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ASSISTIVE TECHNOLOGIES FOR INDEPENDENT AGING: OPPORTUNITIES AND CHALLENGES

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BEFORE THE

SPECIAL COMMITTEE ON AGING
UNITED STATES SENATE

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ASSISTIVE TECHNOLOGIES FOR INDEPENDENT AGING: OPPORTUNITIES AND CHALLENGES

TUESDAY, APRIL 27, 2004

U.S. SENATE,
SPECIAL COMMITTEE ON AGING,
Washington, DC.

The committee met, pursuant to notice, at 10 a.m., in room SD–628, Dirksen Senate Office Building, Hon. Larry E. Craig (chairman of the committee) presiding.

Present: Senators Craig and Dole.

OPENING STATEMENT OF SENATOR LARRY E. CRAIG, CHAIRMAN

The CHAIRMAN. Good morning, everyone. The Senate Special Committee on Aging will convene. The topic of today's hearing is Assistive Technologies for Independent Aging. We are extremely pleased to have all of you with us this morning and to get a glimpse of what I think will be a better future for America's aging population.

I am speaking of the potential of assistive technologies. Advances in such technologies have the potential of revolutionizing how seniors and their families experience the aging process, most importantly, by improving seniors' quality of life and making it possible to remain independent in the comfort of their homes and their communities.

This comes not a moment too soon. Worldwide, the number of people over the age of 60 will nearly double in the next several decades, and of course, here at home 70 million baby-boomers will begin retiring only a few short years from today.

For seniors and their families, assistive technologies offer hope. For America's technological industries, it offers an exciting and expanding marketplace. For policymakers, it offers real potential to free up scarce resources, resources urgently needed as America ages. This morning we will see firsthand demonstrations of some of the cutting edge assistive technologies being developed by America's technological companies and our universities. Importantly, however, we will also be talking about the very real challenges we are facing in bringing these technologies out of the lab and into the marketplace, and from there into America's seniors' homes.

For example, some of the witnesses here today will testify that America's technologies sector has not yet fully embraced the potential market for such technology. Others will speak about the chal-

lenge of translating new technologies into products that are both affordable and practical. Even the most brilliant technology can fall short in that it may be too expensive or too complex for the average senior to use. Through the leadership of organizations like the Center for Aging Services Technologies, otherwise known as CAST, these challenges are beginning to get the attention they deserve.

Our purpose here today is to highlight both the dazzling opportunity and the real challenges that lie ahead as we seek to bring life-enhancing assistive technologies to America's seniors. We appreciate our witnesses and the contributions they will bring before the committee today.

Before I introduce our witnesses, let me recognize Senator Dole, who has joined us, for any opening comments you would wish to make.

STATEMENT OF SENATOR ELIZABETH DOLE

Senator DOLE. Thank you, Chairman Craig. I appreciate your holding this hearing so that we can discuss openly today the opportunities and challenges brought about by the latest technologies in elderly care.

I certainly want to thank our witnesses who have come today to facilitate and educate an open discussion on the newest advancements in technological assistance for our seniors.

As you know, I lost my precious mother back in January, and she would have been, 4 months later, 103-years-old. So, obviously, she has benefited from technological assistance in being able to stay in her own home almost to the ripe age of 103.

The cost of elderly health care in America is rising almost as quickly as the number of those in need of such attention. Studies have indicated that by the year 2040, 30 percent of our population will be considered older. That is over one third of our country that could be in need of some sort of specialized attention, be it in an assisted living facility, private home care, or a full-scale retirement home.

In this age of astounding medical progress, preventive care is a key factor in many aging Americans' lives. Today's technology affords our senior options our grandmothers and grandfathers never even dreamed of. High-tech innovation, such as everyday activity assistance, fall prevention canes and Pill Pets act as independent living assistance for the elderly, as well as offering reassurance to loved ones concerned about the risk their aging family members have in being alone.

I look forward to hearing more about each of these advancements as well as many others in today's hearing. The amount of money we Americans have invested to increase the average life span, of course, reaches into the billions. While medical progress has succeeded in pushing up the average life expectancy, we failed to adequately address how we can approximately care for the millions of Americans now living well into their 70's, 80's and beyond, such as my mother. Many of today's technologies in aging medical care can offset some of the financial burden of the increasing number of seniors seeking health care. It is time Congress considers the individual benefits of technological assistance as well as the economic ones.

I look forward to your testimony this morning.

Thank you, Mr. Chairman.

The CHAIRMAN. Elizabeth, thank you very much.

Before I introduce our panelists, let us proceed this way. We are going to take your testimony, and then several of you have some demonstrations, and I understand there is a bit of a problem of plugging and unplugging, so we will then, after all of your testimonies, we will do the demonstrations, and then I have a series of questions I would like to engage all of you in.

Elizabeth, when you were mentioning your mother, I was thinking it is happening more and more. We understand numbers and demographics and we see this aging population out there, and we hear about centenarians and the number that are here. During the Easter break I attended a 100th birthday of a second cousin, and I then later went to a national convention in which the emcee of the convention of some thousands gathered—and it is an old organization of 133 years—said, "Who is the oldest member here?" Finally, it was determined that it was a man who was 99. He walked up, walked on stage and delivered a 5-minute speech that I would have been proud to claim as mine, and I think, "Oh, my goodness, those are not just numbers on a page out there. They really are people," and it constantly reminds me of our work, and of course, improving the quality of life of those who live longer, and that is what we are all about.

Senator DOLE. Indeed.

The CHAIRMAN. We are very fortunate to have with us today several of the country's leading experts on assistive technology and its potential application for senior populations. Some of these witnesses have brought with them examples of their work, and we will get introduced to one of them. I understand she is a bit under the weather.

Anyway, while we are with that, let me first introduce Eric Dishman, as the Director of the Intel Corporation's Innovative Proactive Health Strategy Research Project, and also the National Chairman of CAST, the Center for Aging Services Technology.

Next we will hear from Martha Pollack. Martha is a professor of Engineering and Computer Science at the University of Michigan, and is one of the country's leading academic scientists in developing assistive technologies for persons with cognitive impairments.

Next we will go to Lydia Lundberg. Lydia comes to us from Milwaukie, Oregon, where she is the owner and founder of Elite Care, one of the country's most technologically sophisticated residence care facilities for seniors.

Next we will go to Joseph Coughlin. Joe is the founder and director of the MIT AgeLab, one of the world's foremost academic centers for the interdisciplinary study of the application of technology for the needs of our seniors.

Then we will go to Stephen McConnell. Steve is the vice president of Public Policy and Advocacy for the Alzheimer's Association, and will speak to us about growing care burdens associated with of course that terrible disease.

Finally, we will visit with Ron Seiler, director of the Idaho Assistive Technology Project at the University of Idaho. Ron has

worked tirelessly for many years to help bring needed assistive technologies to disabled and senior Idahoans, especially those that live in rural parts of our State.

We thank you all for being with us this morning. Now, Eric, we will turn to you, Eric Dishman, director of Intel Corporation's Innovative Proactive Health Strategy Research Project.

STATEMENT OF ERIC DISHMAN, DIRECTOR AND SENIOR RESEARCH SCIENTIST, PROACTIVE HEALTH RESEARCH, INTEL CORPORATION, AND CHAIR, CENTER FOR AGING SERVICES TECHNOLOGIES, A PROGRAM FOR THE AMERICAN ASSOCIATION OF HOMES AND SERVICES FOR THE AGING

Mr. DISHMAN. Good morning, Chairman Craig and members of the committee. Thank you for holding these important hearings. I am honored to be here today both representing Intel Corporation and CAST, the Center for Aging Services Technologies.

Before I even get into that, I should mention when I was 16, living in North Carolina, I am from Charlotte originally, I was a caregiver for my grandmother who had Alzheimer's, so I have been thinking about this for a good 20 years. I am 36-years-old. Everyone is like, "Why are you focused on aging?" I am always the youngest person in the room at most of these conferences on aging, but I have been thinking about this for 20 years in trying to figure out what might we have done to help mitigate some of the effects that that disease had on my family.

I am a social scientist. I am not your typical Intel person. I have spent the last 12 years working in high-tech companies, and in so doing, I have visited about 100 high-tech labs around the country, but more importantly, I have actually lived with and observed and had a family dinner with more than 1,000 households across the United States, who are struggling with health care and care giving issues.

When you take all of that in, after 12 years of doing that, I can tell you that there are literally hundreds of technologies sitting in the labs of American universities and corporations today that could dramatically improve the lives of all Americans, those care giving for our seniors and the seniors themselves, if we can figure out how to get American intellect and imagination and investment dollars focused on the health and aging issues that most of us really do not pay much attention to. I can tell you most people in the technology industry think about digital entertainment, they think about communication, as being the next wave of computing and communications technologies, but all of these things that we are building could radically improve people's lives in their everyday home, so that is the spirit in which I want to say a few comments today.

About November 2002, my lab at Intel had gotten a little bit of press about some of the demos that you will see today, and I started getting calls from executives from companies around the Nation and from long-term care providers saying, how did you get Intel to talk about aging issues publicly? How do we get onto this bandwagon to test out some of these technologies?

I started having conversations with AAHSA, the American Association of Homes and Services for the Aging, and what started out

as informal conversations amongst these people who were e-mailing and calling over the last 2 years has just accelerated into what we call CAST, and now as an organization with more than 200 technology companies, long-term care providers, aging-oriented associations and university researchers, who have come together to try to figure out how do we accelerate the development of assistive home care aging in place technologies? How do we get them out of the lab and into the everyday lives of real people?

As you well know, we did a demo day last month here in the Dirksen Building. There were 16 organizations, almost all of whom the people doing testimony today were part of the CAST initiative and have been leaders in getting CAST off the ground. That was really just to start to show a new vision for long-term care technologies.

I really believe our biggest problem nationally is an imagination problem, not a technology problem. As I said, many of these technologies are sitting in labs, and no one is imagining the need and the market and the possibility of applying them to this domain.

I am going to show you two demos later today. One is a fall-preventing cane, and another is what we call the Everyday Activity Assistant. I will not go into details of those now, but I want to show you, a lot of people when they think Intel, think personal computers. This is the kind of computer that I am talking about today, a little tiny computer that we call a "mote", and what the magic of this little tiny computer is, is that it is a wireless transmitter, it is a tiny microprocessor. What it means is that we can start to embed them in the environment without tearing apart somebody's home, and collecting real world diagnostic or behavioral data that would help to intervene in a disease process. We are not talking about necessarily traditional computers as we have come to know them.

A lot of the demos that you will see today and a lot of the core technologies are really about collecting real-world data where people live, work and play. Today our health care system is optimized and operationalized for once people already have a problem. We have lots of expensive equipment in the hospital. The real question is how do we shift a lot of that technology and that diagnostic capability into people's homes so that you are getting more accurate and more ongoing feedback about how they are doing, so that they can intervene on behalf of themselves or other people can help out.

I want to just show you a couple of pictures because I think it is more important to start with real people than the technology, so I will just bring up a couple of photos from field work that we have done at Intel. I am going to talk about Barbara in a little bit. This is Barbara. She is 61. She was diagnosed with dementia about 2 years ago. I called her and said, "Can I use your photos and your story for this?" She was thrilled because she wants her life experience to help with other people.

She has enormous difficulty just doing everyday activities like making coffee, and there are millions of households like this around the United States, and you are going to see later in the demo, if we start thinking and getting engineers in this world to start imagining how can we help people do everyday activities of

living, that is a really different use of technology that could be really empowering for those folks.

Just show you a couple of other photos, this is Barbara struggling to use the radio, so one of our challenges is making the technology be useful on any device that people are already comfortable with. That could be a television. It could be a radio, whatever they are still capable of using, again, not necessarily a traditional PC.

We saw a lot of households who needed help with daily activities, leaving notes for their families, instructions on how to get dressed. When you are talking about young engineers sitting in a technology company who have not been exposed to this, they cannot imagine that there is somebody who possibly needs a technology that could help them with the sequence of getting dressed by themselves. They cannot imagine how empowering that could be for somebody to still maintain that activity of daily living. So again, a lot of this is really about imagination.

I will close by saying why are there not more companies working on this? In 1990 there were 357 million people worldwide over the age of 65, and by 2020 it is supposed to be 761 million. So given this huge worldwide demographic, why are not more companies doing this? CAST has spent a year doing surveys, interviews and conferences on this topic. We hear things from companies saying, "We do not want our brand associated with aging. We are not sure what products and services would make the biggest difference for seniors." Some of the researchers that we have talked to say that their research falls between the cracks of current Government agencies, and a lot of people end up saying to us, "We are too afraid to even do research in this domain and pull those technologies out of the lab because we are afraid of being sued."

So these barriers, whether they are real or perceived, are keeping the wall up around some of that innovation from moving into this domain, and I hope that with leadership today we can help to galvanize some action and galvanize some attention to these important issues, and pull those technologies and apply them to the aging population.

Thank you.

