

WRITTEN TESTIMONY OF

ERIC DISHMAN

Director and Senior Research Scientist,
Proactive Health Research, Intel Corporation
www.intel.com/research/prohealth

Chair, Center for Aging Services Technologies (CAST),
A program of the American Association of Homes and Services for the Aging
www.agingtech.org

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Hearing on:

Assistive Technology for Aging Populations

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Introduction

Good morning Chairman Craig and members of the committee. My name is Eric Dishman. I am honored to testify here today both as the Director of the Proactive Health Lab at Intel Corporation—a lab dedicated to developing aging-in-place technologies for seniors who are struggling with cognitive decline, cancer, and cardiovascular disease. And as the Chair of CAST, the Center for Aging Services Technologies, a program of the American Association of Homes and Services for the Aging. CAST is a grass-roots organization of more than 200 technology companies, long term care providers, university research labs, and aging-oriented associations that have come together to promote the development of technologies that could radically improve the quality of life for our nation’s seniors and caregivers, while also reducing the nation’s healthcare bill.

I come before you as a 36-year old who well remembers my teenage years in North Carolina when my grandmother’s Alzheimer’s left so many in our family living what has infamously become known as the “36 hour day.” I also come before you as a social scientist who has worked the past 12 years in high-tech companies to research the lives of everyday people to inform the development of new technologies. During that time, I have personally visited, interviewed, even enjoyed a family dinner with more than 1,000 households across the United States. Also on that journey, I have visited more than 100 high tech research labs around the country. All of this has led me to the following conclusion: There are hundreds of technologies sitting in the labs of American universities and technology companies today that could save billions of dollars in our nation’s healthcare bill if we could only focus some of our nation’s imagination, innovation, and investment dollars on the health and wellness needs of our aging population.

Your committee’s leadership is greatly appreciated—and urgently needed—as we begin today to imagine how to accelerate and amplify the development of these kinds of technologies which are so crucial to our nation’s future security and economic wellbeing. In the midst of the unprecedented growth of our population of older Americans and the decline in the number of working age adults who will be able to care for them, your attention to this issue is particularly timely and important.

Intel’s Research Efforts on Assistive and Aging-in-Place Technologies

Andy Grove, Intel’s Chairman of the Board, recently was quoted in Fortune magazine as saying, “[Healthcare] is the largest segment of the economy in the US, and ... it is becoming too expensive to deliver. We’re still living in the “mainframe” era of healthcare.... [W]e can’t, as a society, afford to devote any more of our economy to it.... [W]hat we need is ... the healthcare equivalent of the low-cost PC.”¹ To move beyond mainframe healthcare, we must personalize and “consumerize” health and wellness technologies—getting them into the homes of seniors, where real-time prevention, early detection, improved compliance, and caregiver assistance can occur. Whenever appropriate, we must offload formal healthcare institutions by giving consumers the tools to be more proactive and responsible for their own health and wellness at home.

To begin to imagine—and instantiate—this consumer- and home-centric healthcare vision, Intel has launched a multi-year study of seniors who are dealing with cognitive decline, cancer, and cardiovascular disease. We have taken social scientists and engineers into the homes of everyday Americans to help jumpstart our company’s imagination for these kinds of helpful, healthy technology interventions. Through collaborations with multiple universities around the country (see Appendix A) and with the Alzheimer’s Association (www.alz.org), we have spent the past year living with—and observing—100 households in six cities across the U.S. to identify key opportunities for information technologies to improve their lives. We are publishing our findings and ideas about cognitive assistance technologies in hopes that others will be inspired to focus their research efforts on these important social challenges and market opportunities (see Appendix B for a recent article).

Later this morning, you will see some of those early research prototypes of cognitive assistance systems. In the future, we hope to bring you demonstrations of assistive technologies that can help with cardiovascular disease, cancer, medication errors, medication compliance, and better fitness and nutrition for seniors.

Creating CAST / Center for Aging Services Technologies

In late 2002, Intel began discussions with the American Association of Homes & Services for the Aging (www.aahsa.org) about how to get some of these home health technologies out of the labs and into the hands of consumers and their caregivers. From those initial, informal discussions sprang CAST that has now attracted an avalanche of interest, media attention, and volunteer time from more than 200 organizations committed to developing technologies that help seniors live long and live well—in the most appropriate and unrestrictive living situations—across the entire continuum of care.

On March 16, 2004 here in the Dirksen building, CAST held a demonstration (see www.agingtech.org/techdemo.aspx) of 16 prototype and early product systems designed to help seniors maintain their independence and health. Several of the speakers—and almost all of the organizations—represented here today were exhibitors at the event and have been leaders in helping to launch the CAST effort.

CAST has spent the past year conducting research, interviews, and surveys with providers, technology companies, and university researchers to identify key barriers and challenges to accelerating aging-in-place and aging services innovation (see Appendix C). Many of these will be discussed by presenters today. Our top ten recommendations are listed below:

- 1) Create a sustainable government mechanism that brings together the multiple, fragmented agencies and associations who deal with aging issues to identify top needs and priorities that technologies should address to improve the care of all older Americans
- 2) Enlist top executives from American businesses to come to the table to explore how we, as a nation, can develop innovative aging-in-place technologies and businesses that can help supplement and offload formal healthcare systems
- 3) Work with state and local agencies to accelerate pilot studies of innovative technologies that can help older Americans maintain their independence, health, sense of purpose, and community support from wherever they choose to live

- 4) Establish reimbursement policies and procedures for technologies—such as telemedicine, assistive devices, home monitoring, and aging-in-place systems—that have proven to increase the quality of care for seniors while also reducing costs
- 5) Include long term care/aging services providers and interests in the conversation about—and development of—the national health information infrastructure
- 6) Explore innovative technological approaches to automating the record keeping and reporting (e.g., MDS) that aging services providers do for local, state, & federal agencies
- 7) Develop cross-agency funding initiatives (e.g., NIH, NSF, DARPA, NIST) of research for aging-in-place technology solutions that promote prevention, early detection, improved compliance, and caregiver support
- 8) Remove perceived and actual liability barriers to companies and universities doing more research and development in home health and aging-in-place technology solutions
- 9) Evaluate and remove other barriers to American business competitiveness—especially compared to companies in Asia and Western Europe—in the emerging home health and aging services industries
- 10) Make broadband internet connectivity available to every home in the U.S., especially in rural parts of the country, to enable new aging-in-place and home care solutions

One of the main goals of CAST is to help focus our nation’s R&D energies on aging services and aging-in-place opportunities to improve the care of older Americans. We hope to work with this committee—and with all interested parties in government—to help tear down these barriers and to put aging issues front and center in the minds of researchers, companies, and funders. We ask for your help to channel the enormous energy and attention that CAST has brought to the promise of aging services technologies into enduring policies and pilot programs that can get these technologies into the hands of seniors, caregivers, and providers as soon as possible.

Real World Example: Helping Barbara with Everyday Activities

I would like to introduce you to Barbara, one of the participants in Intel’s year-long study of families that are dealing with cognitive decline, to give you an example of the kinds of technology systems that may help to transform our healthcare and long term care systems.

We met Barbara, now age 61, in her California home two years ago. She was diagnosed with dementia in May of 1999 when her family first noticed she was having trouble counting out change at the store. Today, even setting the table for dinner, washing her hands at the sink, or turning on the radio can prove impossible for her. We watched her struggle for an hour just to make a cup of tea. Her husband says it’s the highlight of Barbara’s day when she can come down and fix a warm beverage by herself. She is worried that she is on the verge of institutionalization, especially when she cannot manage to achieve everyday activities like making tea, which you and I take for granted.

Inspired by Barbara’s story and many others like her, Intel researchers have built a laboratory prototype that might someday help her to carry out everyday activities and to stay in her own home for as long as possible. The system uses inexpensive wireless sensors to detect that no one has entered the kitchen today—or opened the cabinets where the tea cups are kept. The computer waits as long as possible for her to remember to get something to drink on her own, but once it

reaches a certain threshold of concern, the assistant software locates and prompts the senior, first with a television commercial for tea, and finally with an explicit textual prompt on the TV.

Importantly, the system waits again to see if she needs help making tea to avoid prematurely replacing her capacity to act on her own. If she is slow to start opening cabinets or moving the teapot, the system finally uses the kitchen television to ask if she needs help. If she says “yes,” it proceeds to support and monitor her progress, offering her video instructions of only the steps she misses: finding a mug in the cabinet, finding a tea bag, pouring the hot water, or adding the sugar.

Research into intelligent systems that can help people like Barbara to continue to conduct everyday activities may provide enormous returns on the investment: 1) Barbara and the millions like her may have the satisfaction of staying more independent and active in their own homes; 2) we may be able to reduce the costs of long term care by delaying her admission into more expensive care facilities; 3) these systems may provide some brief respite for family and friends who today must pay constant vigil to their loved ones, often while working a full-time job; and 4) these systems may be able to reveal nuanced changes in Barbara’s everyday abilities that her physicians can use to better track—and treat—her cognitive condition as it progresses.

Though designed to help someone like Barbara to age-in-place, these same underlying technologies—the wireless sensor network, the intelligent machine learning software that detects her activities, and the digitally connected network of everyday devices such as her television—may prove valuable to many other groups in our society. Thousands of parents of children with autism have written to me that they need these kinds of intelligent electronic devices. These technologies could also help improve the lives of long term care providers by automating the Minimum Data Set (MDS) that almost every skilled nursing facility must fill out on every resident they care for. Such computer systems could automatically enter the amount of care provided by the staff, thus improving accuracy of their reimbursement records and reducing the stress of the nursing staff that is exhausted by so much data entry and documentation.

Government Leadership Needed to Drive Aging-in-Place Innovation

Given U.S. and worldwide demographic trends that show the doubling of the population of seniors over the coming decades, you might ask “Why aren’t more companies and universities working on aging-in-place and assistive technologies?” We’ve heard numerous answers to that question during our CAST workshops and conferences of the past year, ranging from “We don’t want our brand associated with aging,” to “We’d like to work on products for seniors, but we’re not really sure what products are most needed.” “Our research falls through the cracks of current government funding agencies,” say many university researchers. Almost everyone has said something to the effect of: “We’re too afraid of being sued to do any research on home health technologies for seniors.”

These comments represent just some of the barriers, real or perceived, to developing home health technologies that offer the best hope for increasing the quality of care for our growing population of seniors, while also reducing healthcare costs. I ask today that this committee help us find a mechanism that can bring together the right parties and harness the innovation potential to

transform our healthcare and long term care systems *before* we reach crisis mode from the disruptive demographic changes heading our way. CAST has done a tremendous job pulling together people from many fields, identifying top policy and priority issues, and bringing more media attention to the aging-in-place challenge, but we need government leadership to turn all of this potential into real results.

I have so much faith in the power of free-market innovation—in the brilliance of the American innovation engine—to develop new products and services that can significantly improve our lives. But the innovation engine sometimes needs a nudge from government—to help remove barriers and provide incentives to promising new areas of research. We need the federal government to help capture corporate America’s attention to focus on the aging and healthcare issues that surround us. We need a government mechanism to help galvanize action—across agencies, industries, universities—to create the next generation of long term care technologies for a new generation of older Americans who, like Barbara, need and deserve the best and brightest innovations we can imagine.

Thank you, Mr. Chairman and members of the committee, for this important hearing. Thank you for leading the charge to improve the lives of seniors throughout this great nation.

