State of Technology in Aging Services

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Center for Aging Services Technologies

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INTRODUCTION:

The majority of the world's increasingly older adult population requires some degree of formal and/or informal care due to loss of function as a result of failing health. In the U.S., nearly three-quarters of older adults suffer from one or more chronic diseases, according to the Centers for Disease Control (CDC). The cost and burden of caring for older adults is steadily increasing [1]. Changes in the Medicare system in the U.S. led to a shift in responsibility for care from institutions (e.g., nursing homes) to the community (individuals and families). Meanwhile, the role of informal caregivers in providing care to the older adult population has greatly increased over the past two decades.

Consequently, informal caregivers are viewed as an unpaid extension of professional caregivers, providing most of the care to older adults requiring long-term care. In fact, there is evidence that family and friends are the sole care providers for about three-quarters of all community-dwelling older adults [2]. Informal caregivers have experienced increased physical burdens and emotional strains as a result of this shift in long-term care responsibilities. Furthermore, health care providers, including aging-services providers, are faced with a shrinking professional caregiving work force at the same time [3].

Compounding workforce issues is the proportion of the world's population over age 60, which is expected to double by 2030 to 20%. In the U.S., the number of older adults is expected to grow to 108 million over the next 15 years, which represents 45% of the adult population. Older adults currently account for 60% of overall health care spending in the U.S. Appropriate management of chronic disease in older adults can significantly reduce the U.S. health care bill. Furthermore, 92% of these older adults live alone in their own apartments, homes, independent living facilities or assisted living facilities, including about 50% of those 75 and older. Such statistics clearly demonstrate an urgent need for innovative technology-based tools that enable older adults to live independently and maximize caregivers' efficacy by providing timely health information and delivering more effective care [4].

This change in the demographic, and its potential economic impact on industrialized nations, has prompted active research in technology solutions for automated functional and health status monitoring and assistance [5]. In the meantime, modern sensor and communication technology, coupled with advances in data analysis and artificial intelligence techniques, is causing a paradigm shift in remote management and monitoring of chronic diseases. In-home monitoring has the added benefit of

measuring individualized health status and reporting it to the primary care provider and caregivers alike; allowing timely and targeted preventive interventions [6].

In addition, the U.S. government, through the Office of the National Health IT Coordinator, is leading the development and nationwide implementation of an interoperable health information technology infrastructure to improve the quality, safety and efficiency of health care and the ability of consumers to manage their health information and health care. Several new partnerships have formed, such as Continua Health Alliance, which is comprised of technology, medical device and health care industry leaders dedicated to advancing telehealth solutions that empower people and organizations to better manage health and wellness. These developments have facilitated proliferation of technology products and prototypes. However, the scalability and feasibility of these technologies to succeed in a new health care paradigm has not been evaluated.

In what follows, we will define aging-services technologies, the caregiver network and the stakeholders in the process of caring for seniors. We will then present a vision for technology-enabled care together with its potential value propositions for the stakeholder. In section 5 we present classes of the technologies that may play a significant role in a technology-enabled care paradigm, presenting their intended use, intended users, value proposition to the different stakeholders and some of their possible unintended drawbacks.

2. Definitions:

2.1. Aging Services Technologies

Aging-services technologies can be broadly defined as technologies that can influence the aging experience for seniors, including their quality of life, health outcomes, satisfaction and/or the quality of care they receive. These include technologies that can be used by seniors, caregivers (both professional and informal), health care providers and aging services providers to improve the quality of care, enhance the caregivers' experience, efficiencies and cost-effectiveness. These technologies broadly include assistive, telemonitoring[1], telehealth[2], telemedicine[3], information, and communication technologies that intend to improve the aging or care experience.

For the purpose of this report, aging-services technologies will be categorized into three broad categories based on the relationship these technologies address between the older adult and his or her environment (safety), oneself (both physical and mental health and wellness), and others (social connectedness), and evaluated based on their value propositions to each of the stakeholders in the care process. The technologies may be further divided into sub-groups within these three broad categories, if needed, based on either their principle of operation or type of information they provide.

2.2. Caregiver Network

The concept of a caregiver network encompasses all caregivers that may be engaged in delivering care services to seniors. The caregiver network includes professional caregivers, informal caregivers and care services providers. An informal caregiver is a person who is not paid to provide care services, for example, a family member, a friend or a volunteer. A professional caregiver is a person who is trained and paid to provide care services, such as a physician, a specialist, a therapist, a nurse, a pharmacist, a nutritionist, a social worker or a nurse aide. A care service provider may be a provider of health care, home care services, long-term care services or rehabilitation services. A successful caregiver network involves the contribution of all these groups and effective information sharing, coordination and communication between them, and can hence be significantly enhanced by technology.

[1] A broad term describing the combined efforts of health telecommunication, information technology, and health education to improve the efficiency and quality of health care. Telehealth usually encompasses using these technologies in self-management.

[2] The use of audio, video, and other telecommunications and electronic information processing technologies to monitor patient status at a distance.

[3] The use of medical information exchanged from one site to another via electronic communications for the health and education of the patient or health care provider for the purpose of improving patient care. Telemedicine includes consultative, diagnostic and treatment services.

2.3. Aging Services Stakeholders

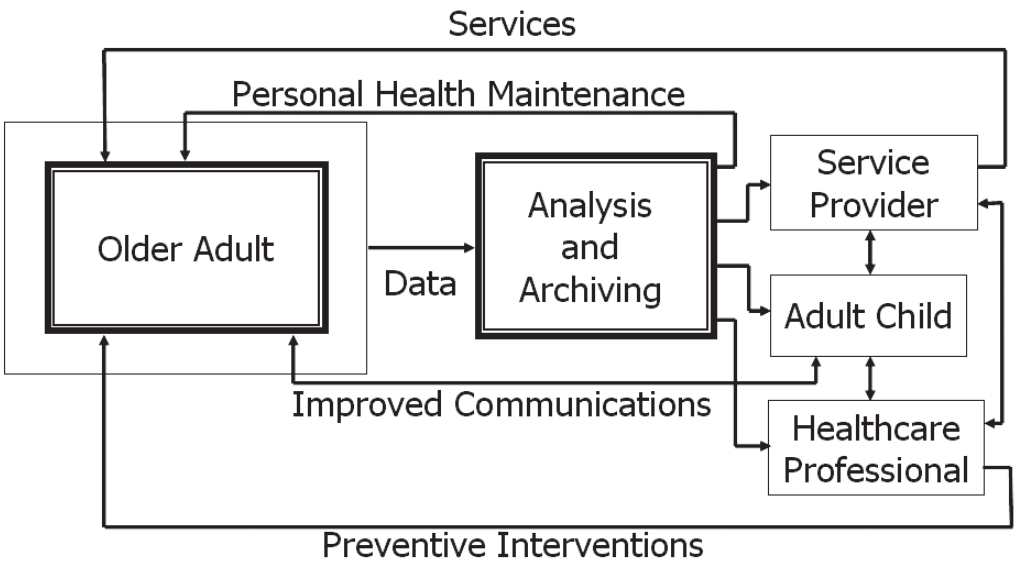
Stakeholders in the care process include all parties that have an interest in the success of aging and care services. In addition to seniors and their caregivers' network, defined above, stakeholders in aging services include payers, such as Medicare, Medicaid, or health or long-term care insurance providers.