[The prepared statement of Mr. Dishman follows:]

WRITTEN TESTIMONY OF

ERIC DISHMAN

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A program of the American Association of Homes and Services for the Aging
www.agingtech.org

Presented to
U.S. SENATE SPECIAL COMMITTEE ON AGING

Hearing on:

Assistive Technology for Aging Populations

Tuesday, April 27, 2004
10:00 a.m.
628 Dirksen Senate Office Building

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

CareWheels, http://www.care-wheels.net Claude Goodman, Director	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.
Center for Future Health University of Rochester, http://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, http://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 & Science University Biomedical Engineering, http://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 & Computer Science, http://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.
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APPENDIX B

Article Reprint:

Inventing Wellness Systems for Aging-in-Place

by

Eric Dishman

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COVER FEATURE

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* interview[1]

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The US Congress, already facing an annual healthcare 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 Research[5]

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

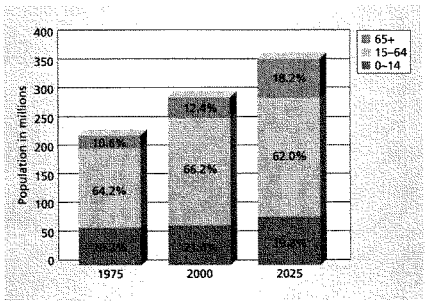

Figure 1. US population growth of three age groups for 1975 and 2000 and projected for 2025. The elderly segment is increasing almost twice as fast as the rest of the population. (Source: US Census Bureau)

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

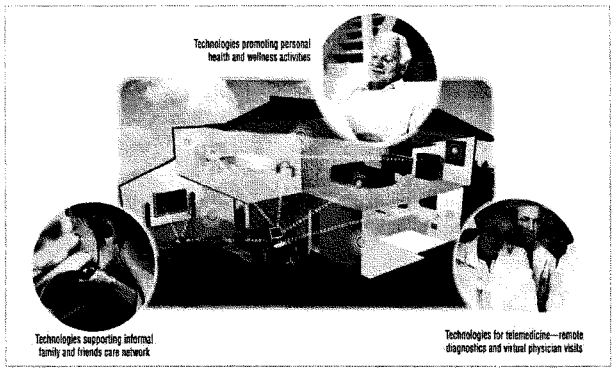

Figure 2. The home as a key location in the healthcare chain. Home health technologies should enable healthcare consumers and their informal and professional caregivers to work together to ensure the best quality of life.

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
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.

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 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.

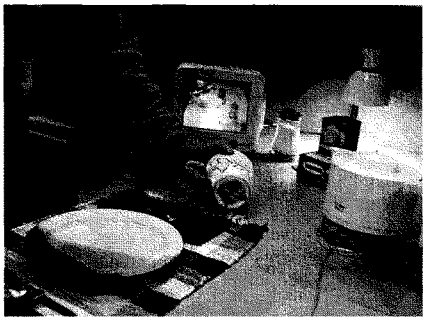

Figure 3. Prototype kitchen sensor system. Mote sensor technology implements contact and magnetic switches to sense movement of objects in the kitchen.

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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APPENDIX C

Article Reprint:

Progress and Possibilities: State of Technology and Aging Services 2003

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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 professional 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"

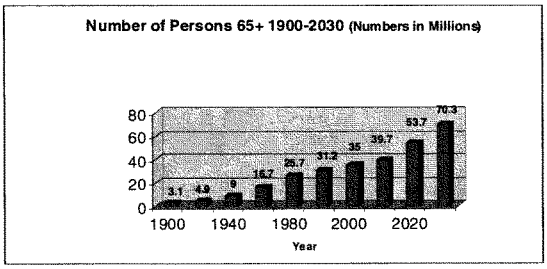
The American Association of Homes and Services for the Aging (AAHSA), working with professors from the Wharton School of Business, conducted a major "scenario planning" study to look at trends and changes in aging services from 2002 to 2012. One of the two major uncertainties that the study revealed 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.



(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]

Number of U.S. workers per Social Security beneficiary[18]	
1950:	16
1996:	3.3
2030:	2
Number of adult caregivers for each disabled elder [19]	
1990:	11
2050:	1

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 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%
Based on data from the CAST Technology Survey 5/12/03	

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 devised 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 Milwaukee, 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 resourses.

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,

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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and Services for the Aging (AAHSA)

The CHAIRMAN. Eric, thank you very much for that very enlightening testimony. If there are companies out there with an age bias, my attitude toward them as I age will change. [Laughter.]

Mr. DISHMAN. Vote with your wallet. [Laughter.]

The CHAIRMAN. Now let us turn to Martha Pollack. Martha is a professor of Engineering and Computer Science at the University of Michigan, and is one of the leading scientists in the area of assistive technologies.

Martha, welcome to the committee.

STATEMENT OF MARTHA E. POLLACK, PROFESSOR OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE, UNIVERSITY OF MICHIGAN, ANN ARBOR, MI

Ms. POLLACK. Thank you, Mr. Chairman. Mr. Chairman and Senator Dole, I really want to thank you for holding this hearing on this very important topic.

Today I want to describe to you some advanced technologies that have the potential to help our Nation meet the challenges posed by its rapidly aging population. Let me be clear at the outset, technology is not a panacea. It will never and should never replace human caregiving. But when used to supplement human caregiving, advanced technologies that are now emerging in the laboratory have the potential to greatly improve the quality of life for older adults and their caregivers.

Let me give you a few examples. My first two examples are systems developed by a consortium of researchers at the University of Michigan, University of Pittsburgh, Carnegie Mellon and Stanford. Autominder is a system designed to remind people with memory decline about their daily activities, so things like taking medicine and eating regularly. You can go out today and buy reminder systems, but generally they function like glorified alarm clocks, issuing fixed reminders for activities at pre-specified times, and this inflexibility greatly limits their effectiveness. Older adults, just like younger adults, do not follow ironclad schedules. In contrast, Autominder attempts to provide flexible personalized reminders. It can either run on a hand-held computer that will connect wirelessly to a variety of sensors, or more futuristically, on Pearl, the mobile robot that we have brought with us today.

Let us consider a typical Autominder user who I will call Claire, a forgetful, 80-year-old, diabetic woman, who is supposed to eat a meal or a snack every 4 hours and who currently has an infection that requires her to take antibiotics on a full stomach. We do not tell Autominder that Claire has to take her medicine at say, 8 a.m. Instead we just tell it that she has to take the medicine at the same time as she eats breakfast and dinner, and then whenever Autominder recognizes that Claire is eating breakfast, it will remind her at that time to take her medicine if she forgets to do so. It does this by popping up a message in large type or by speaking aloud in a synthesized voice.

Similarly, we do not rigidly tell Autominder that Claire has to eat at 7, 11, 3 and 7. We just specify the 4-hour interval. If Autominder can recognize that Claire has eaten lunch at 11:15, it will remind her to eat again 4 hours later at about 3:15, maybe even a little earlier if Claire's favorite television program is on

from 3 to 3:30. We use a variety of artificial intelligence techniques in Autominder to achieve this kind of flexibility.

My second example is IMP, a walker designed for people who are disoriented. IMP has a very simple interface on which someone selects the location to which she wants to go, and it then displays a shifting red arrow that guides her there. I will demonstrate IMP at the end of this panel's comments today.

My final example is a system called COACH, which has been developed by Canadian researchers for people with moderate to severe dementia. Where Autominder provides reminders for many distinct activities over the course of a day, COACH guides its user through a single activity, hand washing, providing cues whenever a step such as soaping, rinsing or drying is forgotten or done in the wrong order. Follow-on versions of COACH will provide assistance with toileting, something that is particularly trying for caregivers.

There are many more projects that I could describe to you, but I hope that these three are sufficient to convince you of the promise that is inherent in assistive technology for older adults. Yet there are significant technological challenges that must be met to realize this potential. First of all, there will need to be fundamental advances in using wireless sensor technology to monitor and measure activities of daily living. Second, since extensive customization for each user will be economically infeasible, artificial intelligence techniques need to be developed to make these systems work. Third, work on human computer interaction must by pursued to design interfaces that are extremely easy to use by people who may not only be cognitively impaired but may also have visual, auditory and/or motor difficulties. Finally, these systems raise crucial privacy concerns which must be addressed from both the technological and policy perspectives.

Currently it can be difficult to find sufficient funding to support university research on assistive technology for elders because the work tends to fall between the cracks of agencies like the NSF, which supports scientific and engineering trials but not clinical trials, and the NIH, which traditionally has not funded computer science.

To ensure that assistive technology will be ready by the time we as a Nation need it, I would propose that this committee explore the possibility of developing a cooperative funding mechanism that provides a stable source of support. This could plausibly involve a joint program of the NSF and the newly formed National Institute on Biomedical Imaging and Bioengineering, NIBIB, or the NIA.

I personally feel very fortunate to be conducting research that can have such significant societal benefit, and I feel fortunate to be doing it at the University of Michigan where I have access to expert faculty and intelligent students from the many disciplines that must work together to make the promise of assistive technology real.

I look forward to the day that this technology is in wide use, helping older adults live better lives.

Thank you very much.

[The prepared statement of Ms. Pollack follows:]

SPECIAL COMMITTEE ON AGING
UNITED STATES SENATE

Hearing On:

Assistive Technology for Aging Populations

Tuesday, April 27, 2004
10:00 a.m.
628 Dirksen Senate Office Building

Statement of:

Dr. Martha E. Pollack
Professor of Electrical Engineering and Computer Science
University of Michigan
Ann Arbor, MI

Mr. Chairman and Members of the Committee:

Good morning. My name is Martha Pollack and I am a Professor of Electrical Engineering and Computer Science at the University of Michigan, where I conduct research on the design and assessment of assistive technology for older adults. I want to thank you for holding a hearing on this important topic.

As your committee knows, our nation is facing an enormous challenge as a result of the dramatic demographic shift underway. According to U.S. Census Bureau projections, by 2030 approximately one in five Americans will be elderly, compared to one in eight today, and this increase will continue through the first-half of the century [1]. As senior citizens come to constitute a greatly increased proportion of our population, we have to ask how we will assure their care. How will we enable them to meet the range of challenges that they may face as a result of their increased likelihood of having physical, sensory, and cognitive deficits?

Today, I want to describe to you some advanced technologies that have the potential to help elders meet those challenges. Let me be clear: technology is not a panacea, and it will never—and should never—replace human caregiving. But when used to *supplement* human caregiving, advanced technologies that are now emerging in the laboratory have the potential to greatly improve the quality of life for older adults and their caregivers. This technology can increase the autonomy of our senior citizens, and in particular, enable them to "age in place", that is, remain living in their homes for longer periods of time. A large body of research has shown that older Americans prefer to maintain independent households as long as possible [2], and indeed, 95% of our elders live in

private residences [3]. Additionally, institutionalization has an enormous financial cost, for elders and their caregivers, as well as for the U.S. Government, which under the auspices of Medicaid and Medicare, pays for nearly 60% of the nation's $132 billion annual nursing home bill [4]. Thus technology that can help seniors live at home longer provides a "win-win" effect, both improving quality of life and potentially saving enormous amounts of money.

Devices that compensate for physical and sensory deficits have been developed for a number of years. These range from low-tech artifacts that are in wide use, such as lift-chairs and ergonomic door-handles, to more technically sophisticated, but higher cost, systems now available on the market, such as text-to-speech systems for people with low vision and digital programmable hearing aids. In addition, there are futuristic devices still in the laboratory, such as obstacle-avoiding wheelchairs [5, 6] and devices that allow people with limited mobility to control household appliances using simple hand gestures [7].

Yet some of the most exciting and promising advances involve technology that can help older adults compensate for cognitive decline. While we now know that severe cognitive impairment is not a part of normal, healthy aging, we also know that aging does affect certain cognitive processes [8, 9]. Additionally, of course, the major dementing illnesses that lead to severe cognitive impairment are much more prevalent amongst older adults than younger ones. Assistive Technology for Cognition (ATC) can help cognitively impaired people in one or more of the following ways:

- by *monitoring* their functional activities in order to provide feedback to their caregivers,
- by *assessing* their cognitive status, and
- by *assisting* them in the performance of their daily activities.

Let me briefly describe to you examples of ATC systems intended for each of these goals; more extensive surveys can be found elsewhere [10, 11].

Monitoring systems aim primarily at ensuring safety and well being, and at reducing caregiver burden, by tracking an elder's behavior and providing up-to-date reports to his or her caregiver. Early examples of such systems include personal alarm systems that enabled elders to summon help by pushing a button. The best known of these is Lifeline (formerly LifeCall), whose advertisements made famous the catch phrase: "Help; I've fallen and I can't get up". Technology has advanced significantly since then, and today monitoring systems deploy networks of sensors installed in an individual's home to automatically track an elder's activities. The network may include environmental sensors such as motion detectors and RFID readers that determine where a person is, contact switches on cabinets and refrigerator doors that indicate whether they've been opened, and pressure sensors in beds and chairs. It can potentially also include biosensors worn by a person to measure vital signs such as heart rate and body temperature. The collected sensor data is continually monitored both to determine deviations from normal trends that may indicate problems (e.g., failure to eat meals regularly, as determined by lack of motion in the kitchen) and to detect emergencies that require immediate attention (e.g., falls, as indicated by cessation of motion above a certain height). Caregivers can get

status reports on a regular basis, typically by checking a web page, and are also alerted to emergencies by phone, pager, and/or email. Examples of advanced monitoring systems include research projects [12, 13, 14, 15, 16], a demonstration system being used in an elder-care residential setting, which will be described by another participant in this hearing [17], and a handful of commercially marketed products.

There has been less work done to date on the second use of assistive technology for cognition, which involves *assessing cognitive status.* Typically, when a person needs to be evaluated for cognitive impairment, the evaluation is done in a formal medical setting, such as a psychologist or occupational therapist's office. In contrast, with advanced technology, one can potentially perform such assessment in a person's home, while they perform everyday activities, over an extended period of time. This may produce more accurate assessments, and it may also enable early identification of cognitive changes in at-risk patients. An example of project that is investigating the use of technology for assessment is now underway at the National Rehabilitation Hospital. In this project, sensors are being placed in a kitchen in which patients will perform everyday tasks such as making tea. Studies are being conducted to determine whether performance metrics based on data gathered from the sensors provide good indications of level of cognitive functioning [18]. (In the pilot study, the kitchen is on hospital grounds, but later phases of the study will evaluate system utility in actual homes.) Similar projects are also underway elsewhere [19, 13].

