THE NEW ERA OF CONNECTED AGING:
A Framework for Understanding Technologies that Support Older Adults in Aging in Place

2014

Center for Technology and Aging

CITRIS CENTER FOR INFORMATION TECHNOLOGY RESEARCH IN SANTA CLARA VALLEY
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The New Era of Connected Aging

Executive Summary

The United States is a rapidly aging nation. This demographic change is quickly outstripping the capacity of family caregivers, providers, and programs and services that serve the aging population. To address the impending increase in the demand for health care and long-term care, new programs must be created that reinforce the ability of older adults to thrive in their homes and communities, and support them in aging independently.

We are at the dawning of “Connected Aging” in which the growing array of Internet-based technologies and mobile devices increasingly will support older adults in aging in place. Emerging technologies will enable both older adults and their caregivers to address a comprehensive range of medical, health, social, and functional needs. In addition, technology-based solutions that connect older adults to friends, family, and the community are becoming more viable; older adults and their caregivers are growing increasingly tech savvy; technology usability is improving; and price points are descending. As indicated in Figures 1 and 2 older adults’ use of technology, whether it be social networking, text messaging, use of the internet, or use of mobile phones/tablets, is growing at an ever increasing rate.

![Fig 1: Trends in technology use by older (65+) adults (Pew Internet Research report 2009-2012)](image1)

![Fig 2: Mobile phone use by age groups (Pew Internet Research report 2012)](image2)
Executive Summary

At the same time, technology is rapidly evolving. For example, early technologies such as remote patient monitoring have proven successful in supporting care coordination and management for older adults with complex conditions and needs, leading to improved health and well-being and reduced health care utilization. Existing technologies are now moving off of purpose-built devices and on to off-the-shelf cell phones, smart phones, tablets, and personal computers. Meanwhile, a wide range of new consumer-oriented technologies is coming into use. These include activity trackers paired with mobile apps for virtual health coaching, web sites that help older adults and caregivers get access to critical resources such as non-medical home care, and provider platforms that can support increasingly mobile professional homecare workers, to name just a few.

This issue brief is intended to help decision makers in the health care, aging-services, and policy communities understand the emerging range of technologies that can empower older adults to remain independent in the community, while increasing the capacity of formal and informal caregivers. To assist in better understanding of the landscape, the issue brief describes a framework that organizes connected aging technologies into four main categories based on its primary location of use: body, home environment, community, and caregiving. It also discusses key emerging technologies and provides a discussion of how the new era of connected aging may unfold and its primary drivers.

The Emerging Landscape of Connected Aging

By 2030, according to the U.S. Census Bureau projections, 25 percent of the U.S. population will be 60 and older and 19 percent of the population will be 65 years of age and older. Every day, 10,000 baby boomers are turning 65. At least 90 percent of those 65+ have one or more chronic conditions. At the same time, the population of professional and informal caregivers is declining, especially in relation to the potential demand for care and support.

A collision of factors threatens to undermine the health and independence of older Americans – at a time when that independence needs to be reinforced. AARP surveys consistently reflect that seniors prefer to age in place at home. However, 20 percent of older adults go without the care they need because of a lack of caregiver support. In addition, 30 percent of U.S. adults who are caregivers for parents or spouses sacrifice wages and benefits. On a societal level, U.S. employers lose up to $33.6 billion per year because of absenteeism due to caring for an older relative.

How do we solve these challenges? Usable and affordable technologies for multiple solutions could help. Technologies that address the aforementioned challenges can empower seniors to better manage their health, stay connected to their communities, and get access to the services they need to remain independent in their homes and other community-based settings. New technologies also can make family caregivers’ lives easier by giving them tools to more easily support their loved ones being able to age in place. Finally, connected health technologies can create new opportunities for equipping health care professionals to better and more efficiently attend to the social, medical, and functional needs of older adults in the community.
Executive Summary

Decision makers in the healthcare, aging-services, and policy communities need to understand the range of existing and emerging technologies that support and empower older adults and their caregivers in remaining independent in the community. To date, much of the attention has gone to traditional telehealth and telemedicine technologies, which until recently were largely purpose-built, highly specific hardware products that are both expensive and costly to scale in deployment (e.g., telehealth hubs). When deployed as a tool in community-based care coordination and management programs, these technologies have often been successful in helping older adults remain healthier and out of the hospital. However, these technologies are fast becoming one small piece of the connected-aging universe, as this issue brief will show.