Successful aging services and care delivery entails some level of alignment of the interests of all stakeholders, and a primary focus on the best interests of the aging population and society at large. The success of aging and care also hinges upon effective information sharing, coordination and communication between stakeholders.

3. CAST's Vision for Technology-Enabled Care, and its anticipated value proposition for the stakeholders:

The use of information technologies in the care environment is perceived by care professionals to have a value on the levels of administration, integration of services, care quality, and professionalism [7]. It can be argued that a new paradigm for geriatric care can emerge with more integrative technologies. For example, the activities and selected physiological parameters of an older adult can be monitored in his or her own living setting through sensors embedded in the environment or the other objects, wearable monitoring technologies, telehealth devices, and other technologies. The environment is the place the older adult calls home and it may be the person's house or apartment in the community, or a residence provided by an aging-services provider—a continuing care retirement community, an independent living apartment, assisted living unit, etc. Safety, activity, physiological, health and socialization data can be analyzed, archived and mined to detect indicators of early disease onset, deterioration or improvement in health conditions at various levels. The care delivery diagram in Figure 1 illustrates the process.

Figure 1. Model for the Technology-Enabled Geriatric Care Paradigm.



Data analysis results, at various levels, can be made available to all stakeholders in the care process, including the monitored older adults, their professional caregivers, informal caregivers and primary health care providers, and integrated into an electronic medical or personal health record accessible to authorized caregivers whenever they need them.

The monitored individual can use the analysis results in personal health maintenance (e.g., diet, exercise). Informal caregivers will get objective assessment of their loved ones' ability to remain independent, and peace of mind when everything is fine. This reassurance will eliminate interrogation, questioning and role reversal between the older adult and their adult children and would increase the social content of their communications. This will improve the quality of life for both parties, as well as reduce unnecessary early institutionalization of older adults driven by the anxiety of their children.

When the older adult needs assistance in some of his or her activities of daily living (ADLs)[4] or instrumental activities of daily living (IADLs)[5], professional caregivers accessing the reports will have an objective assessment of their actual needs and can determine the appropriate care package. They can coordinate, dispatch and track the delivery of care and services to the monitored older adults via home care agencies (e.g., meals on wheels, bathing) if they live in the community, or on-site direct care workers if they live in a continuum of care facility.

[4] ADLs (Activities of Daily Living) include the ability to move from one place to another, eat, bathe, toilet, and dress in addition to the ability to control the bladder and bowels [8].

[5] IADLs (Instrumental Activities of Daily Living) include the ability to use transportation, shop for necessities, prepare meals, and perform house work [9].

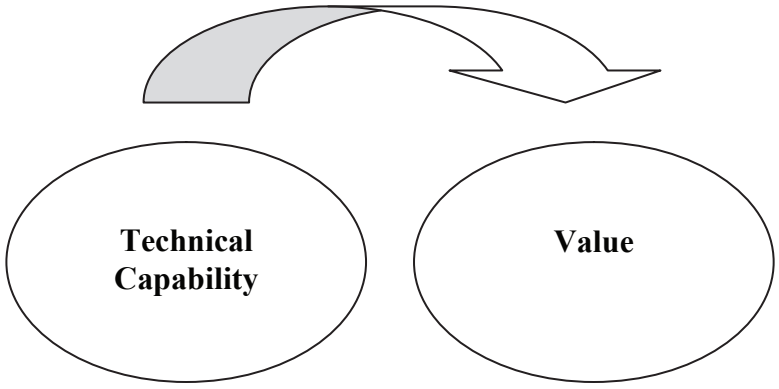
Primary health care providers can perform an evaluation of the monitored older adult's health that is more comprehensive than the "snapshot" assessment obtained during an annual physical examination. They may be able to detect the early onset of disease and prescribe appropriate interventions (including preventive interventions), and can monitor the efficacy of these interventions objectively and longitudinally.

Finally, access to the analysis of the same objective data by all authorized stakeholders is expected to improve the communication between them (e.g., the aging-services provider and the adult child, when deciding on the most appropriate care package for the older adult).

This paradigm exploits the technical capabilities of embedded sensing, ambient intelligence[6], interoperability[7] and interconnectivity between different devices in the home, as well as other information and communication technologies, in automating continuous assessment, documentation and communication. It enables a network of professional and informal caregivers to coordinate and deliver high-touch care when needed. The paradigm is expected to prolong and enhance the independence of seniors, delay their transition to nursing facilities and thereby reduce the overall cost of care. Figure 2 presents the concept of turning a technical capability of these technologies into value through the caregiver network.

Figure 2. Turning the technical capability of technology into value through the caregiver network.

Table 1 summarizes the technical capabilities of the technology and the resulting value utility of this paradigm for seniors, caregivers in their network and payers.



[6] A vision of the future where we are surrounded by electronic environments, sensitive and responsive to people.

[7] Interoperability: the ability of two or more systems or components to exchange information and to use the information that has been exchanged.

Table 1. Technical capabilities and potential value for the technology-enabled care paradigm for seniors and caregivers in their network

Seniors	Informal Caregivers	Professional Caregivers		Payers
		Service Providers	Healthcare Professionals	
Capability				
Objective, up-to-date assessment of health, functional abilities, and care needs	Objective, up-to-date assessment of health, functional abilities, and care needs of their loved ones	Objective, up-to-date assessment of health, functional abilities, and care needs of seniors	Objective, up-to-date assessment of health, functional abilities, and care needs of seniors	Objective, up-to-date assessment of health, functional abilities, and care needs of seniors
Values				
• Health self-management • Sense of security • Prolonged/ enhanced independence • Improved quality of life	• Opportunity to participate in the management of the health and care needs of their loved ones • Peace of mind • Reduced care burdens and strains • Improved quality of life	• Identification of services needed • Coordination of services • Dispatching appropriate timely services as needed • Improved caregiver efficiency • Reduced caregiver workloads • Improved customer satisfaction • Revenue opportunity	• Chronic disease management • Detection of early disease onset • Early and preventive interventions • Monitoring efficacy of interventions • Improved efficiency • Potential revenue opportunities • Improved customer satisfaction	• Enhanced quality of care • Reduced care costs • Improved customer satisfaction

4. Categories of Aging Services Technologies:

We reviewed aging-services technologies, both existing and under development, and categorized them into three broad categories, based on the relationship these technologies address between the older adult and his or her environment (Safety), oneself (Health and Wellness), and others (Social Connectedness). These technologies were evaluated based on their value propositions to each of the stakeholders in the care process. Within these three broad categories, the technologies may be further divided into classes, where warranted, based on their principles of operation or the type of information they provide. The classes of technology are briefly described below, with discussion of their advantages, disadvantages, technical capabilities and requirements.

