



**U.S. Department of Health and Human Services  
Assistant Secretary for Planning and Evaluation  
Office of Disability, Aging and Long-Term Care Policy**

# **REPORT TO CONGRESS:**

  

# **AGING SERVICES TECHNOLOGY STUDY**

**June 2012**

## **Office of the Assistant Secretary for Planning and Evaluation**

The Office of the Assistant Secretary for Planning and Evaluation (ASPE) is the principal advisor to the Secretary of the Department of Health and Human Services (HHS) on policy development issues, and is responsible for major activities in the areas of legislative and budget development, strategic planning, policy research and evaluation, and economic analysis.

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The Office of Disability, Aging and Long-Term Care Policy (DALTCP), within ASPE, is responsible for the development, coordination, analysis, research and evaluation of HHS policies and programs which support the independence, health and long-term care of persons with disabilities--children, working aging adults, and older persons. DALTCP is also responsible for policy coordination and research to promote the economic and social well-being of the elderly.

In particular, DALTCP addresses policies concerning: nursing home and community-based services, informal caregiving, the integration of acute and long-term care, Medicare post-acute services and home care, managed care for people with disabilities, long-term rehabilitation services, children's disability, and linkages between employment and health policies. These activities are carried out through policy planning, policy and program analysis, regulatory reviews, formulation of legislative proposals, policy research, evaluation and data planning.

This report was prepared under contract #HHSP23320095647WC between HHS's ASPE/DALTCP and the National Opinion Research Center. For additional information about this subject, you can visit the DALTCP home page at [http://aspe.hhs.gov/\\_/office\\_specific/daltcp.cfm](http://aspe.hhs.gov/_/office_specific/daltcp.cfm) or contact the ASPE Project Officer, Hakan Aykan, at HHS/ASPE/DALTCP, Room 424E, H.H. Humphrey Building, 200 Independence Avenue, S.W., Washington, D.C. 20201. His e-mail address is: [Hakan.Aykan@hhs.gov](mailto:Hakan.Aykan@hhs.gov).

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This report was prepared under the leadership of the Office of Disability, Aging, and Long-Term Care Policy in the Office of the Assistant Secretary for Planning and Evaluation (ASPE) at the U.S. Department of Health and Human Services (DHHS), through a competitively awarded contract to NORC at the University of Chicago and the LeadingAge Center for Aging Services Technologies (CAST), with funding and close cooperation from the Office of the National Coordinator for Health Information Technology (ONC).

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## **ABSTRACT**

Older adults, people with disabilities, and those who provide services and supports to these individuals utilize a variety of aging services technologies (ASTs) to achieve and maintain maximum physical function, to live as independently as possible, to study and learn, and to participate in and contribute to society. The potential benefits offered by these technologies are of great interest because of the aging of the U.S. population and the accompanying increase in caregiving responsibilities among family and friends, and because of the stresses being placed on the health-care system as a result of the increase in the number and complexity of chronically ill and disabled adults. This report presents findings from the Aging Services Technology Study, which was mandated in Section 13113(c) of the American Recovery and Reinvestment Act of 2009 (ARRA) (Public Law 111-5) as “a study of matters relating to the potential use of new aging services technology to assist seniors, individuals with disabilities, and their caregivers throughout the aging process.” It provides a detailed discussion of ASTs related to eight care issues; a discussion of the interplay of ASTs with health information technology; and an exploration of barriers to the development and adoption of ASTs, including a discussion of potential strategies that can be implemented to address these barriers. The report provides a systematic framework for considering the existing evidence supporting the effectiveness of a diverse array of ASTs, information pertaining to ASTs that are under development, and those that are available outside of the U.S., thereby fulfilling the legislative mandates stipulated in ARRA.



# EXECUTIVE SUMMARY

## Introduction

Technology has become an indispensable aspect of modern life. In addition to common technologies such as computers and cellular phones that improve the efficiency and quality of our lives, technology can also support older adults and people of all ages with disabilities, as well as those who provide services and supports to these individuals. The potential benefits of these technologies are of particular relevance because of the aging of the U.S. population and the corresponding increase in the caregiving responsibilities among family and friends, and because of the stresses on the health-care system resulting from the increase in the number and complexity of chronically ill and disabled adults. Aging Services Technologies (ASTs) hold promise for addressing a number of key care issues that affect the elderly and individuals with disabilities, and their formal and informal providers of services and supports. The purpose of this report is to present findings from the Aging Services Technology Study, mandated in Section 13113(c) of the American Recovery and Reinvestment Act of 2009 (ARRA) as “a study of matters relating to the potential use of new aging services technology to assist seniors, individuals with disabilities, and their caregivers throughout the aging process.”