The third main use of assistive technology for cognition is to provide guidance to people as they carry out their daily activities. For example, *activity-cueing systems* guide people through multi-step activities such as bathing or simple meal preparation, issuing cues to perform each successive step in the activity. Activity-cueing systems may be particularly beneficial to people with severe cognitive impairment. For instance, the COACH system [20, 21] is designed for people with moderate to severe Alzheimer's disease. It guides its user through the process of handwashing, providing cues whenever a step such as soaping, rinsing, or drying is forgotten or is done in the wrong order. To decide whether a cue is needed, the COACH system relies on information from a sensor network specially designed for the washroom, interpreting that information using Artificial Intelligence (AI) techniques.

Activity cueing may also be helpful for less severely impaired people. An interesting example is the Cook's Collage, a system currently under development [22]. The Cook's Collage is a video-based system that records a person's activities as he or she cooks a dish, selects frames from a video that represent the previous six steps taken, and displays these on a monitor, so that the user can check to see what has just been done. This might be important if, for instance, he or she is temporarily distracted from the cooking task by a telephone call. Advanced image-understanding techniques are needed to interpret the video stream and map individual video frames to logical steps in the cooking task.

Where activity-cueing systems provide reminders about multiple steps in a single action, *schedule-management systems* instead provide individual reminders about multiple activities, in the context of a daily plan. That is, they remind people when to take their medicine, when to eat meals, when to take care of personal hygiene, when to check in with their adult children, and so on. Early schedule management systems used alarm clocks, calendars and buzzers, [23, 24, 25], while later studies employed pagers, cell phones and palmtop computers [26, 27, 28]. Regardless of the delivery platform, these early systems—like most commercially available reminder systems today—function like glorified alarm clocks: they issue fixed reminders for activities at pre-specified times. Unfortunately, this greatly limits their effectiveness, because older adults, like younger ones, do not live their lives according to ironclad, unchanging schedules. To be useful, schedule-management systems need to be much more flexible.

Let me illustrate what I mean by describing an advanced schedule-management system called Autominder that my students and I have been developing at the University of Michigan [29, 30, 31]. Autominder can either run on a mobile robot such as Pearl, who we have brought with us to this hearing, or on a handheld computer, which can potentially be connected to the kind of sensors that I described earlier. In the future, we hope also to present reminders on "wearable computers" such as wristwatches or pendants. In all cases, the interface is very simple, consisting simply of reminders that are either displayed textually on a screen or spoken aloud by a synthesized voice.

Consider how Autominder is being designed to interact with an older adult like Claire, a forgetful, 80-year-old diabetic woman, who is supposed to eat a meal or snack every four hours, and who currently has an infection that requires her to take antibiotics on a full stomach. We don't tell Autominder that Claire has to take her medicine at, say 8a.m.; instead, we tell it that she has to take the medicine at the same time as she eats breakfast and dinner. Then, whenever Autominder recognizes that Claire is eating breakfast, it will remind her to take her medicine if she forgets to do so. Similarly, we don't tell Autominder that Claire has to eat at, say 7, 11, 3, and 7; we just specify the 4-hour interval. If Autominder sees that Claire ate lunch at 11:15 (say, because it received information from the sensors saying that she opened the refrigerator, put something in the toaster, and opened and closed the cabinet where she keeps her dishes), then it will remind her to eat again at 3:15—or maybe a little earlier if her favorite TV show is on from 3:00 to 3:30. To achieve this kind of flexibility, we are using a variety of Artificial Intelligence techniques in Autominder; these enable it to model an elder's plan, to track the plan's execution, and to reason about whether and when to issue reminders.

I want to describe to you one final example of assistive technology for cognition, because so far all the examples I have given have focused on problems arising from memory decline, but there are other types of cognitive impairment that can affect older adults. IMP, which we will demonstrate at the end of my oral comments, is designed for people who have problems with orientation. Although IMP is a walker, and thus suitable for use by people with motor problems, it is primarily a cognitive aid. Developed at Carnegie Mellon and the University of Pittsburgh, IMP has a very simple interface that allows a person to select the location to which he or she wants to go, and then just follow a

shifting red arrow to get there. IMP would potentially be particularly useful for residents of assisted living facilities who have a hard time navigating to the dining room, gift shop, exercise room, and so on. Like Autominder, IMP relies heavily on artificial intelligence technology, which it uses to compute the orientation of the arrow as the user walks along [32]. Other technologically sophisticated devices that help a person compensate for disorientation include the Activity Compass, a Palm pilot-based system intended for people with early Alzheimer's disease. The Activity Compass uses GPS to learn a model of its user's routine travel behavior, predict likely destinations, and suggest routes should the user become lost [33].

As I hope these examples have illustrated, there is very good reason to believe that technologies now under development can help us meet the coming crisis in elder-care. But significant technological challenges remain to be met, most notably in four key areas:

1. Much of the emerging technology relies heavily on ***sensing technology***, and there will need to be fundamental advances in using wireless sensor networks to track and measure activities of daily living. We are really just beginning to understand how to design sensor networks that are reliable, secure, and easy to install and maintain—and we are even less far along in understanding how to use the information we can obtain from those networks to recognize everyday activities.

2. To be useful to older adults, assistive technology needs to be flexible and adaptive. Extensive customization for each user will be economically infeasible, and thus the systems we design need to be "self-tuning". Advanced computational techniques, and in particular, ***Artificial Intelligence techniques***, need to be developed to make these systems work.

3. Even the most powerful system will fail if its intended users cannot interact with it. Research into ***human-computer interaction*** must be pursued to develop interfaces that are extremely easy to use by people who may not only be cognitively impaired, but may also have visual, auditory, and/or motor difficulties.

4. Because much of the technology under consideration involves observing a person's everyday activities, crucial ***privacy concerns*** arise, and it is imperative to address these from both the technological and the policy perspectives.

In short, there is foundational work still to be done to realize the promise of assistive technology for older adults, and it is work that must be done by multi-disciplinary teams that include not only computer scientists, roboticists, and electrical and mechanical engineers, but also psychologists, physicians, nurses, occupational therapists, privacy experts, and representatives of the family-caregiving community.

Currently, federally sponsored research support for the design of this class of technology is patchwork, and it can be difficult to find sufficient funding because the work tends to "fall between the cracks" of agencies like the National Science Foundation, which

supports scientific and engineering research, but not clinical trials, and the National Institutes of Health, which traditionally have not funded computer science. To ensure that the foundations are put in place so that assistive technology will be ready by the time we, as a nation, need it, I would propose to this committee that they explore the possibility of developing a cooperative funding mechanism to provide a stable source of support for research on assistive technology for an aging population. This could plausibly involve a joint program of the NSF and either the National Institute on Biomedical Imaging and Bioengineering or the National Institute on Aging.

I feel very fortunate to be working on a topic that can potentially have such significant societal benefit, and I feel fortunate to be working on it at a major public research university that is as well-regarded as the University of Michigan, where I am able to interact on a daily basis with expert faculty and talented students from the many disciplines that must work together to make the promise of assistive technology real. I look forward to continuing to work in this area, and to the day that this technology is in wide use, helping older adults live better lives.

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The CHAIRMAN. Martha, thank you very much for that testimony, and we look forward to your demonstrations.

Now let me turn to Lydia Lundberg. As I mentioned, she comes from Milwaukie, OR, where she is the owner and founder of Elite Care, one of the country's most technologically sophisticated residential care facilities for seniors.

Welcome to the committee.

STATEMENT OF LYDIA LUNDBERG, OWNER, ELITE CARE, OATFIELD ESTATES, A RESIDENTIAL CARE FACILITY IN MILWAUKIE, OR

Ms. LUNDBERG. Thank you, Chairman Craig and Senator Dole, for holding this hearing, and I am very honored to be here.

In 1971 I immigrated to this country from Germany, and the only job I could find was as a nursing aide in a skilled nursing facility. So here I am today, and I think it speaks loudly for all things are possible in this country if you work hard at it.

Our facility in Milwaukie, we are getting many visitors from around the world to see what we are trying to accomplish there. I am also on the commission of CAST, and I speak around the world actually on the subject of technology.

We are a family run entrepreneurial business and we believe that if we are to enjoy our own old age, we need to shift the paradigm of elder care. We are investing our retirement savings to develop a system for long-term care that incorporates both technology and our mission to create elder-directed communities.

While many see the increasing numbers of frail elders as a burden on our society, we believe that they are part of the solution. With the use of the power of the proper assistive technologies, they can retain their active positive role and contribute to their environment regardless of where they live.

With our design of the Extended Family Residence and the use of technology, we are creating the farm families of the past while integrating technology of the future. In this model every generation has value and purpose.

Information gleaned from the technology is used to allow elders to live and engage in purposeful life.

In addition, our family portal, which is the one of the things I will demonstrate, brings peace of mind to the families of the elderly. Today, the lack of information about parents causes the kids to worry. We are constantly thinking, "Mom got lost coming home from the store yesterday. She cannot live by herself any more. What is Mom doing all day? Is she eating properly?" When Alzheimer's or short-term memory loss is involved, kids tend to fix the problem by incarcerating their parents in locked facilities.

We have personal experience with this. My father was just diagnosed with congestive heart failure in Germany, so I am trying to deal with all this long distance, and my husband's mother lives in Florida, who thankfully is still quite healthy.

About 50 percent of our residents would be in locked Alzheimer's facilities. Instead, they live in 12-suite houses where they can participate in life to the best of their abilities. Residents are not separated by diagnosis or cognitive ability. The technology supports their independence, safety, and puts the family's mind at ease.

Although we are a residential care facility, the technology and algorithms we are developing will enable all elders to function at higher levels, thus keeping them in their own home longer, in assisted living or residential care facilities longer, and hopefully keeping them out of skilled nursing facilities and hospitals.

In order to take us further, some of the areas where I think we really need help are as follows. There should be more opportunities in research dollars for supporting long-term care technology, especially where the private sector can benefit from such grants as the NIST ATP Grant, which we happen to have applied for.

We also are trying to develop partnerships with universities, such as Oregon Health Sciences University and companies like Intel. It is challenging to bring together providers, researchers and tech companies to work together on these problems. It is critical that we do so.

More work needs to be done to develop sensors that are cost effective and are easily used for automatic data collection. This can lead to predicting falls, strokes, heart attacks, thus allowing for interventions that may prevent these things from happening. There can be great savings in health care costs, great maintenance of quality of life.

There should be tax incentives to encourage early adopters. One of the biggest struggles with taking a system such as ours to other facilities would be how can I pay for it? What is my return on this?

We need to look at how the reimbursement of costs can be for implementing technology. Could there be a reduction in liability insurance? Will there be a reduction in management staff? Can insurance and Medicare payments for implementing technologies in homes by used?

Then one of the other big areas where the Government can help would be to encourage and accept electronic data for Medicare reimbursement and quality control standards.

Thank you very much.

[The prepared statement of Ms. Lundberg follows:]

Written testimony of

Lydia Lundberg

Owner, Elite Care - Oatfield Estates
A Residential Care Facility in
Milwaukie, Oregon

Presented to:

US SENATE SPECIAL COMMITTEE ON AGING

Hearing on:

Assistive Technology for Aging Populations

Tuesday, April 27th, 2004
10:00am
628 Dirksen Senate Office Building

Good morning Chairman Craig and members of the committee. My name is Lydia Lundberg and I am the co-owner of the most technologically advanced elder care facility in the world. We are getting visitors from around the world, to see what we are doing. As a leader in the effort to develop this technology, I am on the commission of CAST (Center for Aging Services Technology) and am asked to speak around the world on this subject.

We are a small family- run entrepreneurial business, who believes that if we are to enjoy our OWN OLD AGE, a paradigm shift is necessary in the care of our elders, We are investing our retirement savings to develop a system for long term care, that incorporates both technology and a mission to create elder directed communities..

While many see the increasing numbers of frail elders as a burden on our society, we believe that they are part of the solution. With the use of proper assistive technologies, they can retain their active, positive role and contribute to the environment regardless of where they live.

With our design of the Extended Family Residence™ and the use of technology, we are re-creating the farm families of the past, while integrating technology of the future. In this model, every generation has value and purpose. Information gleaned from the technology is used to allow elders to live an engaged, purposeful life.

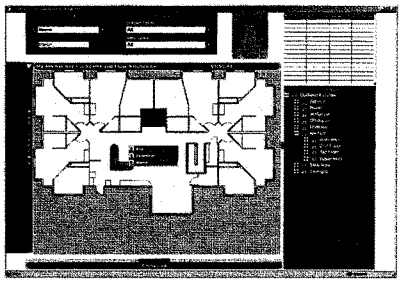
In addition, our family portal technology brings peace of mind to the families of the elderly. Today, the lack of information about parents causes kids to worry. We are constantly thinking, "Mom got lost coming home from the store yesterday, she can't live by herself anymore.". "What is mom doing all day? Is she eating properly? " When Alzheimers / short term memory loss is involved, kids tend to 'fix' the problem by incarcerating their parents in locked Alzheimer's facilities.

About 50% of our residents would be in locked Alzheimers facilities. Instead they live in 12-suite houses, where they can participate in life to the best of their abilities. Residents are not separated by diagnosis or cognitive ability. The technology supports their independence, safety, and puts the families' mind at ease.

Although we are a Residential Care Facility, the technology and algorithms we are developing will enable all elders to function at their highest level. Thus keeping them in their home longer, in Assisted Living / Residential Care Facilities longer, and hopefully keeping them out of Skilled Nursing Facilities and Hospitals .