References citing evidence of a quality (e.g., technical capability or value proposition) are listed immediately after the quality. Furthermore, references were divided into two groups: objective references which present quantitative evidence of the effectiveness of the technology; and subjective references which present qualitative/testimonial evidence (without quantitative information) of the effectiveness of the technology. Accordingly, the reference number will be followed by the one of the two qualifiers: objective or subjective.

4.1. Safety technologies: If effective, the value proposition these technologies offer may include: enhanced sense of security, prolonged independence, improved quality of life and potential for improved health outcome for seniors; peace of mind and reduced strain for informal caregiver; improved quality and reduced liability for the care provider; and improved care quality and reduced health care bill for the payer and society in general.

These technologies are out of pocket expenses and not reimbursable; some of these technologies may be covered under the All-Inclusive Care for the Elderly (PACE)[8], and Medicare Advantage for Special Needs Populations (MA-SNPs)[9] programs.

Direct support for effectiveness in improving quality of life and reducing health care costs is generally unavailable [10] (which does not mean that these technologies do not have any effects); most literature focuses on the functioning of the technology and leaves the benefits/effects to assumption. The literature also points out privacy, cost and usability design concerns [11 Subjective], as well as evidence that there is generally a lack of awareness about these technologies among providers, and that seniors use lower-tech solutions [12 Subjective]

4.1.1. Fall detection and prevention technologies: For this class of technologies reliability is highly important. False negatives carry a higher weight than false positives. Reliability information is generally scarce. The effectiveness of these technologies depends on the setting, availability of caregivers and response protocols. A comprehensive review of these technologies is provided in [13].

4.1.1.1. Wearable: User activated push button on a pendant or wristband such as Philips Life Line (www.LifelineSystems.com), Life Alert (www.lifealert.com), **and automatic,** such as Tunstall's wearable fall detector (www.tunstall.co.uk), which is accelerometer and tilt sensing based, and FallSaver (www.fallsaver.net) chair alarm, which is patch that integrates tilt angle measurement; similarly there are many pressure sensitive pad based chair and bed alarms primarily for institutional setting. FallSaver have shown reductions in falls in institutional settings [14 Objective]. The reductions, however, may vary with settings, staffing levels, and response protocols. **User's potential non-compliance (both intended and unintended) is a potential problem.**

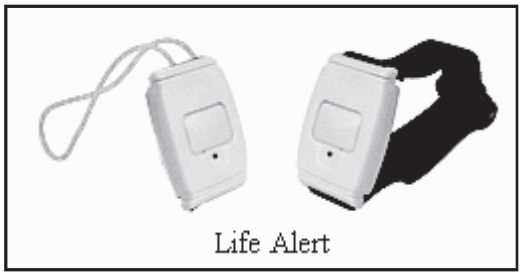
[8] A Program of All-Inclusive Care for the Elderly (PACE) is a capitated benefit that features a comprehensive service delivery system and integrated Medicare and Medicaid financing. The PACE model was developed to address the needs of long-term care clients, providers and payers. For most participants, the comprehensive service package permits them to continue living at home while receiving services rather than be institutionalized. Capitated financing allows providers to deliver all services participants need rather than be limited to those reimbursable under the Medicare and Medicaid fee-for-service systems. The PACE model of care is a permanent entity within the Medicare program and enables states to provide PACE services to Medicaid beneficiaries as a state option. Participants must be at least 55 years old, live in the PACE service area, and be certified as eligible for nursing home care by the appropriate state agency. The PACE program becomes the sole source of services for Medicare- and Medicaid-eligible enrollees.

An interdisciplinary team, consisting of professional and paraprofessional staff, assesses participants' needs, develops care plans, and delivers all services (including acute care services and when necessary, nursing facility services) which are integrated for a seamless provision of total care. PACE programs provide social and medical services primarily in adult day health centers, supplemented by in-home and referral services in accordance with the participant's needs. The PACE service package must include all Medicare- and Medicaid-covered services, and other services determined necessary by the interdisciplinary team for the care of the PACE participant.

PACE providers receive monthly Medicare and Medicaid capitation payments for each eligible enrollee. Medicare-eligible participants who are not eligible for Medicaid pay monthly premiums equal to the Medicaid capitation amount, but no deductibles, coinsurance or other type of Medicare or Medicaid cost-sharing applies. PACE providers assume full financial risk for participants' care without limits on amount, duration, or scope of services. www.npaonline.org/website/article.asp?id=4

[9] A new fast-growing Medicare managed care option created under the Medicare Modernization Act (MMA). Insurers offering MA-SNPs are able to tailor plan designs and delivery to serve the needs of beneficiaries eligible for Medicare and Medicaid (dual-eligible), beneficiaries in nursing homes or at risk of institutionalization, and beneficiaries with chronic or severe conditions.

Of course, there are low-tech solutions that provide weight support and enhance balance, such as canes, walkers and wheelchairs as well as hip protectors, which reduce the impact upon falling [15 Objective]; hip protectors are usually faced with high resistance [16 Objective], which reduces their overall effectiveness [17 Objective, 18 Objective].


Life Alert

4.1.1.2. Embedded in the environment (**User's compliance is not required.**)**:** The University of Virginia's floor vibrations-based fall detector (marc.med.virginia.edu/projects_gaitmonitoring.html), which showed promising reliability on crash-test and anthropometric dummies [19 Objective]; motion-based (Living Independently's QuietCare, (www.quietcaresystems.com), HealthSense (www.healthsense.com), GrandCare (www.grandcare.com) and many research groups, including Virginia (marc.med.virginia.edu), used motion-based "possible fall" alerting functionality when lack of motion is detected)[10]; and imaging-based, including SIMBAD and the University of Missouri's research effort (eldertech.missouri.edu/index.htm).


Grand Care Systems

[10] The immunity of the motion detectors to the movement of pets is an important feature to look for in all systems that use such detectors, especially if the user or facility have pets, as the movement of pets may cause the system to miss an actual fall.