References

1. B. Schlender, “Intel’s Andy Grove: The Next Battles in Tech,” *Fortune*, 28 Apr. 2003, pp. 80-81.

APPENDIX A**RECENT/CURRENT GRANTS FUNDED BY INTEL RESEARCH COUNCIL**

<p>CareWheels, http://www.care-wheels.net Claude Goodman, Director</p>	<p>CareWheels is enabling working-age people with disabilities to provide TeleCare Services directly from their networked SmartHomes into the SmartHomes of frail elders. We have built a Residential Test-bed at the Pine Point Apartments in Portland (an independent living residence for low income Oregonians with severe disabilities) to design and evaluate networked SmartHome technologies, both for working-age people with disabilities - and by proxy - for frail elders, all of whom wish to live with maximum independence at home. The set of technologies we are exploring includes: wireless sensors and network connectivity, SmartHome controls based on contextual computing and a conversational agent, and internet-based SmartHome monitoring of Activities of Daily Living.</p>
<p>Center for Future Health University of Rochester, http://www.centerforfuturehealth.org Philippe Fauchet, Director</p>	<p>This multidisciplinary research laboratory is dedicated to creating a system of smart tools for consumer health management. These personal health tools will require wireless technology and integrated systems for information management and remote communication. Product and concept testing occurs in the Smart Medical Home.</p>
<p>Georgia Tech Aware Home Research Initiative, http://www.cc.gatech.edu/fce/ahri/ Elizabeth Mynatt, Director</p>	<p>A two-story, 5,000-square-foot home functions as a laboratory for interdisciplinary development and evaluation of domestic technologies. Aging-in-place projects include the “digital family portrait,” which uses activity recognition sensor system technology that outputs to a simple graphical view of everyday activity levels.</p>
<p>MIT Changing Places Consortium, http://architecture.mit.edu/house_n/ Stephen Intille, Principal Investigator</p>	<p>MIT’s Media Lab has teamed with the Department of Architecture’s House_n in a research consortium that emphasizes links between the home and places of healing, work, learning, and community. A current Intel project uses wearable and environmental sensing to detect an occupant’s activities to help develop software that recognizes appropriate times to present computer-generated proactive health communications.</p>
<p>Oregon Health & Science University Biomedical Engineering, http://www.bme.ogi.edu/ Misha Pavel, Principal Investigator</p>	<p>OHSU’s Point-of-Care Engineering Laboratory develops technologies for early detection and remediation of aging changes. A multidisciplinary group is using intelligent biosensors in a three-year project to continuously monitor seniors’ movements and develop new ways of detecting cognitive impairment.</p>
<p>University of Michigan, Electrical Engineering & Computer Science, http://www.eecs.umich.edu/~pollackm/ Martha Pollack, Principal Investigator</p>	<p>Autominder is a handheld device developed as a “cognitive orthotic” to assist people who suffer from cognitive decline. The device employs AI to construct rich activity models that can monitor and detect discrepancies in task execution. Autominder technology was deployed in “Pearl,” Carnegie-Mellon’s robot assistant to the elderly.</p>
<p>University of Washington, Assisted Cognition Project, http://www.cs.washington.edu/assistcog/ Henry Kautz, Principal Investigator</p>	<p>This interdisciplinary project that focuses on proactive memory aids has developed the Adaptive Prompter, a sensor network system that records activities in a state-of-the-art prototype retirement community. The system uses AI techniques to support good decisions about when to intervene in helping someone carry out an everyday task.</p>

APPENDIX B

Article Reprint:

Inventing Wellness Systems for Aging-in-Place

by

Eric Dishman

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Inventing Wellness Systems for Aging in Place



Unlike “mainframe healthcare,” personal wellness technologies can scale with the needs of an aging population. They can also drive a demanding specification for the requirements of ubiquitous, proactive computing in everyday life.

Eric Dishman
Intel Corp.

In 1999, I led a team of Intel social scientists in an anthropological study of 100 households in the US and Europe that had been early adopters of broadband technology. One of the participants in this study was Sheila, a schoolteacher who had been the first person on her block to get high-speed Internet access because she wanted to videoconference with her granddaughter, who lived three time zones away.

Even while complaining of the “hideous Ethernet cables” snaking around her living room and the recurrent need to reset the modem, Sheila also described the technology as “nothing less than a miracle for the relationship it has given me with my granddaughter.”

Having already given up her much-loved career to care for her own ailing mother, Sheila now faced becoming a caregiver for her husband’s mother as well. She was asking for another technological miracle:

What we really need is something to help us look in on my mother-in-law, who lives alone in upstate New York. She has early-stage Alzheimer’s, and the closest person who can help her is Tom’s sister who lives five hours away. Surely we’re not the only ones needing help helping our parents!

Sheila’s pleas for help in caring for aging parents were shared by almost every person in our study over age 40. As a result, in April 2002, I proposed Proactive Health (www.intel.com/research/

prohealth/), a small lab that is exploring the ways technology might assist with the care of a growing elderly population. Our mission is to catalyze a research ecosystem around information technologies that can help people be more proactive about managing health-related activities.

The lab currently focuses on households dealing with three particular conditions that have enormous impact on seniors’ lives: cognitive decline, cancer, and cardiovascular disease. These conditions provide a diverse and sometimes extreme set of research challenges to guide the development of “aging in place” technologies. In addition to improving the quality of life for seniors and their caregivers, these technologies could also reduce the increasing costs of clinic- and disease-oriented approaches to care.

Ultimately, aging-in-place research supports a broader vision of “personal wellness systems” that provide highly individualized support for home-based healthcare to all age groups.

AN AGING POPULATION WORLDWIDE

[Healthcare] is the largest segment of the economy in the US, and ... it is becoming too expensive to deliver. We’re still living in the “mainframe” era of healthcare.... [W]e can’t, as a society, afford to devote any more of our economy to it ... [W]hat we need is ... the healthcare equivalent of the low-cost PC.

—Andy Grove, *Fortune* interview¹

The US Congress, already facing an annual health-care bill of more than \$1.5 trillion, is struggling to provide prescription drug benefits for the elderly and shore up the Social Security system that supplements their income. And it's less than 10 years before the first "baby boomers" reach retirement age, ushering in an era when the elderly population is for the first time expected to outnumber the young.²

Figure 1 shows the US population growth for three different age groups from 1975 to 2025. The overall population increase over this period is about 60 percent, from almost 216 million in 1975 to close to 350 million projected in 2025. However, the percentage of the population under age 65 declines, and the percentage age 65 and older increases from 10.6 in 1975 to 18.2 in 2025.

This trend is global. The worldwide population over age 65 is expected to more than double from 357 million in 1990 to 761 million by 2025.³ Older adults already constitute one-fifth of the total population of much of Western Europe and Japan. In many countries, the ratio of workers to retirees will drop to 2:1, which will profoundly affect national economies and business productivity.

Meanwhile, longevity has given rise to expensive age-related disabilities and diseases, such as Alzheimer's. In addition to the standard medical treatment for these conditions, a 1997 study found that almost one-third of US adults, most of whom also held full-time jobs, were serving as informal caregivers—mostly to an elderly parent.⁴ The 1997 cost of replacing this assistance to older Americans was estimated at a minimum of \$45 billion.

Clearly, "business as usual" will not work for healthcare systems. We must invent a different way of caring for a rapidly growing population of older adults—historically the most expensive demographic to treat—while reducing already unsustainable healthcare costs that plague virtually every major government.

FROM MAINFRAME HEALTHCARE TO PERSONAL WELLNESS

Healthcare's costs, coverage problems, and demographic pressures mean system overload; its formal institutions can't cope with the future. What will ease the pain? A major shift, enabled by technology, to self-care, mobile care, home care.

—Forrester Research⁵

We already have an infrastructure for managing illness: a body of medical knowledge for classifying tissues and symptoms; an arsenal of pharmacolog-

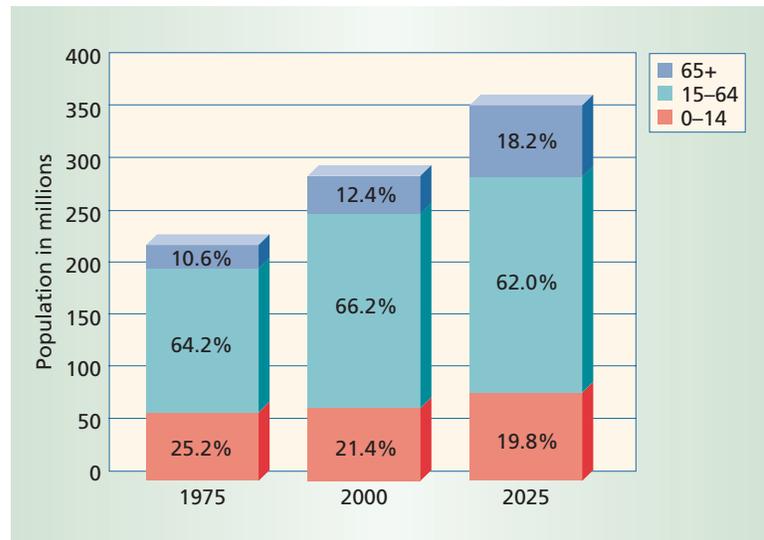


Figure 1. US population growth of three age groups for 1975 and 2000 and projected for 2025. The elderly segment is increasing almost twice as fast as the rest of the population. (Source: US Census Bureau)

ical and medical technologies to help treat disease; and a clinic-oriented healthcare paradigm that is optimized for reacting to crisis. Now we must invent an infrastructure for maintaining wellness: a body of knowledge for holistic approaches to preventive care; an arsenal of personal technologies to help detect disease early and support compliance with commonly accepted care plans; and a consumer-oriented healthcare paradigm that is optimized for aging in place and informal caregiving.

Andy Grove's mainframe metaphor is apt. To move beyond mainframe healthcare, we must personalize and "consumerize" health and wellness technologies—pushing them into the home, where real-time prevention, diagnosis, and treatment can occur. Cost-saving transformations in healthcare will only occur when we shift the locus of innovation from physician-operated systems at the healthcare mainframe to consumer-operated personal wellness systems deployed in homes, workplaces, even cars.

Telemedicine, still in its infancy, has begun this push with home-based videoconferencing and medical diagnostic technologies that support a "virtual exam." However, telemedicine alone cannot solve the crisis that an aging population poses because it perpetuates the formal healthcare system. It keeps expensive, overburdened doctors and nurses in the loop, and it focuses our investment and innovation on treating disease instead of preventing it.

TECHNOLOGIES FOR AGING IN PLACE

How will personal wellness systems achieve real cost savings? Only carefully designed technology trials will tell for sure, but we do know that the cost of care increases with increased levels of assistance. Helping seniors stay as independent as possible makes sense.

In 2003, the US National Research Council sponsored the Technology for Adaptive Aging workshop to identify applications that could help older adults live healthier and more productive

Support systems that help people change their everyday behaviors can prevent many problems in the first place.

lives.⁶ Intel's Proactive Health research group is focusing on four promising areas.

Promoting healthy behaviors

Most macroeconomic analysis of healthcare has shown that the key to simultaneously saving costs while maintaining quality healthcare is to foster more healthy behaviors in large segments of the population. Designing support systems that can help people change their everyday behaviors at home, work, and play—not just when they are at a medical clinic or prompted by illness or other medical emergency—can prevent many problems in the first place.

Not all of these problems are life threatening. For example, many nursing home admissions occur because of incontinence. A system that appropriately and discreetly reminds someone at risk to go to the bathroom before they have an episode could save the high costs of nursing home care and keep many seniors happily in their own homes for years longer.

Automatic data input is a primary technological challenge in the prevention domain. The questions that aging-in-place technologies must answer are a superset of the questions for digital home technology in general. How can we automatically capture data about people's daily activities? How can we visualize the data in meaningful ways? What architectures will people trust to collect data on their behalf?