For the purposes of Section 13113(c) of ARRA, ASTs are defined as any “health technology that meets the health-care needs of seniors, individuals with disabilities, and the caregivers of such seniors and individuals.” This is a very broad definition that could include potentially thousands of technologies that are currently available or in development. To ensure that the Aging Services Technology Study is both comprehensive and systematic in addressing the legislative requirements for the study for different potential audiences, a framework for the study was developed that builds upon previous studies and utilizes a selected set of care issues. The care issues included in this study were chosen based on a review of published literature, input from experts in aging, disability, and technology, and feedback from a Technical Advisory Group that was convened for this study. This process resulted in a list of care issues that affect a significant number of people, are associated with significant costs, and have the potential to be improved through the use of non-pharmaceutical ASTs. For each care issue, the study reviews its prevalence and the magnitude of its associated personal, financial, and caregiving costs. Each chapter also reviews currently available ASTs that address problems associated with the care issue (including a synthesis of the evidence of their effectiveness in addressing these problems), examines ASTs that are under development, and analyzes the extent to which ASTs are available in other developed countries but not in the United States. The study also presents a separate discussion of the interplay of ASTs with health information technologies. In addition, it details barriers to development and adoption of ASTs and potential strategies for addressing them that are applicable to all care issues covered in this study.

## Summary of Overall Findings

This study explores application of ASTs to a number of care issues that are highly relevant to older adults and people with disabilities. Like the care issues they address, these ASTs are numerous and varied. Some technologies that are currently available have single, straightforward functions, such as detecting falls; others, like activity monitoring systems, perform multiple functions. Further, although some ASTs are designed to support a single user (e.g. consumers, caregivers, providers), others have design features that support multiple users and help facilitate communication among them. Some ASTs, such as technology-enhanced wheelchairs and canes are variations on common appliances or assistive devices, while others are complex systems in which multiple technologies are integrated into a suite of supportive services aimed at preserving multiple aspects of independence.

In addition to the wide variety of existing ASTs, there are new technologies under development that are applicable to all of the care issues discussed in this report. Many of these emerging technologies offer improvements to existing products and technology-enhanced services. These improvements often involve modifications to functionality, design, or the interface between the technology and caregivers or providers. In contrast, many other ASTs under development are entirely new products that approach the provision of services and supports in novel, innovative ways.

There is substantial heterogeneity in the amount and quality of the available evidence supporting the efficacy and cost-effectiveness of the ASTs examined in this report. Some ASTs lack compelling evidence of their benefits simply because they are too new to have undergone thorough investigation. Other technologies have been studied more extensively, but with mixed results. A number of factors may be responsible for these mixed results, including an actual lack of efficacy, inadequate or inappropriate testing procedures, and small sample sizes. In addition, many of these studies approach cost-effectiveness simplistically, do not engage payers or involve aspects related to financial incentives. There are, however, a number of ASTs that have been studied with robust, reproducible results. For a great majority of ASTs, these results provide strong evidence of both clinical and economic benefits, suggesting that specific ASTs can help improve health outcomes, preserve individuals' ability to continue living independently in the community, improve care coordination, and reduce the cost of care. In some cases, ASTs can also improve the quality of life of informal caregivers by relieving certain physically and emotionally burdensome caregiving duties, and improve quality of care by increasing providers' access to accurate, timely, and relevant health information.

This study also examines the availability and use of ASTs outside of the United States. ASTs that are currently available in other countries are often similar or identical to those available in the U.S., but enjoy broader acceptance and penetration abroad, particularly in the European Union. This is due in large part to government initiatives to

encourage AST adoption and use, such as increasing public awareness and available incentives, as well as efforts to build and maintain the infrastructure to support them.

The interface between health information technology (health IT) and ASTs that collect and can transmit important health data offers additional promise for improved care that has the potential to benefit consumers, caregivers, and providers alike. Health IT ensures that the data can be properly shared and leveraged in the context of other health information. For example, when data generated by ASTs are incorporated into an electronic health record, the result is a permanent medical record that can be shared among providers and that offers a more complete view of patients' health and treatment history. Thus, the interplay of health IT and ASTs can facilitate communication, support clinical decision-making, and enhance quality of patient care, regardless of geographic location or institutional setting. Although this potential has been recognized by providers, AST developers, and other stakeholders, there are challenges associated with the AST-health IT interplay, mostly related to challenges associated with health IT development and implementation.