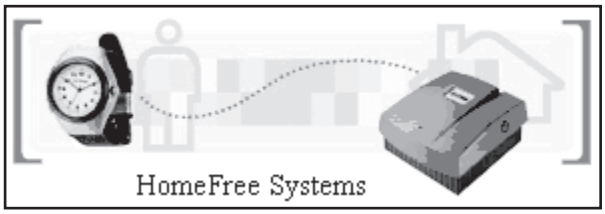
4.1.2. Mobility aids (User's compliance is required.): Mobility aids, traditionally used to enhance balance and/or help in weight support, are being adapted and enhanced to enable seniors to navigate safely in their environments. Examples include the iBot stair-climbing two-wheel balancing powered wheelchair (www.ibotnow.com), Guido the guiding walker (www.haptica.com/id2.htm), the University of Virginia's robotic walker (marc.med.virginia.edu/projects_eldercarerob.html) and CMU's and the University of Michigan's guiding walker (www.ri.cmu.edu/centers/merit). The cost of these technologies can be high, due to high product liability insurance. These technologies have not been sufficiently evaluated in the field. A review of these technologies is provided in [20].

4.1.3. Stove use detectors: Purely environmental. The University of Virginia uses a stove-top temperature sensor and sends an alert when a possible forgotten stove is detected. StoveGuard (www.stoveguard.ca) produces electric stove switches, and Tunstall has a gas shut-off valve (www.tunstall.co.uk/products.aspx?PageID=143). These technologies have not been widely adopted or evaluated in the field.

4.1.4. Smoke and temperature monitors: Purely environmental, either wired (not easy to retrofit existing structures) or wireless (easier to retrofit). Stanley (www.seniortechnologies.com), Honeywell (www.hommed.com), GE (www.gesecurity.com) and Tunstall (www.tunstall.co.uk/home.aspx) offer these products. These technologies are generally deemed reliable.

4.1.5. Door locks: Based on access-control technology, currently targeted mainly at institutional settings. Some of these technologies do not entail wearing or carrying an ID badge, pendant or wrist band, and rely on numeric keypads, biometrics (finger prints) or a combination of the two. Vigil Health Solutions (www.vigil.com) and Stanley (www.stanleysecurityproducts.com) offer these products.

4.1.6. Wander management systems: Require a wearable ID badge, pendant or wrist band, and hence **rely on the user's compliance.** HomeFree (www.homefreesys.com), and Vigil offer these products for institutional settings. Oatfield Estates also implemented this functionality in its EliteCare system, along with deterring alternatives (automatic sprinkler systems, and notifying staff when a resident attempts exit into a potentially unsafe area) that are smarter than locking doors. The technology is designed mainly for institutional settings; some research on global positioning system (GPS)-based systems and/or radio frequency (RF) monitoring linked to local police departments is ongoing, but is controversial. GPS-based systems may not function reliably indoors, and RF may work indoors, but RF coverage is a potential issue for reliability. To overcome these drawbacks, combination systems that integrate GPS with RF or wireless cellular tracking technologies are starting to emerge; examples include the Atlas Rx Alzheimer's tracking system (www.seniorcaresolutionsonline.com/atlas.html) and GPSit's Find & See (www.gpsit.com), which combines GPS and wireless cellular tracking technologies.



4.2. Health and wellness technologies: Includes a base station with or without two-way video, usually with proprietary peripheral sensors, such as BP cuff, scale, spirometer, glucometer, pulse and temperature readers, wired or wireless connectivity (e.g., Viterion (www.viterion.com), Honeywell HomMed (www.hommed.com), Philips (www.medical.philips.com/main/products/telemonitoring), WebVMC (www.webvmc.com), Vitel Care (www.vitelnet.com), Health Buddy (www.healthhero.com), etc.). Some are interactive and incorporate condition-specific branching logic. Imetrikus (www.imetrikus.com/products.asp) has a universal connectivity hub, MetriLink, which allows connecting off the shelf low-cost health products (blood pressure monitors, gloucometers, etc.) to download the data to the Imetrikus Personal Health Record, MediCompass, to be shared with health care professionals.

Tele-visits that entail two-way video are reimbursable, with limitations. Store and forward technologies (without two-way video) are only reimbursable in Alaska and Hawaii.

4.2.1. Wellness Monitoring Technologies:

4.2.1.1. Wearable: Value proposition may include better health outcome for the person, and reduced health care bills to payers.

BodyMedia

These technologies entail gross activity monitoring based on accelerometers as well as other sensors. Examples include simple pedometers, actigraphs (e.g., Minimitter's Actiwatch (www.minimitter.com/Products/Actiwatch/index.html)), and HomeFree's activity monitors to more sophisticated devices that incorporate physiological measurements, such as skin temperature and metabolic function (e.g., BodyMedia (www.bodymedia.com)). These technologies were originally designed mainly for self-managing fitness/wellness applications; **these devices rely on the user's compliance.** They work indoors as well as outdoors. There is some evidence that they do help in managing weight and weight-loss programs, along with dietary and exercise modifications, in obese populations [22 Subjective]; there is a dearth of evidence of their cost-effectiveness.

4.2.1.2. Environmental (passive)/non-wearable: The value proposition for these technologies encompasses coordination of care [23 Objective, 24 Objective], better health outcomes for the person 23 Objective, 24 Objective], reduced cost of care [25 Objective], reduced professional caregiver workloads and increased caregiver efficiency [25 Objective], peace of mind for informal caregivers and reduced informal caregiver burdens and strains [26 Objective, 27 Objective].

These systems are based on embedding sensors in the environment to monitor daily life activities/behavior (such as QuietCare and others including, HealthSense and GrandCare), monitoring activities of daily living (University of Virginia (marc.med.virginia.edu/projects_smarthomemonitor.html)), and monitoring sleep quality (University of Virginia (marc.med.virginia.edu/projects_naps.html), Elite Care (www.elitecare.com)). Mainly targeted at professional and informal caregivers for coordinating care and early detection of decline in function or health issues; do not require user's compliance. These systems work indoors only, mostly when a person is living alone. If the motion detectors are not pet immune, the presence of pets may affect the accuracy of the inferences and alerts generated by the system.


Elite Care Badge

4.2.1.3. Hybrid: Hybrid wearable and environmental wellness monitoring systems require a wearable RFID reader and tagging objects in the environment with RFIDs, and they monitor ADLs; these are still in the research phase (e.g., Intel and University of Washington (www.intel.com/research/prohealth)). These technologies require the

compliance of the user, and may not be scalable/practicable with existing technologies due to the low reliability and short battery life of the reader.

