

The Future of Aging in Place

How connected devices and AI will transform support for older adults and their caregivers

Executive Summary

Most adults **want to age in place**. Technology – along with more accessible homes and caregiver support – will transform aging in place for both older adults and their caregivers. This paper will examine:

- the drivers of aging in place
- the current state of housing and improvement opportunities
- the importance of caregiving
- challenges in optimizing current aging in place technology
- what a future technology platform might look like
- market opportunities for technology and non-technology companies (and who might pick up the tab)

Improving the aging in place experience for older adults and caregivers creates a positive feedback loop that will allow us to:

- extend the time older adults can safely remain in their homes
- increase the length and quality of older adults' lives by improving their physical, cognitive, social, and emotional wellbeing
- reduce stress and improve relationships between family caregivers and older adults
- reduce eldercare and healthcare costs

This paper is for:

- Startups and innovators improving the aging experience for older adults and caregivers
 - Investors interested in the future of aging
 - Care service providers serving older adults and their families
 - Employers, financial advisors, estate planners and other service providers that want to understand the impact and opportunities of aging on their businesses
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Introduction

The good news is more people are reaching retirement age and those that get there live longer. Between 1950 and 2016, the likelihood of adults reaching age 65 increased 44% for men and 31% for women. The likelihood of 65-year-olds living to 90 roughly tripled for both.

Likelihood of survival from age 21 to 65		Likelihood of survival from age 65 to 90		
	Men	Women	Men	Women
1950	56.2%	65.5%	6.8%	11.5%
2016	80.9%	87.5%	22.6%	33.7%

Sources: SSA, SSA, National Office of Vital Statistics, author's calculations

With this rise in life expectancy, and the wave of baby boomers riding it, comes the need to manage the conditions that come with advanced age on massive scale.

This paper discusses the role of technology – along with optimizing housing choices and enlisting the help of caregivers – in improving the wellbeing of older adults and extending the time they can safely and happily remain in their homes. While much of the innovation applies equally to older adults that prefer (or require) living options other than remaining in their homes, I've chosen to focus on aging in place for several reasons:

- **Most seniors want to remain in their homes.** A 2018 AARP survey found that more than 76% of adults want to remain in their homes as long as possible. COVID has likely pushed that percentage higher.
- **Most seniors are in fact remaining in their homes.** 92% of seniors (65+) remain in their homes. Of the remainder, about 4% choose to move to Assisted Living

facilities, [1.5%](#) move to Continuing Care Retirement Communities (CCRCs) – a continuum of living options from Independent Living to Assisted Living to full nursing – and [3.8%](#) live in nursing homes.

- **For most, it is an economic necessity.** It is well established that Americans are woefully under-saved for retirement. According to [a recent Transamerica Study](#), the median retirement savings of Baby Boomers is only \$140k, while 60% have less than \$50k saved for retirement. The costs of alternative housing, meanwhile, are steep. The median monthly costs for Assisted Living and a private room in a nursing home are [\\$4,051 and \\$8,517](#), respectively. Entry fees for CCRCs range from \$107,277 to \$427,054 with monthly service fees of [\\$2,089 to \\$4,154](#).

While the purpose of this paper is to explore the role technology will play in transforming aging in place, its promise cannot be realized without proper housing and the help of family and professional caregivers.

Housing

Current state of housing

For seniors who choose to move when they retire, many do so early in retirement when geographic preference is the primary consideration in choosing where to live. However, the further into retirement we progress, the more critical our physical space is to successful aging. Most older adults live in structures ill-suited to aging in place.

According to a 2020 [Census Bureau](#) report, less 10% of U.S. homes meet the National Institute on Aging's definition of "aging-ready;" a bedroom on the first floor, no step entry, and a full bathroom on the first floor with at least one accessibility feature (raised toilet seat, shower seat, or grab bars). [A Harvard review](#) of the data found only 3.5% of homes have complete single-floor living, no-step entry, and extra-wide halls and doors to accommodate wheel chairs. When wheelchair accessible switches and outlets and lever-style doors and faucets are factored in, that drops to 0.9%

The same Census Bureau report found that only 1.5% of all homes had a bathroom with all 3 accessibility features. If all of those homes are owned by 65+ households, it would mean 94% of 65+ households lack an accessible bathroom. If they were all owned by 85+ households, nearly 62% would lack one. This is likely a large contributor to falls.