Development and adoption of ASTs is hampered by various important barriers. An important barrier is the widespread lack of awareness of ASTs, which results in underutilization among consumers, caregivers, and providers. Among those who are aware of these technologies, AST use is limited by concerns about evidence of effectiveness, stigma, privacy and security, usability, impact on workflow, difficulties with interoperability, liability, and affordability. Despite these challenges, all of these issues are being addressed gradually as ASTs garner increased attention among consumers, researchers, payers, and policy-makers alike. Indeed, this study finds a range of potential strategies that can address these barriers, spark AST innovation, and encourage adoption. These strategies include focused efforts to increase awareness and expand the AST consumer base and improve alignment of existing programs and incentives to encourage AST development and adoption.

## Summary of Care Issues Findings

### *Falls*

Falls often result from an unfavorable combination of physical, behavioral, and environmental factors. As a result, fall-related technologies address multiple fall risk factors. These include tools for fall risk assessment, prevention, and detection. ASTs are effective in fall assessment and prevention functions and, when combined with health IT solutions, they facilitate clinical decision-making and the planning of clinical interventions. Many fall detection devices successfully detect falls, but some are more effective and reliable than others in that they can generate alarms that can be acted upon by providers and caregivers. Fall-related technologies under development include canes and shoe insoles that collect data to assess fall risk, improved algorithms for calculating fall risk, sensory stimulation devices to improve balance, wireless devices that transmit fall alerts and the patient's location to a call center, smart phone

applications for fall detection and alert transmission, and devices that detect falls in the home through vibrations in the floor. Although many European countries use technologies similar to those employed in the U.S., these devices have been integrated into existing care delivery systems more effectively in Europe and thus adoption is more widespread than in the U.S.

### ***Chronic Disease Management***

Most ASTs for chronic disease management address one or more issues that are central to successful disease management: 1) frequent monitoring; 2) communication and care coordination; and 3) promotion of effective and sustained self-care. These technologies include telehealth; remote patient monitoring devices that can be used to monitor, record, and transmit health information to physicians; and clinical decision support for physicians. Evidence supporting the efficacy of these technologies varies by device and health condition. For instance, while remote patient monitoring devices benefit patients with diabetes and heart failure, telehealth has yielded mixed results treating heart failure patients, but promising results for chronic obstructive pulmonary disease and hypertension. A number of innovative technologies for chronic disease management are under development. These include cloud-computing technologies, nanotechnology that allows physiological monitoring and data transmission through small devices like contact lenses, implantable monitors that overcome compliance issues, and artificial organs. There is little difference between chronic disease management technologies available in the U.S. and those available in other developed countries. However, in Canada and Europe, greater efforts have been made to promote adoption through investments in technology, demonstration projects, and utilization of the medical home model to provide continuity and efficiency of care.

### ***Medication Management***

Medication prescription and administration errors, non-adherence, side effects, and adverse drug interactions are challenges that can be addressed by medication management technologies. These technologies include electronic prescribing; computerized physician order entry; clinical decision support systems; telepharmacy; and devices that dispense medication, provide reminders, and in some cases monitor adherence. These technologies increase physician access to patients' medical histories and have been shown to reduce medication errors. Studies on telepharmacy show that telepharmacy may improve medication management. Evaluations of dispensing, reminding, and monitoring devices suggest these ASTs may improve adherence and lower rates of hospital and emergency room visits. Advances in medication management technology aim to enhance both patient adherence and safety using advanced reminding and/or dispensing functions; and provision of context-based reminders, including ascertainment and monitoring of medication ingestion and potential drug or food interactions. Several unique medication management technology projects are under way in the European Union, including mining hospital repositories for data to assess risks for, prevalence, and probable causes of adverse drug events; efforts to

improve care and management by improving interoperability in Europe; and medication identification systems for the visually impaired.

### ***Cognitive Impairments***

Technologies that address cognitive impairments and decline include those focusing on prevention, detection, and intervention. Technology-enhanced prevention efforts typically focus on maintaining cognitive capacity through word games, social contacts, and other types of task-specific daily stimulation. Detection-oriented technologies include cognitive testing and home-based activity monitoring as well as advanced neuroimaging techniques. Interventions can involve technology-enhanced memory aids, GPS-based anti-wandering systems, and memory-targeted electronic games. Task-specific games tend to have limited benefits on long-term cognitive health, and the effectiveness of efforts to prevent depression and decline via social contact are as yet unproven. Technologies that detect cognitive impairments and decline are well-tested and effective in most cases, while intervention methods vary in their effectiveness. New technologies often enhance the capabilities of existing devices or systems, while others involve advanced home monitoring and data transmission. Some European countries leverage similar technologies but with a heavy emphasis on and government investment in “social alarms” (i.e., systems that provide various cognitive supports to patients and allow caregivers to monitor them remotely).