4.2.2. Telemedicine and telehealth: Telemedicine technologies are targeted at health care professionals and are used primarily by home health providers, physicians and hospitals, mainly in chronic disease management and for short-term follow-up after hospital discharges, whereas telehealth technologies encompass using them, along with educational information, in self-management of one's health.

The value proposition includes improved health outcomes and quality of care [21 Objective], increased caregiver/provider efficiency and reduced cost of care to payers [28 Objective]. Direct support for the effectiveness of these technologies in improving health is growing, but evidence on lowering health care costs is less certain [10 Objective, 21 Objective]. Outcome studies are generally scarce or inconsistent; more outcome oriented research is needed [21 Objective]. These technologies require users' compliance, and interventions based on these technologies are generally reimbursable with some limitations.

4.2.2.1. Traditional telemedicine: Includes a base station with or without two-way video, usually with proprietary peripheral sensors, such as BP cuff, scale, spirometer, glucometer, pulse and temperature readers, wired or wireless connectivity (e.g., Viterion (www.viterion.com), Honeywell HomMed (www.hommed.com), Philips (www.medical.philips.com/main/products/telemonitoring), WebVMC (www.webvmc.com), Vitel Care (www.vitelnet.com), Health Buddy (www.healthhero.com), etc.). Some are interactive and incorporate condition-specific branching logic. Imetrikus (www.imetrikus.com/products.asp) has a universal connectivity hub, MetriLink, which allows connecting off the shelf low-cost health products (blood pressure monitors, gloucometers, etc.) to download the data to the Imetrikus Personal Health Record, MediCompass, to be shared with health care professionals.

Tele-visits that entail two-way video are reimbursable, with limitations. Store and forward technologies (without two-way video) are only reimbursable in Alaska and Hawaii.

4.2.2.2. Ambulatory and wearable monitors: Ambulatory and wearable monitors: Ambulatory and wearable monitors connect via wire—or wirelessly—to a recoding device that sends the data. These include ambulatory electrocardiography device (also known as Holter monitors). An example of these systems is LifeWatch's (www.lifewatchinc.com/LWTpo_vsm.html) cardiac monitors that use a Bluetooth-enabled cell phone as a data recorder and connectivity gateway. These devices rely on the compliance of the users as well.

4.2.2.3. Purely interactive Q&A systems: These systems do not have dedicated peripheral measurement devices. An example of these technologies is ZumeLife (www.zumelife.com); these technologies are generally not reimbursable, except possibly under PACE and MA-SNPs.

4.2.2.4. Video phones and 2-way video stations: These devices are used to connect with a health care professional for telemedicine, televisits, and teleconsults; interventions with these technologies are generally reimbursable with limitations. An example of a simple system is KMEA's videophone (www.kmea.net).

4.2.2.5. Passive/environmental/non-wearable: The University of Virginia's bed monitor for vitals and clinical sleep assessment (under validation) and instrumented walker for gait and balance assessment are examples of this category of telemedicine/telehealth technologies that are under research; such technologies are generally not reimbursable, except possibly under PACE and MA-SNPs.

4.2.3. Medication compliance technologies: These technologies have monitoring, reminding, dispensing features and combinations thereof. Most of these technologies are stand-alone and are targeted at the seniors or the caregiver. Simple monitoring is offered by QuietCare. Intel and Oregon Health and Sciences University (OHSU) (www.orcatech.org/index.php) have prototypes of monitoring and reminding systems and Honeywell HomMed has a medication monitoring and reminding system as part of the telemedicine suite. The Med-eMonitor from Informedix (www.informedix.com) incorporates reminding and educational information/ instructions. The MD2 (www.md2.com) and CompuMed (www.compumed.com) products have the dispensing functionality but may require a professional caregiver to perform the loading and programming. Most products have usability/ user interface issues for elderly users. Many products can be found on the Internet (e.g. on www.epill.com).


MD2 Dispenser

These devices have the potential to improve health outcomes and reduce cost of care, and to provide peace of mind to informal caregivers, but are generally not reimbursable. There is some preliminary evidence of their effectiveness in improving medication compliance, but more objective evaluation studies, aiming to evaluate their impacts on health outcomes and the cost of care, are warranted.

4.2.4. Cognition: These technologies are fairly recent and they fall into three categories: stimulation and entertainment, assessment and reminder systems. These technologies are out-of-pocket expenses.

4.2.4.1. Stimulation and entertainment systems: The value proposition includes enhanced memory, delayed cognitive decline (and physical), improved quality of life, reduced caregiver burdens and reduced cost of care to payers. These include computer-based cognitive stimulation products that are founded on the plasticity property of memory; one example is PositScience (www.positscience.com). There is preliminary evidence that these technologies may have positive impacts on memory in the short term [29 Objective]. Some technologies incorporate embedded assessment capabilities; examples include Dakim (www.dakim.com), and OHSU's research (see below for comments on the assessment aspects).

Entertainment systems for both physical and mental stimulation, such as Nintendo Wii (wii.nintendo.com) and It's Never 2 Late (www.in2l.com), may have a positive impact on the quality of life of the user as well as potential for improved health outcome. These technologies may also enhance social interactions in group settings.

More objective evaluation studies are warranted to assess the impacts of these technologies.

4.2.4.2. Assessment technologies: The value proposition is early detection of cognitive decline for early interventions. Nexis and Dakim are examples of computer-based cognitive assessment tools. The embedded assessment is generally based on measuring response time, and response time is attention-dependent and hence may require broader environmental monitoring and complexity of understanding the context of the testing, if done in the home; response time may also depend on dexterity (which can be reduced by flaring arthritis), vision and hearing abilities; hence the assessment may not be always reliable. There are other Web-based versions of standard clinical assessments as well. A comprehensive evaluation of computer-based cognitive assessment is presented in [30].

Studies are needed to prove the validity of the results of such programs in the field under different assessment scenarios to prove their practicability.

4.2.4.3. Reminder and orthotics systems: Research on reminder systems is active at Intel research laboratories, the University of Toronto (www.ot.utoronto.ca/iatsl), the University of Rochester (www.cs.rochester.edu/u/kautz/ac), the University of Michigan, the University of Dundee (www.computing.dundee.ac.uk) and Accenture (www.Accenture.com). These technologies rely on environmental monitoring, including video monitoring, and complex context understanding, or hybrid monitoring. These systems, which are mostly in the research prototype phase, may not be scalable, due to high computational complexity. At this time it is unclear how effective these systems may be in the real world as they have not been fully evaluated in the field. More rigorous validation and evaluation studies are needed to prove the validity of the results of such systems and assess their effectiveness and cost-effectiveness in the field.