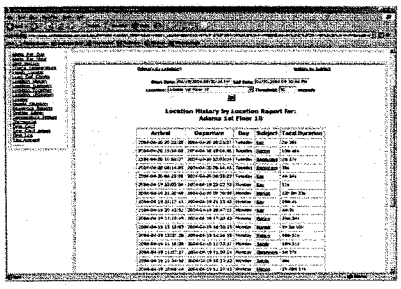
Demonstration of technology:

The family portal is one of the features that demonstrates what our technology can do. This is great for families who want to be more involved with their parent's care. It is a secure internet connection, password protected. It is our hope that when we get this perfected, we can install this system into individual homes.



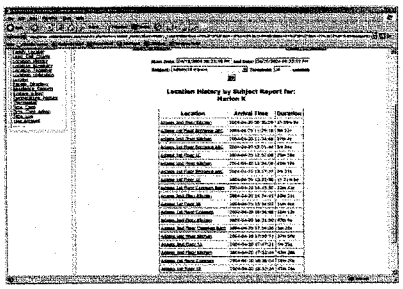
The Visual Locator

shows where Marion is at this time. She is moving around and we can see every time she leaves or enters a room. She will go sit on the bed and it shows the instant load cell readings.



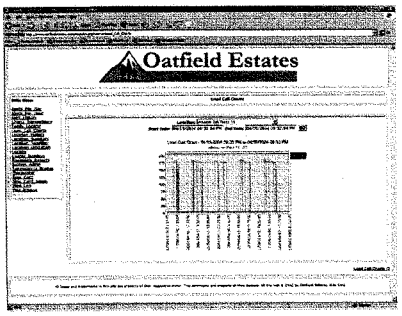
Location History / Suite

If I want to know who has been in her room, I can go to the location history, which shows by name, who was in her room and how long they stayed. This gives me an indication if he is getting the care she requires. I don't know exactly what they are doing, but by the time of the visits, the duration and knowing what care she requires, I can make assumptions.



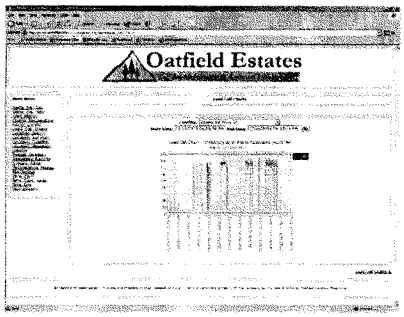
Location History / Person

If I want to know, where Marion has been spending her time, I can go to the location history. It shows how much time he was spending in the main area or in her suite.

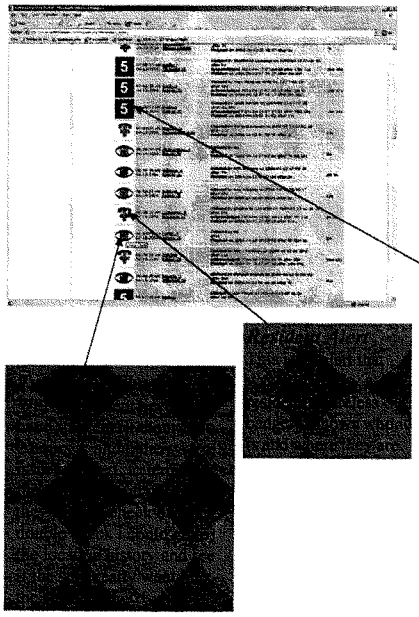


Load Cell Charts

This shows 5 days of load cell readings for Marion. It shows that her sleep patterns are the same for 5 nights. This is valuable information for many reasons. If there is a change in medication, and it affects her sleeping, it would show up here. She wouldn't necessarily be able to tell me. I can go back in time for as long as she has been at Oatfield Estates.



Here is a Load Cell chart from 6 months ago. It looks like Marion was tossing and turning a lot more and getting out of bed at night. This could be caused by different medication at the time.

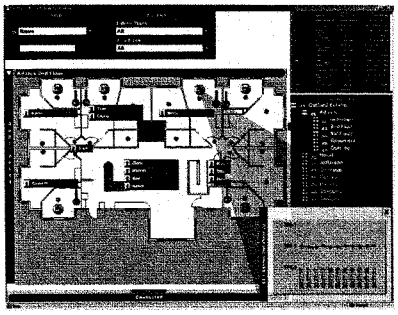


Manangement Information:

In addition to having the location and load cell information available for all residents, just as you saw in the Family Portal, as management I can check alert history for any time frame. This screens shows the alerts that happen in any given time.

Bed Bug
uses the load cells under a residents bed, to alert the staff when he/she gets out of bed. This is used for residents who are a fall or wandering risk. It can be turned on to work al day or only at night.

This report also shows me, who responded to the alert, how long it took to respond and how long the staff spent with the resident.



Visual Locator

With the visual locator, I can visually see who is where. Where the staff are (red icons), where the residents are (blue icons). I can see the temperatures, if doors are open or closed, if lights are on, if fans are on, and who is in bed.

The information collected by the load cells and the location are stored in a data base. The screens I have shown you represent a fraction of information that can be gotten from this data base. Currently we consider it a DRIPsystem, data rich - information poor.

What we need:

- Funding for research to develop algorithms that will lead to actionable information. "Is dad not moving around as much as he used to? Is he sleeping more / less? Is he losing or gaining weight?"
- Long term, research can also develop predictive models. "When there is x % of change in movement, you need to worry about Y (Heart Failure, etc)". This information can then be used for giving warning to the elder, physician, family and possibly prevent hospitalization.
- We believe there should be more opportunities and research dollars for supporting long term care technology R&R like the NIST ATP Grant, which we have applied for. (See Addendum)
- We are trying to develop partnerships with universities, such as Oregon Health Sciences University and companies like Intel. It is challenging to bring together providers, researchers and tech companies to work together on these problems. It is critical that we do so.
- More work needs to be done to develop sensors that are cost effective and are easily used, for automatic collection of data. This can lead to predicting falls, strokes, heart attacks, thus allowing for interventions that may prevent these things from happening. Great savings in health care cost, great maintenance of quality of life.
- Tax incentives to encourage early adopters.
- A method for re-imbursing costs of implementation of technology such as:
  - reduction in liability insurance
  - reduction in management staff
  - insurance / medicare payment for implementing technology in homes or LTC's
- Standards for easier integration of software and hardware
- Acceptance and encouragement of electronic data by the government for both MediCare re-imburse ment and quality control standards.
- Reduction of cost of hardware, wiring, retrofitting.

Addendum

Application for NIST ATP (National Institute for Standards and Technology, Advanced Technology Program) Elite Care applied for a $2,000,000 grant on April 14th, 2004. Receiving this grant would greatly enhance our ability to further develop technology so desperately needed for the care of our elders. Below is the Executive Summary of our application., along with letters of support.

EXECUTIVE SUMMARY

Long term care (LTC) in the U.S. currently cares for over 2 million elderly residents. This number is expected to greatly increase as the baby-boomers reach their elder years in the immediate decades ahead with the associated increase in the cost burden on Medicare and Medicaid. In addition, facilities are challenged to provide adequate care using minimally trained staff, whose turnover rate exceeds 100% per year. Thus, facilities often cannot adequately monitor residents for care needs or changing health risks. This project aims to create and test and anticipatory interactive feedback management system which increases caregivers' competence, encourages residents' sense of independence and reduces labor costs through the use of electronic monitoring.

Through the use of sensors, the augmented individualized management system (AIMS) can monitor selected activities of daily living (ADL) and health risks of residents. Fusing these data will form the basis for predictive models of care for care givers and can cue residents to care for themselves to the extent of their abilities.

The proposed system will use existing technological monitoring currently being piloted at the applicant organization, Elite Care at Oatfield Estates, develop new monitoring technologies, and fuse the data to create feedback to direct caregivers' care to residents. To achieve the aims of this project, AIMS R&D must overcome multiple scientific and technology barriers in five areas: sensors, data fusion, activity modeling, assistance and systems integration.

The engineering problems. Sensor networks are the first challenge. AIMS must continuously track residents and staff indoors and out to resolutions of one foot, determine their proximity to facility objects and each other in real time, and monitor many physiological signs non-invasively and unobtrusively. The systems challenge is as daunting. AIMS is a diverse combination of embedded, sensor, database, intelligence, communication, networking, and control technologies never before integrated. Despite this complexity, AIMS must perform compute-intensive, scientific processing in real-time on huge data streams with high reliability and accuracy. Existing sensors that have been primarily used for industrial applications have never been combined on a common platform to allow the data to be access on a real time basis to assist in the quality of life as well as increase the functioning level of the resident.

AIMS must fuse sensor data about a person's actions and clinical signs, along with environmental conditions and situational information, into estimated activity states. Predictive modeling must integrate sequences of activity states into high-level models of activities of daily living. From these models, plan recognition techniques must determine intention in order to assist residents. Finding useful prompts and dialogs to assist persons with cognitive disability is the final barrier. Adaptive techniques will enable AIMS to learn which prompts work until there are theoretical models of how people with cognitive disabilities perform tasks. Predictive modeling also fuses a resident's clinical state and activity performance into estimates of health state (physical and mental), thus enabling AIMS to prompt staff for health care. All these advanced technologies must blend end-to-end to realize meaningful assistance to residents.

Innovations. Many innovations are planned, including: (1) local area positioning system for indoor tracking, (2) smart scene sensors that protect individual privacy, (3) Bayesian inference networks to estimate action states, (4) a spatio-temporal data model of facility activity, (5) extended hidden Markov models for predictive activity modeling, (6) decision theoretic control of the assistance user interface, (7) real-time web service standards for open systems integration, and (8) adaptive technologies and evolutionary architectures.

Other Research: All other research in AIMS focuses on smart homes for independent living. Prolonging productive, independent living at home is the ultimate goal of care technologies. However, the path to this vision is for LTCF. Larger settings offer significant economic and technical advantages over homes. The large, long-term care industry converges in facilities; home care is a minor, fragmented segment. Home automation is a component business; plug-and-play AIMS will arrive only after interfaces are worked out in facilities. Facilities offer the necessary economy of scale to support this development.
Technology Impact. Integrated AIMS will foster open interfaces for medical monitors and assistive devices. Local positioning technology can be put in mobile units, e.g. to track emergency services. Fusion and modeling will provide a new foundation for further research.
R&D Plan. The plan is to use extreme programming and extreme sensor integration on an existing site. This will accelerate the time frame and leverage of the existing system which is in place. By doing it this way we will be able to attain results in a very short time frame. Otherwise it would take many more years to go from engineering to beta test to roll out. With the age wave upon us and the lack of nurses and other care givers in the pipeline it becomes imperative that new systems are developed quickly. It should be noted that the system that we will be implementing at Oatfield Estates is a redundant system as it is not need or required by regulation so in no way impedes or lowers the quality of life for existing residents. Not sure we need this.
Economic Merit. Medicare and Medicaid costs are soon expected to outstrip revenue.. The largest drain on the system is the rapidly increasing elder population and their care. The second largest drain are the MR (mentally retarded) and DD (developmentally disabled) populations that are starting to age and their primary care givers are starting to need care as well. Without implementing systems such as AIMS that leverage both the patients own abilities so they need less help, and the caregivers ability, we will be ill prepared to afford the necessary care for the baby boomers when they begin needing assistive care.
AIMS Markets. The markets for AIMS are the frail elderly and handicapped MR DD populations who want to maintain their independence or LCTF who want to leverage and augment their knowledge and staff with technology. AIMS will reach a $200M U.S. market within a few years (about 2010) and grow to several $B in the next decade.. Along with other AIMS applications (e.g. day-care, emergency service, prison) the world market ii estimated to be $10B by 2020.
The Economic Path. The benefits to individuals and facilities will drive the commercialization. Technology license and research publications will disseminate results. Elite Care will commercialize LCTF AIMS with four R&D phases and a strategic marketing plan.
The Social Imperative. AIMS is the promise of compassionate, cost-effective, long-term care to extend the independent, productive, and healthy years of our citizens and enrich their lives. AIMS will foster communities more like extended families, instead of dependents. AIMS could reduce health-care costs by early detection of health risks and fostering resident activity. This approach can help redirect some of our nation's health care expenditures to other arenas. As care costs soar and staff decline, NIST/ATP can greatly accelerate AIMS to help solve the nation's looming crisis in long-term care.

THE FLORIDA STATE UNIVERSITY

College of Medicine

Tallahassee, Florida 32306-4300
Telephone: (850) 644-2250, FAX: (850) 644-0158

4/14/2004

Regarding: NIST ATP proposal

To whom it may concern;

I lend my full support to Elite Care's proposal for a NIST ATP grant for developing a systematic method for utilizing clinical data obtained electronically to better manage elder residents in a community-based care facility. Elite Care has been a national model for implementing real life applications of the "Smart Home" technology in congregate living. While many Smart Home model programs exist at universities, there are very few models that actually employ a licensed care facility to test its applications. This unique aspect is vitally important to translate the good idea of using electronic monitoring and communications in long term care into a usable, affordable solution for the future.

The need for such an approach is undeniable. Economic pressures are hitting up against never-before-seen demographic changes that demand new solutions to the many failures seen in long term care. A recent report on the future of family medicine (http://www.annfammed.org/cgi/content/full/2/suppl_1/s3) documents how adoption of electronic approaches to health care is a necessary component to the very survival of family medicine as a discipline. The entire medical care system is beginning to focus more on chronic disease management (rather than the traditional approach of acute care) and certainly community-based long term care is a significant portion of that movement. There is increasing recognition that transitions in care, i.e., when a resident moves from their assisted living to a hospital or nursing home, are the points at which medical errors are most likely to occur. The ever growing complexity of health care demands 21st century approaches to managing problems to prevent them when possible, catch them quickly when they occur, and ensure that the problem is completely addressed and follow-up is ensured. It is for all these reasons that the initiatives being investigated at Elite Care are worthwhile areas of study.