Software agents are another technology that can provide various kinds of assistance for home-based care, but its effectiveness depends on the right balance of "assistance" versus "nuisance" as well as appropriate interfaces, devices, and media.

Finally, we know that peer support is an effective tool for changing behavior. We need to determine what kinds of online support paradigms are effective for seniors and what technologies can help remote households check in on each other.

Early disease detection

As more biological and behavioral sensors find their way into the home, we have the opportunity to study the unfolding of disease processes in ways never before imagined. Mobile, embedded, wearable, and even implantable technologies can help to establish personal baselines—typical sleep patterns, eating habits, body temperature, and blood pressure.

Home-based sensor and diagnostic technologies could help establish "disease signatures" that show up physiologically and behaviorally before more severe symptoms become readily apparent. For example, sensor networks combined with an intelligent inference engine might someday not only

detect dementia's onset earlier but also perhaps analyze its type according to a complex calculus of the nature of memory loss, social behaviors, and changes in personal routines.

Research must address not only medical science and engineering issues but also questions of storing and analyzing data collected perhaps over decades. Trust and privacy also pose critical policy and technological challenges in this area.

Improved treatment compliance

Decades of pharmacological and physician research have led to the notion of "evidence-based medicine" and healthcare "best practices." In other words, medical professionals have a pretty good idea of what courses of action will help people recover from thousands of diseases and injuries. Getting people to follow those courses of action is a different challenge.

Home-based systems that allow personalization and customization of everything from the device to the application and interface offer hope for improving human compliance with the care plans the medical community has studied and sanctioned. Some studies show that even slight improvements in people's compliance with medication regimens could save more than \$50 billion annually in the US.⁷

Compliance-assistance technologies can help in many other areas as well. The potential benefits of physical therapy for seniors are often lost, and the costs can even increase, if patients perform rehabilitation exercises incorrectly once they leave the clinical setting. A sensor system that could track body movements and offer specific suggestions via a computerized "coaching agent" could lead to significant improvements in this area.

Determining the most effective means and media for helping people to follow their care plan is a key interdisciplinary research topic. Distributed and mobile interfaces are another topic: How can we help people comply with their care plan no matter where they are?

In healthcare, personalization technology obviously must maintain rigorous standards. It must also answer the question of how to build adaptive, self-learning systems that automatically tailor individual compliance messages according to past encounters with the device.

Support for informal caregiving

If the healthcare system is to scale successfully with the coming wave of seniors, technologies must leverage the current care that friends, neighbors, coworkers, and family members provide. What

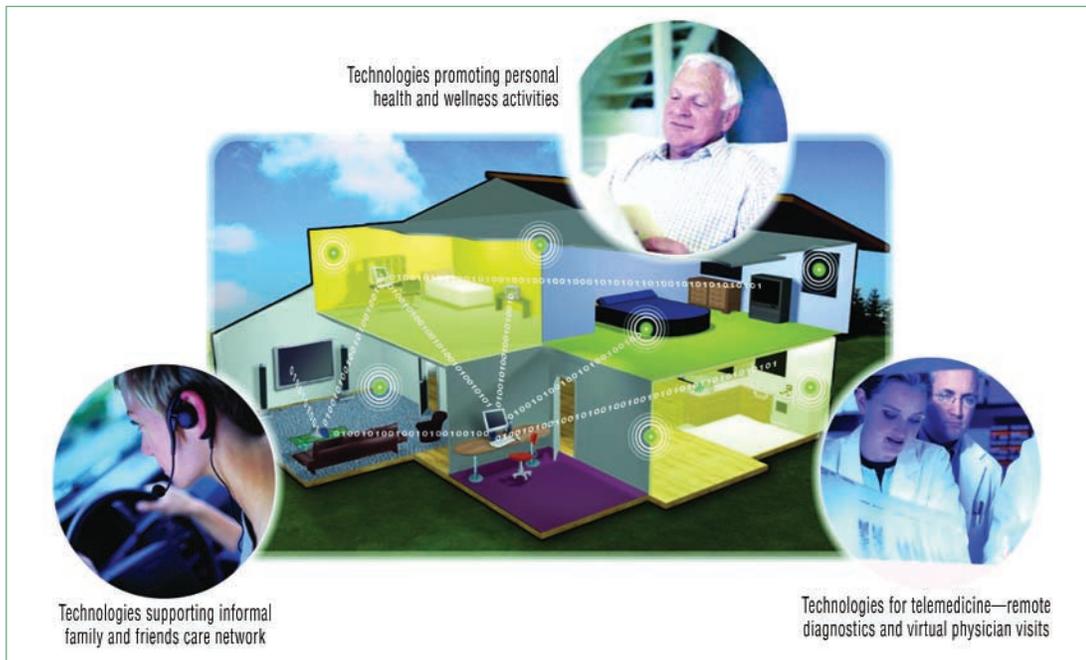


Figure 2. The home as a key location in the healthcare chain. Home health technologies should enable healthcare consumers and their informal and professional caregivers to work together to ensure the best quality of life.

kinds of interfaces and systems can help adult children care for their aging parents from a distance? What are the privacy, security, legal, and ethical issues involved in remote monitoring of another person's everyday activities?

Answers to these and other questions can help improve the quality of life of caregivers who provide the backbone of support for functionally disabled seniors around the world.

HOME-BASED HEALTHCARE

Personal wellness systems are not meant to replace the mainframe system of hospitals, clinics, and physicians but rather to put seniors and the activities of daily living more squarely into the healthcare mix. As Figure 2 shows, the home must become as much a locus for healthcare innovation as the hospital.

Systems that encourage seniors to maintain physical fitness, nutrition, social activity, and cognitive engagement so they can function independently in their own homes for as long as possible can help address the social and financial burdens of an aging population.

At the same time, the informal caregiving network of family members, neighbors, and friends—both local and far away—needs new ways to check in on seniors, increase communications, respond to emergency conditions, and avoid caregiver burnout.

Professional caregivers need access to remote, real-time diagnostic data through telemedicine technologies that help them conduct remote checkups on their elderly patients to detect troubling trends such as increased blood pressure or loss of appetite.

Of course, “home” is not always a house. The hundreds of households participating in Intel studies include very different notions of what “home” means, depending on cultural background, health

status, financial means, and proximity to friends and family members.

The ultimate goal of personal wellness systems is to improve the quality of care for seniors no matter where they live, but technology could assist with transitions from one level of care to the next and help prevent premature placement in the more expensive assistance domains.

TESTBED FOR EVERYDAY COMPLEXITY

The real challenge for research now is to ... explore the implications and issues associated with having hundreds of networked computers per person. These networked computers will work together to learn our habits and patterns and be proactive in providing us with the information and services we need for a healthier, safer, more productive, and enjoyable life.

—David Tennenhouse, VP and Director of Intel Research

It would be foolish for any technology company to ignore either the market that the worldwide “age wave” opens up for home-based healthcare technologies or the challenge the caregiving burden will present in maintaining a productive workforce. But Intel is also interested in this domain because it provides a challenging context for developing the next wave of computing and communications technologies.

Personal wellness systems for aging in place offer a unique testbed for engineering systems that support Intel's proactive computing vision (www.intel.com/research/exploratory/). Proactive computing looks beyond the desktop-PC model of human-computer interaction to—as the name sug-

Proactive Health Research Projects

To catalyze a research ecosystem around proactive health issues, the Intel Research Council has funded aging-in-place projects with numerous universities.

Center for Future Health, University of Rochester; www.centerforfuturehealth.org

Philippe Fauchet, Director

This multidisciplinary research laboratory is dedicated to creating a system of smart tools for consumer health management. These personal health tools will require wireless technology and integrated systems for information management and remote communication. Product and concept testing occurs in the Smart Medical Home.

Georgia Tech Aware Home Research Initiative; www.cc.gatech.edu/fce/ahri/

Elizabeth Mynatt, Director

A two-story, 5,000-square-foot home functions as a laboratory for interdisciplinary development and evaluation of domestic technologies. Aging-in-place projects include the “digital family portrait,” which uses activity recognition sensor system technology that outputs to a simple graphical view of everyday activity levels.

MIT Changing Places Consortium; http://architecture.mit.edu/house_n/

Stephen Intille, Principal Investigator

MIT’s Media Lab has teamed with the Department of Architecture’s House_n in a research consortium that emphasizes links between the home and places of healing, work, learning, and community. A current Intel project uses wearable and environmental sensing to detect an occupant’s activities to help

develop software that recognizes appropriate times to present computer-generated proactive health communications.

Oregon Health and Science University, Biomedical Engineering; www.bme.ogi.edu/

Misha Pavel, Principal Investigator

OHSU’s Point-of-Care Engineering Laboratory develops technologies for early detection and remediation of aging changes. A multidisciplinary group is using intelligent biosensors in a three-year project to continuously monitor seniors’ movements and develop new ways of detecting cognitive impairment.

University of Michigan, Electrical Engineering and Computer Science; www.eecs.umich.edu/~pollackm/

Martha Pollack, Principal Investigator

Autominder is a handheld device developed as a “cognitive orthotic” to assist people who suffer from cognitive decline. The device employs AI to construct rich activity models that can monitor and detect discrepancies in task execution. Autominder technology was deployed in “Pearl,” Carnegie Mellon’s robot assistant to the elderly.

University of Washington, Assisted Cognition Project; www.cs.washington.edu/assistcog/

Henry Kautz, Principal Investigator

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gests—computing systems that anticipate people’s needs and take appropriate action on their behalf.

The “Proactive Health Research Projects” sidebar summarizes current projects that the Intel Research Council (www.intel.com/research/university/) is funding to test new home health and aging-in-place technologies. These initial activities make clear that no single company or institution, regardless of its size, can tackle the breadth and depth of basic technical, systems engineering, and usability research required to bring personal wellness systems to market.

Medication compliance offers a simple example of both the potential and challenge of designing effective personal wellness systems. Many seniors take up to 10 medications per day. Taking the right pills at the right time is often burdensome, and mistakes easily occur. Exact compliance with prescribed courses of treatment could save billions of healthcare dollars annually.

The state of the art in medication compliance today is an electronic caddy that centralizes pill taking in an automatic dispensing machine that provides audio prompts to take pills at just the right time. However, this model has numerous problems. First, few

seniors—at least in Intel’s many household studies—put all of their pills in one place. Thus, having a single dispensing site rarely works. Second, people can easily miss the caddy prompts. Moreover, some people deliberately ignore the alerts because they find them to be impersonal, inappropriately timed, or embarrassing. Further, the system itself has no way of determining whether the right person is actually taking the pills, and it offers little to no assistance if someone gets off the normal medication routine.

Saving lives and significant dollars through improved medication compliance will likely require a complex system of simple technologies integrated with intelligent tracking software. With multiple wireless sensors, a system can be more intelligent about sensing where someone is, whether or not they have opened a pill bottle anywhere in the home, even how interruptible they might be at a given moment.

The reminder can come through any device—perhaps a wristwatch, the television, a phone that is close by, or whatever device has most effectively promoted compliance in the past. The prompt can be suggestive and secretive—a gentle reminder whispered through a wireless hearing aid—or a

nagging nuisance such as the television refusing to play again until the right pills are taken. Even the prompt modality—a bland textual reminder on a screen, an audio prompt in a beloved relative’s voice, or an anthropomorphized computer agent that looks and sounds like a pharmacist—can elicit radically different results for different people.