4.3. Social connectedness technologies: The value proposition is increased social connectedness, improved quality of life and potential for improved health outcome for both seniors and caregivers (primarily informal caregivers). These involve out-of-pocket expense to seniors and/or families. Literature on the types of technology available and its effectiveness is scarce. Commonly used means of communication in younger generations such as cell phones and computers are being adapted for elderly use, but few companies and researchers are looking at the problem in innovative ways.

Congregate care providers are starting to explore some of these technologies, e.g., Nintendo Wii, Dakim and It's Never 2 Late as they may enhance social interactions in group settings.

4.3.1. Phones: Amplified, big button phones provide basic functionality.

4.3.2. Cell phones: Most have usability issues. The JitterBug Cell Phone (www.JitterBug.com) is an example designed for senior users. These technologies have the capability to offer, in addition to basic communication functionality, different communication modalities such as video reminders, multimedia messaging to keep seniors connected with grandchildren, etc.

Jitterbug Cell Phone

4.3.3. Monitoring for social connectedness: Intel's presence lamp, solar displays for social health, and caller ID that pulls the picture and information about the caller and their relationship and presents the information to a person with Alzheimer's are examples technologies that help measure social interaction and provide feedback to the senior and caregivers in their network. The feedback displays were valued by elders and their caregivers, and have resulted in subtle and overt increases in social engagement [31 Subjective].

4.3.4. Senior friendly e-mail and web portal systems: It's Never 2 Late, GrandCare, Celery (www.mycelery.com, a paper to e-mail scanner), etc.

4.3.5. Video phones and 2 way video conferencing: Motorola's Ojo Video Phone (www.motorola.com/ojo) is an example; it requires broadband connectivity.

PS. *Some video phones are used conduct telehealth, tele-visits and tele-consults with a health care providers, which is a different context.*

Objective evaluation studies are needed to quantitatively assess the impacts of these technologies.

5. Barriers to Access and the Proliferation of Aging Services Technologies:

Seniors need many services including those provided by medical specialists, transportation, special equipment, rehabilitation, home health and personal care. The access barriers to these services include organizational, geographic and financial access, and naturally underserved populations face more of these barriers [32]. Information and communication technologies have many perceived benefits and the potential to alleviate some of the access barriers. These technologies also face major barriers to implementation which include: lack of access to capital by care providers, high initial cost with uncertain payoff due to fragmentation of the payment system, complex systems and lack of data standards that permit exchange of data, privacy concerns and legal issues [33].

Another barrier cited in the literature is shortage of outcome studies demonstrating the value of the technologies, especially regarding cost-effectiveness and efficiency. The success of these technologies almost always involves simultaneous investment in organizational changes, innovative business strategies and human capital [34].

In short, overarching requirements for the success of these technologies, and hence the technology-enabled care vision, include the ***interconnectivity*** between the different systems and ***interoperable information systems*** to guarantee completeness and continuity of information between all the care settings, including the home and long-term care settings, and hence continuity of care: EMRs, EHRs, PHRs, care coordination systems, care documentation and charge capture systems. In addition to acceptance and usability by end-users, and potential payment/reimbursement mechanisms or affordability (if out of pocket), these technologies need to demonstrate their value propositions in outcome-oriented field pilots, and possibly larger-scale demonstration projects. Finally, organizational changes, innovative business strategies and human capital are essential to the success of these technologies.

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State of Technology Barriers/Benefits Matrix – Safety Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Fall Detection/Prevention	Reliability is a requirement; false negatives carry a higher weight than false positives. Reliability information is scarce Effectiveness depend on the setting in which the technology is used, and response protocols Prevention is limited by the availability of caregiver	Sense of security Improved quality of life Improved health outcome in case of a fall	Reduced liability Improved professional caregiver efficiency Increased resident/ family satisfaction	Reduced care burdens	Peace of mind Reduced caregiver strains	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Safety Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Wearable Mostly pushbutton and/ or accelerometer and inclinometer based Examples include: LifeAlert, FallSaver, Stanley TABS, Tunstall	Limited by user's compliance Some could work outdoors, as well as indoors	Sense of security Improved quality of life Improved health outcome in case of a fall	Reduced liability Improved professional caregiver efficiency Increased resident/ family satisfaction	Reduced care burdens	Peace of mind Reduced caregiver strains	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Safety Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Environmental Mostly motion sensors based, sometimes in combination with other sensors Examples include: QuietCare, HealthSense, GrandCare, UVa's floor-vibrations fall detector; University of Missouri's Imaging-base fall detector Prevention systems include Samarion's imaging-based system in addition to bed and chair alarms	Pet immunity of motion detectors is important User's compliance is not required Indoors only Effectiveness depend on the setting in which the technology is used, and response protocols Prevention limited by available of caregivers	Improved sense of security Improved quality of life Improved health outcome in case of a fall	Reduced liability Improved professional caregiver efficiency Increased resident/ family satisfaction	Reduced care burdens	Peace of mind Reduced caregiver strains	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Safety Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Mobility Aids wheelchairs and walkers are being technologically enhanced to enable seniors to navigate safely in their environments University of Virginia's, CMU's and University of Michigan's walker are examples	User's compliance is required Many still in research phase Cost is likely to be prohibitive without reimbursement Liability is a potential barrier	Added independence and freedom Improved quality of life Improved health outcome	Increased resident/ family satisfaction	Reduced care burdens	Peace of Mind Reduced caregiver burdens	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Safety Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Stove Use Detectors Purely environmental These technologies monitor stove use to automatically turn the stove off after a period of time or inferring a forgotten stove Examples include University of Virginia's system, and commercially available StoveGuard and Tunstall gas shut-off valve.	Some devices limited to electric stoves, others limited to gas ranges (no manufacturer provides both types)	Improved sense of security Improved quality of life Reduced risk of fire damage, and insurance	Reduced liability Improved professional caregiver efficiency Reduced risk of fire damage, and insurance Increased resident/ family satisfaction	Reduced care burdens	Peace of mind Reduced caregiver strains Reduced risk of fire damage, and insurance	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Safety Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Smoke and Temperature Monitors Purely environmental Stanley, Honeywell, and GE have these products	Wired (not easy to retrofit), wireless (easier to retrofit) Battery life may become an issue with some units	Improved sense of security Improved quality of life Reduced risk of fire damage, and insurance	Reduced liability Improved professional caregiver efficiency Reduced risk of fire damage, and insurance Increased resident/ family satisfaction	Reduced care burdens	Peace of mind Reduced caregiver strains Reduced risk of fire damage, and insurance	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Safety Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Door locks Based on access control technology, currently targeted mainly at institutional settings Some of these technologies do not entail wearing or carrying an ID Badge, pendant or wrist band, and rely on numeric keypads or biometrics (finger print) or a combination of the two Vigil, Stanley etc. offer these products	Currently meant for institutional settings Badge-based systems require the compliance of the user Systems that utilize the wearable badges rely on the user's compliance	Improved sense of security Smart deterrents (like the ones employed by EliteCare) may enhance sense of independence, and quality of life	Reduced liability Improved professional caregiver efficiency Increased resident/ family satisfaction	Reduced care burdens	Peace of mind Reduced caregiver strains	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Safety Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Wander management systems Requires a wearable ID badge, pendant or wrist band, and hence the user's compliance HomeFree, and Vigil have these products for institutional settings Oatfield Estate also implemented this functionality in their system	Currently meant for institutional settings Systems that utilize the wearable badges rely on the user's compliance	Improved sense of security Smart deterrents (like the ones employed by EliteCare) may enhance sense of independence, and quality of life	Reduced liability Improved professional caregiver efficiency Ability to locate wanderers quickly Accurate record of wandering events may lead to better coordinated care Increased resident/ family satisfaction	Reduced care burdens Ability to locate wanderers quickly Accurate record of wandering events may lead to better coordinated care	Peace of mind Ability to locate wanderers quickly Reduced caregiver strains	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Wellness Monitoring Technologies - Wearable Gross activity monitoring based on accelerometers as well as other sensors; examples include simple pedometers, actigraphs to more sophisticated devices that incorporate physiological measurements, such skin temperature Mainly for self-managing fitness/ wellness Examples include Minimitter Actiwatch, and Bodymedia	Rely on the user's compliance They work indoors as well as outdoors Visual, auditory, speech disabled elderly will not be able control some devices Other physical or cognitive impairments may limit the use of the technology in the elderly Some payers are encouraging their use and starting to consider covering them	Improved health outcomes Improved quality of life Empowerment and self-directed health (e.g. weight loss management)	Potential added revenue opportunities if a service provider is in the loop Opportunity for prevention, early detection and intervention	(if involved) More longitudinal health information available/better diagnosis and treatment Opportunity for prevention, early detection and intervention	More informed about senior's health Improved communication regarding health with senior and professional caregiver Opportunity for prevention, early detection and intervention	Reduced cost of care through prevention, early detection and intervention