The team at Elite Care is incredibly dedicated to their mission and extremely innovative in their approaches. They have been able to forge numerous close working collaborations with scientists who provide insight and guidance. They have excellent information technology experts that have designed simple and accessible technologies for use in their environment. They have dedicated staff to provide the care that serves as the "learning laboratory" for their innovations. And they have a compassionate and caring approach to aging that ensures success.

I strongly urge you to give their proposal your support.

Sincerely,

Kenneth Brummel-Smith MD

Kenneth Brummel-Smith, MD
Chair, Department of Geriatrics

The Arc

The Arc of the United States

People First, Visionary Leadership, Community Participation, Diversity, Integrity and Excellence

Reply to: ☑ 1010 Wayne Ave., Suite 650, Silver Spring, MD 20910, (301) 565-3842 (301) 565-3843 Fax

Reply to: ☐ 1331 H St., NW, Suite 301, Washington, D.C. 20005, (202) 783-2229 (202) 783-8250 Fax

The national organization of and for people with mental retardation and related disabilities and their families

April 13, 2004

Bill Reed
President and CEO, Elite Care
4444 SE Oatfield Hill Road
Milwaukie, OR 97267

Dear Bill:

I am pleased to offer The Arc's support of the application you are submitting with HSU to NIST for an ATP grant. The Arc is the nation's oldest and largest family and consumer organization for people with cognitive, intellectual and developmental disabilities. The work you are doing is important to the future of The Arc's constituents, people with cognitive, intellectual and developmental disabilities.

Being able to determine how to record and analyze longitudinal information on residents and staff, looking for subtle differences that help predict changes in condition and then reacting would be invaluable for programs serving people who have support needs, but can be made more independent with the use of the technology you are perfecting.

Being able to record this information and feed it back to the proper personnel so when questions arise about ones condition you are able to answer questions that might be asked, whether they are mobility, socialization, eating, vital signs, bowel movements sleep patterns and stability, can improve both the care of the individual in question, and make the most effective use of limited staff resources.

Staff resources comprise approximately 75% of the cost of services for people with cognitive, intellectual and developmental disabilities. We are desperately seeking solutions that would make staff more effective, and that can allow for fewer staff to support people in ways that they want to live. We are hopeful that your technology will assist in making staff more productive and, if we can extend the capability and span of control of staff, we can compensate them better helping to reduce turnover. The technology has the potential of doing all of this while increasing the independence and decisionmaking ability of people with disabilities.

Please le tem know if I can provide any further information.

Sincerely,

Steven M. Eidelman
Executive Director

MAYO CLINIC

200 First Street SW
Rochester, Minnesota 55905
507-284-2511

Eric G. Tangalos, M.D.
Internal Medicine

April 9, 2004

RE: Elite Care Grant Application to NIST ATP

To Whom It May Concern:

I am pleased to endorse the application from Elite Care to study the care giver model of support they have created in Oregon. I have been involved with the development of their programs since inception and can attest to the use of smart technologies for the care of the frail and vulnerable. Their assisted living model is unique in its approach to achieve a maximum level of independence for each resident irrespective of the clinical condition.

I have worked with both their Intel and Oregon Health Sciences University partners as well. This is an excellent team that understands the clinical needs of the patient as well as the tecimology that underpins their unique approach. Mathematical models to predict change can be accomplished by these investigators. The NIST ATP Grant will allow the synthesis of data to create reproducible and generalizable action plans.

The Elite Care team has now been at this for quite some time. They have the tenacity to deliver an exciting product that is valid not only in the commercial world but to the research community as well.

Eric G. Tangalos, M.D.
Professor of Medicine
Chair, Division of Primary Care Medicine

EGT/ams

Center for Aging Services Technologies CAST

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

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

April 9, 2004

To whom it may concern:

This letter is to show my support for Elite Care in their effort to obtain a grant from the NIST Advanced Technology Program. As Executive Director of the Center of Aging Service Technologies (CAST), I recognize the leadership they have shown in demonstrating how technology can help benefit the care provided to older adults. As someone personally acquainted with the Elite Care management team, I believe that they have the determination and expertise to do so.

In the two years that I have been familiar with the project, Elite Care has pioneered a unique, and highly sophisticated, passive monitoring framework and data collection environment. Their development team has taken patient monitoring to a high level of completeness while minimizing the obtrusiveness to daily patient life.

While the monitoring mechanism firmly established, Elite Care has come to the next, and perhaps more challenging, stage of development. The rich data set collected continuously on every patient must be interpreted to offer any real value. The interpretation itself is complex and unprecedented. Algorithms must be developed to convert the data into both diagnostic and predictive diagnoses. These diagnoses must then be presented to the proper party (i.e. resident, caregiver, or doctor) in the format most useful to them.

The task of mining such voluminous data is daunting, but I believe the Elder Care team has the wherewithal to accomplish their goals and to the help others in the field benefit by the knowledge gathered.

Elite Care currently has the support of Intel and OHSU. Joyce Collings is acting as the primary investigator. A grant from NIST ATP would allow them to make important advances to help the entire field. I support their application for this grant and hope you give it positive consideration.

Sincerely,

Russell T. Bodoff
Executive Director

A program of the American Association of Homes and Services for the Aging

The CHAIRMAN. Lydia, thank you very much.

Now let me turn to Joe Coughlin. He's the founder and director of the MIT AgeLab, one of the world's foremost academic centers for the interdisciplinary study of the application of technologies on the needs of seniors.

Joe, welcome to the committee.

STATEMENT OF JOSEPH F. COUGHLIN, Ph.D., DIRECTOR, MIT AGELAB, & NEW ENGLAND UNIVERSITY TRANSPORTATION CENTER, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Mr. COUGHLIN. Thank you, Mr. Chairman, and Senator Dole, and thank you very much for inviting me here to represent my team back at MIT and the many researchers that are involved.

In many ways, it is a nice surprise to be here, because if you think about it, what we are talking about really is celebrating a policy success, and that is that the investments over the past 100 years have actually gotten us to live longer, and now that we are living longer we are saying, what are we going to do with that time, that bonus, if you will.

Senator Dole, you inspired me with a similar story of your mother living to the grand old age of 103, 104, thereabouts. Sarah Knauss in Pennsylvania lived to 119-years-old, and she framed our challenged far better than any of us in academia certainly can that often lack poetic prose. That is that she enjoyed her longer life because she had her health and she could do things. So that is the policy challenge here. How do we enable people to live longer by having their health and to do things? Because simply having the time does not necessarily mean that you are going to have quality of life.

My presentation, if you will, or thoughts on the matter are twofold. One, is to talk to the technology, and two, to hopefully leave you with some policy thoughts as to where we might go with this.

I would rather not describe the technology functionality per se, but really challenge the assumption that what we want to do is to use technology to do what we do better. I would submit to you that we do not want to do that, and anyone who uses technology to do what they do today better, is actually not getting their return on investment and it is not a very good use of Federal R&D dollars as well. We want to use technology to do things differently, to think differently about the future of aging entirely, thinking about how it is going to bring different players to the table, thinking about how it is going to redefine our quality of life, and thinking about new ways of indeed paying and creating, if you will, inventing a lifestyle, not for the frail elderly, but for those of us in middle age so that when we become frail these things are already in place.

To make that happen I would point to you a converging coalition of expectations. One: adult caregivers and the older adults themselves. People now are sandwiched, if you will, as you must have heard of the boomer generation that are interested in not only spending dollars but searching for solutions, if you will, to care for themselves and to care for their parents. Employers are a new partner at the table, not just in R&D, not just in terms of seeing this as a market, but the amount of lost productivity of caregivers coming to work late, leaving early or taking long lunches to take

care of Mom, Dad or a spouse, is a very real drain on their own productivity.

The distinguished Senator whose name is on this building once said that with a billion here and a billion there, pretty soon you are talking real money. One study suggests that there is upwards of $29 billion of lost productivity in the workplace due to caregiving. I would submit to you that that is real money.

Chairman Craig, your own Governor from Idaho is leading the National Governors Association on long-term care. They are struggling with the fact that 25 percent of the budgets in State houses today are going to health and aging. There is a now emerging coalition of families, governments and others, looking for real solutions. So this growing alignment is actually an opportunity politically to build the coalition to match it with now what are, as you can see in front of you, an abundance of solutions that are chasing the problems associated with aging.

So just three very quick ideas that we are working on to show you not the functionality of the technology but how it is different.

Retail health: Using the information technology and the sensors that we are going to be talking about later on today to envision how the drugstore, the grocery store and institutions that are quintessentially private, may provide care and assistance in making decisions in real time in the shopping time about healthy decisions.

Senator Dole, you were kind enough to mention our Pill Pet. The idea of using emotions and guilt, if you will, to remind people to take their meds, using the pharmacist, if you will, as part of that compliance effort as well. Facilitating that check up a day, using sensors to make people be able to manage congestive heart failure, diabetes in the home. That is actually not exactly very new news. Telemedicine has been with us for 40 years. If it is such a good idea, why is it going nowhere fast? I will submit to you that its great promise now is bringing together players that we have never thought of before. In Japan, Tokyo Power and Electric is now providing telemedicine to the home. Here in the United States, as indicated by the Comcast event a few weeks back, we are now looking at Phillips and perhaps even Comcast Cable looking at bringing health to the home via our cable channel.

Let me quickly advance to one last thing which is the transportation issue. How can we look at transportation to make driving and mobility a continuing issue of safety and independence and freedom, using technology to make the car smarter for that.

Let me close very quickly, and we can talk more about questions on what are those policy indications that we may want to think about? One, to reinforce Eric's point, is the idea of creating markets, and I would suggest to you that believe it or not I may be one of the first academics here, much to the chagrin of my colleagues, to ask not for money from the Federal Government for R&D, but actually to create tax credits for people that want to buy these systems in their home, to have companies want to invest in R&D and to have companies invest in elder care. If the market is there, they will get over their age bias. They will find that there is a market. They will find that there is a need.

Second, yes, we do need research and education, not in the way you may think. I think we do need a stable line that has been talked about by Martha Pollack in terms of research for R&D, but there is a technological literacy problem with the folks who will use these technologies. The social workers, the gerontologists, the physicians, the nurses, who are high touch but are low tech, do not understand how this is going to fundamentally change their practice and business.

Last, I would leave you with the third area, which is to facilitate partnerships. We need the Federal Government's support to engender a certain courageous attitude on the part of business, universities and caregivers, that it is OK to work with, say the local grocery store, to find new and novel ways of delivering nutrition services in the region, that it is OK to work with a university about commercializing a product. It is all right now to work with Government agencies of all levels to deliver care in ways we have never thought of.

Thank you very much for this opportunity and I look forward to your questions.

[The prepared statement of Mr. Coughlin follows:]

Testimony of

Joseph F. Coughlin, Ph.D.
Director

MIT AgeLab

& New England University Transportation Center

Massachusetts Institute of Technology

before the

Special Committee on Aging
United States Senate

April 27, 2004

Testimony of
Joseph F. Coughlin
Director
MIT AgeLab &
New England University Transportation Center

Special Committee on Aging
United States Senate
April 27, 2004

Chairman Craig, Senator Breaux and distinguished members of the Special Committee on Aging, thank you for this opportunity to present testimony on opportunities and challenges of using technology to support older adults and caregivers.

At the MIT AgeLab I lead a team of researchers, students and global companies that seek to develop new ideas and technologies to improve the quality of life of older people and those that care for them.

Our work is "use-inspired basic research." While broad in vision, the AgeLab seeks to be profoundly practical in improving everyday living -- transportation, health, communications, work, personal planning & decision making, play, recreation, and caregiving, while seeking to advance basic understanding of how aging impacts and is impacted by social, economic and technological systems.

Our research is motivated by a shared belief that the appropriate use of technology, along with innovations in its delivery, can have a significant impact on the quality of life for older adults, their families and caregivers.

Based within MIT's School of Engineering's Engineering Systems Division (ESD), our activities involve an array of disciplines including engineering, computer science, human factors, health and medical sciences, design, social work, gerontology, management, marketing, and the social and behavioral sciences. We take a systems approach to technology and aging – looking at technology as only a partial solution. Our research aim is to rapidly move innovations from the laboratory bench to people's lives as soon as possible to benefit today's as well as tomorrow's older adults. To achieve this, the AgeLab seeks to transform technology into true innovation by understanding how it is used and adopted by older people and caregivers in the context of behavioral, business and policy realities.

Confronting a Longevity Policy Paradox

The hearing today should be viewed as a celebration of policy success and technology's promise. While making the long list of humanity's successes over

the last century, many of us listed space travel, medicine, the Internet, few actually noted that we have made large strides in achieving the historic pursuit of humankind – longer life.

One hundred years ago life expectancy was less than 50. Today, with years of public and private investment we have made advances in everything from sanitation, to medicines, to healthcare, to nutrition, adding nearly thirty years of life. Now most in the United States can look to living well into their 70s – where the fastest growing part of the population is now 85+.

This great policy success leaves with a policy paradox – a longevity paradox. Now that we are living longer what will we do with our thirty year longevity bonus? How will we live, work, play, care and remain connected productive Americans in old age?

Sarah Knauss lived to 119 years of age. When asked about her life and why she enjoyed her longevity, she was said to enjoy longer life because she "had her health and she could do things." That is today's policy challenge and opportunity, not to simply live longer – we have achieved that for many – now the challenge is to live better.

