortable, slowing their loss of memory and giving them a greater sense of agency.¹

A number of important studies have recently considered how communities must adapt to rapidly-aging populations – and the many benefits of doing so. Some of these involve architectural and urban

¹ Trout, Jonathan and Jeff Smith. 2022. 5 Benefits of Aging in Place. *Retirement Living*, December 27. <https://www.retirementliving.com/5-benefits-of-aging-in-place>

planning, while others focus on integrating recent advances in technology, particularly AI, robotics, remote learning and communication, and the use of data sets to ensure that all populations are represented fairly and solutions are applied effectively. Many of these are identified in the Berkeley Roundtable on the International Economy (BRIE) working paper *Welbehealth: Case Study of Adapting PACE under COVID-19* (<https://brie.berkeley.edu/publications/welbehealth-case-study-adapting-pace-under-covid-19>), UC Davis' Center for Healthcare Policy and Research publication *Planning Healthy Aging Communities*, David Lindeman's presentation on *Healthy Aging, Technology and Innovation*, David Lindeman's chapter on *The Role of Digital Technology in Healthy Aging Communities*, and Stanford University's Center for Human-centered Artificial Intelligence (HAI) *Balancing Fairness and Efficiency in Health Plans*.²

Taken together, these studies do an excellent job of identifying the means by which California communities can provide for a healthier (both mentally and physically) population of older adults. Broadly speaking, these studies call for making existing communities more "aging-friendly," building new communities that are prepared for new technologies as they become available ("future proofing,") and creating and expanding a policy environment designed to support new communities and new technologies.

2.1 Factors driving technology adoption by older adults

The adoption of technology by older adults is driven by affordability, accessibility, independence, and confidence.³ Some factors important to user adoption include the following:

- \ To maximize the probability that the user will find interacting with the technology useful, the design of the technology should include adequate assessment of user needs, usability analyses and studies, and design methodology that focuses on the appropriate user base. This assessment should include needs-finding through interactions with older adults from a range of socioeconomic backgrounds, caregivers, and clinicians, recognizing that users will have a range of different attitudes towards and experiences with technology.
- \ Use of universal design principles is key, including gathering requirements from the appropriate user groups and the development of a single interface for all functions, rather than separate devices or interfaces.
- \ "Zero-effort technologies" that require little or no effort from the user – particularly older adults - will limit the opportunity for user error. Planners should work to optimize such "zero-effort" technologies.

² Melinkow, Joy, et al. 2021. Planning Healthy Aging Communities. *UC Davis Center for Healthcare Policy and Research*. <https://health.ucdavis.edu/media-resources/chpr/documents/pdfs/planning-healthy-aging-communities-june-2021.pdf>; Nitzberg, Mark, John Zysman, and Amelia Michael. 2021. Welbehealth: Case study of adapting PACE under COVID-19. BRIE Working Paper 2021-4. https://brie.berkeley.edu/sites/default/files/ucb_case_study_welbehealth_brie_wp-4.pdf

³ For a fuller description of the barriers to adoption and the factors driving technology usage by seniors, see Lindeman, David A, Katherine K Kim, Caroline Gladstone, and Ester Carolina Apesoa-Varano. 2020. Technology and Caregiving: Emerging Interventions and Directions for Research. *The Gerontologist* 60(1), 41-49. doi: 10.1093/geront/gnz178

- \ For wearable sensors, design input should include an assessment of the appropriate sensors and compatibility with users, especially for systems that are to be used over an extended period of time. When possible, truly non-invasive solutions should be sought.
- \ When considering user adoption, care should be taken to provide the right amount of information. Presenting only necessary data avoids information overload for seniors, who do not necessarily want more data.
- \ Current Federal and industry standards focus on IT access rather than usability. To ensure accessible and usable services, universal design principles must be applied to information and communication technologies.⁴

Another critical issue in the consideration of technology-enabled services and programs in age-friendly communities is user training, an often neglected requirement that can be the greatest factor in successful or unsuccessful technology implementations. Specialized training and support can help older adults transition to new technologies.⁵

2.2 Primary uses of technology to support healthy aging-in-place

Technology has become a core component of communities that support healthy aging-in-place, and there is evidence that even before COVID-19, seniors were already increasingly utilizing technology to remain independent.⁶ In 2019, the National Science and Technology Council (an executive branch office associated with the White House) delivered a report for the White House, *Emerging technologies to support an aging population*. Produced by the multi-departmental Task Force on Research and Development for Technology to Support Aging Adults, the report identified six primary areas that it described as critical to the independence and well-being of the aging population, areas in which digital technology could be successfully utilized to assist aging-in-place. These included (1) key activities of independent living (hygiene, nutrition, and medication) (2) cognition (monitoring, training, and financial security) (3) communication and social connectivity (4) personal mobility (5) transportation and (6) access to healthcare.⁷ These focus areas align with the WHO's priority domains for age-friendly communities, most notably the built environment, transportation, housing, communication, and health services, all of which will be addressed further in this chapter.

⁴ Some standards for accessibility for telecommunications services and web content have been outlined in the Telecommunication Act Accessibility Guidelines (TAAG) and the Web Content Accessibility Guidelines (WCAG). The TAAG and WCAG standards have as their express purpose to make information and communication technology and internet websites more accessible to persons with a disability. Web Accessibility Initiative. 2021. Web Content Accessibility Guidelines Overview. W3C. <https://www.w3.org/WAI/standards-guidelines/wcag/>

⁵ Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Planning Committee presentation. University of California, Davis Health, Sacramento, CA, March 9 (presentation can be emailed on request); Lindeman, David, Katherine K Kim, Caroline Gladstone, and Ester Carolina Apesoa-Varano. 2020. Technology and Caregiving: Emerging Interventions and Directions for Research. *The Gerontologist* 60(1), 41-49. doi: 10.1093/geront/gnz178

⁶ See for example, Rinderud, Peter. 2021. Seniors and technology during COVID-19: the latest insights. The Ericsson Blog, January 26. <https://www.ericsson.com/en/blog/2021/1/seniors-and-technology-during-covid>

⁷ National Science and Technology Council, United States Government. 2019. Emerging Technologies to Support an Aging Population. Task Force on Research and Development for Technology to Support Aging Adults. <https://trumpwhitehouse.archives.gov/wp-content/uploads/2019/03/Emerging-Tech-to-Support-Aging-2019.pdf>

2.2.1 Cognition and independent living

Adults commonly experience cognitive changes as they age, with increasing prevalence at older ages. Though varying in severity, these changes can interfere with independent living and personal safety, including the ability to manage chronic health conditions. Architects and urban planners need to consider technologies that help to monitor changes in cognition, provide mental training, and coordinate financial management in order to reduce the impact of cognitive decline and increase the ability to live independently. While the evidence base for the effectiveness of these technologies is still limited, a robust cognitive fitness movement that claims to enhance brain function and memory using technology-enabled programs has emerged. A number of startups have moved to address one of the key issues related to cognitive decline: managing financial assets and decision making. These companies have developed online resources to manage and track financial assets and transactions to prevent elder abuse.⁸ Technology-enabled systems will need to support increasingly complex services for older adults and family caregivers for the management of financial resources and assets.

2.2.2 Communication and social connectivity

Communication between older adults encompasses the physiological ability to utilize multiple senses, the ability to understand each other, and the ability to communicate across close and long distances. As they age, older adults may face communication challenges due to hearing loss, language and cultural barriers, and social isolation. Communication to support connectivity needs to be one of the greatest priorities of developers and policy makers

working on creating new, age-friendly communities. The technologies that support healthy aging by strengthening older adults' connections with their personal, professional, and broader network in a community include hearing devices (including next generation hearing devices and systems), translation tools (e.g., Google translate), and social media applications. While these technologies have become very important due to social isolation as a result of COVID-19, the use of communication technologies to improve interpersonal connectivity will become increasingly critical in supporting older adults well past the restrictions brought on by COVID-19.⁹

2.2.3 Personal mobility

The ability to move comfortably and safely is necessary for independent living. In this case mobility has a broad definition and refers to all movement including leaving the bed, walking, exercising, driving, and using public transportation. As adults age, they often become less mobile, losing control over their movement and becoming more prone to slipping and falling. Architects and developers need to incorporate multiple technologies that support mobility (e.g., transfer devices, remote monitoring, automated vehicles), including enhanced infrastructure (i.e., broadband, power, and technology support), into their design for a community. These technologies can be used to support assisted movement, in-home rehabilitation, and safety monitoring, as well as help older adults maintain access to their homes and the surrounding community. Given that falls are the greatest cause of morbidity and mortality for older adults, falls prevention and tracking are critical means for applying technology to maintain the well-being of individuals in a single

⁸ For instance the companies EverSafe, <https://www.eversafe.com/home-21/>, and True Link Financial, <https://www.truelink-financial.com/>.

⁹ Faverio, Michelle. 2022. Share of those 65 and older who are tech users has grown in the past decade. Pew Research Center, January 13. <https://www.pewresearch.org/fact-tank/2022/01/13/share-of-those-65-and-older-who-are-tech-users-has-grown-in-the-past-decade/>; Nelson Kakulla, Brittne. 2020. Older adults keep pace on tech usage. AARP Research. <https://www.aarp.org/research/topics/technology/info-2019/2020-technology-trends-older-americans.html>

family home or congregate setting (i.e. [SafelyYou](#)). In addition, the greatest single use of technology by older adults in the U.S. is for personal emergency response systems (PERS), which need to be considered as integral from a community-wide perspective. Critical items involved in providing a secure and safe environment also include appliance detectors (e.g., stove use detectors) and smart home systems (e.g., [Google Nest Hub](#)).¹⁰

2.2.4 Transportation

Mobility beyond the home and neighborhood is necessary to access social, health, and business facilities. As adults' physical and cognitive abilities change as they age, their transportation needs and requirements change as well. Some older adults drive without assistance, some may require assistance, and many others rely on public transportation and ride hailing services. Technologies to support these needs include vehicular modification, advanced assistive technologies, systems to access public transportation, ride hailing services, and paratransit systems. Technologies that support these services (e.g., SilverRide or Lyft) require significant broadband and technology system support.

Autonomous vehicles are increasingly viable technology solutions for developers of aging communities. While these vehicles are not yet widely deployed in age-friendly communities, the advent of AI and the application of 5G has greatly increased the viability of autonomous vehicles as being a transportation alternative for older adults. Autonomous vehicle technology requires vehicles to have sensors to enact travel in the most efficient way without human intervention. The main benefits of autonomous vehicles for older adults arise when the burden of operating the vehicle is taken out of the hands of a driver. Generally, autonomous vehicles are able to reduce travel times, car accidents, and traffic congestion. For older adults,

autonomous vehicles will improve overall driving safety, increase comfort and ease of using a car, and provide an opportunity for them to continue meeting their mobility needs even after experiencing age-induced physical and cognitive changes. In addition, older adults can obtain more access to societal engagements that they were previously excluded from, including but not limited to employment opportunities, social and leisure activities, shopping, and public health and medical services. While early applications of autonomous vehicles have primarily been limited to age-friendly campuses with structured routes, developers and architects should build in infrastructure and technology support for autonomous vehicles into their age-friendly community design.