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Non-wearable Embedding sensors in the environment to monitor daily life activities/ behavior, ADLs, and sleep quality Mainly targeted at the professional and informal caregiver for coordinating care and early detection of decline in function or health issues Examples include QuiteCare, HealthSense, Grand Care, Elite Care, and University of Virginia	Do not require user's compliance Work indoor only, mostly on a person living alone Pet immunity feature of the motion detectors is important Technology could be viewed as an invasion of privacy	Prolonged independence Improved health outcome Improved quality of life	Potential for capturing lost revenue/added revenue opportunities Coordination of care Improved care provider efficiency Reduced caregiver turnover	Coordination of care Improved data regarding the senior's health Improved diagnosis/ better health outcomes	More informed about senior's health Improved communication with senior and professional caregiver Reduced burdens and strains of care	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Hybrid Hybrid wearable and environmental wellness monitoring systems require a wearable RFID reader and tagging objects in the environment with RFIDs, and they monitor ADLs Still in research phase e.g. Intel and University of Washington	Require compliance, and may not be scalable/ practicable (reliability and battery life of the reader)	Prolonged independence Improved health outcome Improved quality of life	Potential for capturing lost revenue/added revenue opportunities Coordination of care Improved care provider efficiency Reduced caregiver turnover	Coordination of care Improved data regarding the senior's health Improved diagnosis/ better health outcomes	More informed about senior's health Improved communication with senior and professional caregiver Reduced burdens and strains of care	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Telemedicine & Telehealth **Traditional Telemedicine Stations** Targeted at the professional caregiver and are used primarily by home health, physician, and hospitals mainly in chronic disease management and for short-term follow-up post-discharge from hospital Examples include Honeywell HomMed, Viterion, Phillips, Health Buddy, and numerous Universities	Require compliance of the user Limited by capacity of call center/ processing limitations Technology could be viewed as an invasion of privacy Some equipment can be relatively expensive	Prolonged independence Improved health outcome Improved quality of life	Potential for capturing lost revenue/added revenue opportunities Coordination of care Improved care provider efficiency	Coordination of care Improved data regarding the senior's health Improved diagnosis/ better health outcomes	More informed about senior's health Improved communication with senior and professional caregiver Reduced burdens and strains of care	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Ambulatory and Wearable Monitors They connect via wire or wirelessly to a recoding device that sends the data These include cardiac event and Holter monitors An example of these systems is LifeWatch's cardiac monitors that use Bluetooth enabled cell phone as a data recorder and connectivity	Require compliance of the user Limited by capacity of call center/ processing limitations Technology could be viewed as an invasion of privacy Some equipment can be relatively expensive	Prolonged independence Improved health outcome Improved quality of life	Potential for capturing lost revenue/added revenue opportunities Coordination of care Improved care provider efficiency	Coordination of care Improved data regarding the senior's health Improved diagnosis/ better health outcomes	More informed about senior's health Improved communication with senior and professional caregiver Reduced burdens and strains of care	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Purely Interactive Q&A Systems These systems do not have dedicated peripheral measurement devices, an example of these technologies is ZumeLife gateway These devices rely on the compliance of the user as well; these technologies are generally not reimbursable, except possibly under the PACE and MA-SNPs	Require compliance of the user Limited by capacity of call center/ processing limitations Technology could be viewed as an invasion of privacy Some equipment can be relatively expensive	Prolonged independence Improved health outcome Improved quality of life	Potential for capturing lost revenue/added revenue opportunities Coordination of care Improved care provider efficiency	Coordination of care Improved data regarding the senior's health Improved diagnosis/ better health outcomes	More informed about senior's health Improved communication with senior and professional caregiver Reduced burdens and strains of care	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Video Phones and 2-way Video Stations These devices are used to connect with a health care professional for telemedicine, televisits, and teleconsults; interventions with these technologies are generally reimbursable with limitations. An example of a simple system is KMEA's videophone	Require compliance of the user Limited by capacity of call center/ processing limitations Technology could be viewed as an invasion of privacy Some equipment can be relatively expensive	Prolonged independence Improved health outcome Improved quality of life	Potential for capturing lost revenue/added revenue opportunities Coordination of care Improved care provider efficiency	Coordination of care Improved data regarding the senior's health Improved diagnosis/ better health outcomes	More informed about senior's health Improved communication with senior and professional caregiver Reduced burdens and strains of care	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Passive/ Environmental/ Non-wearable University of Virginia's bed monitor for vitals and clinical sleep assessment (under validation) and instrumented walker for gait and balance assessment are two examples of this category of telemedicine/telehealth technologies that are under research; such technologies are generally not reimbursable, except possibly under the PACE and MA-SNPs	Does not require the compliance of the user Technology could be viewed as an invasion of privacy Some equipment can be relatively expensive	Prolonged independence Improved health outcome Improved quality of life	Potential for capturing lost revenue/added revenue opportunities Coordination of care Improved care provider efficiency	Coordination of care Improved data regarding the senior's health Improved diagnosis/ better health outcomes	More informed about senior's health Improved communication with senior and professional caregiver Reduced burdens and strains of care	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Medication Compliance Technologies Most technologies are stand-alone and are targeted at the senior or the caregiver Simple monitoring is offered by QuietCare. Intel and OHSU have prototypes of monitoring/ reminding systems and HomMed has a med monitoring and reminding system as part of their telemedicine suite MD2 has the dispensing functionality	Most products have usability/ user interface issues Some seniors have complicated medication regiments that some technologies are unable to accommodate Dispensing systems require a professional caregiver to load and program them	Improved compliance Better health outcomes	Improved quality of care	Improved compliance Better treatment plans made on compliance outcomes	Reduced caregiver strains	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Cognition Simulation and Entertainment Systems Computer based cognitive stimulation with embedded assessment examples include Dakim, OHSU's research Cognitive stimulation could be effective and may have positive impact on cognitive health outcome in the short term Entertainment systems for both physical and metal stimulation: Nintendo Wii and It's Never 2 Late	Mostly research phase technology Little evidence of outcomes	Improved quality of life Improved cognition and/ or function Prolonged independence Opportunity for social interaction in congregate settings	Improved resident and family satisfaction Competitive edge	Possible improved health outcomes	Improved satisfaction Reduced caregiver burdens	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Assessment Systems The embedded assessment is generally based on measuring response time, and response time is attention dependent and hence may require broader environment monitoring and complex context understanding; response time may also depend on dexterity (flaring arthritis), vision, and hearing abilities, hence the assessment may not be reliable	Mostly research phase technology Maybe subject to variability due to extraneous factor including dexterity, vision acuity, distractions and familiarity with the input device Requires validation	Potential for early detection, and intervention to improve health outcomes	Potential for standardized longitudinal assessment Opportunity for early detection, and intervention Improved care provider efficiency	Potential for standardized longitudinal assessment Reduced caregiver workloads	Opportunity for early detection, and intervention	Reduced cost of care