Technology in many ways has enabled us to live longer lives, it is only appropriate to ask how technology can help us live better lives. My testimony is in two parts. First, a snapshot of selected problems in aging and technologies that may manage or remedy those problems, and second, a recommendation to the Committee that we not become so focused on devices and technology-enabled systems that we lose sight of the nation's need to establish a sustainable process of innovation that goes beyond developing technologies alone, but seeks to make the institutional and policy changes necessary to make these solutions available, acceptable and affordable to all Americans. Though the main focus of our discussion today is on the technology, the real policy opportunity is to align an increasingly activated public, emerging interests and the availability of technology to achieve these changes and exact real improvement in the lives of older people and their families.

Converging Expectations

The aging and health for today's older adults and their adult children, the baby boomers, is an expectations game. Historically the public definition and debate of aging and long-term care was to craft a safety net. Today, it is about supporting the public's expectation that we can live longer AND better. Because it is about expectations, it has become more political. Older adults and baby boomers are now demanding solutions to help them age well, independently and with dignity. They are becoming knowledgeable and activated looking for both public and private institutions to provide innovative services that rely, in part, on technology.

However, in addition to older adults and adult children, there is a new stakeholder in aging – employers. Similar to the years before worksite day care became the norm, not the novelty, employers are finding that eldercare is not the worker's dilemma alone, it is their issue as well. One in four families provide care to an older adult. A national survey reports that at least 50% of employees in Fortune 1000 firms see eldercare as a greater issue than childcare in the workplace. Somewhere in these halls Senator Dirksen was credited with saying (I am paraphrasing) "a billion here and a billion there and soon we are talking real money." Mr. Chairman, at least one study suggests that eldercare is costing "real money" to employers – an estimated $29 billion in lost productivity. Business, along with the families of older adults, is now looking for novel ways to address the needs of their employees and an aging population.

Seeking to stem the explosive cost of aging services and healthcare, the Federal and state governments are looking to technologies to deliver services more efficiently. Nearly 25 cents on the dollar of state budgets are going to aging and health-related services. In response to this fiscal dilemma and the needs of older people, Governor Dirk Kempthorne of Idaho and Chairman the National Governors Association, launched his initiative "A Lifetime of Health and Dignity: Confronting Long-Term Care Challenges in America. Under Governor Kempthorne's stellar leadership, this initiative has identified both the potential of technology to assist individuals and state agencies, but has generated a thirst for knowing more about these innovations as well as a demand for assistance in implementing them today.

There is growing awareness and alignment between older people, their families, employers, public agencies and others that technology may offer significant benefits. This political reality, combined with the fact that technology is now, generally speaking, cheaper and widely available, more usable (we are still plagued by technology understood only by the technologists), and increasingly linked to services that provide real value to people. As indicated by others presenting testimony today, and in the recently released National Academies book, Technology for Adaptive Aging, which many here contributed to, a wide range of increasingly ubiquitous technologies that may find their way into our homes, workplaces, cars, retail experience, long-term care setting and on (maybe inside) our bodies have the potential to assist, monitor, remind, and support older people and caregivers alike.

Technological-Enabled Innovations in Health, Decision Making and Transportation

Although many look to technology to help us do something better, technology used appropriately does not help us do things better, it changes what we do, alters our expectations and brings new players to the table. Three project areas we are working on at the MIT AgeLab illustrate this.

Retail Health – Many of our decisions around health and wellness are not made in the doctor's office where information and awareness is plentiful, nor are they made entirely in the home. Our daily shopping experience in the drug store and grocery store is the venue of much of our health decision making. The MIT AgeLab is working on developing the concept of Retail Health. An increasing number of retailers are providing screening services for diabetes, obesity, hypertension, etc., in the store. At the AgeLab we are seeking to leverage this opportunity, available technologies and the shopping experience of older adults, caregivers and boomers to provide information at the "point of decision" in the shopping aisle. One such project includes the use of a personal advisor that takes your personal diet, lifestyle and medical regimen and helps you or your caregiver make choices between food products. Rather than providing generalized benchmarks for the "average 65 year old diabetic" the MIT AgeLab personal advisor uses a smart handheld or shopping cart to help the consumer make a selection between products, balancing decisions that may include salt, fat, or other ingredients.

A related project is developing a "connected-kiosk" that builds upon the frequently seen in-store platoforms that can be used for weight, blood pressure, measurement, etc. The MIT AgeLab's project seeks to provide the means to take this service several steps forward, collecting the data for the user, providing suggestions based upon their needs and enabling them to contact (in real time) with a health specialist that may be based at one of the many major health centers that are practicing telemedicine across the country.

Our Pill Pets promise to help older adults adhere to their medication schedule. Similar to the child's toy from Japan that requires you to play with the device or it grows sick and eventually dies, the Pill Pet requires you to play with it, report that you took your medication or it too becomes sick and dies. If the Pet should pass on, it can only be brought back by the pharmacist. Research indicates that play, emotion and guilt may serve as greater motivators than the rational approach of simply reminding the patient – the Pill Pet is an attempt to apply all human dimensions of behavior to health.

A Check-Up-A-Day – Nearly 110 Americans manage at least one chronic disease another 70 million manage at least two. Adults 50+ tend to be the most likely to manage co-morbidity. The center of gravity of health care has been moving for sometime from the hospital and doctor's office to the home and the individual. Work being done across MIT, other universities and industry laboratories are making the idea of a check-up-a-day a reality for the chronically ill. As this Committee has heard in previous hearings, many agencies and private insurers are providing monitoring services to support older people with congestive heart failure, diabetes, asthma and now obesity. The innovation here is less the technology, but how these devices are changing the array of service providers we can look to for innovation in technology and service delivery. In Japan, we see Tokyo Electric Power in partnership with Matshusita to provide

monitoring services older adults in metropolitan Tokyo. Here in the United States, as recently presented at the Center for Aging Services Technologies (CAST) event here on Capitol Hill, we are seeing how the local cable provider, in this example – Comcast, and a device manufacturer, Philips, have teamed up to bring both health monitoring and personalized health content to the home.

Intelligent Transportation Systems – Although frequently overlooked until it is not available, transportation is an area where technology is beginning to improve both the safety and mobility of an aging society. Although we typically define transport as getting from point A to point B, that is an over simplification. Recalling Sarah Knauss and being able to "do things," as part of her happiness; transportation is the glue that allows us to access all those great and little things that together are life.

Personally and politically, transportation, driving in particular, is freedom, independence and the very identity of the vast majority of older Americans. Those that are no longer comfortable or able to drive show a marked decline in mental as well as physical wellbeing. Although most older drivers are safe drivers, and most choose to "self-regulate," that is limit their driving at night, busy periods, poor weather, this is a public safety success and personal tragedy at the same time. Limited driving for most is limited life. Choosing not to go out for one reason or another is a self-imposed limitation in life activities, visit a friend, see a grandchild or simply go out for a cup of coffee. To keep an older society healthy and well we must keep it on the move.

In partnership with The Hartford Financial Services Company, and the US Department of Transportation's University Transportation Centers Program, the MIT AgeLab has been conducting behavioral, policy and technology research to make the car safer and extend the safe driving life of older drivers and envision other technologies that make alternatives to the car more acceptable.

Many of the technologies that are moving to the car include warning systems to advise on a possible collision or proximity of another vehicle or object. Other devices seek to improve night vision a problem that begins far earlier than most of us would like to admit. Working with these systems and others in our lab's simulator, Miss Daisy, we have found that these "intelligent" systems while offering great promise also present a challenge to the older driver.

Introducing new technologies to the car fundamentally changes the driver's understanding (often built up around several decades of experience) of how the car works and in some cases may attempt not to assist but to substitute for the driver's own judgment. Technology is not always 100 percent accurate. An in-vehicle warning is not a substitute for looking. Most of the technologies being introduced to the car offer particular benefits to the older driver, but tax the memory, capacity and judgment of drivers of all ages. Considerable research to

understand the Janus-face of technology and its role on older adults in the car as well as other environments must be conducted.

A smarter car will help many drivers older and younger. However, new technologies and design must increasingly focus on the safety of the older driver and passenger. While some indicate that the high fatality rate of drivers over 70-75 is an indication of operator performance, it is far more likely to be due to frailty. Ensuring that the car is able move us as well as keep us safe from childhood through adulthood remains one of the greatest technical and policy challenges facing government and industry.

Other research includes the use of technology to improve the range of alternatives to driving. Nearly 70 percent of older adults live beyond where transit serves well or at all. Para-transit costs an estimated $7 to $50 per ride to provide, taxing many other public programs to fund, and provides far less than optimal transportation. New technology to address everything from vehicle design to dispatching and scheduling may increase the responsiveness of these services while manage their costs.

Technology and Aging: The Policy Challenge

The technologies presented today and in other venues capture the imagination and offer the promise of extending Sarah Knauss' experience to the rest of us – enabling us to have our health and to do things. While it is tempting to continue with other examples of devices that are symbols of the potential of technology to improve the lives of countless older people, it is my firm belief that the true innovation, and that the true challenge of leveraging technology for an aging society is not a technological problem alone, but it is our ability as researchers, governments and business to rapidly move these ideas from laboratories to living rooms. This requires the development and sustained support of an infrastructure that supports research and education, creates markets and facilitates partnerships.

Research and Education

Pieces of this infrastructure are already in place. The work being done across the Federal Government including the Roybal Centers, individual NIA grants, the US Department of Education's Rehabilitation Engineering Research Centers, the US Department of Transportation's University Transportation Center Program and others all support research that helps develop new technologies to support older people and caregivers. In addition to continuing support of these activities that are the seed corn of innovation in area, greater emphasis should be placed on how technology developers can ensure that the existing system of aging services can take full advantage of the technologies being developed. These services include home care providers, area agencies on aging, community centers, transit providers, publicly-funded social workers and geriatric case managers among

others. Additional resources should be made available to improve the outreach by university and industry researchers to these stakeholders to improve and change how services are delivered as well as to learn from the field the true requirements.

In addition to research, technology education remains the "property" of technologists in universities. As a result, innovation is often stalled when commercialized or put in the field, failing to prove its efficacy or return on investment. This is often because of poor technology, however, it may more often be because there has not been an adequate investment in the technology literacy of those caring for an aging society. Overcoming this change management problem is critical to realizing the nation's investment in technology and need to find effective ways to address the demands of older people and caregivers.

Technology education programs, particularly in information technology, should be developed and become a mainstay of the many professions that provide care. These include physicians who are unsure how telemedicine fits into their practice, nurses who were not trained to use technology in the field, case managers, gerontologists and social workers that are high touch but unaware of how they could increase their care with the right technology.

Create Markets

The Federal Government's greatest power is to set the agenda and to create an environment that influences both public attention and the allocation of resources personal, private and public. Unlike other policy areas, aging does not have the advantage of trigger events that galvanize public attention, industry focus and government purpose. Slow demographic change, while dramatic in impact, does not readily capture attention. There is a wealth of technology available today that could benefit older adults and their caregivers and most likely reduce cost of service delivery in the public sector.

Government agencies do not often see how technology may fundamentally change their programs and instead focus on incremental improvements. Excluding a few leaders, industry is slow to see the aging population as an opportunity not as a cost. Individuals and families fail to see how they need to plan for their parents AND their own aging.

In addition to recent changes in healthcare financing, the Federal Government should actively seek ways to create markets that stimulate more research, commercialization and would pay for innovative technologies and services. This would include research & development tax incentives to firms seeking to leverage their expertise to develop novel devices and services for older adults and caregiving. Tax credits to incent companies who develop eldercare services and benefits programs. To leverage the growing investment of out-of-pocket

expenditures in health and other areas, consideration should be given to develop incentives for families who invest in technologies and services in their home or the home of their parents.

Facilitate Partnerships

New technology often means new stakeholders. Envisioning the local utility company as a provider of health, education or simply emergency services to the home will require support from all levels of government. Encouraging private firms to take the risk in a new market with a new, albeit older, population will require government agencies at all levels to think differently about who is in the business of aging. Likewise, additional support for thought leaders in state, regional and local jurisdictions to team with industry to create new approaches to delivery and care should be provided and showcased for others across the country. For example, envisioning how the local grocery store may be seen as an outlet of nutrition services as well as a commercial enterprise may leverage both their easy access and economy of scale in a way that no public agency could provide alone.

The Senate Special Committee on Aging is to be commended for placing the issue of technology and aging on the government agenda. This Committee in recent years has sought to understand and promote both the promise and potential of technology in an aging society. Mr. Chairman, your efforts in telemedicine in your home state of Idaho are particularly noteworthy. Likewise, Senator Breaux has invested considerable energy in highlighting technology's role in older people's lives. Thank you for the opportunity to testify today. I would be pleased to answer questions.

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The CHAIRMAN. Joe, provocative testimony. Thank you very much.

Now let me turn to Steve McConnell, vice president for Public Policy and Advocacy for the Alzheimer's Association.

Steve, welcome to the committee again.

STATEMENT OF STEPHAN McCONNELL, SENIOR VICE PRESIDENT, ADVOCACY & PUBLIC POLICY, ALZHEIMER'S ASSOCIATION

Mr. MCCONNELL. Thank you, Mr. Chairman, Senator Dole. Thank you for calling this hearing today and for inviting the Alzheimer's Association. We appreciate your leadership and we appreciate your terrific staff as well.

This committee and the members of this committee understand the epidemic of Alzheimer's disease as well as anybody. There are 4½ million people now with Alzheimer's disease. That will grow to as many as 16 million by the middle of this century because of the aging of the baby boom population. One in 10 Americans over 65 and nearly half of those over 85 are suffering from Alzheimer's disease. Alzheimer's is the most important problem in our long-term care facilities. More than half of residents in nursing homes and at least half in assisted living have Alzheimer's disease.

As a result of that, we will see Medicare expenses for dementia-related care increase by more than 50 percent in this decade alone, and Medicaid expenses by 80 percent. American business is spending $61 billion dealing with an Alzheimer's disease.