The point is that personalizing even such a simple system poses numerous technical, privacy, and usability problems. The range of sensors, devices, algorithms, applications, and interfaces—all of which must work seamlessly and securely across multiple locations and contexts—shows that, like all proactive computing domains, even beginning to test the efficacy of health technologies for aging in place demands interdisciplinary research and systems-level thinking.

Given that personal wellness technologies and integration must be stable and reliable enough to sometimes help with life-and-death decisions, they will drive a demanding specification for next-generation computing that is effective for almost any industry, business, or use.

CASE STUDY: COMPUTING FOR COGNITIVE DECLINE

A good day for Betty is when she is able to make tea for herself. This disease has completely changed our priorities.

—Jim, caregiver for his spouse, Betty, who has Alzheimer’s

A recent report showed that the 4 million Americans with Alzheimer’s disease cost US businesses more than \$61 billion in 2002 due to lost productivity and healthcare coverage costs.⁸ Given an estimated increase in Alzheimer’s cases in the US to more than 14 million by the middle of this century, this disease alone could bankrupt the Medicare system that provides insurance for people over age 65.

Using methods borrowed from anthropological and other social sciences, Intel recently completed observations, interviews, and focus groups of 100 US households that included seniors suffering from conditions ranging from the “normal” memory decline of healthy elders to extreme cases of stroke-based dementia and advanced Alzheimer’s. We sought to understand what needs, problems, and goals personal wellness systems should try to address for everyone involved in caregiving.

The lives of Betty and Jim, participants in our field studies, show the need for a technology that can intelligently adapt to the day-to-day variability



Figure 3. Prototype kitchen sensor system. Mote sensor technology implements contact and magnetic switches to sense movement of objects in the kitchen.

of Betty’s declining health as well as to Jim’s increasing needs as her primary caregiver.

Betty was forced to retire early from an engineering career since, like most people with moderate-stage dementia, she now forgets not only names and faces but also the sequences of everyday tasks, such as getting dressed or making a cup of tea. Jim still works full time but does all he can to help Betty remember to eat, drink, and take her medications. He helps Betty practice these activities of daily living, hoping that “practice makes perfect” is still applicable to her mental functioning and will help her maintain her independence as long as possible.

A cup of tea

Inspired by Betty and Jim’s story, we built a prototype system in our lab to prompt and assist someone in fixing a cup of tea and to monitor progress in that activity over time. Figure 3 shows the prototype system, which uses “mote” sensor technology to implement a small plug-and-play processor and wireless transmitter. Motes are tiny, self-contained, battery-powered computers with radio communication links. The technology was originally developed through collaboration between the University of California, Berkeley, and the Intel Research Berkeley laboratory (www.intel-research.net/berkeley).

The prototype system implements five kinds of sensors:

- off-the-shelf motion sensors for activity detection;
- simple pressure sensors placed in chairs to determine whether or not someone is sitting;
- contact and magnetic switches to sense the movement of drawers, cabinets, or objects in the kitchen;
- radio frequency identification antennas situated between the family room and the kitchen to identify foot traffic through small RFID tags



Figure 4. Sensor network with screen display. A battery-powered device wirelessly collects data from sensors embedded in household items such as a floor mat or chair. The device transmits data to the PC display to alert a caregiver about a change in a person's activity.

placed in people's shoes; and

- an infrared-tracking camera that detects whether or not a person wearing an IR badge has fallen down.

All of this raw, real-time data travels through the wireless mote network into a host PC for processing, prioritization, and communication.

Because dehydration often afflicts people with Alzheimer's disease, our system can infer that no one has been in the kitchen or opened the cabinets where the mugs are kept. The system waits as long as possible for Betty to remember to get something to drink on her own, but once it reaches a certain threshold of concern, the assistant software locates and prompts her, first with a television commercial for tea, and finally with an explicit textual prompt on the screen.

Even if they can understand and process this kind of reminder, many seniors can forget the prompt as they move toward the kitchen and get distracted by something like seeing mail on the coffee table. We therefore instrumented classic "smart home"

technologies like X10 control of the light and sound sources to help keep the person on task.

Once Betty is in the kitchen, the system again waits to see if she needs help making tea. With cognitive conditions, it is critical that the machine not prematurely replace the human's own capacity to act. If Betty is slow to start opening cabinets or moving the teapot, the system finally utilizes the kitchen television to ask if she needs help. If she says "yes," it proceeds to monitor her progress, offering her video instructions of only the steps she misses: finding a mug in the cabinet, finding a tea bag, pouring the hot water, or adding the sugar.

The prototype's inference and assistance capabilities are primitive. Nonetheless, its design goals include not only helping to make tea and perform other kitchen activities but also longitudinally tracking data that shows how much help was needed, how often, and which steps were most difficult. This data can help detect Betty's rate and type of cognitive decline.

Adaptive functionality

On her more lucid days, Betty can still use the television remote control and utter simple voice commands to interact with a system, but on some days, even simple technologies like a radio prove daunting for her. Unfortunately, Betty's condition is likely to worsen to the point that she could lose both her physical and verbal capacities. At that stage, the system must adapt to provide more support for Jim, the caregiver, than for Betty.

We observed many seniors with advanced Alzheimer's sitting most of their daylight hours in the same chair, but the caregivers' fears about them falling demanded constant vigil and co-presence. Chair sensors and fall detectors can help monitor the safety of loved ones, thus freeing caregivers to work or rest in other parts of the house.

Figure 4 shows our current prototype system. The system uses whatever home device is closest to Jim to alert him that "Betty has gotten up," followed by a more urgent alert of "Betty may have fallen" if the system senses from the infrared cameras that she is at floor level.

Fieldwork first and last

Again, these systems are only laboratory prototypes. We used them to help instantiate findings from our fieldwork and to begin building out the wireless sensor and electronic device networks for testing personal wellness systems in the homes of real seniors and their caregivers. As we move from the laboratory to real-world trials, we have chosen

to tackle something less ambitious than the full activity-detection system described for Betty and Jim. Our current focus is on developing proactive tools to help with what we call “social health monitoring and support.”

In our year of field research, we found that many people with mild cognitive impairment—a condition that progresses into full-blown Alzheimer’s for some people and that stabilizes at milder forms of memory loss for others—went into self-imposed exile and isolation because they could no longer remember the names and faces of even close friends or family members. This social isolation can spiral into depression, and the lack of social stimulus can actually accelerate cognitive decline.

We are building and testing a wireless sensor network that looks for a sudden decline in social contact. The network provides visualizations of social activities and employs a screen phone that uses sensor data to provide rich contextual cues, such as who is calling, when you last spoke, and what you discussed.

We plan to use these kinds of home-based technologies to aid in the early detection of cognitive decline, to embed cognitive assessment metrics into everyday activities such as using the phone, and to help those experiencing decline stay socially active and engaged for as long as possible.

As we move toward developing the infrastructure for inventing wellness systems—in the aging-in-place domain and beyond—the usability issues of proactive health systems could pose the biggest research challenges of all.

Data fusion and visualization applications must turn sensor data into meaningful, actionable information for consumers who have little knowledge of or patience with database queries. Computerized coaches and online assistants must fit appropriately into everyday activities and devices. Data mining applications must compare current health data both to an individual’s lifelong database and to large volumes of aggregated public health data.

The healthcare crisis presents both enormous opportunities and obstacles as our planet’s human population ages. If companies, governments, and seniors themselves are to remain healthy in the midst of current demographic changes, we would all do well to answer Sheila’s call for “help helping our aging parents.”

Caregiving needs are inexorably and inevitably becoming part of our everyday lives. Through real-time, real-world data capture about individual biology and behavior, proactive wellness-oriented

systems offer fundamental new ways of understanding—and intervening in—aging and disease processes to better manage our health. ■

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Eric Dishman is the director of Intel’s Proactive Health Strategic Research Project. He is also the chair of the Center for Aging Services Technologies (www.agingtech.org). His research interests include design for consumer technologies, ubiquitous computing, and social research methodologies. Dishman received an MS in speech communication from Southern Illinois University. Contact him at eric.dishman@intel.com.

APPENDIX C

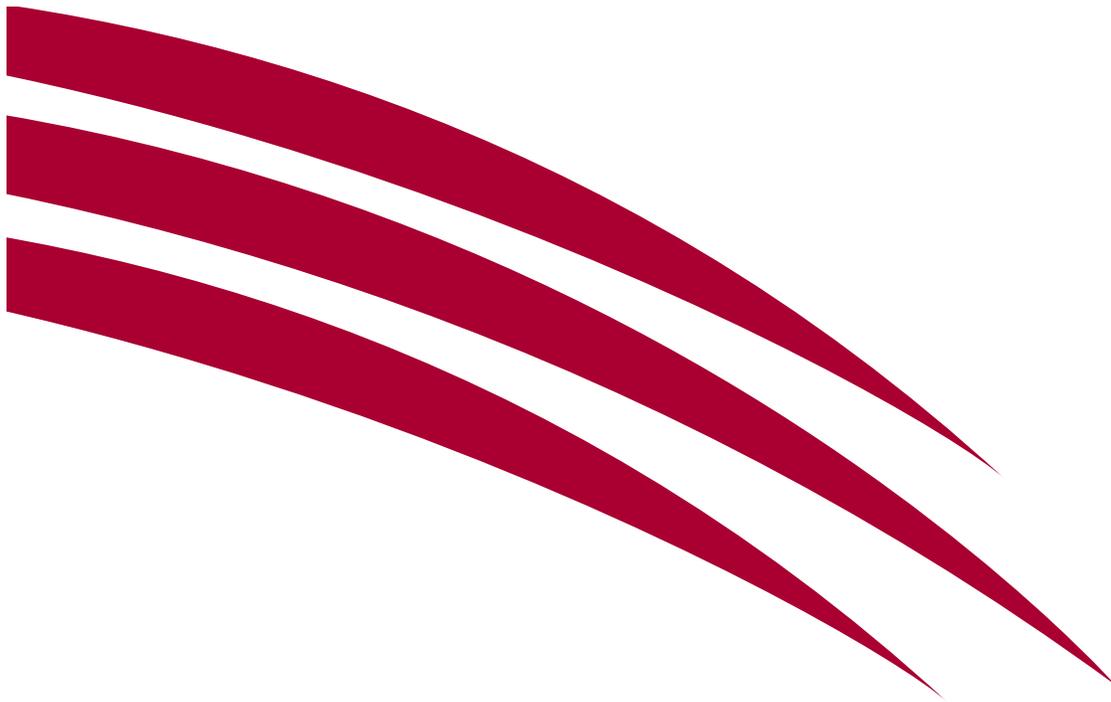
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State of Technology and Aging Services 2003**

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2003**

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Progress and Possibilities

State of Technology and Aging Services
2003



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A program of the
American Association of Homes
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2519 Connecticut Ave., NW
Washington, DC 20008-1520
Phone (202) 508-9463
Fax (202) 220-0032

Web site: www.agingtech.org

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CONTENTS

1. INTRODUCTION: IMAGINING A NEW FIELD FOR A NEW ERA	3
2. CONFRONTING TODAY'S OBSTACLES AND TOMORROW'S CRISIS	5
3. UNLEASHING POTENTIAL: THE MARRIAGE OF TECHNOLOGY AND AGING SERVICES	9
a. Introduction	
b. CAST Serves as Catalyst	
c. A Closer Look at Aging Services Technologies	
i. Enabling Technologies	
ii. Operational Technologies	
iii. Connective Technologies	
iv. Telemedicine	
4. THE IMPACT: STRIVING FOR PREVENTION AND WELLNESS	16
5. MEETING OF THE MINDS: PARTNERS IN AGING SERVICES TECHNOLOGIES	19
a. Introduction	
b. Defining Roles	
i. Aging Services Providers	
ii. Technology Companies	
iii. University Researchers	
iv. Consumer Product Companies	
v. U.S. Government	
6. CONCLUSION: PLANNING FOR A NATIONAL CRISIS.....	24
7. RECOMMENDATIONS FOR ACTION	26

INTRODUCTION: IMAGINING A NEW FIELD FOR A NEW ERA

"Developing technologies for the future of aging services is as much an imagination problem as a technology problem," says Eric Dishman, director of Proactive Health Research for Intel and chair of the Center for Aging Services Technologies.