### ***Sensory Impairments***

ASTs addressing sensory impairments can be classified as intervention options, auxiliary and adaptive aids, technologies that address household responsibilities, and those focusing on navigation. Interventions related to hearing impairment include hearing aids, middle-ear implants, cochlear implants, and electric acoustic stimulation; vision-oriented technologies include lenses and magnification devices. Technologies that combine hearing and vision functions are also available. Auxiliary aids and adaptive equipment can also compensate for sensory loss. These include talking watches, phones, and electronic devices with large buttons. A number of technologies are available to facilitate computer use and reading among people with visual and hearing impairments, and devices that translate text to speech, amplify sound, and modify smart phones to aid the hearing-impaired are also currently available. ASTs that assist with navigation such as GPS units and technology-enhanced supports such as intelligent walkers and canes can help older adults with visual impairments retain functions that are critical for independent living. These technologies will benefit individuals with acquired sensory impairments due to aging, as well as children, youth, and adults with developmental and other disabilities. Innovative technologies are under development to address challenges associated with sensory impairment. These include surgical options (artificial retinas, and retinal and cochlear implants) as well as enhanced cell phones and other technologies. A particularly innovative effort in the European Union aims to address challenges in the home with a technology platform that integrates television, phone, and computers, and transmits audio signals to wireless

hearing aids. A similar effort seeks to integrate devices and transmit visual information to smart phones.

### ***Depression***

A number of ASTs target depression-related problems such as challenges associated with diagnosis, lack of access to mental-health professionals and services that results in inadequate treatment, perceived stigma on the part of affected individuals, loss of motivation and sense of purpose, and social isolation. These technologies include telemental health applications, internet and social networking applications, computer-based monitoring and symptom questionnaires, wearable and embedded monitoring devices, and software- and internet-based games. All of these technologies are intended to increase social contacts and/or interactions with health-care providers, which can mitigate symptoms of depression. A number of technologies under development attempt to leverage the internet to decrease social isolation and loneliness, while others attempt to better identify symptoms of depression using voice recognition software and physiological symptom monitoring. Other countries are similarly focused on increasing social connectedness and contact with caregivers via the internet and integrated technology platforms in the home.

### ***Mobility Impairments***

ASTs that address mobility impairments include wheeled mobility equipment, mobility aids (e.g., chairs, canes, walkers), rehabilitative devices (e.g., aids to improve balance, walking, and posture), and multi-purpose devices (e.g., wheelchairs with additional lifting, stair climbing, and exercise functions). These devices are mostly well-recognized as safe and effective. Several technologies are currently under development that enhance the functionality of existing technologies to create “intelligent” mobility aids such as autonomous wheelchairs, smart/robotic walkers, and mobile robotic assistants, as well as improved rehabilitative devices. Similar efforts to create intelligent or enhanced mobility aids are under way in other countries. Scientists in Japan and Israel are designing robotic suits that increase users’ strength and mobility with a combination of supportive braces and sensors that move the AST in concert with the users’ natural body movements.

### ***Functional Decline***

Addressing the physical aspects of functional decline requires ongoing assessment of disability precursors, timely detection of events associated with functional decline, and effective interventions. Functional decline may be the result of aging or of developmental or acquired disabilities, or “functional limitations,” such as muscular dystrophy or other neuromuscular diseases, ALS, and multiple sclerosis. Examples of ASTs that address these challenges include wearable devices (e.g., activity monitors that record gait, balance, physical activity, energy expenditure), passive monitoring systems (e.g., video- or sensor-based home monitoring that tracks sleep cycles, activity levels, falls, and/or changes in routine that may signal of illness),

and interactive technologies (e.g., online symptom questionnaires, medication reminders, and wellness systems that involve patients and caregivers in symptom monitoring and care). Passive monitoring ASTs have the most robust testing and support in the literature, whereas evidence on the effectiveness of wearable devices and wellness platforms is more limited and mixed. Technologies under development focus on new approaches to detecting changes in gait and balance, stimulation of the extremities to improve gait and balance, systems that integrate multiple data streams in the home to identify declining function, and “smart” devices (e.g., walkers, canes, and home systems) with advanced functionalities to detect physical barriers in the environment, assist the user, and transmit an alert to caregivers in an emergency. International efforts to develop, validate, and promote use of assistive technologies in the home are widespread. European countries have made greater strides in the adoption and integration of certain ASTs into their health-care systems (e.g., social alarms, wearable activity monitors, physiological monitors, and telehealth). Robotic technologies under development in Japan and Israel (described in the mobility impairment chapter as well) are unique technologies that can also provide benefit to individuals with functional impairments in need of walking assistance.