So the Alzheimer's Association believes that assistive technology can be helpful, helpful to caregivers, helpful to people with this disease, helpful in advancing the day when we have treatments and eventually a cure.

I would like to mention three areas where technology can play a role. In the area of diagnosis and the development of treatments, there is an initiative now under way sponsored by the National Institute on Aging and the pharmaceutical industry, with support from organizations like the Alzheimer's Association, to look at imaging technology, MRIs and PET scans, to be able to detect changes in the brain more quickly. This is important as we introduce interventions, drug and other interventions so we can determine their effectiveness much more quickly. Without this technology, we must want 10, or 15, or 20 years for a number of people to develop Alzheimer's disease to determine if the intervention is effective. So Technology can be very helpful in diagnosing and also advancing the day that we have treatments available for people.

Second, technology can help caregivers. This committee knows that most caregivers are family and friends, and caregiving is very stressful. One in eight caregivers of people with Alzheimer's disease suffers injuries or illnesses because of their caregiving. One in three older caregivers suffer clinical depression. We know that older spouse caregivers are more likely to die because of their caregiving responsibilities.

Technology can support caregivers, and we are not only talking about family caregivers but paid caregivers as well, who are underpaid, and under appreciated. There is high turnover. Technology can help by supporting people with this disease so they can live

more independently through monitoring technology and other devices to reduce the stress on caregiving. Technology can be helpful in training caregivers as well through interactive voice, robotics, dynamic video and so forth. Of course, telemedicine and telehealth can also be helpful and can work for people with dementia as long as there is someone cognitively intact to help out.

Finally, technology can help people with Alzheimer's disease. We now know that this disease begins as much as 20 years before symptoms appear. As we have gotten better at diagnosis, people are being diagnosed much earlier, and that enables us to use technology to help people remain independent and to maintain a quality of life. Smart houses with automatic cutoff devices, kitchen heat sensors, monitors and medication dispensers, some of which you are hearing about today, can help people function independently longer. This is not only about cost savings and help for families and caregivers, it is also about human dignity.

We believe that we have to approach this from many points of view in our society. The Alzheimer's Association created a technology work group more than 2 years ago, and last July we joined with Intel Corporation to create the Everyday Technologies for Alzheimer's Care, ETAC, which will fund research to identify and develop new models of Alzheimer's disease care based on current and evolving technologies. We will do this by facilitating exchange among a variety of disciplines from bioengineering and robotics to architecture and nursing. We will fund research to seek practical improvements in detecting and preparing for disability, for delaying onset of symptoms, for providing support for caregivers and so forth.

We have also joined the Center for Aging Services Technology, CAST, sponsored by the American Association of Homes and Services for the Aging. We have created a Coalition of Hope made up of more than 150 organizations representing 50 million people who are dedicated to eliminating the impact of this devastating disease.

There are four things we would like to recommend. (1), that we create a national commission on technology and aging with a special emphasis on cognitive impairments; (2), that the Government support research on assistive technology in partnership with private industry and organizations like the Alzheimer's Association; (3), convening a series of hearings to continue to shine a light on this issue as you are doing today, which is very important; and finally, that we continue to support research so that someday we can have a world without Alzheimer's disease.

In closing I would like to pick up on this notion of people living much longer. I am reminded of the comment by Maggie Kuhn, when she said that the best thing about growing older is you outlive your enemies. [Laughter.]

There are many enemies to us as we age, the cognitive and physical assaults. Technology can help us defeat those enemies.

Thank you.

[The prepared statement of Mr. McConnell follows:]

alzheimer's association

TESTIMONY OF

STEPHEN McCONNELL

Senior Vice President, Advocacy & Public Policy
Alzheimer's Association

Presented to
U.S. SENATE SPECIAL COMMITTEE ON AGING

April 27, 2004

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Good afternoon, Chairman Craig and members of the committee. Thank you for inviting the Alzheimer's Association to testify about the opportunities and challenges of assistive technologies for persons with Alzheimer's disease.

The growing epidemic of Alzheimer's disease is generating catastrophic human and economic costs to American society and to societies around the world. The goal of the Alzheimer's Association, working in partnership with government and private industry, is to eradicate this disease. Through these combined efforts of the Association, National Institutes of Health, and the pharmaceutical industry, advances in medical treatment have surged forward in recent years. In the meantime, we must improve diagnosis, treatment and care; support family caregivers; address human resource challenges in the delivery of health care services; and improve care in facilities, at home, and in communities, whether rural, suburban or urban. We must do this in cost-effective ways that enhance quality of life for individuals, families and caregivers.

These are no small challenges, but technology provides enormous opportunities for addressing them. The Alzheimer's Association has assumed a leadership role by investing significant resources in exploring these technologies through the creation of a Technology Workgroup, by launching with Intel Corporation the Everyday Technologies for Alzheimer Care consortium, and by joining the Center for Aging Services Technologies commission sponsored by the American Association of Homes & Services for the Aging. In addition, the Alzheimer's Association recently announced that more than 150 local, state and national organizations representing more than 50 million Americans have come together to form the "Coalition of Hope" – the largest coalition ever organized to support increased funding for research to find new treatments to help those with Alzheimer's disease. We are pleased that the Senate Special Committee on Aging has called this hearing today and we look forward to working with the Committee and other government agencies to advance the technology and aging services agenda.

While much of the developmental work in technology is being carried out by private sector organizations, the Alzheimer's Association believes there is a definite role for the federal government. In addition to continued oversight, a key role is to bring stakeholders together in order to draw attention to the issues and give impetus to developmental efforts. A national commission on technology and aging, with special emphasis on those with cognitive impairments, should be created to focus public and private attention and resources on addressing these issues. A series of additional hearings should be convened to provide oversight on progress, to stimulate interest among various stakeholders, and to identify policy impediments to implementation of technological solutions.

Other roles for the federal government include supporting research on assistive technology in partnership with private industry and voluntary health agencies like the Alzheimer's Association. In addition, emphasis should be place on continuing and increasing federal funding for Alzheimer's disease research to maintain the momentum of advanced understanding of the causes and potential treatments of the disease while also seeking to find solutions for improving the care of those already diagnosed with the disease.

The Growing Alzheimer Epidemic

The challenges posed by Alzheimer's disease affect this country at a personal, an economic, and a societal level. An estimated 4.5 million Americans currently have Alzheimer's disease.[1] Increasing age is the greatest risk factor for Alzheimer's. One in ten individuals over age 65 and nearly half over 85 are affected.[2] The number of Americans with Alzheimer's will continue to grow as our population ages and life expectancy rates soar. By 2050, Alzheimer's could affect anywhere from 11.3 million to 16 million people.[3]

Caring for persons with Alzheimer's disease takes an enormous toll on the U.S. healthcare system. At any particular time, approximately 20 percent (1.1 million) of persons with Alzheimer's are in nursing homes and between five and ten percent (450,000 - 600,000) are in assisted living facilities.[4] By 2010, Medicare costs for beneficiaries with Alzheimer's are expected to increase nearly 55 percent, from $31.9 billion in 2000 to $49.3 billion and Medicaid expenditures on residential dementia care will increase 80 percent, from $18.2 billion to $33 billion.[5] Nearly half (49 percent) of Medicare beneficiaries who have Alzheimer's disease also receive Medicaid.[6] The average annual cost of Alzheimer care in a nursing home is $64,000.[7] Medicaid pays nearly half of the total nursing home bill and helps two out of three residents pay for their care. Alzheimer's disease costs American business $61 billion annually, $36.5 billion of which is caused by the lost productivity of employees who are caregivers.[8] Utilizing assistive technologies to prolong a person's ability to live independently, thus reducing the need for expensive institutional care, has the potential to save billions of dollars in Medicare and Medicaid spending, as well as family budgets.

Caring for persons with Alzheimer's also places a heavy burden on the families and friends of those with the disease. Alzheimer caregiving is intense, hard, and exhausting work. Seventy percent of people with Alzheimer's live at home, where family and friends provide the majority of their care.[9] Alzheimer caregivers devote more time to the day-to-day tasks of caring and they provide help with greater numbers of activities of daily living (including incontinence, one of the biggest challenges of caregiving). One in eight Alzheimer caregivers becomes ill or injured as a direct result of caregiving and one in three uses medications for problems related to caregiving.[10] Older caregivers are three times more likely to become clinically depressed than others in their

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[1] Hebert, LE; Scherr, PA; Bienias, JL; Bennett, DA; Evans, DA. "Alzheimer Disease in the U.S. Population: Prevalence Estimates Using the 2000 Census." *Archives of Neurology* August 2003; 60 (8): 1119 – 1122.

[2] Evans, DA; Funkenstein, HH; Albert, MS; et al. "Prevalence of Alzheimer's Disease in a Community Population of Older Persons: Higher than Previously Reported." *JAMA* 1989; 262(18): 2552 – 2556.

[3] Evans, *op cit.*

[4] Centers for Medicare & Medicaid Services, FY 2000 Medicare claims data for a 5% random sample of Medicare beneficiaries.

[5] Medicare and Medicaid Costs for People with Alzheimer's Disease. Washington, D.C.: April 2001: The Lewin Group.

[6] Health Care Financing Administration, Data from Current Beneficiary Survey. Presentation Materials from HCFA.

[7] P. Fox *et al.* (2001) "Estimating the Costs of Caring for People with Alzheimer's Disease in California: 2000-2040" *Journal of Public Health Policy* (I) (2001) 88-97

[8] Koppel, R. Alzheimer's Disease: The Costs to U.S. Businesses in 2002. Washington, D.C.: Alzheimer's Association; 2002.

[9] Losing a Million Minds: Confronting the Tragedy of Alzheimer's Disease and Other Dementias. U.S. Congress Office of Technology Assessment; U.S. Government Printing Office, 1987.

[10] S Tennestedt et at "*Depression among Caregivers of Impaired Elders*" New England Research Institute, Watertown, MA (1990).

age group [11] and one study found that elderly spouses strained by caregiving were 63 percent more likely to die during a four-year period than other spouses their age.[12] Assistive devices that allow individuals with cognitive impairments to complete activities of daily living with less dependence on their caregivers is one area in which technology may help alleviate some of the fatigue and "caregiver burnout" faced by loved ones of individuals with Alzheimer's disease.

The caregiving challenges presented by Alzheimer's disease extend to the long term care workforce as well. Today more than 1 million nursing assistants provide as much as 90 percent of hands-on care in nursing homes and other settings.[13] The Bureau of Labor Statistics estimates that by 2006, personal home and care aides are projected to be the fourth-fastest growing occupation, with a dramatic 84.7 percent growth rate expected.[14] Despite the growth in the industry and the increased demand for talented workers, there is a long term care workforce crisis. National long term care staff turnover rates are at an alarming 94 percent annually.[15] Numerous issues contribute to this crisis including insufficient staff, low wages, inadequate benefits, lack of dementia-specific training, little or no job recognition and few career advancement opportunities. Staffing shortages affect the overall quality of care to residents and contribute directly to staff turnover. One of the most important steps toward improving the quality of care is better training. Certified Nursing Assistants surveyed in a 1999 Iowa Caregiver's Association report indicated that their work was increasingly demanding and complex and that they needed more training and orientation. Respondents specifically mentioned the importance of Alzheimer's training and understanding behaviors related to dementia. With up to 16 million people expected to develop Alzheimer's disease by the middle of the 21st century, nearly all of whom will eventually require total care, a solution to the workforce crisis must be found immediately.[16] Technology that can be used to provide ongoing, interactive training for staff in long term care facilities is one part of the solution to the broader workforce problem.

Individuals living with Alzheimer's disease face challenges at all stages of the disease. Common symptoms at the beginning and moderate stages are impaired memory, judgment, and reasoning ability. As Alzheimer's progresses, individuals with the disease may lose the ability to manage their own health care, may not be able to follow medication instructions, and may need frequent cueing or reminders when completing routine tasks. All are likely at some point in the disease process to require 24-hour supervision and assistance. Individuals with Alzheimer's may also experience difficult or challenging behavior problems that lead to violent episodes, an issue explored by this committee in a hearing just last month. Several population-based studies have found that upwards of 90 percent of people with dementia develop one or more psychiatric and

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[11] Tennestedt, *op cit.*

[12] R Shultz et al "Caregiving as a Risk Factor for Mortality" *Journal of American Medicine* 282:23 (Dec 15, 1999).

[13] *Direct-Care Health Workers – The Unnecessary Crisis in Long Term Care.* Washington, DC: January 2001: Paraprofessional Healthcare Institute.

[14] U.S. Bureau of Labor Statistics. National Occupational Employment And Wage Estimates for 2000. Washington, DC.

[15] U.S. General Accounting Office. Testimony by William Scanlon, Director, Health Care Issues: Nursing Workforce: Recruitment and Retention of Nurses and Nurse Aides Is A Growing Concern. GAO-02-750T. U.S. General Accounting Office: Washington, DC.

[16] Evans, *op cit.*

related behavioral problems.[17] Wandering is another common and potentially life-threatening behavior associated with Alzheimer's disease. Studies report wandering in 4 to 26 percent of nursing home residents with dementia and in up to 59 percent of community-residing individuals suffering from the disease. Utilizing existing technology, such as electronic monitoring devices, may provide solutions to the everyday challenges faced by individuals with Alzheimer's disease.

The Potential of Technology

Technological innovations have enormous potential to address some of the challenges posed by Alzheimer's disease. Through our partnership with The Center for Aging Services Technologies (CAST), the Alzheimer's Association is working to identify how technology can improve Alzheimer care and services.