According to NIA, 80% of the [3 million falls](#) seniors take each year occur in the bathroom. 800,000 of those falls require hospitalization at a cost of \$55 billion, [75%](#) of which is borne by Medicare and Medicaid. Nearly 38% of those falls result in hip fractures and [one-third](#) will die within 12 months, a mortality rate [nearly 3.5 times](#) that of adults without a hip fracture. Those that survive the first year continue to have higher mortality rates for 10 years.

Better housing options

A home that accommodate aging in place is essential for successful aging; no amount of AgeTech can compensate for one that is not. Fortunately, solutions exist.

Those who have resources to build a new home or re-model their current one can employ [Universal Design principles](#), which may add modestly to the cost of the project, or hire architects, contractors, and designers that have designations such as a [Certified Aging-in-Place Specialist](#) or [Certified Living In Place Professional](#) to include custom features to address specific needs such as height-adjustable counters, sinks, and toilets, ADA roll-in showers, plumbing for in-house dialysis, and ceiling track systems to safely move the mobility impaired.

A more economical option is purchasing a home in a 55+ community. They do not typically incorporate all of the Universal Design principles found in custom home, but many have single floor living, wide entrances, at least one large bathroom, and an open design that makes moving about the home easier for the mobility impaired. Many of the features designed into custom homes can be added to many standard 55+ homes if and when they are needed.

Emerging trends

- **Senior cohousing.** Senior cohousing is similar to 55+ communities with individually owned housing units and shared common space. The primary difference is that these "intentional neighborhoods" are planned from the start to have a high degree of social cohesion. Shared medical resources such as PAs that make weekly rounds may be a feature in the future.
- **Mobile accessible living space.** Many seniors are reluctant to leave a home that holds decades of memories. They often reach a point where they are physically or emotionally unable to cope with a move or the disruption of a major renovation. [Wheel Pad](#) is a 200 square foot, ADA accessible pre-fab home addition that includes living space and a bathroom. It connects easily to the main house and is designed so the structure can

remain permanently on the wheels used for delivery. There is a separate entrance for caregivers, and a ceiling track system to facilitate transfer of mobility impaired adults to their bed, toilet, and shower.

Planning is critical to wellbeing

For seniors that wish to age in place, health events that force moves to Assisted Living have detrimental effects on their health and happiness. A typical unwanted transition to Assisted Living unfolds as follows:

An 85-year old has a sudden medical emergency: a broken hip from a fall. Their care cannot be accommodated at home so they are moved to assisted living. The average stay is 3 years, after which time they either pass on or move to a skilled nursing facility.

Unwanted transitions out of the home take an incredible toll on the emotional health and wellbeing of older adults. [A 2003 study](#) published in the American Journal of Geriatric Psychiatry found that 13% of Assisted Living residents were clinically depressed, and more than one-third had “symptoms of depression”, about 5 times higher than an [NIMH study](#) that found only 5.9% of seniors have “some form of depression.”

Caregiving services (and services for caregivers)

Family caregivers often need help with not only hands-on care for seniors, but also assistance making caregiving decisions, tactical help, and self-care. Fortunately, help is available:

- **Non-medical homecare.** The most common form of homecare, these services include companionship and help with the [Activities of Daily Living](#) (ADLs).
- **Home healthcare services.** These include visiting nurses, CNAs, PT, OT, and medical social services.
- **Geriatric Care Managers (GCMs).** GCMs (generically) or certified [Aging Life Care Professionals](#)® are often licensed nurses or social workers who evaluate older adults and help them and their families make key health and safety decisions, determine what support is needed, and hire those resources. GCMs may also support caregivers by taking the role of “quarterback” for the care plan, overseeing care and making referrals as issues arise to other geriatric specialists.
- **Tactical help.** Providers of Assisted Living referrals are broadening services to help families evaluate housing, homecare, and an array of offerings from providers that serve seniors. Some are independent and others are franchisees, such as Assisted Living Locators. Franchisees in [NH](#), [MA](#), and [CT](#) are particular active in finding these support services to seniors and their families, often without cost.
- **Respite care.** For family members that choose to take care of their loved ones themselves, both medical and non-medical homecare providers can provide occasional support without contracted weekly minimums.
- **Caregiver self-care.** Organizations such as [Family Caregiver Alliance](#) and [Alzheimer's Association](#) have resources to help caregivers care for themselves.

As technology enables seniors to remain at home ever longer, it will create new opportunities for providers of support services.

Support from Caregivers

Technology will allow more seniors to safely age in place while extending the length and increasing the quality of their later years. It will permit more people with debilitating conditions to remain safely, comfortably, and happily in their homes for longer than they can today. Technology will not only improve longevity and increase the quality of life, but it will also cut the cost of care, particularly critical given deficit in retirement savings.

But without human support, it is all but useless. Technology is simply an enabling tool. It enables older adults to remain safely in their (aging-ready) homes *with some degree of caregiver support* more safely and for longer than caregiver support alone.

The Emergence of Connected Devices

The last several years has seen a proliferation of wearables, sensors, connected devices, medical devices, and communication platforms, designed to provide support for seniors, their families, and caregivers. These include:

- **Health & Safety** (fall detection, medicine compliance, vital sign monitoring, disease management and prevention, activity monitoring, home and device monitoring, ambulation assistance, telemedicine, Remote Patient Monitoring, Personal Emergency Response Systems)
- **Social engagement** (video communication, outreach reminders, personalized content and content sharing)
- **Personal Care** (cognitive health, toileting, incontinence, hydration, grooming)
- **Medical devices** (in-home dialysis, cardiac and respiratory monitors)

This technology has contributed significantly to improving the quality of life for older adults and caregivers. This paper will not delve into specific technologies or products ([Laurie Orlov's blog](#) is a great resource for that), but rather look at some of the implementation challenges to fully leveraging the technology's potential and explore what an end-to-end eldercare platform might look like in the very near future.

Health & Safety monitoring has seen an acceleration in recent years, and the market is beginning to evolve beyond matching a single product to an issue (e.g. a wearable to detect falls for an unsteady parent) toward more bundled solutions that serve as partial platforms. However as needs evolve and evermore products come to market, caregivers may become so awash in the data they generate, it could prove more burden than blessing. Consider the following scenario:

Helen is 87, widowed, and in relatively good health. She has a caregiver, Clare, who provides companionship and light housekeeping from noon to 3pm Monday through Friday. Her only daughter Sarah, a working mother of three, lives 100 miles away. Helen has:

- *a wearable that detects falls and monitors her pulse and blood oxygen levels*
- *sensors in her bedroom, bathroom, and kitchen doorways to detect movement*
- *a Bluetooth enabled blood pressure monitor she uses every morning*

- *a Bluetooth enabled blood glucose monitor she uses before and after every meal*
- *a smart pill dispenser to manage medication*
- *a smart burner to prevent fires from unattended stoves*

Some of the challenges facing Sarah and her mom:

- For devices that send notifications to caregivers, each must be configured separately and may have different communication protocols.
- For devices that do not send notifications, the data they collect have little value.
- Sarah might receive dozens of notifications a day, none of which indicate a problem. As alerts become a nuisance Sarah often tunes them out.
- If Sarah is the only recipient for medical information, vital sign warnings will be missed every time Sarah is asleep, out of cell service, or has her phone in airplane mode, increasing the likelihood of an adverse health event.