For definitional purposes, this brief seeks to create a new concept of “connected aging” that builds upon the concept of “connected health.” Connected health focuses on the use of telecommunications and Internet-based technologies to broaden the provision of care to non-clinical settings, such as the home and the broader community. One dimension of these technologies is that they can be used to monitor individuals with chronic conditions to detect, and thus prevent, complications and crises that can lead to acute episodes. To maintain their health and well-being, it is just as important to provide individuals with automated health coaching, based on monitoring vital signs, activity, and behavior. Connected health is about both providing the basis for timely, preventive treatment and for precluding the need for treatment through empowerment and self-management.

“Connected Aging” recognizes that successful aging is more than just about health – it is about empowering and supporting the whole person through telecommunications and Internet-based technologies. A widely recognized study published in the Archives of Internal Medicine in Summer 2012 reinforces the interplay of social, health, and functional factors: 43 percent of older adults say they are lonely, and those individuals are twice as likely to have functional limitations that could lead to nursing home placement and/or result in premature death. As such, “connected aging” is about the use of Internet-connected technologies to support the whole person in multiple ways, including:

- Health, wellness (including both physical and cognitive health), and prevention
- Functional limitations and chronic disease management
- Social connectedness to friends, family, and community organizations
Touring the Connected Aging Landscape

The following framework presents the landscape of technologies for connected aging through four categories that are based on the purpose and primary location of the technology:

**Body**: Products that support monitoring and management of an older adult’s physiological status and mental health for maintaining wellness and managing the chronic conditions

**Home Environment**: Products that support monitoring and maintaining the functional status of older adults in their home environments

**Community**: Technologies that enable older adults to stay socially connected to their families, friends, and local communities

**Caregiving**: Technologies and products that support both informal and formal caregivers in providing timely and effective care and support to older adults and persons with disabilities in their homes

The final category in particular highlights how many technologies can be used both to empower older adults in managing their own health and remaining independent while also enabling them to be monitored by either professional or informal caregivers.
Touring the Connected Aging Landscape

**Body**

Technologies that fall under the category of Body primarily support the health and wellness of older adults by monitoring physiological and mental health status (Figure 3). This includes traditional devices such as weight scales, blood pressure cuffs, and blood-glucose meters – that are now also connected to the Internet. Expanding on the “Quantified Self” movement, a rapidly proliferating range of body-worn sensors can measure everything from activity levels to sleep patterns to heart rate. Many products provide Web and mobile tools for tracking and analyzing data generated by sensors and other devices. Some can provide automated virtual coaching – such as activity monitors that offer automated advice.

![Connected aging technologies for the body](image-url)
## Touring the Connected Aging Landscape