2.2.5 Access to healthcare

Healthcare systems involve many different participants with multifaceted functions and strategies, including patients, families, caregivers, clinicians, communities and community services, and social services and support systems. Oftentimes, older adults with multiple chronic conditions will receive fragmented, suboptimal, and contradictory care in multiple care settings. Technologies can not only support older adults' ability to carry out activities of daily living, but are central to supporting access to health care and the collection of health information for older adults, family caregivers and providers alike. In many cases technology enables older adults to participate in maintaining their own health and being proactive with their family and health care team. Technologies that support access to health care include software and hardware systems that can be worn, embedded in the home or residence, monitor or track older adults, and/or support health and health care remotely. Many of these technologies provide an objective assessment of a person's ability to live independently, allow healthcare providers to identify the early onset of

¹⁰ Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.

disease, and help health care providers to coordinate needed care and services. These technologies include, among others, remote monitoring technology, electronic health records, residential monitoring and sensor systems, reminder systems, medication management systems, vision and hearing support, robotics, and palliative care support. Finally, coordination of health care activities through digital technologies, such as telehealth, can significantly increase the effectiveness and efficiency of healthcare delivery.¹¹

2.2.6 Additional technology considerations

There are several additional applications of technology use that architects and developers should consider when assessing overall community needs in age-friendly communities. These include lifelong learning, family caregiving, supporting older adults in the workforce, and supporting special populations.

Lifelong learning. Technology has made it possible for people of all ages to continue pursuing their interests and developing new skills. The emergence of new technologies has transformed the way we receive and process information, collaborate and communicate with one another, and engage in various learning activities. As adults experience changes in their physical and cognitive abilities over time, their functional and learning capabilities are also impacted. Assistive technologies provide personalized support for all students to learn effectively. In addition, information technology expands knowledge and access to virtual self-learning opportunities. The Osher Lifelong Learning Institute (often know as OLLI) is a set of in-person and online courses targeted on adults 50 and older and the

Posit Science BrainHQ, a set of courses designed to upgrade mental acuity and brain health, are two very different learning platforms that are technology-enabled.¹²

Family caregiving. Technology has become an indispensable part of family caregiving: it can be used to help caregivers support older adults health and socialization needs by facilitating service scheduling and delivery, assist in managing chronic illness, improve caregivers and older adults' socialization and support, and offer information and resources on a "just in time" basis. If employed to its fullest, technology can improve the quality of life of family caregivers as well as their physical, economic and psychological well-being. Family caregivers are often more knowledgeable about emerging innovations in technology and are in a position to both recommend technologies that will support both their relative and themselves, they also expect state-of-the-art technology. In addition, family caregivers frequently are the decision makers for technology choices for their relatives, suggesting they should be key informants for age-friendly community planning efforts.

Older Adults in the Workforce. Technology can enable a more inclusive and productive workforce, helping bring older populations into the workforce and assisting workers to maintain meaningful employment as they age. New technologies support (re)skilling and training tailored to the cognitive and physical needs and skills of diverse individuals. In addition, assistive technology can mitigate physiological changes (e.g. hearing, vision) for older adults who want to, and increasingly have to, remain in the work force. Architects and developers need to account for technologies and technology infrastructure that will support an older workforce,

¹¹ The preceding set of paragraphs is from Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Planning Committee presentation. University of California, March 9; see also Perry, Matt. 2016. David Lindeman wants technology to be your friend. California Health Report, November 21. <https://www.calhealthreport.org/2016/11/21/19836/>

¹² Pruchto, Rachel. 2019. Technology and aging: An evolving partnership. *The Gerontologist* 59 (1). <https://academic.oup.com/gerontologist/article/59/1/1/5281343?login=false>

especially for older workers that will increasingly work remotely or from home. For example, more sophisticated technology and connectivity will be needed to support artificial Intelligence-enabled (AI) assistive hardware and software to enhance an individual's skills. Age-friendly communities will be catalyzers for creating new jobs and allowing older adults to continue participation in the workforce from their own residences.¹³

2.3 Key emergent technologies and potential barriers to acceptance

A range of studies have considered what will be the most important technologies for older adults to age in place, and the potential barriers to acceptance.

Broadband technology

Broadband is central to the success of all age-friendly community planning, providing the connectivity necessary for older adults to easily obtain necessary online services. Reliable, high-speed internet can make it easier and more convenient for older adults to access a variety of specialized online services designed to make their lives easier and more enriching. AARP has identified that improved connectivity can improve the needs of older adults in five areas: personal fulfillment, health preservation, social connectedness, functional capability and activity, and caregiver support. For older adults broadband is critical for access to mobile solutions, home connectivity, and access in congregate settings.

Key issues for planners include insuring broadband accessibility, affordability, and quality.¹⁴

- \ Potential Barriers to adoption:
 - \ Not all communities, especially in rural areas, have broadband capabilities;
 - \ Not always affordable for older adults.

Next generation wireless technology (5G)

5G is shorthand for the 5th generation standard of mobile communications technology that provides wireless networking at data speeds 20 times faster than previous speeds and latency levels 10 times lower than current delays. Data are transferred more efficiently and quicker than ever before. Ultimately, faster network speeds equate to a greater capability of handling all the connected devices that will be present in the lives of older adults in the near future. Applications of 5G include household health devices by healthcare providers, video communications systems with family and friends, and home devices providing convenience and comfort. 5G can also support medical situations where elderly patients have to be operated on remotely. For instance, if a surgeon had to use a robotic arm to operate on an elderly patient due to logistical constraints, it is imperative that there is no delay present while the surgeon directs the robot's actions and in the real-time visual feedback that the surgeon is receiving. 5G speed and latency advances are fundamental to the viability of many technology-enabled solutions, such as autonomous vehicles. 5G stands to optimize the way technologies like the aforementioned and so many more operate and communicate with one another, ultimately leading to a higher quality of life for older adults.¹⁵

¹³ National Alliance for Caregiving. 2011. e-Connected Family Caregiver: Bringing Caregiving into the 21st Century. United-Healthcare. <https://www.unitedhealthgroup.com/content/dam/UHG/PDF/2011/UHC-NAC-eConnected-Family-Caregiver.pdf>; Lindeman, David, Katherine K Kim, Caroline Gladstone, and Ester Carolina Apesoa-Varano. 2020. Technology and Caregiving: Emerging Interventions and Directions for Research. *The Gerontologist* 60(1), 41-49. doi: 10.1093/geront/gnz178

¹⁴ Bonaccorsi, Manuele, Laura Fiorini, and Filippo Cavallo. 2016. A Cloud Robotics Solution to Improve Social Assistive Robots for Active and Healthy Aging. *International Journal of Social Robotics* 8, 393–408. doi: 10.1007/s12369-016-0351-1, cited in: Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.

¹⁵ Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Plan-

Wearable technology (“wearables”)

Wearables are electronic devices that are worn closely or within the body to detect, analyze, and transmit information from an older adult. Recent developments have allowed wearable devices to be embedded in clothing, worn as jewelry, implanted within or placed on the body. Wearables have a variety of applications, but it is a prominent consumer device due to the popularization of smartwatches and activity trackers and the advent of COVID-19. Although only 3.3% of all wearable users are 65 years or older, wearables are rapidly being adopted as a means of supporting older adult’s autonomy and quality of life. Wearable health monitoring devices can provide immediate feedback on vital signs, such as heart rate and blood pressure, which can reduce physical checkups and decrease the risk of hospital admission. Wearables can also provide physicians with updated information about the older adult’s vitals and activity levels, which can quickly address impairments in their cognitive functional ability, mobility, and psychosocial functioning. As the cost and design of wearables improves, age-friendly communities will increasingly be able to/expected to support older adults, their families, and providers through the use of wearables, whether for safety and security, health care monitoring, or enhanced engagement. Land use planners need to anticipate future broadband speed and bandwidth that will be able to fully support wearables in order that they function effectively and seamlessly for older adults.¹⁶

Smart home sensors (IoT)

Interconnected sensing technology, commonly referred to as the Internet of Things (IoT), is revolutionizing aging-in-place to meet the needs of older adults. Sensors can collect information which can be processed through machine learning techniques to draw behavior patterns and health states from data. IoT devices include smartwatches, smart home sensors, cameras, microphones, and both indoor and outdoor tracking devices. These devices provide objective, reliable, and remote monitoring, assessment, and support of older adult’s environment and physical state. Land use planners need to be able to anticipate how sensors will be best implemented to support an older adult’s daily routine to ensure their independence, including care providers development of treatment plans based on a behavioral profile extracted from a sensor, and/or family members use of smart security and monitoring systems to check-in on a loved one. Sensors will be able to remind older adults to take the correct medications at regular times with their timely reminders from their smart medication dispensers. Similarly, planners will need to anticipate installation of sensor-based devices that will provide reliable, efficient, and affordable options to monitor behavior and measure cognitive and physical health statuses. IoT helps power wearable devices that can help people with autism spectrum disorder navigate the day with a greater sense of safety and security. For example, Awake Labs builds software for smartwatches that tracks the wearer’s reactions (e.g., raised heart rate) and sends warnings to caretakers when the user is feeling stressed. Sensors and IoT devices are core technologies for smart homes, smart buildings and smart cities.¹⁷

ning Committee presentation. University of California, March 9.

¹⁶ Ibid.

¹⁷ Stavropoulos, Thanos G., Asterios Papastergiou, Lampros Mpaltadoros, Spiros Nikolopoulos, Ioannis Kompatsiaris. 2020. IoT Wearable Sensors and Devices in Elderly Care: A Literature Review. *Sensors* 20(10). doi: 10.3390/s20102826, cited in: Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.

- \ Potential Barriers to adoption

- \ Relatively high costs;
- \ Difficulty of use;
- \ Privacy concerns;
- \ Connectivity to high-speed internet.

Telehealth

Telehealth has become an essential technology that planners will need to fully incorporate into age-friendly communities. Telehealth enhances health care and health education delivery and support using telecommunications technologies, and encompasses a broad variety of technologies and tactics to deliver virtual medical, health, and education services. Using technology to provide health services when the patient and provider are not in the same location, telehealth in the past decade has slowly gained more interest and utilization, but before COVID-19 essentially remained a niche area in health care. While older adults were accelerating their use of technology, COVID-19 vastly accelerated that transition, allowing health systems and health care providers in every area of care to pivot sharply towards remote care.¹⁸ Even as COVID-19 recedes as a public health crisis, the use of remote telehealth continues to grow – a trend that shows no signs of changing in the future. Telehealth includes technology-based remote communication, live video, mobile health, remote patient monitoring, and store-and-forward technologies. Telehealth has become a primary vehicle for the delivery of health care in age-friendly communities.¹⁹ Key to the utilization of telehealth in these communities will be whether changes telehealth policy and reimburse-

ment will become permanent. Older adults have become comfortable with using telehealth during the pandemic, suggesting that telehealth will rapidly become integral to communities serving older adults.²⁰

- \ Potential barriers:

- \ Quiet and secure location is necessary for consultations;
- \ Privacy and internet security concerns need to be addressed;
- \ Training is necessary to ensure seniors understand the systems involved.