Imagine a country in which eldercare needs surpass childcare in level of importance to families. Imagine a society in which one out of three households deals with a member suffering from cognitive decline.¹ Imagine a workforce with 400,000 fewer nurses to provide care.² Imagine a social and healthcare system that is on the verge of collapsing under the weight of its most needy beneficiaries. Imagine a workplace where employees are continually missing work to deal with eldercare emergencies.

These scenarios take little imagination for professionals in the aging services field because they are becoming the reality of tomorrow. These scenarios are part of common dialogue taking place among aging service providers and government policy makers today. But while these professionals have had enough foresight to acknowledge that the current system cannot provide for the needs of the graying baby boomers — let alone elderly people today — they have yet to put forth innovative solutions to address these alarming problems.

Imagine a pair of socks that can detect swelling in an older person's feet and relay the change to a caregiver. Picture a "smart" cat that can calm an agitated Alzheimer's patient by purring at their bedside. Envision tracking devices for the soles of shoes that can monitor an older person's gait for irregularities, and ultimately prevent a crippling fall. These are just a few of the innovations that promise to transform the aging services field — from an overburdened safety net to a highly efficient preventative system.

Leaders of the Center for Aging Services Technologies (CAST) came together initially with a vision that a collaboration of technology companies, aging service providers, university researchers, government representatives, and business interests has the potential to revolutionize the way we care for our aging population. CAST envisions technology solutions that will make aging services more efficient, effective, wellness-oriented, and consumer-friendly.

We must take our imagination a step farther, past the looming demographic crisis, towards creative answers that will prepare society to deal with a large portion of its population. Aging services technologies offer the opportunity to bridge tomorrow's aging boom with the innovations that can provide imaginative and feasible solutions. Only by harnessing creative brainpower can we move ahead to meet the challenges that confront us today, and that will only grow larger in the future.

CAST is working to bring the right minds to the table. These partners, who represent diverse interest groups, must confront the realities of today and the future and drive forward technological progress to meet the needs of the largest population of older adults in human history.

Scenario Planning Study Shows that Technology is the "Linchpin"

The American Association of Homes and Services for the Aging (AAHSA), working with professors from the Wharton School of Business, conducted a major "scenario planning" study to look at trends and changes in aging services from 2002 to 2012. One of the two major uncertainties that the study revealed is "Will there be major advances in medical and/or information technologies to assist in care for the elderly?" (The other major uncertainty is "How well funded will services for the aging be and through what mechanisms?")

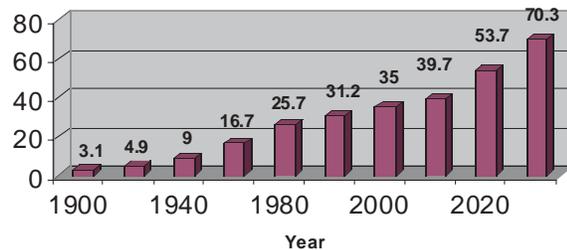
The most pessimistic scenario was called "Living Desert", in which there is a severe lack of resources to care for the elderly, there are no significant technical or medical breakthroughs, and technical resources are diverted to other areas such as homeland security.

The most optimistic scenario was called "New World", in which a prosperous U.S. economy brings private and public money to services for the aging. Technological innovation will lead to improved quality of life, including major advancements in particular diseases, such as a delay in the onset of Alzheimer's, and cures for Parkinson's and osteoporosis. The "New World" scenario would also include smart-houses, effective robotics, and other innovations that will make it easier for older adults to live at home or in a facility and receive the appropriate level of care.

CONFRONTING TODAY'S OBSTACLES AND TOMORROW'S CRISIS

When American colleges admitted the first Baby Boomers in 1964, they had no idea how this enormous group would strain, challenge, and ultimately transform the collegiate infrastructure that had accommodated the previous generation.³ Young boomers not only demanded a freer educational system and better student-to-professor ratios, but they became a voice for radical change in national politics that demanded the country's attention.

Number of Persons 65+ 1900-2030 (Numbers in Millions)



(Note: Increments in years are uneven. Based on data from the U.S. Bureau of the Census)

As this demographic bulge known as the Baby Boomers rode through the decades, they overhauled and reshaped American culture, politics, and markets. The diaper shortage in 1946 was just a preview of the changes that were to come with their arrival.⁴ Their stages of life have shaped our nation's recent history, beginning in the 1940s and 1950s when Dr. Spock's parenting advice was in high demand, peaking in the charged 1960s,⁵ when Woodstock attracted an unexpected 500,000, and continuing into the 1980s and 1990s when double income households transformed the U.S. economic structure.

Just as they revolutionized youth, 76 million Baby Boomers are poised to challenge the very concept of growing old. Every seven seconds, another baby boomer turns 50.⁶ While the percentage of the population 65 and older has tripled from less than 5 percent in 1900 to 12.4 percent in 2000,⁷ growth will explode as the number of people over the age of 65 will increase by 76 percent in the years 2010 to 2030.⁸

In the face of such staggering projections and the historical precedents of this generation's tremendous impact, the status quo is not acceptable. Government policy makers must support

new approaches to aging services, companies need to invest in and help drive new solutions, and aging services providers must be open to adjusting their current business models.

The disproportionate growth of the elderly population "will throw into question the sustainability of today's retirement systems — and indeed, society's very ability to provide a decent standard of living without overburdening the young."

*Center for Strategic and International Studies*⁹

Could it be that society lacks foresight, and perhaps is less interested in devoting attention to an age bracket that has traditionally been stigmatized, or is it no more than lack of awareness of the challenges that we face. Just as 76 percent of Americans believe that they will never need long-term care,¹⁰ our society may be less inclined to confront the graying of its largest population group.

These two failures — society's lack of foresight and subscription to ageism — go hand in hand, for, as the historical examples portend, the future will revolutionize our concept of aging. We need to change the image of aging where an older person is no longer stereotyped on television, movies and in books as a docile, penny-pinching BINGO-player from the depression era, but an active, respected, and mature adult.

Baby Boomers will place similar demands on the aging services system as they did on the collegiate system in the 1960s — demanding care the way that they want it in the place where they want it. We are seeing the impact today. Aging services facilities have better staff-to-resident ratios, more freedom to move around the facility and to have a say in their care, a more personal atmosphere, and more connection with the outside community. Seventy-six million voices are likely to be heard, particularly when they carry the purchasing power and political clout that Baby Boomers do.

The New Older Consumer

"Today's first wave of Baby Boomer's heralds the coming ranks of the new consumer. Making up almost half of the U.S. population, graying consumers have the college education, the cash, the computer experience, and the heightened expectations to make significant demands upon the health care system of the 21st century."

*Kemper & Mettler, Managed Care Quarterly*¹¹

But a revolution in aging services cannot happen overnight, which makes our call to action even more urgent.

Those who think that we can put off dealing with the demographic dilemma until it is upon us are deeply mistaken. Aging services is already struggling to meet the needs of today's elders, and the situation grows more critical every day. Though we have had more than a half a century to prepare for the day that the historic boom of babies reached a ripe old age, we have not laid groundwork in aging services nearly adequate enough to provide for this population.

Severe staffing shortages currently exist in many long-term care facilities nationwide, as large numbers of nurses near retirement and as low wages and demanding work make nursing assistant positions unattractive.¹² Many long-term care facilities are finding that Medicare and Medicaid reimbursements fall short of covering their costs of care. Affordable senior housing is dwindling dramatically.¹³ For every subsidized housing unit that became available in the year 1999, nine applicants were on the waiting list for an open unit.¹⁴

The sheer number of Americans approaching old age is astounding. But the fact that this new cohort of millions expects the ailing current system to provide for their needs is simply frightening. Already, the United States does not have adequate housing, health care facilities, financial resources, or caregivers to address the needs of its senior population today. The situation only worsens with each passing day.

Furthermore, Baby Boomers will have to share scarce aging services resources with an even older group that is already draining them: the "oldest old". In 1900, there were 122,000 Americans age 85 and over. For 2002, that number was projected at more than 4.5 million. By 2020, it is estimated there will be over 6.5 million Americans at least age 85.¹⁵

Medical science and technology in many ways has exasperated the aging challenge by enabling people to live much longer. We need to help make these added years meaningful and fruitful. The threat of the approaching demographic wave is made more dire by the fact that the aging pool is not naturally draining, but sustaining itself longer and longer through better medicine and technology. It doesn't require much of a leap of imagination to carry the metaphor and envision the result of a large wave hitting a pool that is already filled to capacity: chaotic spillover.

The approaching age wave will affect every aspect of American life. The family unit for example, will no longer be focused mainly on child rearing. Eldercare needs are growing so rapidly that by 2005 eldercare will surpass childcare in level of importance to American families. Nearly 60 percent of the adult population is or expects to be a family caregiver.¹⁶ This care-giving burden will fall on women disproportionately, as 77 percent of those providing care to older family members and friends are female.¹⁷

The economy will undoubtedly suffer as a result of the caregiving strains placed on the U.S. workforce. In 1997, people leaving work to care for their elderly relatives cost American business up to \$29 billion in

Number of U.S. workers per Social Security beneficiary¹⁸

1950:	16
1996:	3.3
2030:	2

Number of adult caregivers for each disabled elder¹⁹

1990:	11
2050:	1

lost employee wages.²⁰ As more and more people miss or leave work to care for elderly family members, our workforce will already be suffering from a general decline in the ratio of workers to retirees.

The U.S. is not the only country that will face a demographic crisis in its near future. The age wave is a problem in developed countries all over the world. In Italy, Japan, and Spain, the fastest-aging countries, there will be as many retirees as workers by 2040.²¹ Japan's aging population is growing twice as fast as in any other developed nation and their businesses are already suffering from labor shortages.²²

This alarming demographic trend is a problem of global proportions. However, if confronted in an effective way, the solutions to the aging dilemma will be within our reach. If history offers us a wealth of examples of how changing demographics placed strains on the American system, it offers even more cases in which American business, government, and other interest groups rose to the challenge of meeting the needs of the American people.

Why should we shirk from the opportunity to overcome our largest societal challenge today, especially when the consequences of inaction are so severe? Rather than deny the alarming realities of tomorrow and delay our action, we must harness American ingenuity to develop creative solutions to the looming aging services problems.

UNLEASHING POTENTIAL: THE MARRIAGE OF TECHNOLOGY AND AGING SERVICES

a. Introduction

When Eric Dishman began Intel's Proactive Health Research Project by touring the home of an Alzheimer's sufferer named Carl, his imagination ran wild with technological possibilities. Dishman saw Carl struggle to keep his multiple medications straight and imagined a smart pillbox that could track usage and aid a forgetful user. Dishman noted Carl's care and supervising needs and imagined smart furniture that could record human activity and relay vital information to caregivers.

Dishman witnessed Carl's worsening memory and imagined smart appliances that could utilize common devices like televisions to send reminders about daily living activities, like simple food preparation. Applying his technological knowledge to eldercare needs, Dishman developed a vision. He saw how a "smart home" could aid someone with a deteriorating mind to live safely in their familiar home environment for as long as possible.