For technology to be most effectively leveraged, a comprehensive platform is needed rather than a series of products or partial platforms. There are startups beginning to make headway in this area. Here are 5 of the challenges facing platform developers and their potential customers:

1. **Needs are unique and change over time.** Each situation is unique, making it difficult for out-of-the box systems to satisfy all of the requirements of every older adult and their caregiving team. Needs also change over time and the approach to addressing new needs is often iterative, rather than a reassessment of the totality of the new situation. For example, an older adult with a wearable monitoring vital signs may develop issues with balance. An additional wearable purchased to detect falls may be uncomfortable and not worn.
2. **Needs can be difficult for family to accurately diagnose.** The children of older adults may not have a complete understanding of the support needed and solutions available, so there may be gaps (*this is true for technical and non-technical support*).
3. **Number and variety of devices presents technical challenges for platform providers.** As the number of connected devices continues to grow (and partial-platform providers expand into one another's turf), relatively fewer will be plug and play and integration becomes more of an issue.

4. **Technical limitations of caregivers.** The technical skills and knowledge of family and caregivers may limit the effectiveness of new devices. *At Purchase:* They might assume any device can work on burgeoning platforms and purchase devices that are not plug and play. Most lack the skills to get data from such devices on to the platform, to the extent it is possible. *Ongoing support:* Caregivers may have challenges maintaining connectivity and troubleshooting devices over time, even for those that are plug and play.
5. **Coordinating support and managing data.** Data and alerts need to be specifically useful/actionable to each caregiver. As individual needs increase and technical functionality improves (e.g. machine learning to predict health or safety issues based on relationships between different data elements), delegating responsibility among members of a care circle for monitoring/action becomes more complex.

All of these challenges are surmountable, and indeed represent market opportunities, but recognizing the challenges and growing awareness of the potential solutions will require collaboration and educating the market.

Earlier interventions

Support often comes after some kind of incident occurs and an older adult “suddenly” needs help. In reality, increased support should have begun months if not years earlier. We are generally not good at asking for help and very good at concealing that fact that we need it, making timely deployment of critical support difficult.

Adult children are usually tasked with initiating these conversations. Caring.com has [advice on initiating the conversation](#) and overcoming objections, but sometimes seniors may be more receptive from a message that comes from outside the family. Two candidates:

- **Financial advisors.** Advisors have an intimate understanding of their financial health and are accustom to talking about periods of life transition with their clients. Benefits to advisors of being proactive; 1) it is a chance to deepen the relationship at an important touch point; 2) it is an opportunity to build a rapport with the next generation and potentially retain assets;

3) in addition to better outcomes, early optimization of housing and support can result in significantly lower care costs, reducing the drag on assets under management.

- **Estate Planning Attorneys.** Drawing up or revising documentation that stipulates what happens when clients pass is the perfect time to encourage them to seek help ensuring that does not happen for as long as possible.

Future State: An Integrated Care Solution

In the future, an integrated care solution will address the shortfalls and challenges inherent in the current environment of products and partial platforms. Below are the outlines and accompanying graphic of a health issue and a social engagement opportunity that illustrate how an integrated care solution can aid older adults like Helen and their caregivers.

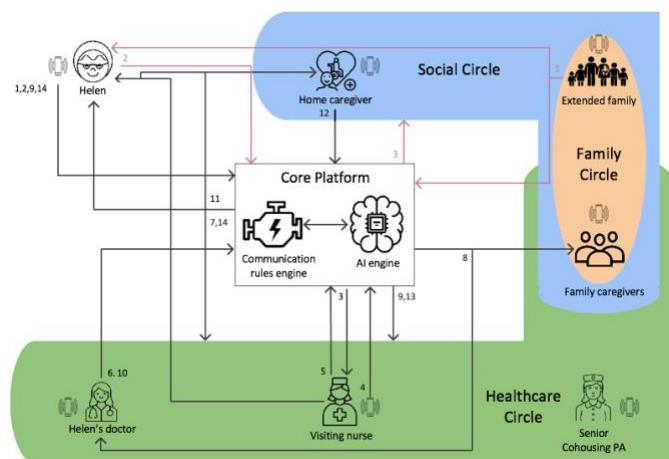
Health issue (black)