Voice First

Voice First refers to the category voice-controlled applications and devices that leverage Natural Language Processing, Artificial Intelligence, and machine learning. Voice First addresses a fundamental challenge for older adults' ability to effectively and efficiently use and master technology-enabled interventions and devices. A Voice First approach is a leap forward from its predecessors ("mobile first") in its quality of technology interactions for aging adults. As talking to technology has become commonplace, Voice First technologies are simple but functional for users, providing reliable responses to questions ("What time does yoga start today?") and commands ("Can you ask the nurse to stop by"), including explanations for how to use new features. These technologies can evolve without users having to carry out upgrades themselves. This allows seniors to master these technologies at any level of

¹⁸ For a discussion on the impact of COVID-19 on technology adoption, see Iacovone, Leonardo, Natasha Kapil, Lukasz Marek Marc, Giovanna Marcolongo, Ilias Skamnelos, and Gallina A. Vincelette. 2021. Leveraging digital technology during the pandemic. Brookings Institution Brief, July 14. <https://www.brookings.edu/blog/future-development/2021/07/14/leveraging-digital-technology-during-the-pandemic/>; Clipper, Bonnie. 2020. The Influence of the COVID-19 Pandemic on Technology: Adoption in Health Care. *Nurse Leader* 18 (5). <https://www.sciencedirect.com/science/article/pii/S1541461220301713>; Rinderud, Peter. 2021. Seniors and technology during COVID-19: the latest insights. The Ericsson Blog, January 26. <https://www.ericsson.com/en/blog/2021/1/seniors-and-technology-during-covid>

¹⁹ McElroy, Jane A., Tamara M. Day, and Mirna Becevic. The Influence of Telehealth for Better Health Across Communities. *Preventing Chronic Disease* 17, July 16. https://www.cdc.gov/pcd/issues/2020/20_0254.htm; Health Resources & Services Administration. 2022. Tips for Telehealth Success. <https://telehealth.hhs.gov/>

²⁰ Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.

technical proficiency. Additionally, Voice First enabled devices and systems are relatively affordable. Many standalone basic unit prices range from \$30 – 50. In 2020 as the pandemic brought upon spikes in social isolation, senior living communities quickly adopted voice-enabled technologies to improve residents' mental wellbeing and social activity.²¹

- \ Potential barrier to adoption
 - \ Reliable wi-fi is a prerequisite, which as noted above, can be a challenge in rural areas.

Virtual reality (VR) /Augmented Reality

Immersive experience technologies such as Virtual Reality (VR), Mixed Reality, and Augmented Reality (AR) that simulate interactive real-life scenarios to provide a sensation of “reality” and “being there” will be widely implemented in age-friendly communities. The use of these technologies can mitigate spatial and physical constraints to provide a desirable environment, situation, and experience to users. Virtual reality also offers the ability to perform tests in an adaptive environment that can be adjusted according to various patients' needs. The use of VR systems for disease treatment has been already explored in several areas, such as brain damage, poststroke intervention, musculoskeletal recovery as well as cognitive restructuring therapies, exercise, and memory problems. In general, the use of VR technology serves as a valuable tool to qualitatively and quantitatively improve older adults', their families', and their caregivers' overall quality of life. Virtual humans have been created to provide an older adult living on her/his own with

a customized 3D personal-care assistant to support behavior and reduce loneliness.

Service providers, health practitioners, social entrepreneurs, and technology developers have expanded the use of VR/AR beyond traditional entertainment purposes. For example, balance training has been shown to be effective in reducing risks of falling, which is a major concern for older adults. Usually, exercise programs are individually prescribed and monitored by physiotherapeutic or medical experts. Unfortunately, supervision and motivation of older adults during home-based exercises cannot be provided on a large scale, in particular, considering an ageing population. Augmented reality (AR) in combination with virtual coaches has been applied to this challenge. Similarly AR technologies such as apps, games, and books can positively affect people with autism spectrum disorder (ASD) in different domains such as social interaction, communication, facial emotion recognition, and functional skills. AR is especially suitable for people with ASD and other populations because it utilizes visual learning, playing to a strength typically associated with ASD. VR and AR are also increasingly serving as preferred training modalities for health care, hospitality, and other areas requiring experiential workforce training. Embodied Labs is an evidence-based, immersive VR-based training platform for caregivers and service providers. Virtual training platforms allow trainees to immerse themselves in virtual labs that simulate real-life situations faced by older adults, enable them to embody patients' perspectives and conditions, helping users provide more effective care.²²

²¹ Orlov, Laurie M. 2021. The future of Voice First Technology and Older Adults - 2018. Age in place tech. <https://www.ageinplacetech.com/page/future-voice-first-technology-and-older-adults-2018>

²² Mostajeran, Fariba, Frank Steinicke, Oscar Javier Ariza Nunez, Dimitrios Gatsios, and Dimitrios Fotiadis. 2020. Augmented Reality for Older Adults: Exploring Acceptability of Virtual Coaches for Home-based Balance Training in an Aging Population. Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, 1–12. <https://doi.org/10.1145/3313831.3376565>; cited in Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.

\ Potential barriers:

- \ Not as conducive to scaling as other technologies;
- \ May lead to “tech adoption reluctance.”

Robotics

The use of robots clearly has enormous potential benefits for assisting with healthcare for aging seniors, and their adoption by the healthcare industry would seem to be a logical extension of their widespread use in monitoring, surveillance, and basic tasks for business and industry. Yet such use in healthcare is not yet widespread, despite successful models from Japan and, to a lesser extent, India.²³ Despite the potential, the use of robots for advanced tasks is at the moment somewhat situational, though they have proven themselves particularly valuable in surgical situations. The expansion of robotics into other areas are now being developed to not only respond to an individual's needs but also to learn and modify their behavior based upon their user's needs and requirements. This is especially useful for older adults who need assistance in maintaining mobility, health, safety, and social connectedness. Robots and robotics are increasingly being utilized in various community health care functions such as helping older adults

with physical and cognitive rehabilitation, surgery, telemedicine, drug delivery, patient management, and more.²⁴ An additional benefit of robots is that they are highly efficient in doing repetitive tasks, can address many basic patient needs for extended periods of time, can be easily accessed by users at their discretion, and keep spaces clean and orderly on a regular basis. Overall, robots have been shown to improve older adult and provider satisfaction as well as allowing individuals to live independently in a range of residential settings while ensuring a high quality of life with improved safety and security.²⁵

Data and data analytics

Underlying the aforementioned emerging technologies has been the rapid advent of data and data analytics. In addition to the massive increase in Big Data, advances in data analytic methods and capabilities have increased at an unprecedented pace. These analytic approaches include artificial intelligence and machine learning techniques that have led to the development of predictive analytics and other robust data methods. New approaches to data management and analysis now allow for the analysis and extraction of information from data sets that had been traditionally too large and complex to be analyzed. Taken together, these advances present an opportunity to personalize care and services

-
- ²³ Alvey, Robert S. 2021. Robotics in healthcare. *Online Journal of Nursing Informatics* 25. <https://www.himss.org/resources/robotics-healthcare>; Chamzas, Constantinos, Feyisayo Eweje, Lydia E. Kavrakı, and Elliot L. Chaikof. 2022. Human Health and Equity in an Age of Robotics and Intelligent Machines. National Academy of Medicine, March 21. <https://nam.edu/human-health-and-equity-in-an-age-of-robotics-and-intelligent-machines/>; For the use of robots in healthcare in Japan, see Wright, James. 2023. Inside Japan's long experiment with automating health care. *MIT Technology Review*, January 9. <https://www.technologyreview.com/2023/01/09/1065135/japan-automating-eldercare-robots/>; Eggleston, Karen, Yong Suk-Lee, and Toshiaki Iizuka. 2021. Robots and Labor in the Service Sector: Evidence from Nursing Homes. National Bureau of Economic Research, Walter Shorenstein Asia Pacific Research Center. <https://aparc.fsi.stanford.edu/research/impact-robots-nursing-home-care-japan>; For India, see Deo, Niyati and Ashish Anjankar. 2023. Artificial Intelligence with robotics in healthcare: A narrative review of its viability in India. *Cureus* 15 (5). <https://www.cureus.com/articles/116306-artificial-intelligence-with-robotics-in-healthcare-a-narrative-review-of-its-viability-in-india#!/>
- ²⁴ Trafton, Anne. 2021. The (Robotic) doctor will see you now. *World Economic Forum*, March 10. <https://www.weforum.org/agenda/2021/03/why-robots-can-be-beneficial-in-healthcare/>; Tobis, Slawomir, Joanna Piasek, Mirosława Cylkowska-Nowak, and Aleksandra Suwalska. 2022. Robots in Eldercare: How Does a Real-World Interaction with the Machine Influence the Perceptions of Older People? *Sensors* 22 (5). doi: 10.3390/s22051717.
- ²⁵ Pearce, Alan, et al. 2012. Robotics to Enable Older Adults to Remain Living at Home. *Journal of Aging Research*, Special Issue. doi: 10.1155/2012/538169; Mitzner, Tracy L., et al. 2014. Identifying the Potential for Robotics to Assist Older Adults in Different Living Environments. *Internal Journal of Social Robotics* 6(2), 213-227. doi: 10.1007/s12369-013-0218-7

for older adults by quantifying models of their lifestyle and environment. For example, data analytics can allow health physicians to differentiate routine health concerns from an imminent life-threatening event. In another example, if motion sensors aren't activated and the lights are turned off during a period when they historically might have been active, a system could be designed to predict that the resident has fallen or gotten hurt. In having significantly more data and more robust data analysis techniques available to older adults and local service providers alike, land use planners should anticipate the need to provide access to ever greater data systems, data analytic capacity, and the need to provide power to support these computing and data systems as they design age-friendly communities.²⁶ With the advent of Large Language Models, data and AI are expected to rapidly provide new advancements and applications in both health care and engagement, for providers and older adults alike.

Driverless vehicles

As older adults age, their mobility is necessarily compromised. Even chores such as shopping or visiting the doctor can become a burden. Car sharing can help, but it can be expensive and not always reliable. In the longer-term, driverless or assisted driving can help seniors remain independent as individuals age in place.

\ Potential Barriers

- \ Technology is not yet at the point where it could be adopted by older populations (or indeed any population);
- \ Broadband is necessary for more rural communities;
- \ Likely numerous regulatory hurdles.