Dishman's three-year research project uncovered great potential for technology in aging services. His findings bode well for technological advancements in both the home environment and the full range of aging services settings, from senior housing to skilled nursing facilities. Perhaps the most promising part of Dishman's findings is that the needed technologies will not necessarily require major technological breakthroughs. Much of the technology needed to care for elderly individuals in their homes or in facilities is already in existence today. Technology companies and business leaders need to study how existing technologies and research can be applied to fill this need.

b. CAST Serves as Catalyst

The American Association of Homes and Services for the Aging (AAHSA) recognized that no single organization was meeting the challenge that the approaching age wave poses. There was no cohesive force bringing together all of the interested parties that could help develop and benefit from the needed solutions. AAHSA President and CEO William L. (Larry) Minnix, Jr., D.Min., authorized a major new initiative, the Center for Aging Services Technologies (CAST), to bring together key interests groups to drive an aging services technologies agenda.

CAST Survey of AAHSA Members	
What Types of Enabling Technologies Would Benefit Aging Services?	
Monitoring and Sensor Devices	45.8%
Resident Communications with Caregivers and Family	30.5%
Medication Dispensing	22.0%
Security/Safety Systems	19.5%
Work Force Needs	6.8%
Mobility Needs	4.2%
What Types of Automation Technologies Would Benefit Aging Services?	
Workforce needs Automation	81.0%
Office Systems Automation	37.2%
Medication & Treatment Plan Automation	23.1%
Communication	10.7%
Back Office Automation	8.3%
Automated Security & Safety Systems	3.3%
How Would Tele-Health Technologies Benefit Aging Services?	
Increase Efficiency of Level of Care	58.4%
Independence	13.3%
Decrease Cost /Time	9.7%
Other	3.5%
<i>Based on data from the CAST Technology Survey 5/12/03</i>	

In November 2002, Russ Bodoff at AAHSA and Eric Dishman at Intel worked together to launch CAST — for the first time bringing together university researchers, major business and technology companies, aging services providers, and government representatives. CAST's aim is to harness the potential of aging services technology to meet the needs of today's and tomorrow's elders.

The eclectic partnership is what makes CAST such a promising force in the field of aging services technology. It assures that all interest groups will understand one another's needs and priorities. For example, a technology company should not forge ahead in creating new products for frail elderly without consulting aging services providers to find out what types of devices are suited for aging services settings and what products they are interested in purchasing.

AAHSA's leadership of CAST has already aided the field by gathering valuable data from providers concerning their use of technology. CAST recently surveyed 131 AAHSA members to discover where future investments should be directed. Nearly half (45.8 percent) of those who responded said that enabling technologies like monitoring and sensor devices would help their organization better accomplish its mission; 81 percent said that automating paperwork that consumes valuable health care staff time would be beneficial; and more than half (58.4 percent) said that implementing tele-health would increase the efficiency of care in their organization.

Conference Shapes the Future of Aging Services

With the largest turnout ever for a conference on aging services technologies, leaders in the aging services field took the initiative at a major conference to shape their future by addressing technology needs and potential in aging services. The "Future of Aging Services Conference," sponsored by the American Association of Homes and Services for the Aging (AAHSA), was held April 7-9, 2003 in Washington, D.C. Conference attendees learned:

- ✦ How and why aging services technologies require a bold paradigm shift.
- ✦ How university research laboratories, consumer product manufacturers, technology companies, and aging services providers are working together to improve care for older adults.
- ✦ How global positioning systems, wireless phones, robot-assisted therapy, and interactive television will increase quality of care, reduce costs, and enhance independence for older adults.

"Global aging is both a blessing and a looming catastrophe," AAHSA President and CEO William L. (Larry) Minnix, Jr., D.Min. told the more than 900 administrators of aging services facilities, researchers from university labs, executives from technology and consumer product companies, and government agency officials who attended the conference. "Aging services technologies will offer solutions."

Proactive Computing and its Impact on Aging Services David Tennenhouse, Intel Vice President & Director of Research

Proactive computing will become a disruptive technology that may impact the aging services field. Here's the vision for the future:

It's 6:00 am June 12, 2012. Your alarm goes off, sending a signal to turn on both your shower and the coffee machine in the kitchen. The current weather and stock updates are displayed on your mirror while you prepare to step into the shower. You wonder aloud about the traffic and news on a client company you are meeting with that morning. The latest information is delivered instantly over your home sound system.

The bathroom scale says you are up three pounds from last week. The information is sent from the scale to your treadmill, which customizes your weekly workout program and increases the number of calories you'll need to burn. A menu-planning program simultaneously decreases the daily calories and fat in your customized daily menu plan.

A sensor in your toothbrush analyzes your saliva and identifies any vitamin, mineral and enzyme deficiencies, along with your current blood sugar levels. Recommended dosages of vitamins and prescription drugs are displayed on the bathroom mirror. You dress and head to the kitchen for your coffee. On the counter is a printed copy of your customized menu, which if followed, should help get rid of those three extra pounds.

As you leave for work, coffee in hand, the house thermostat adjusts automatically to save energy. The security system is activated as you pass through the door. Once in your car, you review all e-mails and voice messages sent after midnight and respond verbally on your voice-activated cellular phone or radio. Traffic is slower than normal. Your car computer notes an accident up ahead and takes you on an alternate route. You arrive at your office with time to spare.

In the connected world of the future, we will be surrounded by networked computers able to sense and anticipate our daily needs and preferences.

Since the November 2002 launch, CAST has discovered what Dishman excitedly calls "a goldmine of interest" among leaders in the partnering fields. Many aging services providers have shown tremendous support for CAST, and some have shared with CAST how aging services technologies are at work in their facilities. Their case examples help create a clearer picture of how technology can function to offer quality care to seniors and illustrate how technology and aging services are beginning to come together.

"Smart Home" Increases Independence

An example of an enabling technology is the Smart In-Home Monitoring System, which is being developed and tested at the University of Virginia's Medical Automation Research Center. This system monitors older people's activities using low-cost, non-invasive sensors. The system can identify changes in a person's eating or sleeping patterns and report them to a caregiver via the Internet. Technology of this type has the potential to make care of the elderly more preventive by detecting disease early on.

c. A Closer Look at Aging Services Technologies

"Aging services" is a broad term, encompassing nursing homes, continuing care retirement communities, assisted living and senior housing facilities, community service organizations and a variety of home-based care services and consumer products. "Technologies" is an even broader term, referring to the wide array of advancements that have brought us all of our modern conveniences. For initial discussions CAST has divided technologies into four categories:

i. **Enabling Technologies** allow the elderly to do more for themselves and to stay in their own homes or independent settings for as long as possible. Such technologies respond to the older consumer's desire to "age in place" rather than enter a facility prematurely. In addition to responding to this consumer demand, enabling technologies alleviate the burden that the age wave places on providers and the government programs that finance long-term care. The longer older adults can remain independent and healthy, the less need there will be for institutionalization, costly care, and constant supervision.

Operational Technologies at Work

Take a look at the technologies that some aging services providers are using in their own living laboratories, in pursuit of better, more efficient models of care:

- ✧ A "nursebot" named Pearl was developed by the University of Pittsburgh, Carnegie Mellon and the University of Michigan. Pearl will aid elderly people with chronic conditions in a variety of ways, such as by reminding them about activities of daily living, taking vital signs, and fetching items. Pearl was tested and well-received by the residents of Longwood Retirement Homes at Oakmont in Verona, Pennsylvania.
- ✧ In Osaka, Japan, Matsushita Electric built a technology-driven community called Sincere Korien. Here, robot teddy bears assist caregivers. Equipped with sensors, the bear-bots help the staff monitor the medical condition of the residents. The bear called Tama has a built-in sensor that is linked to a large screen in the nurse station to help nurses monitor residents from afar.
- ✧ AIBO, a robotic dog was developed by Sony Corporation for consumer use and is now being field-tested with older people in various living environments. AIBO aids older people as living pets have for years: by decreasing feelings of isolation or depression and increasing morale and socialization.
- ✧ Ohio Presbyterian Retirement Services uses automated medical dispensers to improve safety and reduce errors. These dispensers are equipped with audio and visual reminders and personal emergency response systems. By increasing nurse productivity and enabling staff to manage more patients at one time, such technology helps with staffing issues.
- ✧ Oatfield Estates, an assisted living facility in Milwaukie, Oregon, has designed a software program called Automated Care System (ACS). This program will help the facility prolong independence, improve quality control, develop an early warning system, provide biofeedback and bring about greater efficiencies in staff and utility costs.

One way in which enabling technologies could help make this shift from curative to preventative healthcare is through the early detection of Parkinson's disease. Studies show that about two or three years before a person experiences the first tremor of Parkinson's disease, he or she will develop a slight change in gait. The technology needed to monitor such shifts exists, but simply hasn't been adapted for these medical purposes.

ii. Operational Technologies help aging services providers manage their human resources and internal needs more effectively. These technologies respond to the financial and operational difficulties that aging services providers face and try to develop more viable models of care.

Technology offers new ways to reduce labor costs, prevent medical errors, and increase productivity. Operational technologies also promise to create better work environments, which in turn, aids workforce recruitment and retention. In addition, operational technologies can improve quality of care and help facilities operate more efficiently.

Robotics are being utilized to accomplish some of these improvements. Some robotic technologies have been incorporated into hardware that older people are already familiar with, like walkers. Robotic assistants, which are intended to supplement human care, not replace it, may help older people with eating and drinking, taking medications, or calling for emergency help.

Technology can also help facilities monitor levels of care as well as staff performance and response.

iii. Connective Technologies keep elderly individuals in touch with their caregivers, families, and medical resources. This type of technology responds to feelings of isolation, boredom, and even depression that can result from institutionalization or living alone.

Connective technologies promise to improve quality of life by bringing people together and helping an isolated or homebound elderly person access something that they can't physically be present for, like a sporting event covered by Internet radio or a conversation with a relative overseas.

Connective technologies can also offer recreational and educational opportunities for older people that increase quality of life and foster community among individual elderly people that might not otherwise be able to interact. In addition to improving quality of life, connective technologies may

curb the isolation that often allows mental and health deterioration to go unnoticed by loved ones and outsiders.

One example of connective technology successfully at work is a group of older adults called the Silver Stringers, who use publishing software to write their life stories and to publish them on the Internet. There are a few aging services facilities testing communications systems that allow family members access to data reflecting the daily routine of their family members. This process allows the family member greater input and involvement in their relative's care.

iv. Telemedicine allows a medical source to monitor patients from afar. Telemedicine provides a way to extend medical attention and wellness care to older adults to help them continue to live independently.

Telemedicine offers opportunities to serve both an urban and rural client base by decreasing the need for emergency room care or extended hospital stays, which are both extremely costly. With telemedicine available, fewer older people will have to give up their homes to get the kind of medical attention that was once only available in institutional settings. Telemedicine is not a potential replacement for direct "bedside" care; however, it serves as a useful tool for doctors to reach out to those who want to stay independent and healthy for as long as possible.

The Texas Tech University Health Science Center has been a pioneer in the development of telemedicine, bringing comprehensive healthcare to isolated rural regions of Texas. Because they see great potential in the aging services market, the Texas Tech Center is creating a training program for geriatric telemedicine.

Studies done by universities such as SUNY at Stonybrook have demonstrated that tele-health equipment can significantly cut emergency room visits and improve quality of care. Medical conditions such as diabetes and congestive heart failure are examples of conditions that often deteriorate when appropriate care and monitoring do not take place. Since older adults often develop these impairments, the potential health benefits and costs savings offered by tele-health equipment can have a dramatic impact on health care costs.