1. Smart water bottle reports water consumed within typical range
2. Sensors in bathroom detect 25% more frequent visits than normal over the last 2 days
3. Based on Helen's prior UTI history, the platform determines there is a “moderate” chance of a UTI, requiring assessment by a healthcare professional. It knows the best healthcare professional to contact is Helen's visiting nurse who is scheduled to arrive in an hour, and sends her a notification to screen for a UTI.
4. Platform is notified when the visiting nurse arrives 62 minutes later
5. Nurse asks Helen questions and believes a UTI is possible. She collects a urine sample and makes visit notes.
6. Doctor receives visit notes and based Helen's UTI history, starts an antibiotic. Antibiotic is ordered for same-day delivery from local pharmacy.
7. Helen and Healthcare Circle are notified of likely UTI and antibiotic prescription.
8. Doctor and family caregivers are notified when the prescription has been delivered.
9. Smart water bottle and bathroom sensors report normal activity, Healthcare Circle notified.
10. Lab report confirms UTI, doctor confirms antibiotic should be taken to completion.

11. Helen, Healthcare Circle, and Home caregiver are notified of medication instructions.
12. Home caregiver visits the next day and reports that Helen is feeling better.
13. Healthcare Circle is notified Helen's condition appears to have improved.
14. Medication management system advises each day when antibiotic is taken. Helen and Healthcare Circle notified.

Engagement opportunity (pink)

1. Helen's granddaughter shares an article about a Mars expedition she thinks Helen will enjoy.
2. Helen reads the article.
3. Social Circle is informed to encourage engagement on something of interest to Helen.



The graphic is a bit difficult to follow, and that is the point. A UTI caught early is relatively straightforward, but even routine health issues require communication among several parties to prevent them from becoming major ones.

Role of the Core Platform

Since needs are unique and change over time, solutions must be flexible. This would best be enabled by a core platform, into which devices and services can be swapped. This platform performs two critical functions:

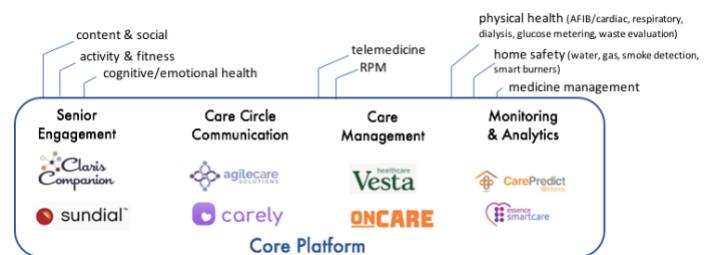
1. **Predictive insights.** Machine learning applications that take data from disparate data elements (water consumption and trips to the bathroom) to catch potential health and safety issues and initiate appropriate interventions. AI will be distributed in that it will be done both on the platform AI engine and within devices and their clouds (e.g. AI-enabled devices that can predict a cardiac arrest 12-24 hours in advance).

Therefore, platform engines (AI and communication) will need to integrate output from device-specific algorithms. The additional data from other devices on the platform may even serve to improve those algorithms.

2. **Smart communication.** Rules engines that process connected device and ML application data to deliver relevant information to each member of the care circle and coordinate communication among members to ensure nothing falls between the cracks. This can be complex. In our simple example, the visiting nurse was alerted (Step 3) because of her scheduled visit. The non-medical home caregiver, part of only the Social Circle, is added to monitor antibiotic adherence (Step 11) because she sees Helen frequently and reminds her to take medications as a matter of course. This information also informs care; knowledge of a condition cues the caregiver to ask relevant questions and calibrates expectations. This fault-tolerant approach to communicating critical needs avoids creating a single point of failure. Informing her Healthcare Circle when Helen has taken her medication ensures she isn't hounded.