2.4 Additional potential barriers to technology adoption

There are a number of additional potential barriers unrelated to specific systems which could also impede full or partial implementation of many technologies. These include:

1. Difficulty with accurate testing and examining and examination of remote patients
2. Negative effects on doctor-patient relationship – lack of direct communication with patients
3. Adoption reluctance (by patients or doctors)
4. Data privacy concerns
5. Difficulty with platform use – confusing systems, lack of immediate feedback and poor oversight
6. Technical issues and resource availability (limited bandwidth and also the need for human resources to provide support)
7. Insurance/reimbursement policies
8. Data availability and accessibility. This is an area of great promise and increasing focus, with much of its potential as yet unrealized. A number of US research universities, including MIT, Carnegie-Mellon, the University of Southern California, Stanford and the University of California, San Francisco, have dedicated significant resources to create comprehensive databases for seniors, but these research areas are still underway and significant resources will need to be dedicated to expand such programs. Other efforts are underway to ensure that senior health issues are not ignored in the use of big data sets, including, perhaps more importantly, the Centers for Disease

²⁶ Anya, Obinna, Hissam Tawfik. 2016. Leveraging Big Data Analytics for Personalized Elderly Care: Opportunities and Challenges. In *Applied Computing in Medicine and Health*, Eds. Dhiya Al-Jumeily, Abir Hussain, Conor Mallucci, Carol Oliver, 99-124. Morgan Kaufmann, 2016; cited in Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.

Control's efforts to create an accessible data base. Some individual states – such as Connecticut and California – have joined this effort as well. A key focus for all working in this area is to utilize big data and make it more accessible to the public as well as architects, city planners and state officials.²⁷

9. System maintenance (rapid updating of policies and technology)
10. The presence of parallel systems (lots of telehealth systems built and implemented at the same time = more complications w/ implementation/organization)
11. Uneven adoption/differing requirements across healthcare systems.
 - \ This would be a place for the State of California to set in with a set of common policies designed to facilitate adoption and integration.
12. Regulatory issues, at both the federal and state levels.
13. Lack of trained caregivers equipped to assist seniors with adoption of new technologies.

2.5 The State of California's pre-COVID-19 plans for its aging population

The State's elected leadership has recognized the importance of planning for an aging population for a variety of reasons, included quality of life issues, an orderly budgeting process, economic competitiveness, and effective long-term planning.

In late 2020, the California Department of Aging incorporated its research and planning into a single document, *The California Master Plan for Aging* (<https://mpa.aging.ca.gov/>). This Master Plan was a systematic effort designed to identify a set of policies to guide the state over the next decade – by 2030.

2.5.1 Key elements of California's Master Plan for Aging

The State of California is very much an active participant in health care for older adults. The California Department of Aging collects data, undertakes research and creates policies and regulations for the state's older adults. The primary compendium for the priority areas for service enhancement is The California Master Plan for Aging, which identifies five “bold” areas that the State has planned to address by 2030:

1. *Housing for all stages and all ages* – including aging populations;
2. *Reimagining health* – closing the equity gap and increasing life expectancy;
3. *Inclusion and equity, not isolation* – keeping older populations active and engaged;
4. *Caregiving* – the goal is one million high quality caregiving jobs;
5. *Affordable aging* – economic security for aging populations.

²⁷ Akinola, Sofiat. 2021. How can we ensure digital inclusion for older adults? World Economic Forum, October 1. <https://www.weforum.org/agenda/2021/10/how-can-we-ensure-digital-inclusion-for-older-adults/>; Gammon, Katherine. 2020. How is big data reshaping aging research and education? USC Leonard Davis, February 3. <https://gero.usc.edu/2020/02/03/how-big-data-is-reshaping-aging-research-and-education/>; For the Centers for Disease Control, see <https://www.cdc.gov/aging/dataandstatistics/index.html>; For state efforts, see for example Connecticut health aging data report, part of a compendium including Rhode Island, Massachusetts, New Hampshire, Mississippi and Wyoming, <https://healthy-agingdatareports.org/#>; For universities, see for example, Data and research resources for population health and health services by the University of California San Francisco <https://pophealth.ucsf.edu/data-and-research-resources>

The California Master Plan for Aging represents the State's perspective on preparation for a healthy aging population, and notes the importance of aging in place, in part because costs are lower due to the need for fewer healthcare professionals to tend to seniors aging at home. However, the Master Plan notes that skilled care is still critical for healthy aging.²⁸

2.6 Aging populations and workforce considerations

According to the California Department of Aging, most of California's senior caregivers – nearly 5 million, are family members or friends. “Of these, almost 1.7 million are caring for someone with Alzheimer's Disease or dementia, usually with little support or training. This constitutes about 4 billion hours of unpaid time, valued at \$63 billion, each year. Women, particularly Black, Indigenous, Latino, and Asian-American women, are providing a disproportionately large share of this care – often while simultaneously caring for children. Households of color are more likely than white households to be multi-generational, which may indicate these families are more likely to be providing unpaid caregiving across the generations. This creates family challenges and can also lead to a reduction in social security income as the work is unpaid. It also can contribute to poverty and debt for low-income households, and take an emotional and physical toll on families.

Paid caregiving is clearly vital to care for the increasing number of aging adults and breaking the cycle of the disproportionately high impact of caregiving on lower-income families. Caregivers can be present in private homes, through community-based services like adult day centers, or in residential care homes, such as assisted living facilities or nursing homes. But according to the California Department of Aging, caregivers have traditionally been poorly-compensated. Direct care workers earn less than half of California's median annual income and one in four falls below the federal poverty line. Eighty percent of caregiving jobs are held by women; many are immigrants (47%), and they are twice as likely as other Californians to live in low-income households. Low wages, stress, and an elevated risk of job-related injury reduce prospects for financial stability for those employed in the caregiving workforce. Rural areas of the state are under even greater stress, particularly San Joaquin, Merced, San Benito, Riverside and San Bernadino counties. That state of affairs is anticipated to worsen over time, and by 2060 counties with populations aged 60 and over would include nearly all of Southern California and most of the Central Valley.

The California Master Plan predicted a shortage of 3.2 million skilled workers – even before COVID-19. The Master Plan therefore established a (somewhat modest) goal of bringing in 1 million new caregivers by 2030.²⁹

²⁸ California Department of Aging. 2021. Masterplan for Aging. <https://mpa.aging.ca.gov/>

²⁹ *ibid.*

3 The impact of COVID-19 and the acceleration of ongoing trends

3.1 Overall impact of COVID-19 on California's economy

As is well known, COVID-19 had an enormous impact on the global economy, and California was no exception. The virus – or more properly, the response to the virus – fundamentally changed the state's economy. California was one of the first states to address the disease, first through lockdowns and masks and later through testing and vaccinations. While COVID-19 upended to the state economy – particularly its supply chains – the state actually weathered the disruptions as well or better than most. Because the state is large, diverse, resilient, politically unified at senior policy levels and frequently geared towards future-oriented technologies, it has been able to rapidly adjust to these transformations in its policymaking.

An important conference in April/May 2021 examined the key areas where the impact of COVID-19 has dramatically affected the economy of the state of California. The conference included the Governor, Lieutenant Governor, Treasury Secretary and Senate Majority Leader as well as key business, NGO and academic leaders from across California. Briefly summarized, seven key themes emerged:

1. California's resiliency has been challenged and found wanting. The state must take risks to change its trajectory. The pandemic accelerated many negative trends, particularly with respect to healthcare, employment and income inequality.
2. The state should play to its strengths – diversity, inclusion and immigration are all important components of California's recipe for success. Retraining in light of

changed employment circumstances is extremely important.

3. Regional and demographic differences will require different responses, since what is good for one region or population in the state may not work for another. California is a very large state – both in area and population – and differing regional needs require different solutions. This means that state government cannot create a single, unified approach but rather a set of differentiated approaches.
4. The Central Valley and Inland Empire and very important for the state's future. The state's areas of greatest need, these inland regions also represent the greatest return on investment in terms of growth, housing, and resiliency. These areas are central to plans regarding retention of business.
5. Upgraded infrastructure, education, retraining and broad-band are critical to the state's future if it wants to retain its edge in the forefront of innovation. This is especially true inland.
6. Regulations are burdensome – more than taxes. Environmental regulations need reformation without losing their efficacy.
7. Ports are a bottleneck – companies are rerouting away from Oakland and Long Beach/Los Angeles. Infrastructure upgrades are necessary to remain competitive.

As the following discussion shows, perhaps the most important impact of COVID-19 was the hyper-acceleration of a number of already extant trends, a great many of which are applicable to aging and health care.³⁰

³⁰ Seven takeaways from California economy after COVID (Appendix A).

3.2 Changes in technology due to COVID-19

COVID-19 resulted in significant changes in the use of technology by older adults, not only in personal technology use patterns but in broader applications in age-friendly communities and across society in general. Specifically in the case of older adults, social isolation, the need for delivery of remote health care and services, increased dependence on digital communication platforms, and the availability of emerging technologies described above, has had a profound impact on the use and acceptance of technology by older adults. Changes in the use and application of technologies for older adults, family caregivers, and providers is in the process of being evaluated.³¹ Evidence from key informants from multiple sectors has shown that certain technologies have been more pronounced than others, particularly diagnostics, monitoring and surveillance and forecasting.³² In particular, representatives from technology, health and gerontological sectors have noted a significant increase in smart homes,

telehealth, wearables, virtual reality, and robotics all technologies noted in Section 2.³³ One recent study notes that "... technology tools were originally identified as mechanisms that would make future care easier or better; however, these tech solutions amidst COVID-19 are now viewed as essential. The use of technology [...] has been accelerated during the current crisis because technology can provide distance, safety for health care professionals and patients, faster results reporting, virtual visits, and more."³⁴

However, there is an important caveat: older adults need significant help with the introduction and adoption of new technologies to optimize their usage and avoid many pitfalls that can lead to frustration or even dis-adoption of technology. For example, aging seniors are much more likely to fall prey to scams, visit fake domains and share fake news than other age groups.³⁵ They are also more likely to cease the use of technology if introduced too quickly and without adequate time to adjust.³⁶