State of Technology Barriers/Benefits Matrix – Health and Wellness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Reminder and Orthotics Systems Reminding Systems University of Toronto, University of ROchester, University of Michigan, University of Dundee, Intel research, and Accenture Rely on environmental monitoring including video monitoring and complex context understanding, or hybrid monitoring	May not be scalable, due to high computational complexity Unsure how effective they are as they are not evaluated in the field yet	Prolonged independence	Reduced care demands	Reduced caregiver burdens/ workloads	Peace of mind Reduced caregiver strains	Reduced cost of care

State of Technology Barriers/ Benefits Matrix – Social Connectedness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Phones Adapted landline phones for senior use, include Amplified sound, big button phones, Caller Id with pictures	Most of these products are aesthetically unappealing	Improved quality of life through increased social interaction Reduced isolation Improved quality of life	Improved client satisfaction	Improved communications	Improved communications	Most technologies and programs are self elected, and out of pocket
Cell Phones – Cellular phones intended for senior's use JitterBug Cell Phone is an example of a cell phone designed for senior users	Most have usability issues Have the potential to deliver additional value added services	Improved quality of life through increased social interaction Reduced isolation Potential for improved health outcome	Improved client satisfaction Potential to generate revenue streams from value added services	Improved communications	Improved communications	Most technologies and programs are self elected, and out of pocket Has potential for reduced cost of care

State of Technology Barriers/ Benefits Matrix – Social Connectedness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Social Monitoring Tracking an individual's reactions with others, research is mainly lead by Intel Research projects include a presence lamp to notify senior a friend or family member is available and a web-based measure of social interaction	Still in research phase Most effective method of promoting social interaction is unclear	Improved quality of life through increased social interaction Reduced isolation Potential for improved health outcome	Improved client satisfaction Potential to generate revenue streams from value added services	Improved communications	Improved communications	Reduced health care cost

State of Technology Barriers/ Benefits Matrix – Social Connectedness Technologies						
Technology – Description	**Requirements Advantages Disadvantages**	**Value to Senior**	**Value to Care Provider**	**Value to Professional Caregiver**	**Value to Informal Caregiver**	**Value to Payer**
Senior friendly e-mail & web portal Efforts have been made to make the internet and its services more available to seniors It's Never 2 Late, GrandCare, Celery (paper to e-mail scanner) etc.	Usability and awareness of product limit adaptation	Improved quality of life through increased social interaction Reduced isolation Potential for improved health outcome	Improved client satisfaction Potential to generate revenue streams from value added services	Improved communications	Improved communications	Most technologies and programs are self elected, and out of pocket Has potential for reduced cost of care
Video Phones & 2-way conferencing – Phones offering both voice and video to improve social interaction Motorola's Ojo Video Phone.	Cost prohibitive Require broadband connectivity Usability and awareness limit adoption	Improved quality of life through increased social interaction Reduced isolation Potential for improved health outcome	Improved client satisfaction Potential to generate revenue streams from value added services	Improved communications	Improved communications	Most technologies and programs are self elected, and out of pocket Has potential for reduced cost of care

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About Blue Shield of California Foundation:

blue shield of california foundation

An Independent Licensee of the Blue Shield Association

Blue Shield of California Foundation is committed to making health care effective, safe and accessible for all Californians, particularly underserved people, and to ending domestic violence.

Goals:

- Universal health coverage for all Californians
- Health care that is effective, safe, affordable and accessible
- Domestic violence prevention

About CAST

The Center for Aging Services Technologies (CAST) is leading the charge to expedite the development, evaluation and adoption of emerging technologies that will transform the aging experience.

CAST four focus areas:

1. Driving a global vision of how technologies can improve the quality of life for seniors while reducing health care costs;
2. Accelerating technology research and development through pilot evaluations with seniors;
3. Advocating to remove barriers to the rapid commercialization of proven solutions; and
4. Promoting dialogue about standards to ensure interoperability and widespread access to aging-services technologies.

CAST is now an international coalition of more than 400 technology companies, aging-services organizations, businesses, research universities and government representatives working together under the auspices of the American Association of Homes and Services for the Aging (www.aahsa.org). The members of AAHSA help millions of individuals and their families every day through mission-driven, not-for-profit organizations dedicated to providing the services that people need, when they need them, in the place they call home.

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