### Body

<table>
<thead>
<tr>
<th>Sub Category</th>
<th>Description</th>
<th>Example Products</th>
</tr>
</thead>
</table>
| **Vital sign monitors** | Technologies that measure vital signs such as weight, blood pressure, blood glucose, heart rate, temperature, ECG, galvanic skin response, gait, and hydration. Some products are designed to measure multiple vital signs in one elegant package while others are available only as "professional" models. Currently a new service has become available where patients can get their ECGs reviewed by cardiologists or cardiac technicians for a small fee without having to go through their provider. | Consumer: AliveCor Heart Monitor  
Basis Watch  
Fitbit Flex™  
Fitbit Aria™ scale  
Nike+ Fuel Band  
Jawbone UP™  
Samsung Gear  
Scanadu Scout™  
Withings Blood pressure monitor and scale  
Provider: CardioNet® MCOT  
iRhythm Zio®  
Preventice BodyGuardian |
| **Activity monitors**  | A rapidly growing set of activity tracking products that measure steps taken, speed, activity levels, calories spent, and amount of time spent in rest or without getting up. Most activity monitors are wrist-worn devices, while others can be carried in the pocket. Smart phones and Smart Watches contain accelerometers that enable their use as activity monitors. | Fitbit Flex™  
FitLinxx Pebble  
Jawbone UP™  
Misfit Wearable’s Shine™  
Withings Pulse |
| **Sleep monitors**  | Individuals and clinicians use these products to monitor sleep to adjust behavior (caffeine intake and other elements of sleep hygiene) or to provide indications of other issues that might require a professional intervention, such as sleep apnea. | BAM Labs® Smart Bed  
Fitbit One™  
Lark Pro™ sleep monitor  
Withings Aura™ |
| **Mood/depression monitors** | Mood/depression monitors provide objective sensing of mood in a reliable manner, though to date, their efficacy is not clinically substantiated. The standard process for using connected health devices to assess mood or depression is based on a questionnaire format. General availability and mass adoption are a few years out. | Mood Scanner (Android app)  
M3™ (Android and iOS app) |
| **Emotion monitors**  | Products enable objective, long-term monitoring of emotions. One product is a wearable wireless biosensor that can detect a body’s ‘harmonic frequency’. With a deep analysis tool it can learn the dynamic shift in a user’s autonomic nervous system. Through a complex algorithm, it can calculate how the sympathetic and parasympathetic systems are functioning (systems that control involuntary responses and fight or flight reflexes). Another product can identify from a caller’s voice whether the caller is at risk for suffering from depression or psychological distress or has co-morbid behavioral health conditions. Originally designed for use in call center applications to improve agents’ interaction quality and customer engagement, these technologies now can be used for remote monitoring of patients vulnerable to mental health problems. | Cogito’s Social Signal Platform (SSP) and Cogito Companion™  
Phyode W/Me wristband |
### Body

#### Sub Category Description Example Products

<table>
<thead>
<tr>
<th>Sub Category</th>
<th>Description</th>
<th>Example Products</th>
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</table>
| Mobile PERS with GPS       | Products for personal safety, including Personal Emergency Response Systems (PERS) and global position service (GPS) tracking devices, have evolved so that they can be activated while outside of the home, providing an important element of protection for older adults. PERS functionality is being combined with a cell phone to provide a powerful mobile tool. Shoes with built-in GPS tracking systems are becoming popular for persons suffering from early stage dementia. Caregivers can create "geo-fencing" to allow movement within a certain boundary around the home, but receive alerts with the geo-position when an older adult wanders off. | Aetrex Navistar™ GPS Footwear System  
GPS SmartSole™  
Jitterbug® 5Star™ Medical Alert Device with urgent response service  
Philips LifeLine® GoSafe |
| Medication adherence systems | Medication adherence devices can now provide medication reminder alerts via interactive voice response (IVR), text messaging, or e-mail. Products are available as multi-day container trays or as lids on pill containers. Caregivers or a pharmacy can program such reminders using a web interface. If an older adult does not open a compartment of a pillbox (or the lid of a pill container) after receiving an alert, the devices can notify a remote caregiver via SMS or e-mail. In a poly-pharmacy situation, to ensure that an older adult has taken the right medication, one product in this category comes with a built-in scanner that takes images of the medication being loaded and status of the prescription after each use. The back-end system can then confirm if the right medication has been taken. | MedMinder™ Maya and Jon PillJogger App and MedWheel cartridge for smartphone  
RxAdvance Pillstation™  
Vitality™ GlowCap®  
ActualMeds™ |
| Medication dispensers      | Medication dispensers provide the right dosage of medication to a person when his/her medication is due, avoiding harm that can be caused by an overdose, as well as preventing drug abuse, especially for narcotic drugs, sleeping pills, etc. Manufacturers often provide a wrap around medication dispensing service that includes the dispenser product. | InRange System’s EMMA®  
Philips Medication Dispenser Service |
| Smart toilets              | Intelligent toilets can passively measure physiological signals using discharged body fluids. Japanese companies have been building smart toilets for more than a decade, but the bathroom products have not yet caught the imagination of U.S. consumers. Products are available but expensive for mass adoption. | Toto’s smart toilet |
Home Environment