-
- ³¹ See for example DeAngelis, Tori "Optimizing tech for older adults," *American Psychology Association*, July 1, 2021 - <https://www.apa.org/monitor/2021/07/tech-older-adults>, which notes that information is in the process of being evaluated. See also Eysenbach, Gunther, Leung, Tiffany, Kebede, Abraham Sahilemichael, Lise-Lotte Ozolins, Hanna Holst, and Kathleen Galvin. 2022. Digital Engagement of Older Adults: Scoping Review. *Journal of medical Internet research* 24 (12): e40192. doi: 10.2196/40192., which indicates that the study of the impact of technology is ongoing.
- ³² Fao, Yan and Fan, Ziyang "10 technology trends to watch in the COVID-19 pandemic," World Economic Forum - <https://www.weforum.org/agenda/2020/04/10-technology-trends-coronavirus-covid19-pandemic-robotics-telehealth/> and Kucukbenli, Emily "AI technology and its role during COVID-19," *Insights at Questrom*, January 26, 2022 - <https://insights.bu.edu/ai-technology-and-its-role-during-covid-19/>.
- ³³ Clipper, Bonnie. 2020. The Influence of the COVID-19 Pandemic on Technology: Adoption in Health Care. *Nurse leader* 18 (5): 500–503. doi: 10.1016/j.mnl.2020.06.008.
- ³⁴ Ibid. See also Pawar, Nikhil, Umesh Kubade, and Pranjali M. Jumle. 4112023. Application of Multipurpose Robot for COVID-19. In 2023 7th International Conference on Trends in Electronics and Informatics (ICOEI), 25–30. 2023 7th International Conference on Trends in Electronics and Informatics (ICOEI), Tirunelveli, India. 11.04.2023 - 13.04.2023. IEEE. doi: 10.1109/ICOEI56765.2023.10125840. Murphy, Robin, Amrita Kathasagaram, Truitt Millican, Angela Clendenin, Paula deWitte, and Jason Moats. 1182022. Analysis of the Use of Robots for the Second Year of the COVID-19 Pandemic. In 2022 IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR), 335–340. 2022 IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR), Sevilla, Spain. 08.11.2022 - 10.11.2022. IEEE. doi: 10.1109/SSRR56537.2022.10018671.
- ³⁵ Nash, Susan, *Older adults and technology: Moving beyond the stereotypes*, Stanford Center for Longevity, April 13, 2019 - <https://longevity.stanford.edu/older-adults-and-technology-moving-beyond-the-stereotypes/>. See also Vaportzis, Eleftheria, Maria Giatsi Clausen, and Alan J. Gow. 2017. Older Adults Perceptions of Technology and Barriers to Interacting with Tablet Computers: A Focus Group Study. *Frontiers in psychology* 8:1687. doi: 10.3389/fpsyg.2017.01687.
- ³⁶ Leung, Tiffany, Rampioni, Margherita, Boucher, Eliane, Oluwamayowa, Ogundaini, Sahari, Noraidah, Moxley, Jerad, Joseph Sharit, and Sara J. Czaja. 2022. The Factors Influencing Older Adults' Decisions Surrounding Adoption of Technology: Quantitative Experimental Study. *JMIR aging* 5 (4): e39890. doi: 10.2196/39890. See also "Why the elderly struggle

Nonetheless, recent articles indicate that rapid adoption of technology necessitated by COVID-19 have had an impact on seniors, and such changes are here to stay.³⁷

These technologies were particularly relevant in a period that required social distancing and significant increases in remote activities. Many post-COVID-19 studies also note that the pandemic accelerated technology adoption by seniors and indicated the likelihood for even greater adoption of these technologies in the future.³⁸ This was particularly true with respect to robotics, where COVID-19 clearly did accelerate realization of their importance by older adults. However, a comprehensive study by the National Institutes of Health of over 200 reports has indicated that while COVID-19 accelerated awareness of the potential for robotics, there remain significant “technical hurdles” to actual adoption for more complex tasks. Full utilization of robotics therefore remains further out in the future.³⁹

3.3 The impact of COVID-19 on technology adoption by older adults

COVID-19 has clearly accelerated the importance of technology for older adults, and at the same time, exposed areas for which need improvement. Some areas which should be expanded include:

- \ Consulting, both for health care and other specialized services;
- \ The real-time use of public health and employment data to address immediate needs in a range of areas, including public health and safety;
- \ The need to reimagine health and safety, particularly for vulnerable populations such as the elderly. This includes building in systemic resiliency;
- \ The need to adequately fund public health.⁴⁰

with technology,” *Easy tech seniors*, <https://www.easytechseniors.com/why-seniors-struggle-with-technology/>.

- ³⁷ Clipper, Bonnie. 2020. The Influence of the COVID-19 Pandemic on Technology: Adoption in Health Care. *Nurse leader* 18 (5): 500–503. doi: 10.1016/j.mnl.2020.06.008.
- ³⁸ Haase, Kristen R., Theodore Cosco, Lucy Kervin, Indira Riadi, and Megan E. O’Connell. 2021. Older Adults’ Experiences With Using Technology for Socialization During the COVID-19 Pandemic: Cross-sectional Survey Study. *JMIR aging* 4 (2): e28010. doi: 10.2196/28010. See, also Pearl, Robert and Wayling, Brian “The telehealth era is just beginning,” *Harvard Business Review*, May- June 2022 – May June 2022 - <https://hbr.org/2022/05/the-telehealth-era-is-just-beginning> and Akinola, Sofiat, “What is the biggest benefit technology will have on aging and longevity?,” *World Economic Forum*, March 30, 2021 - <https://www.weforum.org/agenda/2021/03/what-is-the-biggest-benefit-technology-ageing-longevity-global-future-council-tech-for-good/>. See also Leung, Tiffany, Rampioni, Margherita, Boucher, Eliane, Oluwamayowa, Ogundaini, Sahari, Noraidah, Moxley, Jerad, Joseph Sharit, and Sara J. Czaja. 2022. The Factors Influencing Older Adults’ Decisions Surrounding Adoption of Technology: Quantitative Experimental Study. *JMIR aging* 5 (4): e39890. doi: 10.2196/39890.
- ³⁹ Shen, Yang, Dejun Guo, Fei Long, Luis A. Mateos, Houzhu Ding, Zhen Xiu, Randall B. Hellman, Adam King, Shixun Chen, Chengkun Zhang, and Huan Tan. 2021. Robots Under COVID-19 Pandemic: A Comprehensive Survey. *IEEE access : practical innovations, open solutions* 9:1590–1615. doi: 10.1109/ACCESS.2020.3045792. Also (cited above) Clipper, Bonnie. 2020. The Influence of the COVID-19 Pandemic on Technology: Adoption in Health Care. *Nurse leader* 18 (5): 500–503. doi: 10.1016/j.mnl.2020.06.008.
- ⁴⁰ Bohn, Sarah, “How did California’s employment recover from COVID, and what comes next?,” *Public Policy Institute of California*, March 2022, <https://www.ppic.org/blog/how-did-californias-economy-recover-from-covid-and-what-comes-next/>; Johnson, Ben, Hashida, Corey, Impact of COVID-19 on Healthcare Access, Legislative Analyst’s Office, California State Legislature, May 7, 2021 - <https://lao.ca.gov/Publications/Report/4426>; “Economy at a Glance,” *Bureau of Labor Statistics*, US Department of Labor - <https://www.bls.gov/eag/eag.us.htm>

As noted above, many of these trends have direct or near-direct applicability to aging populations – those considered to be most at risk from COVID-19 and other communicable diseases. Of critical importance: Pre-COVID aging populations were the least likely demographic to utilize technology in almost any form beyond the most basic (telephones, for example). Because of their vulnerability to the virus, that same aging population cohort has rapidly adopted tech as a means of coping with social distancing while maintaining connectedness with family, friends, doctors and the outside world.⁴¹ However, not all older adults adopted such technology at the same rate. Some were unable to access such technology, either because of technical constraints (not enough bandwidth or lack of the proper technology) or simply due to an inability to understand or properly use the technology required.⁴²

A number of important studies have recently considered areas in which communities must adapt to rapidly-aging populations – including the many benefits of doing so. Some of these involve architectural and urban planning, while others take advantage of AI, robotics, remote learning and communication, and the use of data sets to ensure that

all populations are represented fairly and solutions are applied effectively. Many of these go beyond the policy approach put forward in *California's Masterplan for Aging*. A small sample includes the Berkeley Roundtable on the International Economy (BRIE) working paper *Welbehealth: Case Study of Adapting PACE under COVID-19, Health inequalities and inequities by age: Stability for the Health Utilities Index and divergence for the Frailty Index*, David Lindeman's presentation on Healthy Aging, Technology and Innovation.⁴³

3.4 The impact of COVID-19 on the health-care workforce

The healthcare industry in California, including hospitals, pharmacies, workers and employers, has weathered COVID-19 in relatively good shape, though employment in healthcare related industries had previously declined precipitously. According to the non-partisan office of California Legislative Analyst (a state agency designed to provide fiscal policy and advice) “[t]he onset of the COVID-19 pandemic coincided with the largest and swiftest

⁴¹ Mishra, Ram, and Monica Sainy. 2022. Technology Adoption and Usage by the Public During the COVID-19 Pandemic. *Jindal Journal of Business Research* 11 (2): 205–217. doi: 10.1177/22786821221127593. “Tech usage among older adults skyrocketed during pandemic,” AARP Press Room, April 21, 2021 - <https://press.aarp.org/2021-4-21-Tech-Usage-Among-Older-Adults-Skyrockets-During-Pandemic>

⁴² See Malani, Preeti, MD, MS, MSJ, “The impact of social distancing on older adults: Past findings from national poll offer insights,” Institute of Healthcare Policy and Innovation, University of Michigan, April 2020 - <https://ihpi.umich.edu/news/impact-social-distancing-older-adults-past-findings-national-poll-offer-insights>, and Kobayashi, Lindsay, “The impacts of social distancing on older adults,” University of Michigan School of Public Health, April 30, 2020 - <https://sph.umich.edu/podcast/coronavirus/the-impact-of-social-distancing-on-older-adults.html>, “CDC streamlines COVID-19 guidance to help the public better protect themselves and understand the risk,” Center for Disease Control, August 11, 2022 - <https://www.cdc.gov/media/releases/2022/p0811-covid-guidance.html>. See also Frueh, Sara, “Pandemic isolation and the elderly: A doctor reflects on the impacts,” National Academies (Sciences, Medicine, Engineering) January 7, 2022 - <https://www.nationalacademies.org/news/2022/01/pandemic-isolation-and-the-elderly-a-doctor-reflects-on-the-impacts>. See also Hwang, Tzung-Jeng, Kiran Rabheru, Carmelle Peisah, William Reichman, and Manabu Ikeda. 2020. Loneliness and social isolation during the COVID-19 pandemic. *International psychogeriatrics* 32 (10): 1217–1220. doi: 10.1017/S1041610220000988.

⁴³ Nitzberg, Mark, Zysman, John, Michael, Amelia, “Welbehealth: Case Study of Adapting PACE under COVID-19,” *Berkeley Roundtable on the International Economy Working Paper*, June 25, 2021, <https://brie.berkeley.edu/publications/welbehealth-case-study-adapting-pace-under-covid-19>, Yukiko, Asada, Hurley, Jeremiah, Grignon, Michel, Kirkland, Susan. 2018. Health inequalities and inequities by age: Stability for the Health Utilities Index and divergence for the Frailty Index. *SSM - population health* 5:17–32. doi: 10.1016/j.ssmph.2018.04.002.

job losses in recent state history. State policymakers expected that a surge in health care coverage losses would accompany the job losses. However, health care coverage losses did not materialize at similar magnitudes as job losses. Rather, health care coverage has either remained steady or potentially increased during the pandemic. While there have been losses in job-based health care coverage, these losses have been more than offset by increases in other forms of coverage, primarily Medi-Cal coverage. [...] health coverage and job loss trends might not be moving together.” In fact, employment in the health sector in the state is up 5% on the previous year, and salaries are also up (Source: US Department of Labor Bureau of Labor Statistics - <https://www.bls.gov/eag/eag.ca.>).