## **Aging Services Technologies and Health Information Technology**

If effectively integrated with one another, ASTs and health information technology (IT) can offer providers more complete health information that could enhance the quality of clinical care and decision-making. ASTs could interface with a range of health IT systems, including those that store and report information such as laboratory results to those that share information about patients across institutional and geographic boundaries, as well as systems that provide clinicians with real-time alerts and support decision-making based on all available patient information. Recent initiatives and policies encouraging the adoption of health IT, coupled with a growing awareness of the importance of both health IT and ASTs on the part of providers, patients (including children, youth, and adults with developmental disabilities), and caregivers suggest that the next few years may bring new opportunities to leverage these resources for the collective benefit of all stakeholders. For example, home-based medication management systems that can transmit data to the user's health-care provider can supplement data from electronic health records in a manner that gives clinicians detailed information on various parameters related to patients' medication adherence, information that would not otherwise be available. Telemental health strategies such as those employed by the Veterans Administration offer another example of the interface of ASTs and health IT in this area. Although meaningful efforts are under way to facilitate the interplay between health IT and ASTs, significant challenges remain before this goal is met, including important issues related to interoperability, privacy, and security.

## **Barriers to Aging Services Technology Adoption, Use, and Development**

Despite the evidence supporting the utility of a number of ASTs, there are significant barriers to AST adoption and use. These barriers apply to all key stakeholders such as patients (including children, youth, and adults with developmental disabilities), providers, caregivers, payers, and those involved in technology development. Barriers involve issues related to lack of awareness and evidence of effectiveness, stigma, privacy and security concerns, usability and computer literacy, provider workflow, interoperability, liability, alignment of incentives, and investment. We recognize that lack of financing and financial incentives can constitute an obvious barrier to the development, adoption and use of ASTs. However, consideration of options for additional or alternative financing is not a focus of this study. Hence, this study focuses on strategies that could be reasonably implemented without major shifts or expansions in health-care financing. Potential strategies to address barriers to AST adoption and use include increased education of providers and consumers, an enhanced role for professional organizations in the dissemination of AST knowledge, effective use of privacy and security measures, testing and development that maximizes usability for both providers and consumers, as well as ongoing efforts to address interoperability.

Strategies to address AST development barriers include organizing the market through professional consortia that foster partnerships between technology companies, aging services providers, and researchers. Identification and promotion of business models that support the design and evaluation of these technologies offer additional opportunities to address these challenges. Large employers could play a role by encouraging their health insurance providers to redesign employee benefits programs to provide more incentives to employees who engage in technology-enabled self-management, fitness, or other wellness activities. Employers could also negotiate discounts with pre-screened technologies or services as part of their employee benefits packages. These approaches would result in increased demand for ASTs, thereby encouraging investment and development. Dissemination of evidence supporting AST adoption would ultimately increase the market size and encourage investments in the development of new and improved technologies that spur innovation.

## **Conclusions**

While strategies designed to address most of the care issues covered in this report could be informed by additional research, existing evidence suggests that ASTs can and do help address a wide range of critical issues affecting the elderly, individuals of all ages with disabilities, and those who provide health and long-term care support and services to these groups. These issues are prevalent and costly in terms of health care dollars, caregiver burden, and patient quality of life. Technology developers are increasingly aware of consumer demands for not only clinical functionality, but also usability of the devices and the data for patients, caregivers, and providers. For payers,



cost-effectiveness is an important consideration given the volume of patients in need, the aging of the population, and the growing health care costs in general. As such, there is widespread agreement among different stakeholders that new technologies must be clinically effective, user-friendly, and cost-effective so that they can be widely adapted and provide the full range of their potential benefits. New technologies are abundant and capitalize on the rapid technological advances that have arisen in the “computer age.” There are also technologies under development that are as abundant and innovative, but some of these new technologies are in need of further testing, refinement, and validation.

The technologies under development outside the United States are, for the most part, similar or identical to the technologies under development in the United States, but there are key differences between national and international efforts in terms of level of AST adoption and the government’s role in supporting and funding more-widespread adoption and development. There are important barriers to development, adoption, and use of ASTs, but effective strategies exist that can address many of these barriers within existing resource constraints. Therefore, even as the aging of the baby-boomer generation presents a new era of challenges related to public health needs and health-care system pressures, greater availability and adoption of ASTs holds great potential to help address these challenges.