The era of the “smart home” has arrived, enriching home security, automation, and personal control under the broader umbrella of the “Internet of Things” or IOT. Companies working on the IOT have a vision of connecting every device in the world to the Internet and sharing information and data. While a completely connected home environment is still evolving, smart home technologies have a significant presence in existing and new residences. Technologies for the home environment can have a profound positive impact on the lives of older adults who are beginning to develop functional and cognitive limitations but wish to remain in their homes. These technologies monitor activities of daily living, such as getting out of bed, bathing, and toileting, and generate alerts if activities are out-of-sync with observed and established behavior patterns (Figure 4). Other technology products in this category include a variety of sensors that can identify other potential problems, ranging from gas leaks to falls, as well as methods for proactively controlling home appliances and utilities. Technologies in this category are not only finding adoption in the individual home environment but also proliferating in Senior Living communities.
## Touring the Connected Aging Landscape

### Home Environment

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<tr>
<th>Sub Category</th>
<th>Description</th>
<th>Example Products</th>
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</table>
| Fall detection                      | Fall detection technologies can detect falls and automatically call for help when an older adult cannot get up on his/her own or press a personal emergency response system (PERS) button. These technologies, however, can cause false alarms and are still undergoing improvements in algorithmic detection of a fall. | MobileHelp  
Philips Lifeline with AutoAlert System  
SafetyCare EMTWatch™ FallDetect™ |
| Environment sensors/passive monitoring sensors | Many different sensors are used in passive sensing for safety at home. This is by far the most advanced and well-diffused technology area of the aging-in-place market. Sensor products can check a number of items within a house: motion patterns, stove on/off status, carbon dioxide or carbon monoxide levels, presence of smoke, air quality, humidity, and fire. They can dim lights remotely and lock or unlock doors. Motion sensor products can be used solely for monitoring through algorithms to automatically detect movement aberrations and reliably generate appropriate alarms. | Care Innovations™ Quietcare®  
CarePredict™ Tempo™  
Lively  
Lowe’s Iris system  
WellAware® Systems |
| Video monitoring                    | Video cameras can monitor an individual’s activities of daily living and provide caregivers with direct video feed on a smart phone, tablet app, or on the web to check on the status of a family member. | Guardian Medical Monitoring’s Virtually There Care  
Lorex LIVE  
Netgear VueZone™ |
Community

This category includes technologies that can aid older adults in maintaining and strengthening their social ties to other individuals in their local communities. Devices connect older adults to activities, such as health and wellness classes, lifelong learning classes, and clubs and groups of older adults with similar interests. The Connected Aging framework posits that keeping older adults connected to their communities and their interests is a key element to enabling older adults to flourish and remain independent.

Fig 5: Connected aging technologies for the community
## Community

<table>
<thead>
<tr>
<th>Sub Category</th>
<th>Description</th>
<th>Example Products</th>
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</thead>
<tbody>
<tr>
<td>Social communication</td>
<td>Social communication technologies include video-enabled PC or mobile app solutions to communicate with remote family caregivers or friends. Devices include websites that enable older adults to share experiences in a virtual world in the form of online journaling. They turn older adults into empowered “prosumers” of information in the digital world where they both share and learn from each other.</td>
<td>Video communication: Skype&lt;br&gt;Self-journaling sites: CureTogether.com DiabetesMine.com PatientsLikeMe.com Smart Patients</td>
</tr>
<tr>
<td>Physical and cognitive gaming and training</td>
<td>Technologies include both online and mobile app-based cognitive games along with Wii or Kinect games for physical activity and entertainment. Studies of Wii and Xbox Kinect games with gesture recognition have shown good results in improving cognitive ability and/or physical rehabilitation of older adults.</td>
<td>Games.AARP.org Happy-Neuron.com Lumosity.com Onlinegamesforseniors.com PositScience.com Respondesign Wii Fit</td>
</tr>
<tr>
<td>Social networking</td>
<td>Technologies include general online social networking sites, as well as sites that are specially designed for older adults who are among the fastest growing online social networker segments according to Pew Internet Research.</td>
<td>Facebook.com Aarp.org/onlinecommunity MyBoomerPlace.com Tapestry</td>
</tr>
<tr>
<td>Social contribution (hobbies, charities, volunteering)</td>
<td>Technologies that support personal activities and societal contributions include websites that enable older adults to pursue their hobbies, make charitable donations for philanthropic projects, and volunteer.</td>
<td>Volunteer work sites: SeniorCorps.org TapRootFoundation.org&lt;br&gt;Charitable donation sites: Causes.com Razoo.com</td>
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</table>
**Caregiving**