While employment statistics are useful in gaining an overall perspective, they do not tell anywhere near the entire story. Several publications pointed to the changes wrought by COVID-19 in the health-care industry. Briefly synthesized, these include:

1. The need to help healthcare professionals cope with the stress of long hours, constant pressure, illness and fatigue;
2. The need to pay premium salaries to retain healthcare and healthcare support workers;
3. The need for systemic resiliency, including a “Replacement Pipeline” for workers who have retired or quit;
4. The need to introduce labor saving technologies while retaining the same or enhanced levels of quality care;
5. The need to immediately integrate a wide range of new technologies, both for the health care industry and also for patients and clients;
6. The need to integrate remote work into what has traditionally been a hands-on work environment;
7. The need to keep the workforce healthy, both by managing stress and by making sure that workers are vaccinated – which means educating them on the importance of vaccines.
8. The need for a thorough assessment of the damage done by COVID-19 to the health-care industry to make it easier to prepare contingencies for follow-on pandemic events;
9. The need to repair public confidence – badly shaken – after COVID-19.⁴⁴

3.5 Acceptance of new technologies by workforce and family caregivers

The new technologies described above have had a significant increase in acceptance by users, they have also led to dramatic increases in demand by providers, family caregivers, and older adults themselves. Reports from key informants indicate that these technology changes are not only here to stay, but that planners should anticipate increased expectations by users, both older adults and providers, to having greater access to low-cost functional tech.⁴⁵

⁴⁴ Keckley, Paul Dr., Turney, Susan Dr., Varga, Daniel Dr., Weaver, Dennis Dr., “How healthcare is adapting to COVID-19’s lasting impact”, *Modern Healthcare*, November 15, 2021 - <https://www.modernhealthcare.com/providers/how-healthcare-adapting-covid-19s-lasting-impact>. See also Begun, James W. and Jiang, H. Joanna, “Health care management during COVID-19: Insights from complexity science,” *New England Journal of Medicine Catalyst*, October 9, 2020 - <https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0541>. For the State of California’s response, see California Smarter: The next stage of California’s COVID response,” produced by the California Department of Public Health - <https://files.covid19.ca.gov/pdf/smarter-plan--en.pdf>.

⁴⁵ See for example Adler, Richard and Mehta, Rajiv “*Catalyzing tech support to family caregiving*,” *National Alliance for Caregiving*, July 2014 - https://www.caregiving.org/wp-content/uploads/2020/05/Catalyzing-Technology-to-Support-Family-Caregiving_FINAL.pdf and Clipper, Bonnie. 2020. The Influence of the COVID-19 Pandemic on Technology: Adoption in Health Care. *Nurse leader* 18 (5): 500–503. doi: 10.1016/j.mnl.2020.06.008. Lindeman, David. 2020 “The Role of

Some of these technologies are relatively easy to integrate into use, while others require significant investments in training and upgrades to infrastructure and hardware. There is an increased urgency to expanding access to broadband technologies, particularly in rural areas, as a means of creating a platform for access to all of the other technologies needed for making aging in place more practical.

An important area even before the pandemic is training the workforce to in turn train and support seniors to utilize these new technologies. This means a program of constant caregiver training and retraining.⁴⁶

4 The WelbeHealth case study and the potential adaptability of hybrid systems

The adaptability of emerging technologies provided in the midst of the COVID-19 pandemic is clear in a case study of Welbehealth. It provides a depiction of efforts by a provider of the Program of All-inclusive Care for the Elderly (PACE) in California's Central Valley—WelbeHealth—to adapt its care delivery in the face of the COVID-19 crisis.⁴⁷

The case demonstrates the importance of a flexible and dynamic, high-touch approach which nonetheless allows aging seniors a high-degree of independent living. This hybrid approach seems to offer a potential roadmap for enabling healthcare providers an ability to adjust their programs of care even during a pandemic, offering a degree of flexibility which can have a major impact, during a pandemic but also even outside. The one area which needs continued study is the impact on employment – there is so far insufficient data to understand the impact of COVID-19 on the workforce, including workforce adaptability, in this particular case study.

As U.S. national and state policies for elder care evolve, this report offers a depiction of efforts by a provider of the Program of All-inclusive Care for the Elderly (PACE)—WelbeHealth—to adapt its care delivery in the face of the COVID-19 crisis. This case study lays the groundwork for a systematic comparison of adaptation by other elder care models and strengthen the case for policy choices that support success across the various models of care for the elderly.

The Program of All-Inclusive Care for the Elderly (PACE) is a community-based, flexible, and highly effective value-based care model serving the most complex patients - frail elders. PACE services are authorized and coordinated by a dedicated PACE Interdisciplinary Team (IDT) of professionals who partner with the participants and their families to maintain their highest level of functioning, independence and quality of life. The PACE Center is the hub of service delivery – combining a primary care clinic, adult day health care and the IDT care team at one location. PACE participants receive medical, rehabilitative, social and personal care services in

Digital Technology in healthy aging communities,” UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.

⁴⁶ Lindeman, David. 2020 “The Role of Digital Technology in healthy aging communities,” UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.

⁴⁷ Lindeman, David. 2020 “The Role of Digital Technology in healthy aging communities,” UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.

the PACE center, in their homes and additional settings included in the PACE contracted network of outpatient and inpatient service providers.

To qualify for PACE, seniors must be 55 years or older, residing in the approved PACE service area, in need of nursing home-level care and able to be cared for safely in the community with PACE services. PACE programs primarily serve low-income, ethnically diverse seniors and the mitigation of significant social determinants of health adversity (such as access to a safe community, nutrition and healthcare), is central to the model.

Due to the highly flexible model and the fact that their members live primarily at home, PACE providers were in a position to safeguard their older populations during the COVID-19 pandemic. Given that the coronavirus was most deadly to the population they serve – the frail elderly – WelbeHealth quickly implemented their emergency Incident Command System⁴⁸ (ICS), in order to save lives. They introduced adaptations in telemedicine, social engagement and other practical services to keep seniors safe (i.e., delivering groceries and incidentals) resulting in remarkably few COVID-19-related hospitalizations and deaths over the year-plus pandemic period beginning in February 2020.

Key insights from the literature studying PACE programs include: (1) Aligned incentives promote preventive care. PACE's capitated cost model moves the risk from payer to care provider, forcing companies to be innovative and efficient in keeping patients well. (2) Home-based care is more cost-effective and keeps elders healthier and happier longer than institutional care.⁴⁹

4.1 The traditional CASE model

Unlike most, if not all, European nations, the United States has limited national direct funding of its healthcare system (most healthcare programs are run by the states, though most do receive some federal funding, primarily through Medicare (funding for those over 65) and Medicaid (funding for those in the lowest economic quartile in the United States). The Program of All-Inclusive Care for the Elderly (PACE) is one of these Medicare (a federal government health insurance program for people 65 and over) and Medicaid (a joint federal and state program that provides healthcare for low income and disabled people) funded programs, designed to provide necessary medical and long-term care services to the frail elderly through community-based rather than institutional care. PACE providers are organized to provide high-touch, team-based managed medical and social services to frail seniors. A critical feature of the PACE model is that the programs provide and finance the entirety of a participant's care. Before focusing on this subject provider of this study, it is useful to understand the structure and function of the PACE model.

⁴⁸ ICS are being “effectual in managing all emergency, routine, or planned events, of any size or type, and by establishing a clear chain of command [...]. Allowing personnel from different agencies or departments to be integrated into a common structure that can effectively address issues and delegate responsibilities” (American Health Care Association and the California Association of Health Facilities (CAHF), 2011 https://www.ahcancal.org/Survey-Regulatory-Legal/Emergency-Preparedness/Documents/COVID19/NHICSGuidebook_Final2011.pdf, p. 4.)

⁴⁹ See for example Arku, Daniel, Mariana Felix, Terri Warholak, and David R. Axon. 2022. Program of All-Inclusive Care for the Elderly (PACE) versus Other Programs: A Scoping Review of Health Outcomes. *Geriatrics (Basel, Switzerland)* 7 (2). doi: 10.3390/geriatrics7020031.

Care Provided. PACE model providers operate multi-purpose facilities for participants to see their primary care doctor, have regular meals and engagement activities that can provide exercise and socialization, and receive specialty care. PACE programs supplement the care that participants receive in centers with care provided directly in patients' homes. In addition to providing skilled nursing services (such as wound care or injections) in homes, PACE programs work to meet all of a participant's needs required for independent living, and as such support participants with fall prevention, laundry, cooking, personal grooming, and as needed, other activities of daily living (ADLs). PACE not only provides care, but they also provide a social community where seniors make friends and develop a sense of belonging.

Eligibility. To be eligible for PACE, a senior must be 55 or older, deemed eligible by the State for nursing home care, live within a certain distance to the service center, and be able to live at home safely with PACE support. Chronic disease is common among PACE participants, and about half of the population experiences some level of dementia. Most participants are also low-income: nationwide, 90% are dually eligible for Medicare and Medicaid.

Cost structure. PACE programs operate under a capitated model and are thus able to provide more flexible, coordinated coverage to meet all of a participant's needs. By contract with Center for Medicaid and Medicare Services (CMS) and State Medicaid agency (MediCal in California), PACE programs provide any service available through Medicare or Medicaid as determined necessary by the PACE interdisciplinary care team. From the State, a PACE provider receives a monthly rate for long-term care needs that is below the cost of a comparable nursing home eligible population and for healthcare, a monthly capitation from Medicare based on diagnoses and other factors. This complete care, in a capitated cost structure, has proven to yield higher quality and breadth of care at lower cost, through increased efficiency and decreased hospital and

emergency room visits. States pay PACE programs 13% less than the cost of caring for a comparable population through other Medicaid services including nursing homes and home and community-based waiver programs.

Asserted Structural Advantages of PACE Programs.

A centrally coordinated interdisciplinary team (IDT) enables customized, preventive and cost-efficient quality of care. It is an integrated model, where the PACE IDT manages every aspect of care from long-term care, to psychosocial to medical care – primary care, medications, specialty care, hospital care including care transitions, and more. It aligns incentives: PACE directly provides or contracts for all services covered by Medicare and Medicaid and at full risk for total cost of care. The coordination seems to be key to the reported high satisfaction levels while reducing institutional care for the target population. Central to the asserted advantages of the PACE program is that participants live at home and engage actively with the community. A more engaged, purposeful life helps participants take on the challenges of aging. PACE users live longer, healthier lives than those in long-term care.

Participant Demographics and Experience. As part of its comprehensive approach to care, the PACE model emphasizes the importance of the patient experience that extends beyond health needs. Participants are actively engaged in social activities both in centers and in their homes, and participant mental health and well-being is a central focus of patient care. Over the past 45 years of its operation, PACE population demographics have varied. In its most recent census nationwide, PACE enrollees have an average of 5.8 chronic conditions per person; 46% have dementia; 84% need assistance with 1 to 6 activities of daily living; 95% live in the community, and 90% are dual-eligible for both Medicare and Medicaid. PACE enrollment has more than doubled over the last 8 years. PACE programs' capitated model and comprehensive coverage has been successful by many measures over the 45 years in which it has operated.