THE IMPACT: STRIVING FOR PREVENTION AND WELLNESS

Keeping our elderly independent won't just benefit the individuals who go on living in comfortable, familiar environments. Facilitating home living alleviates the pressure that today's older adults and tomorrow's Baby Boomers place on our aging services system, our economy, and our younger generations. For every older person that remains healthy and independent — through technologies such as preventative weight and gait monitoring, pill dispensation devices, emergency alert systems, or telemedicine — one less person will have to rely on a nurse's aide to bathe them, an emergency room visit to detect a simple urinary tract infection, or institutionalization to provide physical therapy for a broken hip after a fall.

Russ Bodoff of AAHSA and CAST identifies great potential in making our costly aging services system more preventative. "The curative approach in aging services, and health care in general, is tremendously costly. The key to limiting these costs is prevention and proactive approaches. Hundreds of billions of dollars can be cut from our nation's health care bill if we apply technologies proactively," says Bodoff.

Intel's Dishman adds, "We also want technology to be more proactive, to anticipate people's health-related needs and take whatever action is appropriate on their behalf." Our current system is designed for treatment rather than prevention.

Hip fracture scenarios make this metaphor quite literal. More than 340,000 times a year, an older person breaks a hip. This type of fracture usually demands a major shift in care; about half of those that make it into rehabilitation never walk again. About 40 percent need to move into a long-term care facility.²³ A simple slip and fall comes with a huge price tag and a drastic change in lifestyle.

"The key to limiting these costs is prevention and proactive approaches. Hundreds of billions of dollars can be cut from our nation's health care bill if we apply technologies proactively," says Bodoff.

By focusing on wellness, aging services technologies could prevent such traumatic errors. The occurrence of tragic hip fractures could be drastically decreased through simple technological products. Tracking devices in shoes can be used to monitor an older person's gait to assess their fall

risk. Medication reminders can help an older person fight the risk of osteoporosis, by keeping their calcium intake steady for years. Safe, low impact exercise machinery could also function to strengthen the bones of an elderly person. Lastly, simple devices such as smart walkers or hallway rails could aid a frail elderly person in safely maneuvering around their home or an aging services facility. If we can give the elderly the appropriate tools to be their own caregivers, we have made huge strides towards successfully managing limited aging services resources.

Aging services technologies can also reduce the burden placed on caregivers. "Caregiver burnout is a huge problem we're trying to address through technology," explains Dishman. "One avenue we're exploring is how sensor networks could provide a level of monitoring such that the at-home caregiver would know it's safe to take a nap for an hour or so or pursue some other activity." Connective technologies offer to ease the emotional burden of relatives of elderly people, who may be attempting to monitor their loved one's health from afar. Also, because caregivers are oftentimes not free to leave the house, connective technologies such as online support groups, may address the issue of caregiver isolation and function to alleviate stress and guilt.

Intel's Dishman adds, "We also want technology to be more proactive, to anticipate people's health-related needs and take whatever action is appropriate on their behalf. Our current system is designed for treatment rather than prevention."

In addition to promoting wellness among those elderly who live independently and their caregivers, aging services technologies can make equivalent strides within institutional settings, where aging services providers and professional caregivers struggle with the same challenges of providing quality care in the least restrictive environment.

There are countless examples of ways in which aging services technologies can benefit older Americans, their loved ones, aging services providers, and their employees. The cost prevention and efficiency that can be achieved through wellness-oriented aging services technologies will bring financial relief to all of these groups, as well as to the federal, state, and local governments. All stand to gain from the progress of aging services technologies.

But innovative developments in aging services won't naturally evolve or magically turn out of a technology company's assembly line on their own volition. The progress of aging services

technologies hinges on the collaborative effort of all interested parties, from overburdened providers to opportunistic companies. Only with contributions from all players can the right ideas and perspectives emerge and spark the collective imagination needed to overcome the dilemma we face today and in the decades ahead.

MEETING OF THE MINDS: PARTNERS IN AGING SERVICES TECHNOLOGIES

a. Introduction

Three years after he first walked through the house of a struggling Alzheimer's sufferer and imagined technology that could wire caregiving devices right into its walls and furniture, Eric Dishman has not lost an ounce of enthusiasm for aging services technologies. He speaks of its potential with the zeal of someone who holds a promising secret, and is aching to share it with world. But Dishman knows that he alone cannot unleash the power of aging services technology. He insists that the future of the field will rely on the collective contributions of many different partners.

"Transforming the home into a useful locus of health care is an ambitious systems integration effort that will require broad participation from numerous industries," Dishman declares. "No one organization is capable of tackling all of the complex challenges involved."

Who must contribute to the aging services field, and who stands to gain from the field's advancement? The final portion of this paper aims to answer these crucial questions and in doing so, to summon the individual interest groups to action.

b. Defining Roles

i. Aging Services Providers

Having provided for the needs of our nation's elders for years, aging services providers have their fingers on the pulse of consumer needs. Providers are attuned to older peoples' preferences and have begun to get a feel for how Baby Boomers' desires differ. They can predict better than anyone else, what types of products and services will be in high demand. As experts in the aging field, providers must make their knowledge available to companies that are trying to tap into the new market.

Providers must serve as an intermediary between suppliers (technology companies, consumer product companies, etc.) and consumers. By representing the needs of the population they serve, providers will help gear technological development in the right direction today so that it will meet consumer need at critical points in the future.

Providers can also serve as "living laboratories" by opening up their organizations to new technological offerings and relaying feedback to companies about how they functioned in the provider facility. It is no secret that the current model of care for the aging is not meeting the needs of our current elders, and it certainly will not withstand the demographic pressure ahead. Knowing this, providers must be open to alternative models and innovations. Progress can be surprising and even unsettling, but the only way to move forward is to give all options fair consideration.

Providers have a tremendous amount to gain from aging services technologies. They will benefit both from healthier older people and better, more efficient ways of providing care. If technology can make services and long-term care more efficient for providers, then they may have more money to invest in things such as worker recruitment and retention, resident care, and facility development.

Improving quality of life and expanding offerings serves to improve public perception of long-term care and bolsters consumer confidence. Providers will benefit tremendously from the aging services revolution that technology can bring. The largest beneficiaries will be those that join in the development of aging services technologies today and guide its course to meet their needs.

ii. Technology Companies

Technology companies have a crucial role to play in the advancement of aging services technologies. Companies need to recognize the enormous market for aging services related products and hopefully respond to the marketplace needs. Drawing on the help of aging experts, technology companies need to unleash their research capabilities to develop innovations that allow elderly people to remain independent and healthy for as long as possible.

While cutting edge innovations are key to advancing aging services technologies, adapting technologies that already exist for aging applications are equally as important.

Technology companies that take the lead in anticipating future demand will have an advantageous foothold in the vast aging services market. Those technology leaders that work quickly to develop solutions will be in the prime position to both profit and make a valuable contribution to head off a societal crisis that will impact their employees and their customers.

iii. University Researchers

Aging services technology cannot make progress without the help of university researchers. Universities will need to unleash the creative thought processes that exist on their campuses and be engaged in helping respond to this challenge. They must rise to the challenge in league with providers and technology companies to develop innovative solutions that will help our country avert a major demographic crisis.

A shift in research funding priorities is imperative. More funding must be directed towards aging services research so that experts can accurately gauge how technology can improve the aging services system. New partnerships must be forged with consumer product and technology companies, government agencies, and aging services providers.

Those universities that lead the way in researching aging services technology will be poised to meet a major societal challenge and aid the country in overcoming it. Furthermore, because aging services will grow tremendously during the next few decades and open various career opportunities, universities will do their students a great service by exposing them to aging services and engaging them with the opportunities that the future will bring.

iv. Consumer Product Companies

Although the mental picture of 76 million gray heads may be enough to get most consumer product companies rethinking their target markets, U.S. companies need to paint a more detailed picture of elderly consumers in order to plan for their demands. Members of the Baby Boom generation promise to be very different types of consumers than those of their parents' generation. They are informed, demanding, and accustomed to being part of a majority that is catered to.

Furthermore, as many Baby Boomers are aiding their parents in choosing aging services today, they have grown familiar with the field and expect improvements. Due to the unprecedented political muscle that this generation has wielded, Baby Boomers also demand more options. Lastly, technology has a much stronger foothold among Baby Boomer consumers, who have been accustomed to the fast-paced innovation of the Internet Age and expect technological developments to enhance their consumer options.

Having recognized the vast and largely untapped aging services market and evaluated the nature of today's and tomorrow's consumer demands, consumer product companies must embark on an

effort to develop products that can meet the needs of aging individuals and aging services providers. These products must aim to promote wellness and independence, and also provide adequate selection for older consumers.

Consumer product companies that adapt their production to offer attractive products to older consumers will help make old age a less stigmatized stage of life. For example, a walker wouldn't be something people dread purchasing if a wide array of designs, gadgets, colors, and added amenities made the walker appealing to older consumers. Consumer product companies must reach out to gain an in-depth understanding of older peoples' preferences, and plan their production accordingly.

Lastly, it is imperative that consumer product companies collaborate with technology companies. Cross-industry partnerships must be made in order to produce the kind of large-scale out-put necessary to meet current and future consumer need. Those companies that join in the collaborative effort now will be in a position to gain the most in the future. Diaper companies came up short in providing for the boom of babies in the 1940's. We've had a half a century to anticipate another boom on the opposite end of the life spectrum. Opportunism can't wait another day.

v. U.S. Government

The U.S. government needs to take action to confront the aging demographic dilemma. Legislators, executive officials, government agencies, researchers, and research funders must all acknowledge and call attention to the problem in their respective arenas. Legislators and government officials today can push the age wave into the federal spotlight and illuminate how aging services technologies can help the nation provide for its graying population.

Promoting the development and application of aging services technologies and enlisting their support and resources behind CAST and other current efforts is another important step. The appropriate government representatives should take measures to help educate and draw key industry leaders into the collaborative effort driving aging services technology forward. Funding must be appropriated for research in aging services technologies so that the necessary advancement can take place in time to meet future need. Policy makers should help evaluate current policies or regulations that may slow down the innovation and rapidly commercialize

technology-based products and services that help older people live independent, fulfilling lives while supporting the needs of aging care facilities.

Government representatives should become more involved in CAST and help in discussions dealing with issues of privacy, ethics, cost, liability, and reimbursement.

The U.S. government will also benefit by a high deployment of aging services technologies. At a time when Medicaid, Medicare, and Social Security funds are dwindling, technological developments and wellness-oriented applications offer to reduce health care costs and offer innovative solutions for the host of challenges facing the United States, and the larger global community. If the U.S. does not take immediate action and support efforts to apply technology to aging services, it will have a dilemma of massive proportions on its hands.

CAST leaders urge the government to set up a special commission to deal with what Eric Dishman calls the "next national security nightmare." CAST asserts that our aging services dilemma demands both full-time attention and swift planning. CAST believes that a government commission staffed with experts and equipped with the necessary resources will be best able to help drive solutions for our aging services challenge.

CONCLUSION: PLANNING FOR A NATIONAL CRISIS

In 1996, Senator Daniel Patrick Moynihan sent a letter to the President, urging him to pay attention to what he referred to as "The Year 2000 Time Bomb." Moynihan's urgings prompted the establishment of a special Y2K commission. An executive order followed in the year 1998, which required all federal agencies to fix the Y2K problem in their systems. The same year the Department of Defense named a director of the Y2K Oversight and Contingency Planning.²⁴

When New Years 2000 passed without a glitch, some Americans who were not aware of the great effort and global coordination that had gone on behind the scenes in both the public and private arenas concluded that Y2K was nothing more than hype. No one will ever know what would have happened had such extensive precautions and preparations not been made. In fact, from the day the term "Y2K" was coined, there was never any certainty around the predictions, nor any of the measures taken to fix the problem. The nation planned for crisis nonetheless.