Caregiving includes both formal (professional) coordination of care and informal care (family caregivers). Technology-enabled caregiving products are typically web sites and technology platforms that support both informal and professional caregivers (Figure 6). Platforms and services can be used either to make care workflow more efficient (e.g., software platforms for mobile care providers) or act as the aggregator to deliver various services older adults require to safely age in their own home. Professional care providers who oversee many older adults with one or more chronic conditions can use a platform that supports various patient-facing technologies for assessing health risks, providing education, or modifying behavior.
## Caregiving

<table>
<thead>
<tr>
<th>Sub Category</th>
<th>Description</th>
<th>Example Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Informal caregiver platform</td>
<td>Products are mostly platforms with a portal service (tips and best practices) that match service providers with older adult-caregivers who are searching for specific services. These technologies are continuing to mature and in the near future are likely going to include extensive user reviews such as Yelp.com or Angie's List to assist caregivers in making informed decisions.</td>
<td>AARP.org/caregiving Care Innovations™ Connect Caregiver Caring.com Caregiver.com ElderCareLink.com</td>
</tr>
<tr>
<td>Formal care coordination platform</td>
<td>Mature telehealth platforms have been in service for a decade or more. New platforms with web and/or mobile app interfaces are being used by professional care coordinators to either streamline care coordination workflow or manage patients with complex disease conditions through remote monitoring solutions.</td>
<td>HealthyCircles™ by Qualcomm Life Lumeris care collaboration platform McKesson Vital Procura Clinical solution PatientPoint.com</td>
</tr>
</tbody>
</table>
Connected Aging technologies have touched the lives of a relatively small percentage of the older adult population. Within the next one to three years a number of new or underdeveloped connected aging technologies and platforms will be available for older adults, family caregivers, and health and social service providers. Figure 7 provides a sample of the connected aging technologies and platforms that have significant growth potential:

**Body**

<table>
<thead>
<tr>
<th>Technology</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Smart medication management</td>
<td>Through an ingestible sensor activated only when inside the body, Smart pills objectively determine whether a person has taken their medication. Products are CE-marked and FDA-cleared, but not yet mass marketed in the U.S. Proteus Digital is pioneering the technology.</td>
</tr>
<tr>
<td>Smart body sensors</td>
<td>&quot;Flexible electronics” enable manufacturing of external, tattoo-like sensor patches that can be attached to skin or clothing, depending on what needs to be monitored. They are effective in gauging function of specific organs and in monitoring heart rate, blood oxidation, and hydration. Boston-based MC-10 and Sano Intelligence are working on such technologies. Large technology companies like Google and Apple are also in the process of developing consumer facing smart body sensors. Google's smart contact lens using miniaturized electronics that measures blood glucose from the teardrop is an example.</td>
</tr>
<tr>
<td>EMR connected medical devices for remote monitoring</td>
<td>Work is ongoing to enable medical devices for measuring vital signs at home to connect directly to a care provider’s EMR system. AliveCor ECG app can now directly send ECG recordings and ECG analysis reports to the Practice Fusion EHR system. More medical devices will go this route in the near future.</td>
</tr>
</tbody>
</table>
The diabetes foot ulcer detection mat is an emerging technology that will allow detection of foot ulcers in diabetic patients. Boston-based MIT Labs spin-off Podimetrics is developing a sensor pad that will collect blood flow data and transmit it wirelessly when a user steps on the mat. An algorithm in the cloud will detect if the user is developing an ulcer.