PACE by the Numbers	
45	Years as operational model serving frail seniors
97.5 %	Families who would recommend PACE
16 %	Cost reduction in rate of hospitalizations
44 %	Reduction in hospitalization rate compared to duals in nursing homes
60 %	Reduction in hospitalization rate compared to duals in other HCBS
80 %	Reduction in participant depression rate
31 %	Increase in life expectancy
\$10K	Tax-payer savings per patient <i>An Oklahoma state-sponsored study showed that PACE saves \$1,000,000 annually per 100 patients. Tax-payer savings per patient</i>

4.2 WelbeHealth – A case study of one PACE provider

Our case is an examination of the adaptation of WelbeHealth, a California PACE provider, to the COVID-19 pandemic. WelbeHealth is a physician-led healthcare services company, founded on the mission of serving the most vulnerable seniors with quality, compassion and value through the PACE model of care.

WelbeHealth opened its first center in Stockton (California) in January 2019, currently serves over 750 frail seniors and has the capacity to serve thousands more seniors in need. WelbeHealth has a simple organizational structure intended to enable agile decision-making which, in the context of COVID-19, seems to have worked well. When COVID-19 hit in early 2020, concerned about the deadly consequences of exposure for its frail population, WelbeHealth leaders sought to respond decisively by closing the centers, limiting in-person contact, shifting to telehealth and launching its incident command system (ICS) to protect their participants.

By rapidly transforming its care model, WelbeHealth had exceptional results: as COVID-19 cases rose across the country — and in particular within nursing home populations — WelbeHealth did not have a single COVID-19 death during the first 8 months of the pandemic. WelbeHealth and the PACE community overall performed better than nursing homes. The National PACE Association has been collecting COVID-19 data from the majority of their membership since late April 2020. Through April 25, 2021 the PACE COVID-19 death rate was 3.8%, a number only one-third the 11.8% death rate in nursing homes. WelbeHealth, applying the NPA methodology during a similar timeframe – total deaths divided by the 12-month rolling average census between May 1, 2020 and April 30, 2021 – calculated a death rate of 2.4%.

The success of WelbeHealth’s COVID-19 responses could be attributed to WelbeHealth’s early action, quick transition to remote care and technology decisions, WelbeHealth’s agile development of the ‘HomePACE program’, as well as the organization’s efficient financial adaptations.

Early Action: As news of COVID-19 began emerging as early as January 2020, WelbeHealth physician leaders drafted a plan in the face of what was, at the time, considered extremely unlikely: what to do in case the distant rumblings of an exotic disease in China became a pandemic. The plan was to implement a full program of care with minimum in-person contact for the entire elder membership as quickly as possible. By March 2020, WelbeHealth had deployed a 4G LTE “WelbeLink” tablet, PPE supplies and a thermometer in each participant home to allow the care teams to maintain regular video communications and deliver telehealth services, including COVID-19 symptom monitoring, doctor’s appointments and socialization. In addition, WelbeHealth provided essential services and supplies to the seniors, including meals, medication delivery and incidentals such as toilet paper to enable them to stay at home. By the time the lockdown was official in mid-March 2020, WelbeHealth had anticipated the changes that would need to be made in healthcare delivery, and as much as possible, had already made the transition to what they called “Incident Command Mode”, where many aspects of participant care – particularly consultations and monitoring services – were provided using telehealth and remote sensing. Through its commitment to adaptable and agile healthcare, Welbehealth was able to quickly deploy the technology and processes to engage, serve and monitor each participant in their home. To do so, WelbeHealth deployed Abbott’s ID Now instruments for rapid molecular point of care testing for COVID-19 to obtain results on team members and participants within minutes ensuring that WelbeHealth staff deployed to participants’ homes were free of COVID-19.

In several ways, WelbeHealth believes it was already well prepared for this quick transition to remote care: (1) Customized care: Because the PACE IDT provides highly customized care, being flexible and accommodating with patient care was already standard practice. (2) Decentralized economics: Because PACE programs operate under a capitated model, WelbeHealth had the financial flexibility to quickly change what type of care they provided without concern about reimbursement. WelbeHealth also benefited from its nimble organization structure: as the pandemic struck, the WelbeHealth executive leadership team was able to act rapidly and aggressively without having to navigate a parent entity. (3) Culture: Lastly, much of WelbeHealth’s leadership emphasized the significance of the company’s culture in their success. WelbeHealth president, Dr. Patterson, credits the company’s mission-driven focus – in particular the idea that “quality comes first, everything else is secondary” – for their exceptional outcomes during the pandemic, in contrast to nursing homes focused primarily on economics.

Quick Response to Lockdown: Transition to Remote Care, Technology Decisions. WelbeHealth quickly procured Personal Protective Equipment (PPE) and testing equipment. It also moved to implement distance care, insofar as possible, by minimizing physical contact with healthcare providers where possible, though of course there were instances where in person meetings were necessary. This required acquisition and deployment of telehealth tools.⁵⁰ (1) Acquisition: In February, the WelbeHealth leadership team negotiated the purchase of several hundred Grandpad tablet devices (senior friendly tablets that enable remote care, branded as “WelbeLink” by WelbeHealth) and home thermometers, one for each participant. By purchasing these tablets early, WelbeHealth beat the later supply chain delays. WelbeLinks are easy to hold, charge, and prop up, with large print and simple buttons; the ones WelbeHealth provided to their participants initially had only three functions:

⁵⁰ For instances when in-person meetings are needed, see “Going to the doctor during COVID: What you need to know” by the Cedars-Sinai staff, April 20, 2020 – <https://www.cedars-sinai.org/blog/doctor-visit-during-covid-19.html>

a central WelbeHealth video function, messages, and games. (2) Rollout: The device rollout posed several challenges: WelbeHealth was faced with sanitizing, transporting, installing, and maintaining hundreds of tablets; training staff to provide care remotely; quickly modifying staffing structures to accommodate the needs of the new program; and, critically, ensuring that each participant was able to receive the care they needed remotely.

Another action WelbeHealth took early was a wholesale move from regular operations to its emergency response incident command system (ICS). Combining both technology and organizational adaptations enabled WelbeHealth to provide high level care remotely. Under Incident Command, clinical directors immediately used remote monitoring devices to substitute for the regular visits at the centers and began daily participant calls to check their health and wellness. For in-person care that was essential, staff was provided with the necessary PPE, testing and sanitization measures, even in the early days of the pandemic.

Adjusting for the Duration. After several weeks in ICS mode, the Welbehealth President decided that it was time to plan to roll off Incident Command (designed to standardize incident responses). In partnership with the Chief Business Development Officer, Dr. Vaneesh Soni, the team built the WelbeHealth “HomePACE” model. “HomePACE” is a long-term, more encompassing program that maintains the regular check-in calls and telehealth programs established during ICS mode, but incorporates other solutions aimed to address the less urgent health needs that had been de-prioritized while addressing the immediate focus on survival. In particular, WelbeHealth began bringing participants into the centers in limited ways to address in-person primary care visits and non-urgent health needs, set up contracts for phlebotomy in the home for labs, and increased focus on social activity and therapy through the tablets to address issues of isolation and mental well-being.

Financial Adaptation. As WelbeHealth fundamentally changed how it delivered care, the financial model of the company adjusted as well. Given that PACE programs are at full financial risk (that is to say, little to no insurance underwriting), the disease had the potential to cause unprecedented hospital expenses. WelbeHealth therefore took unique steps to ensure it was financially capable of protecting patients, taking care of employees and ensuring the longevity of the company. WelbeHealth did this by allocating \$15 million to a pandemic cash reserve based on worst-case projections for claims costs. WelbeHealth also renegotiated lines of credit to extend availability through the duration of the pandemic. Lastly, WelbeHealth built a custom re-insurance stop-loss program in January 2020 (prior to broad understanding of COVID-19) to cover catastrophic cases. As noted above, WelbeHealth invested in new pandemic-related expenses such as large quantities of PPE, testing equipment and WelbeLink tablets, including ongoing connectivity fees. For staffing, WelbeHealth continued to employ the same number of aides, but transitioned them from working in the centers to newly necessary jobs like making check-in calls, prepping delivery kits or grocery shopping.

From the perspective of PACE clinical providers, we interviewed the WelbeHealth Medical Director in Pasadena, who noted that “Participant tablets, point of care testing equipment, PPE, specialist eConsults was super helpful because then I didn’t have to worry as much about [obtaining the necessary equipment due to support and supply chain] logistics.” He also reflected on the limitations of the technology: with the unpredictable lighting and camera resolution, clinicians might misinterpret things during telehealth visits. In addition, Dr. Robinson emphasized the importance of face-to-face time in developing the doctor-patient relationship, which could be limited in telehealth visits. Dr. Robinson considered a hybrid healthcare model to be more efficient: by leveraging telehealth, healthcare providers can increase convenience and access to care for more people when in-person care is not necessary.

From the perspective of PACE participants, we interviewed a number of staff and participants in WelbeHealth’s PACE program. Participants reported that WelbeHealth provided technology equipments such as WelbeLink and thermometers to them, and provided timely, comprehensive health education along with the equipments, which was very convenient and useful in meeting their healthcare needs. Although not all participants consider themselves to be technologically savvy, participants reported that WelbeLink was accessible, easy to use, and a tool for social connection and support. PACE’s high-touch approach to healthcare delivery was crucial to making remote care work, with regular check-ins on its participants’ needs. However, for participants requiring memory care, WelbeLink doesn’t work nearly as well. It is also impossible to replace the social aspect in face-to-face engagements, despite high-tech equipments meeting some social connection and support needs. Remote care is an important tool which should be used when appropriate, but it has important gaps which are much more effectively addressed with in-person care.

4.3 Conclusions from the WelbeHealth case

This study provides an illustrative example of adaptation undertaken by a provider of care for the elderly in the PACE model. Timely adaptations to telehealth and other flexible models of healthcare delivery allow organizations like WelbeHealth to deliver healthcare to America’s aging population in an effective and affordable manner. During COVID-19, WelbeHealth acted early and decisively to minimize exposure with an incident response strategy. WelbeHealth dispersed tablets for telehealth visits, PPE, thermometers, food, medication, and other essentials into participants’ home in time, and provided nearly all care remotely and effectively.

Given that the number of senior citizens is projected to more than double by 2040 in the United States, it is crucial to develop an adequate long-term care for vulnerable elders, and the pandemic has provided an immediate catalyst for work to begin right now. As lawmakers in Washington and State houses across the country consider fundamental changes in how to approach long-term care, flexible healthcare models like PACE deserves further consideration as part of a systematic study comparing models of long-term care including home and community-based services. WelbeHealth’s pandemic experience suggests a model which can be flexible and responsive to patients’ specific needs, while remaining tied to a strong foundation of “high-touch” (that is, in person and ongoing) care. Innovative healthcare delivery models are both more possible than ever before, and more urgent.