There is no doubt, on the other hand, that people age. We are already failing to meet the needs of today's elderly population, which is living longer and growing larger by the day. The problem is here today and will intensify as the years go by. This national security risk is not a supposition, but a reality. The only thing that remains uncertain is whether the demands of an enormous elderly population will take us by surprise, or whether our businesses, technological industry, aging services, and government programs will be prepared to deal with them.

During a time when we are accustomed to associating the term "national security threat" with images of masked suicide bombers, it is a challenge to view senior citizens — who strike us as an innocuous group — as a threat to our country's stability. It requires a leap of imagination to view demographic bulges as frightening problems, or even pressing ones.

But we must take that leap. The stakes are frightfully high; we are not dealing with computer systems, but the lives and care of our peers, parents, and grandparents. Projections on the continuing growth of the elderly population, its needs, and its impact on the world indicate that time is running out and the problem is here and now.

We have about 10 to 15 years before we reach crisis proportions. This is a narrow window of opportunity to lay the groundwork in aging services, collaboration, development, and investment in aging services technologies. We cannot wait.

Those who are skeptical of the affordability of new technologies must consider the growing evidence that many technologies, though expensive up front, can lead to marked reductions in costs by increasing productivity, reducing human error, and improved wellness programs.

Historian and social critic Theodore Roszak once said, "The future belongs to maturity." While statistical projections cast doubt on how smooth and secure old age will actually be for the 76 million Americans who reach it simultaneously, one thing is certain. The future is wide open for those leaders and entrepreneurs that anticipate a mature America and develop the means to provide for it.

RECOMMENDATIONS FOR ACTION

Investment in the application of current technologies and investment in the development of new technologies can show dramatic results in improving an older adult's independence, quality of life and levels of care. At the same time, technology can reduce costs and have a significant positive impact on our nation's health care bill. CAST proposes that approaches are needed.

While much research needs to be done and CAST is pursuing additional data, it is apparent from brainstorming sessions with providers and researchers, results of a recent CAST survey of providers, and discussions with representatives of major research centers, government agencies and companies that we need to identify and concentrate efforts on specific solutions. If we can get major technology and consumer product companies as well as universities to unleash their creative abilities to address technology development, hundreds of billions of dollars can be cut from our nation's health care bill.

Most important, not only will care cost less, but we can improve quality and efficiency of care and independence of life style. Individuals, family members, and caregivers would all benefit by investment in these areas.

Recommendations for providers of aging services

1. Engage in partnerships with technology and consumer products companies to test new products and ideas in real world situations. Providers need to look at applications of new technologies, especially when they offer better levels of quality of care and life style improvement for the older adult.
2. Explore how they can deliver the many services they provide in a variety of environments.
3. Plan how they will fund investments in technologies.

Recommendations for business leaders and the research community

1. Continue developing new technologies or applications of current technologies in the following areas:
 - ◆ Monitoring and sensor devices that can establish the ability to know how an older adult is doing in performing activities of daily living, know when an emergency

takes place, better track and provide greater independence to adults suffering from Alzheimer's and dementia, and provide reminders that assist in maintaining activities of daily living.

- ◆ New communication tools between the older adult, caregivers and family can allow better and timelier information to be shared between the older adult and the family member or caregiver. These technologies — used in any stage of the aging services continuum can improve understanding, provide quicker response to needs, provide emotional well-being through closer family connections and open up new opportunities for the older adult to make new friends, develop new hobbies, and engage in educational and recreational activities.
- ◆ Improved medication dispensing systems for the home that can help prevent the deterioration that takes because an individual forgets to take medication or takes the wrong medication or incorrect dose. Developing new forms of medication dispensing systems that older adults and their caregivers can rely on will significantly reduce health problems and aid wellness.
- ◆ Tele-health solutions can help physicians and nurses better monitor the health of the older adults therefore addressing health problems before they get worse and reducing emergency room visits and hospitalizations. New sets of data can help the medical provider understand trends that they never before had access to and then better respond to the care of the individual.

2. Place the needs of the aging population on the agenda of the Business Roundtable and other leading senior executive industry associations.
3. Partner with aging services providers to better understand the needs of the field.

Recommendations for government

1. Plan a White House sponsored senior industry executive meeting outlining the societal challenge in front of our country. Drive innovation and entrepreneurialism for technology solutions to the aging services challenge.
2. The Commerce Department should educate businesses on the global marketplace opportunities that exist in the aging services field and the danger of losing future market share if U.S. companies are not in a leadership development role.
3. The President of the U.S. should establish a National Commission with participants from companies, aging service providers, university research centers and advocacy groups to coordinate the development of a 10-year plan to map out how our country can proactively respond to the aging challenge,

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4. Invest additional government dollars to support work at major university research centers and/or reorient current funding for aging-oriented technology research.
 5. Reinstate National Institute of Standards and Technology (NIST) Advanced Technology Program (ATP) with a focus on technologies for aging services.

Joint recommendations for all constituencies

1. Participate in private/public sector fact finding missions to Europe and Japan to learn about technology applications they are using and what their results are.
2. Accelerate broadband and wireless deployment throughout America as high speed intranet access will be a key component of wellness and healthcare activities in the home.
3. Address the many policy issues that impact the application of new technologies.
4. Increase collaboration to rapidly advance aging services technologies.

The Center for Aging Services Technologies (CAST)

The Center for Aging Services Technologies (CAST) is the key catalyst for bringing together companies, universities, aging services providers, organizations, and government to drive awareness, development and application of technologies that will improve services for the aging.

Vision. CAST is creating the foundation that will ensure technology solutions attain their fullest potential to meet the needs of our aging society

Mission. CAST's mission is to unleash the potential of technology for innovative development across the continuum of health care, housing and services for the aging in order to:

- ◆ Reduce our nation's health care costs
- ◆ Help older adults maximize their independence
- ◆ Improve quality of care and quality of life
- ◆ Support the needs of professional and family caregivers
- ◆ Increase aging services provider efficiency

Functions. CAST will:

1. Provide opportunities for collaboration to rapidly advance aging services technologies to benefit older adults. Initiatives will include:

- ◆ Bringing together technology companies, researchers, and providers to identify areas where technology can maximize independence and enhance quality of care.
- ◆ Helping technology developers understand the needs of providers so that they can enhance operational systems and human resources management through technology.
- ◆ Encouraging the use of new technologies to foster quality communication among older adults, caregivers, family members and friends that will increase quality of life, new learning, and recreational opportunities.
- ◆ Educating providers on how to incorporate new technologies into their services.
- ◆ Fostering synergy among companies, providers, and older adults to develop new tele-health applications to better monitor health and medical conditions.
- ◆ Leading the aging services field in developing policy positions and participating in major standards initiatives in electronic medical and wellness records.
- ◆ Cultivating global relationships and partnerships to share information and build cross border solutions.

2. Create and maintain an online information clearinghouse to provide the latest information and knowledge on aging services technology developments as well as to provide a forum for providers to engage in discussions with researchers and to share experiences.

3. Engage government representatives to gain support for technology-related policy and facilitate private public sector partnerships to advance technology development and application.

4. Survey and gather the latest intelligence on what is needed by providers, older adults and baby boomers to help ensure that expectations are understood and satisfied.

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⁷ *Commission on Affordable Housing and Health Facility Needs for Seniors in the 21st Century. A Quiet Crisis in America, A Report to Congress.* Washington, D.C., 2002. Available at http://www.seniorscommission.gov/pages/final_report/finalreport.pdf . See page 5.

⁸ "Projections of the Total Resident Population by 5-Year Age Groups, and Sex with Special Age Categories: Middle Series, 2006 to 2010" (NP-T3-C, released online January 13, 2000); and "Projections of the Population by Age, Sex, Race and Hispanic Origin for the United States: 1999 to 2100 (Middle Series)", July 1, 2030 (NP-D1-A), U.S. Bureau of Census.

⁹ *The Center for Strategic and International Studies.*

¹⁰ "GE Center for Financial Learning National Survey Identifies Myths and Misperceptions About Long Term Care That are Costing Americans Dearly," September 25, 2002, www.elfun.org/seniors/long-term-care.asp. Survey conducted by Peter D. Hart Research Associates.

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¹² Hospital and Healthcare Compensation Service, "AAHSA Salary and Benefits Reports" for nursing homes (2002-2003, pages V-3, V-5 and V-7), assisted living (2002-2003, pages V-3, V-4 and V-5), and continuing care retirement communities (2002-2003, pages IV-3, IV-5 and IV-7).

¹³ *Commission on Affordable Housing and Health Facility Needs for Seniors in the 21st Century. A Quiet Crisis in America, A Report to Congress.* Washington, D.C., 2002. Available at http://www.seniorscommission.gov/pages/final_report/finalreport.pdf . See pages 31 and 278 (Table 17. Rent-Assisted Units to Address Unmet Housing Needs of Households Age 65 and Over, 1999-2020.).

¹⁴ Ibid.

¹⁵ U.S. Census Bureau. For 1980, "Table 42, Single Years of Age: 1880 to 1980," 1980 Census General Population Characteristics, United States Summary, page 1-26. For 2002, "Table NP-T4-B, Projections of the Total Resident Population by 5-Year Age Groups, Race, and Hispanic Origin with Special Age Categories: Middle Series, 2001 to 2005," dated 13 January 2000 accessed 12/23/02 at <http://landview.census.gov/population/projections/nation/summary/np-t4-b.pdf> . For 2020, "Table NP-T4-E, Projections of the Total Resident Population by 5-Year Age Groups, Race, and Hispanic Origin with Special Age Categories: Middle Series, 2016 to 2020," dated 13 January 2000, accessed 12/23/02 at <http://landview.census.gov/population/projections/nation/summary/np-t4-e.pdf> .

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¹⁷ Family Caregiver Alliance, "Fact Sheet: Selected Caregiver Statistics," accessed 7/11/03 at http://www.caregiver.org/factsheets/selected_caregiver_statisticsC.html

¹⁸ Social Security Advisory Board, "What Will Happen When the Baby Boomers Retire?" from "Why Action Should Be Taken Soon," dated July 1998, accessed 7/11/03 at <http://www.ssab.gov/rep5iv.html>

¹⁹ "Chronic Care in America."

²⁰ "The MetLife Juggling Act Study - Balancing Caregiving with Work and the Costs Involved," findings from a national study by the National Alliance for Caregiving and the National Center on Women and Aging at Brandeis University, November 1999.

²¹ Richard Jackson and Neil Howe, "The 2003 Aging Vulnerability Index," Center for Strategic and International Studies and Watson Wyatt World Wide, March 2003, page 3-4.

²² Sebastian Moffet, "For ailing Japan, longevity begins to take its toll," Wall Street Journal, 11 February 2003. <http://www.burtonsys.com/AilingJapanLongevityToll.html>

²³ "Better treatment sought for elderly with broken hips," Associated Press, 3 May 2001, accessed 7/11/03 at <http://www.usatoday.com/news/health/2001-05-03-hips.htm>

²⁴ U.S. Department of Defense, "Y2K History," accessed 7/11/03 at http://www.defenselink.mil/specials/y2k/y2k_hist.htm



2519 Connecticut Avenue, NW
Washington, DC 20008-1520
www.agingtech.org

Phone (202) 508-9463
Fax (202) 220-0032

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