<table>
<thead>
<tr>
<th>External sensors for remote monitoring</th>
<th>A fast emerging technology is remote diagnostics, or Lab-on-a-chip, that will permit home application of many tests (e.g., liver tests for patients on statin) at a fraction of the cost of what can only be performed in a laboratory today. Silicon Valley based startup Scanadu is developing a urine testing kit called Scanaflo™ that will test for levels of glucose, protein, leukocytes, nitrates, blood, bilirubin, urobilinogen, specific gravity, and pH in urine to detect liver, kidney, urinary tract, or metabolic disorders. A smartphone app will interpret the test results, store the data, and explain the results to the user.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote laboratory/diagnostics</td>
<td>Technologies that prevent rather than monitor falls are being developed with both wearable sensors to measure posture and gait and an algorithm to predict a fall so that caregivers can prevent it with simple assistive technologies (e.g., providing a walker).</td>
</tr>
<tr>
<td>Fall prevention</td>
<td>Wearable computers like Google Glass with the capabilities of real-time image recognition and bone conduction of sound will emerge as smart assistive technologies that will mitigate vision or hearing impairment for people of all ages. Brain EEG sensing devices like devices built by the Canadian company InteraXon will enable older adults with various degrees of disability to do things like controlling the home environment with the power of their minds.</td>
</tr>
<tr>
<td>Assistive Technologies</td>
<td>'Big Data' is still a buzzword in the healthcare industry but one startup named Ginger.io is working to better utilize large datasets generated by a smartphone to collect data about user movement, calling, and texting information and turn that into useful health insights. Another startup named Wellframe is building an artificial intelligence based patient follow-up system that will adjust a post hospital discharge regimen for a patient based on their progress toward recovery.</td>
</tr>
<tr>
<td>Big Data and Artificial Intelligence</td>
<td>The social and health mobile app marketplace is exploding. In the near future, social apps will not just be about self-expression but will be about solving real problems. Most health apps today are targeted towards wellness and fitness. However, in the future mobile apps will be targeted more towards managing complex health conditions and will be prescribed by physicians like drugs. Baltimore based WellDoc's diabetes management app 'Blue Star' is the harbinger of that change.</td>
</tr>
<tr>
<td>Social and health mobile apps</td>
<td>Technologies are being developed using HIPAA-compliant software platforms that will enable older adults to connect and communicate seamlessly with their provider, family members, friends, and other community members. A variation is available today but is not fully mature.</td>
</tr>
<tr>
<td>Patient/provider/caregiver communication platforms</td>
<td>Robots that support personal care and chores will likely drive the future of home care. Today robotic technologies are available to do some specific household chores. When this technology becomes broadly available and affordable it will transform home care for older adults. Currently almost all major universities with robotics programs are conducting quality-of-life improvement projects. Broader commercialization of multi-function robots is likely in the near future.</td>
</tr>
<tr>
<td>Caregiving</td>
<td>Software platforms that will connect older adults, care providers, pharmacies, labs, and ancillary service providers are being developed that will create a virtual neighborhood for providing coordinated elder care services to support aging in place.</td>
</tr>
<tr>
<td>Local social and commerce networks for aging in place</td>
<td>Robots</td>
</tr>
</tbody>
</table>
The New World of Connected Aging

Turning the Dream of Connected Aging into a Reality

Connected Aging can be integral in older adults’ lives whether they are high functioning, actively engaged individuals or persons who need multiple supports to remain independent in their homes. Many of the technologies described have barely scratched the surface of their ultimate potential to transform the lives of older adults.

The mass diffusion of connected aging technologies that can support older adults in wellness and independence is inevitable. As Figure 8 illustrates younger Baby Boomers’ use of technology tracks closely with that of the overall adult population, indicating the potential for great receptivity to connected aging technology over time.