Adapting senior care to COVID-19:

Conclusions

As is clear from the material above, technological improvements have created more possibilities for aging in place ever more feasible for seniors in California, making life both more convenient and safer for the state's older population. New technologies have increased aging Californians' independence by making it easier to monitor the health of older adults, make necessary interventions, alert healthcare providers of potential threats to their charges, and make in-home consultations safer and more convenient by allowing for remote consultations with healthcare providers. In the realm of convenience and connectedness, these technologies also make it easier for seniors to remain connected with family and friends, provide options for home entertainment, and make it easier to undertake previously complex tasks. They also make it possible for some forms of physical therapy and mental health care to be undertaken at home, relieving care providers of the need for transport and limiting exposure of older adults outside the home.

COVID-19, with its high mortality rate for older adults, initially had an extremely negative impact on the aging population. Older adults, particularly those with pre-existing conditions, were at the highest level of risk from the disease and were forced to self-isolate, frequently with negative consequences. However, as was the case with the general population, the disease also hyper-accelerated many of the trends towards the adoption of technology. Clearly, the pandemic has accelerated the adoption of health care technology by older adults, previously the slowest adopters of new technology, as they learned to connect with family, friends and caregivers at an increasingly rapid pace. As a result, older adults are now among the most avid consumers of technology for entertainment, communications and healthcare. While many of these technologies are still in their infancy, all show great promise.

There are a number of models of institutions working to provide reasonable cost solutions utilizing technology for older adults wishing to age in place. As this paper has shown, one such model showing early success is Welbehealth, a Central Valley patient centered healthcare provider that emphasizes a flexible approach to health care for frail older adults. By emphasizing patient-centered care and careful integration of technology, Welbehealth has been able to move beyond the common practice of an in-person, physician-centered care model: While in-person experiences remain important, timely adaptations to telehealth and other flexible healthcare models have given Welbehealth – and other similar healthcare providers – the opportunity to deliver healthcare to America's aging population in an effective and affordable manner.

5 References

- Abrahamson, Ashley. 2022. Burnout and stress are everywhere. *American Psychological Association Report* 53 (1), January 1. <https://www.apa.org/monitor/2022/01/special-burnout-stress>.
- Akinola, Sofiat. 2021. How can we ensure digital inclusion for older adults? World Economic Forum, October 1. <https://www.weforum.org/agenda/2021/10/how-can-we-ensure-digital-inclusion-for-older-adults/>.
- Akinola, Sofiat. 2021. What is the biggest benefit technology will have on aging and longevity? World Economic Forum, March 30. <https://www.weforum.org/agenda/2021/03/what-is-the-biggest-benefit-technology-ageing-longevity-global-future-council-tech-for-good/>.
- Alvey, Robert S. 2021. Robotics in healthcare. *Online Journal of Nursing Informatics* 25. <https://www.himss.org/resources/robotics-healthcare>.
- Anya, Obinna, Hissam Tawfik. 2016. Leveraging Big Data Analytics for Personalized Elderly Care: Opportunities and Challenges. In *Applied Computing in Medicine and Health*, Eds. Dhiya Al-Jumeily, Abir Hussain, Conor Mallucci, Carol Oliver, 99-124. Morgan Kaufmann, 2016; cited in Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.
- Begun, James W. and H. Joanna Jiang. 2020. Health care management during COVID-19: Insights from complexity science. *New England Journal of Medicine Catalyst*, October 9. <https://catalyst.nejm.org/doi/full/10.1056/CAT.20.0541>.
- Bohn, Sarah. 2022. How did California's employment recover from COVID, and what comes next? Public Policy Institute of California. <https://www.ppic.org/blog/how-did-californias-economy-recover-from-covid-and-what-comes-next/>.
- California Department of Aging. 2021. Masterplan for Aging. <https://mpa.aging.ca.gov/>.
- California SMARTER. 2022. The next stage of California's COVID response. California Department of Public Health. <https://files.covid19.ca.gov/pdf/smarter-plan--en.pdf>.
- Centers for Disease Control and Prevention. 2022. CDC streamlines COVID-19 guidance to help the public better protect themselves and understand the risk. Press Release, August 11. <https://www.cdc.gov/media/releases/2022/p0811-covid-guidance.html>.
- Clipper, Bonnie. 2020. The Influence of the COVID-19 Pandemic on Technology: Adoption in Health Care. *Nurse Leader* 18 (5). <https://www.sciencedirect.com/science/article/pii/S1541461220301713>.
- Fao, Yan and Ziyang Fan. 2020. 10 technology trends to watch in the COVID-19 pandemic. World Economic Forum, April 27. <https://www.weforum.org/agenda/2020/04/10-technology-trends-coronavirus-covid19-pandemic-robotics-telehealth/>.
- Faverio, Michelle. 2022. Share of those 65 and older who are tech users has grown in the past decade. Pew Research Center, January 13. <https://www.pewresearch.org/fact-tank/2022/01/13/share-of-those-65-and-older-who-are-tech-users-has-grown-in-the-past-decade/>.

- Gammon, Katherine. 2020. How is big data reshaping aging research and education? USC Leonard Davis, February 3. <https://gero.usc.edu/2020/02/03/how-big-data-is-reshaping-aging-research-and-education/>.
- Iacovone, Leonardo, Kapil, Natasha, Marc, Lukasz Marek, Marcolongo, Giovanna, Skamnelos, Ilias, Vincelette Gallina A., "Leveraging digital technology during the pandemic," Brookings Institution Brief, July 14, 2021 – <https://www.brookings.edu/blog/future-development/2021/07/14/leveraging-digital-technology-during-the-pandemic/>.
- Johnson, Ben, and Corey Hashida. 2021. Impact of COVID-19 on Healthcare Access. Legislative Analyst's Office, California State Legislature, May 7. <https://lao.ca.gov/Publications/Report/4426>.
- Kakulla, Britne Nelson, "Older adults keep pace on tech usage," AARP Research, January 2020 – <https://www.aarp.org/research/topics/technology/info-2019/2020-technology-trends-older-americans.html>.
- Keckley, Paul Dr., Susan, Turney Dr., Varga, Daniel Dr., Weaver, Dennis Dr., "How healthcare is adapting to COVID-19's lasting impact", *Modern Healthcare*, November 15, 2021 – <https://www.modernhealthcare.com/providers/how-healthcare-adapting-covid-19s-lasting-impact>.
- Kobayashi, Lindsay, "The impacts of social distancing on older adults," University of Michigan School of Public Health, April 30, 2020 – <https://sph.umich.edu/podcast/coronavirus/the-impact-of-social-distancing-on-older-adults.html>.
- Kucukbenli, Emily, "AI technology and its role during COVID-19," Insights at Questrom, January 26, 2022 – <https://insights.bu.edu/ai-technology-and-its-role-during-covid-19/>.
- Lindeman, David A, Kim, Katherine K, Gladstone, Caroline, Apesoa-Varano, Ester Carolina. 2020. Technology and Caregiving: Emerging Interventions and Directions for Research. *The Gerontologist* 60(1), 41–49. doi:10.1093/geront/gnz178 – <https://pubmed.ncbi.nlm.nih.gov/32057082/>.
- Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.
- Lindeman, David. 2022. "Digital Health and AI: Innovations in Health Care Delivery." Pacific Rim Health Innovation Conference presentation, First Affiliated Hospital-Sun Yat-sen University, Guangzhou, China, September 21.
- McElroy, Jane A., Tamara M. Day, and Mirna Becevic. The Influence of Telehealth for Better Health Across Communities. *Preventing Chronic Disease* 17, July 16. https://www.cdc.gov/pcd/issues/2020/20_0254.htm.
- Melinkow, Joy, et al. 2021. Planning Healthy Aging Communities. UC Davis Center for Healthcare Policy and Research. <https://health.ucdavis.edu/media-resources/chpr/documents/pdfs/planning-healthy-aging-communities-june-2021.pdf>.
- Mitzner, Tracy L., Chen, Tiffany L., Kemp, Charles C., Rogers, Wendy A. 2014. Identifying the Potential for Robotics to Assist Older Adults in Different Living Environments. *Internal Journal of Social Robotics* 6(2), 213-227. doi: 10.1007/s12369-013-0218-7.

- Mostajeran, Fariba, Frank Steinicke, Oscar Javier Ariza Nunez, Dimitrios Gatsios, and Dimitrios Fotiadis. 2020. Augmented Reality for Older Adults: Exploring Acceptability of Virtual Coaches for Home-based Balance Training in an Aging Population. Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, 1–12. <https://doi.org/10.1145/3313831.3376565>; cited in Lindeman, David. 2020. The Role of Digital Technology in healthy aging communities. UC Davis Healthy Aging Planning Committee presentation. University of California, March 9.
- Nitzberg, Mark, Zysman, John, Michael, Amelia, “Welbehealth: Case Study of Adapting PACE under COVID-19,” Berkeley Roundtable on the International Economy Working Paper, June 25, 2021, <https://brie.berkeley.edu/publications/welbehealth-case-study-adapting-pace-under-covid-19>.
- Orlov, Laurie M. 2021. The future of Voice First Technology and Older Adults - 2018. Age in place tech. <https://www.ageinplacetech.com/page/future-voice-first-technology-and-older-adults-2018>.
- Pearce, Alan, Adair, Brooke, Miller, Kimberly, Ozanne, Elizabeth, Said, Catherine, Santamaria, Nick, Morris, Meg E. 2012. Robotics to Enable Older Adults to Remain Living at Home. *Journal of Aging Research*, Special Issue. doi: 10.1155/2012/538169.
- Pearl, Robert and Wayling, Brian “The telehealth era is just beginning,” *Harvard Business Review*, May- June 2022 – May June 2022 - <https://hbr.org/2022/05/the-telehealth-era-is-just-beginning>.
- Prucho, Rachel. 2019. Technology and aging: An evolving partnership. *The Gerontologist* 59 (1). <https://academic.oup.com/gerontologist/article/59/1/1/5281343?login=false>.
- Rinderud, Peter. 2021. Seniors and technology during COVID-19: the latest insights. *The Ericsson Blog*, January 26. <https://www.ericsson.com/en/blog/2021/1/seniors-and-technology-during-covid>.
- Surgeon General of the United States. 2022. Addressing health care worker burnout. The US Surgeon General’s Advisory on building a thriving healthcare workforce. <https://www.hhs.gov/surgeongeneral/priorities/health-worker-burnout/index.html>.
- Trafton, Anne. 2021. The (Robotic) doctor will see you now. *World Economic Forum*, March 10. <https://www.weforum.org/agenda/2021/03/why-robots-can-be-beneficial-in-healthcare/>.
- Trout, Jonathan. 2023. Five advantages of aging in place. *Retirement Living*, May 17. <https://www.retirementliving.com/5-benefits-of-aging-in-place>.
- US Bureau of Labor Statistics. 2023. Economy at a Glance. <https://www.bls.gov/eag/eag.us.htm>.