What a Core Platform might look like

With a solution so tightly integrated, it can be difficult to determine what should be included in the core platform and what can be plugged in as peripherals. Below is one approach to deploying a core platform that prioritizes centralizing data analysis and minimizing handoffs. It is illustrated with some of the players in what I see as each of the 4 core categories. There is some overlap in functionality among them, but offers one lens to evaluate the opportunity.



Core functionality is primarily two things; getting information and sharing it. There are many different ways communication flows and because of the complexity of sharing and intelligently routing vital information, it might ideally all be managed by a single platform.

With respect to devices, most current monitoring platforms include passive home monitoring and wearables. That is as

good a place to start as any. More important is the ability to incorporate the data from disparate sources, create actionable insights from that data, and using those insights to inform the communication protocol.

Market Opportunities

The Census Bureau projects that the number of Americans aged 85+ in 2040 will grow by 110%, a growth rate more than 18.5x that of the 18-64 cohort that will be largely responsible for their care. Today's older adults are overwhelming choosing to remain at home. The next cohort of 85+, the Baby Boomers who championed sexual freedom, civil rights, and never trusted anyone over 30, are no less likely to want to maintain their independence. It is also a fair bet the "Me Generation" will have expectations that are considerably higher.

This presents a number of opportunities:

- **Platform Providers.** Development of a core platform, as described above or in another incarnation. It will be interesting to see the extent (or lack) of M&A activity across the 4 core categories as identified.
- **"ADTs of Senior Data."** Part of the next evolution in remote patient monitoring, these companies will monitor critical data 24/7, ensure appropriate people in the care circle respond to urgent issues, and dispatch emergency services if needed.
- **Care coordinators.** The point people on the ground monitoring day-to-day health and safety issues and quarterbacking care. Two interesting opportunities: 1) for GCMs to increase their reach and effectiveness; and 2) [upskilling home caregivers](#) to reduce turnover and provide advancement opportunities.
- **Concierge services.** Concierge services for one-off or short-term tactical support are likely to continue to grow.

Who Pays?

The promise of transforming aging in place is that it will not only lead to better outcomes for seniors, but that it will also slash costs by preventing adverse events and eliminating/delaying moves to Assisted Living and nursing facilities. There are costs nevertheless, and it is important to understand who is likely to be footing the bill.

11% of adults 65+ have long term care insurance ([Urban Institute](#)). Though it depends on options selected at issue, most LTCI policies will cover some or all of these costs. For the remaining 90%, older adults and their families must be

expected to pick up some portion of the bill, but there are likely public funds available to defray part of the cost. Medicare pays for remote patient monitoring, and some portion of this comprehensive yet-to-be-launched platform should fall under RPM. As of June 2020, Medicaid also reimbursed for RPM services in 23 states.

Where else might money come from?

- **Employers.** Employees spend a significant amount of time caring for parents, and it impacts their work. An [AARP Public Policy Institute study](#) found that 22% of workers ages 45-64 were caring for a parent. 68% of them report making work accommodations, including reducing hours, turning down a promotion, arriving late/leaving early, and quitting. Employers lose an estimated \$33.6 billion per year in lost productivity from working caregivers. [Wellthy](#) offers logistical and administrative support to family caregivers, and partners with employers these services as a benefit. In addition to subsidizing caregiver support, employers might also offer employees at or approaching retirement access to professionals to help them begin planning their own transitions to retirement.
- **Health & Life Insurers.** There are obvious benefits to these underwriters of senior risk. Insurers that directly pay for such services may insist on access to data, something which many seniors and their families may resist. An alternative is for insurers to offer premium reductions for customers purchasing approved services.

Final Thoughts

As the percentage of Americans age 65+ swells from [16% today to 22% by 2050](#), improving the aging experience will become both a cultural and business imperative. A tech platform to support aging in place can transform the experience for both older adults and caregivers. However, the opportunities to improve aging go far beyond health and safety. There are opportunities to reinvent mobility, communication, housing, work, financial services, and the way we recognize older adults as consumers. There is a lot to be excited about.

Disclosure:

As of this writing, 8 September 2020, I have not invested in or been retained by any companies referenced in this paper.

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