<table>
<thead>
<tr>
<th>Digital Device</th>
<th>Young Boomers (47 - 56)</th>
<th>Older Boomers (57 - 65)</th>
<th>Silent Generation (66-74)</th>
<th>G.I Generation (75+)</th>
<th>All online adults (18+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cell phone</td>
<td>91%</td>
<td>85%</td>
<td>76%</td>
<td>63%</td>
<td>89%</td>
</tr>
<tr>
<td>Smart phone</td>
<td>38%</td>
<td>27%</td>
<td>12%</td>
<td>3%</td>
<td>63%</td>
</tr>
<tr>
<td>Desktop computer</td>
<td>66%</td>
<td>61%</td>
<td>54%</td>
<td>31%</td>
<td>58%</td>
</tr>
<tr>
<td>Laptop computer</td>
<td>62%</td>
<td>49%</td>
<td>39%</td>
<td>20%</td>
<td>61%</td>
</tr>
<tr>
<td>iPod or MP3 player</td>
<td>36%</td>
<td>24%</td>
<td>10%</td>
<td>5%</td>
<td>44%</td>
</tr>
<tr>
<td>Game console</td>
<td>38%</td>
<td>19%</td>
<td>8%</td>
<td>3%</td>
<td>42%</td>
</tr>
<tr>
<td>e-book reader</td>
<td>19%</td>
<td>13%</td>
<td>9%</td>
<td>5%</td>
<td>21%</td>
</tr>
<tr>
<td>Tablet (e.g. iPad)</td>
<td>27%</td>
<td>23%</td>
<td>17%</td>
<td>6%</td>
<td>25%</td>
</tr>
</tbody>
</table>

Fig 8: Digital device use by age groups (Pew Internet Research report 2012)
As technology advances continue to accelerate so does the process of adoption and diffusion of connected aging technologies. A number of factors will contribute further to increasing the rate of diffusion:

- Costs of technology will continue to drop dramatically, making it increasingly economically viable for payers and providers to significantly expand use of technologies such as tablets, other mobile devices, and a range of smart-home technologies.

- The number of technologically savvy older adults will continue to grow rapidly.

- Usability will increase significantly as technologies such as voice-based user interfaces (e.g., Apple’s Siri) improve in quality.

- The shrinking pool of providers and family caregivers will lead to a greater use of technology to engage older adults and improve program efficiency.

- The ability to include data analytics within connected aging technologies will significantly expand their utility in health promotion and disease prevention, diagnostics, and health care delivery.

- Improved interoperability will increase the seamless linkage of connected aging technologies.

- Payers and providers will become more sophisticated in curating among a vast array of hardware and software products (which in turn will be increasingly indistinguishable) and in using them to support population health management.

- Health care and aging services will continue their integration enabling the emergence of a cohesive concept of whole-person-oriented community-based connected aging.

The value of connected aging has already been demonstrated in the reduced use of health care services and improvements in care delivery, quality of life, and satisfaction. Technology is also benefiting older adults and their caregivers by increasing connectivity with family and community and by offering older adults greater independence in managing their own health care. The full impact of connected aging will be to not just keep older adults from inappropriate levels of care, but to support them in thriving, being independent, and having a significantly better quality of life.
References


2. Caregiving in America Report, Joint collaboration of International Longevity Center-USA and Schmieding Center for Senior Health & Education (Available at: http://www.caregiverslibrary.org/portals/0/CGM.Caregiving in America-Final.pdf)


5. Senior Citizens and Digital Technology 2012: Pew Internet and American Life Project (Available at: http://www.slideshare.net/PewInternet/senior-citizens-and-digital-technology

Center for Technology and Aging

The Center for Technology and Aging is a national leader in the use of patient-centered technologies for older adults. We take our distinctive experience and unique insights and work with health care providers, aging service organizations, payers, philanthropies, and technology companies to accelerate the diffusion of proven technologies to improve the well being and quality of life of older adults.

CITRIS

The Center for Information Technology Research in the Interest of Society (CITRIS) creates information technology solutions for many of our most pressing social, environmental, and health care problems. The mission of the CITRIS Health Care program is to improve access and reduce significant disparities in health resources and outcomes, improve population health, increase patient and provider engagement and improve the efficiencies and costs of health care delivery. The CITRIS Health Care program is a multidisciplinary, multi-campus initiative that supports improvement of health through technology-enabled solutions in California, the nation, and globally.

The primary research themes of the CITRIS Health Care program are focused on:

- Telehealth: Platform technologies & services for remote delivery of health care
- Sensor & Services: Novel sensing for physiology, activity and location
- Gaming, Health & Social Apps, and mHealth: Technology & motivation strategies to engage users in public and personal health