CAST has identified four areas where technology might improve aging services - providing ways to improve independence and allow people to remain independent longer (enabling); addressing the human resources and productivity issues of aging services providers (operational); improving the connections between individuals and their families and social support networks (connective); and dealing with geographic barriers to good care (telemedicine). These focus areas coincide with key priority areas for Alzheimer care.

An example of enabling technology that may help prolong independent living is a "Smart House" that includes features such as stoves with automatic cutoff devices and kitchen heat sensors to prevent fires. "Smart-Houses" may also include devices that cue and remind individuals with Alzheimer's disease to take medications or help them locate lost possessions. In addition, Artificial Intelligence is being tested to help individuals with Alzheimer's disease complete activities of daily living with less dependence on their caregivers.

Promoting safety is another major concern of the Alzheimer's Association. A wide variety of electronic tracking devices are currently available to monitor, track and locate individuals with Alzheimer's disease who wander. The Alzheimer's Association recently held a vendor conference and will soon be pilot testing electronic monitoring devices for possible widespread use.

Operational technology to address human resources and productivity issues includes Interactive Voice Response (IVR) systems that can be used to facilitate dementia screening, education and treatment referrals for staff at multiple sites. In addition, robotics and dynamic video can enhance access to interactive training and supervision for staff in long term care settings. Connective technology to improve the linkages between individuals, their families and social support networks includes IVR systems designed to assist family caregivers in managing persons with disruptive behaviors related to Alzheimer's disease. Other IVR systems are using voicemail networks to measure caregiver stress and provide access to care experts via telephone.

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[17] Testimony of Constantine G. Lyketsos, MD, MHS, Professor of Psychiatry and Behavioral Sciences, Co-Director, Division of Geriatric Psychiatry and Neuropsychiatry, The Johns Hopkins University and Hospital Submitted to Committee on Aging, United States Senate Hearing on "Crime Without Criminals? Seniors, Dementia and the Aftermath", March 22, 2004, Washington, DC.

Telemedicine has the potential to reduce geographic barriers to good care. Telehealth and telemedicine technologies are being assessed for possible use in providing supervision (including monitoring sleep and eating patterns and medication compliance/accuracy) of individuals with Alzheimer's who live alone.

The Need for a Multi-Dimensional Approach

Developing, testing and measuring the viability and feasibility of various technologies to improve care and promote healthy aging requires collaboration among technology companies, researchers, service providers and advocacy organizations. Meeting the distinct needs of the aging population, particularly those with Alzheimer's disease, will require a complex, multi-dimensional approach. The Alzheimer's Association has already started down this road. In January 2001 we convened a Technology Work Group (TWG) to assess the impact of a broad spectrum of emerging technologies on the quality of care and health services for individuals with Alzheimer's disease. Not long after the Association formed the TWG, Intel Corporation launched its Proactive Health Research Project to explore ways in which "ubiquitous computing" could support the daily health and wellness of people in their homes and everyday lives.

Because of our shared interest in assistive technologies, Intel joined forces with the Alzheimer's Association to shape and implement a broader technology initiative. In July 2003, Intel Corporation and the Alzheimer's Association launched the Everyday Technologies for Alzheimer Care (ETAC) consortium. The goal of ETAC is to promote multidisciplinary, evidence-based research in computing, communications, and home health care technologies in Alzheimer's disease care settings. The ETAC initiative will fund research to identify and develop new models of Alzheimer care based up current and evolving technologies in these areas.

ETAC grew from the knowledge that as baby-boomers age: a) the number of people at risk for dementia is increasing dramatically; and b) current models and systems of care will not be adequate to accommodate increasing demands for individualized care. In recent years, while advances in treatments for brief symptomatic relief have surged forward, progress in improving services and technologies for routine care of people with prolonged disability and loss of independent functioning have lagged behind. Delaying and eventually preventing cognitive impairments could have far greater significance for the economics of health and well being than providing short-term, symptomatic relief.

ETAC will stimulate research crossing a variety of disciplines, including: 1) neuroscience, 2) emerging technologies in computing (e.g., communications, robotics, sensors, etc.), and 3) care needs of people with various types and levels of disability. ETAC will create a national forum for technology transfer by facilitating the exchange of ideas and collaborative research among experts from diverse disciplines, including: bioengineering, robotics, artificial intelligence, materials engineering, communications, systems design, software engineering, sensor/transducer networking, architecture, health services, nursing, biology, economics, business, caregiving, etc. This national alliance will promote research, development, and validation of user-friendly technologies as labor saving solutions to difficult and stressful problems of daily care.

Some of the practical outcomes expected by this program include improvements in:

- detecting and preparing for the onset of functional decline;
- delaying the onset of disabling symptoms;
- compensating for function impairments to maintain independence;
- providing support for caregivers to help alleviate stress and depression;
- postponing or preventing placement in residential care settings; and
- increasing accessibility to needed and appropriate healthcare services.

ETAC is an alliance harnessing new and existing technologies to meet the greatly expanding care needs of older Americans. The ETAC consortium is committed to enabling the development, testing, and marketing of assistive technologies to support the daily living needs of persons with cognitive impairment and their caregivers.

Public Policy Issues

There are a variety of public policy aspects, especially around reimbursement and regulatory issues, that may influence the broader development and adoption of assistive technologies for seniors and individuals with Alzheimer's disease. For example, alternative treatment models using telemedicine to help manage care for persons with Alzheimer's disease in rural areas might be very successful, but these models are not currently reimbursable, or reimbursement is very cumbersome. Determining how to measure the practical and care outcomes of using technology, conducting additional research to assess whether technology can reduce the cost of care or increase caregiver efficiency, and promoting more widespread use of existing technology in various care settings are just a few of the challenges faced by this burgeoning field. It will be necessary for government and private industry to examine all public policies, including possible Medicare and Medicaid reimbursement, to determine the impact on the development, adoption and use of technology.

Special Challenges for those with Alzheimer's and other Cognitive Impairments

Efforts to incorporate the use of technology more broadly in the care of persons with cognitive impairments such as Alzheimer's disease pose some unique challenges for caregivers in all settings. These challenges include:

- Adapting existing technologies so that they can be utilized by people with cognitive impairments
- Determining the applicability of existing technologies in various Alzheimer care settings
- Considering the ethical issues related to use of technology, such as obtaining consent, maintaining privacy rights and preserving decision-making autonomy for individuals with cognitive impairments
- Responding to cultural, language and ethnicity issues, both in how people will react to technology and to ensure technology is diffused into communities in ways that are culturally appropriate
- Developing models that integrate human aspects with technology to deliver high quality care with greater efficiency.

All of these issues can be addressed, and while they address issues specific to people with cognitive impairments, they are important to everyone who will be using or be affected by technology in care settings. The Alzheimer's Association Ethics Advisory Panel is one group that could begin to address these issues now.

Recommendations for Government

As was acknowledged earlier, much of the developmental work in technology is being carried out by private sector organizations the Alzheimer's Association believes the federal government can play a role in this area by:

- Creating a national commission on technology and aging, with a special emphasis on those with cognitive impairments, to focus public and private attention and resources on addressing these issues.
- Supporting research on assistive technology in partnership with private industry and voluntary health agencies like the Alzheimer's Association.
- Convening a series of additional hearings to provide oversight on progress, to stimulate interest among various stakeholders and to identify policy impediments to implementation of technological solutions.
- Continuing and increasing federal funding for Alzheimer's disease research to maintain the momentum of advanced understanding of the causes and potential treatments of the disease while also seeking to find solutions for improving the care of those already diagnosed with the disease.

Conclusion

Thank you, Mr. Chairman, for calling this important hearing. We have entered a new era in the fight against Alzheimer's disease. Over the last twenty years we have gone from hopeless to hopeful and are at the point where the goal of a world without Alzheimer's disease is within reach. Working collaboratively, the federal government, the scientific community, the Alzheimer's Association and the pharmaceutical industry have made tremendous progress in the prevention, diagnosis and treatment of Alzheimer's disease. Even with the progress that has been made, we still face many challenges, especially in delivering health care services and improving care for individuals with Alzheimer's disease in facilities, at home and in communities. These are big challenges but technology provides enormous opportunities for addressing them. The Alzheimer's Association has assumed a leadership role by investing significant resources in exploring these technologies through the creation of a Technology Workgroup, by launching with Intel Corporation the Everyday Technologies for Alzheimer Care consortium, and by joining the Center for Aging Services Technologies commission sponsored by the American Association of Homes & Services for the Aging. While much of the developmental work in technology is being carried out by private sector organizations, it is essential that the federal government intervene to enable both sectors to focus more attention and resources on this promising area. We are committed to working with you and all of our partner organizations to shape a future in which technology will improve the lives of people with chronic conditions like Alzheimer's disease, as well as the lives of their caregivers and families.

The CHAIRMAN. Steve, thank you very much for that good testimony.

Now let me turn to our last panelist, Ron Seiler, director of the Idaho Assistive Technology Project at the University of Idaho.

Ron.

STATEMENT OF RONALD SEILER, M.S.Ed, PROJECT DIRECTOR, IDAHO ASSISTIVE TECHNOLOGY PROJECT, CENTER ON DISABILITIES AND HUMAN DEVELOPMENT, UNIVERSITY OF IDAHO

Mr. SEILER. Thank you, Mr. Chairman, Senator Dole. Thanks for allowing me to testify on this very important occasion.

My testimony will focus on three major points. First I would like to talk a little bit about what the current research is telling us about the potential of assistive technology for helping older persons. I would also like to share with you what lessons have been learned by the 56 Assistive Technology Act projects that can be of assistance to the aging network. Last, I would like to provide a list of recommendations for action.

Assistive technology is redefining what is possible for today's older persons. Based on emerging research, based on the collective experiences of the Tech Act projects, and based on my experience as a father of a 23-year-old son with cerebral palsy, who uses assistive technology every day, I am convinced that it holds tremendous potential for helping older persons to be more independent, to be safer in their homes, and for reducing the cost of providing long-term health care.

However, the news is not entirely good, as policymakers often overlook the role of assistive technology in long-term care, and there are a number of systemic barriers that will need to be overcome. This is especially true for those elders that live in the rural areas of our country. More about that in a moment, but first, what is the research telling us about the potential of AT now and in the future?

The short answer is that most observers agree that assistive technology is and will continue to assist older persons to have a higher quality of life. We have good research that tells us that assistive technology can slow the loss of functional ability among frail elders, that it can improve the safety of elders and prevent injury, that it can help older persons to compensate for memory loss, confusion and other forms of dementia, that it can lessen the burden of care for informal and formal caregivers, and it can slow the rapidly increasing cost of providing long-term health care to elders.

Moving from the theoretical to the practical, the collective experiences of the Tech Act projects have much to teach us about providing AT services to elders. Collectively these projects form a national infrastructure for assistive technology and represent the Nation's most valuable repository of experience and expertise related to the application of assistive technology. Perhaps the most valuable lesson learned by the Tech Act projects is that AT can be of great benefit to older persons as it has been for persons with developmental disabilities, but it is critical that an array of services support its use.

Nearly ever Tech Act project conducts initiatives designed to promote the use of AT among elders. For instance, in Idaho, we provide Statewide assessments for older persons with complex technology related needs, many whom are eligible for Medicaid services. In one case we recently provided an assessment for a low-income elderly woman living in our area who just lost her husband, and she was considering moving into a nursing facility. As a result of the intervention at a cost of just under $2,000, the woman has now been able to live in her home for nearly a year near her family and friends. Compared to the cost of moving into a nursing facility, the intervention paid for itself in less than one month.

North Dakota has a program funded by the State Pharmacy Association that is designed to provide a wide range of automated medication dispensers to older persons who have problems managing their medication.

Many States operate equipment recycling programs that identify used assistive devices and advertise them so that others might benefit from their use.

These and many other programs just like them illustrate the types of innovative approaches that can be used to increase the use of AT devices and services for older persons.

However, as I mentioned earlier, there are a number of systemic barriers faced by older persons as they attempt to acquire and use AT. Policymakers often overlook the role of AT in long-term care. There is good evidence to suggest that there is a real basic lack of awareness among older persons, families and professionals about AT, especially in those living in rural areas. There appears to be a lack of community-based services, and those services that do exist are fragmented.

However, the most significant barrier has to do with the funding of assistive technology. There is a lack of coverage for devices used to overcome cognitive impairments. Both Medicare and Medicaid have restrictive funding policies for durable medical equipment, and there is a lack of coverage in private and health insurance.

In closing, how older persons will be cared for with maximum independence and at what cost are two of the critical health care issues facing this country. Most observers now agree that AT has an important role to play in providing long-term care to older persons. As a result I have three recommendations for this committee.

First, I recommend that the committee contact Senator Gregg, Chair of the HELP Committee, and urge him to complete the reauthorization of the Assistive Technology Act of 1998.

Second, even though there are a number of studies that suggest AT can be of great benefit to older persons, there is no comprehensive research that is national in scope. Therefore, my second recommendation is for the committee to ask Congress to authorize a nationwide study related to older persons and assistive technology.

Last, as part of this study, I recommend, as Stephen did, that we hold field hearings to gather more information about the potential of AT for meeting the needs of older persons.

Thank you, and I would also like to enter into the record the comments from the Association of Tech Act Projects which I did not provide previously, so I would like to enter that into the record.

[The prepared statement of Mr. Seiler follows:]

The Opportunities and Challenges of Assistive Technology for an Aging Population

submitted to the
Senate Special Committee on Aging
April 27th, 2004

prepared by
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The Promise of Assistive Technology for Older Persons

Assistive technology is redefining what is possible for today's older persons. In many cases, assistive technology and modifications to the home can increase, maintain, and improve the functional capabilities of elders. Increasing functional capabilities leads to more independent and productive older persons who are better integrated into the mainstream of society and community life. According to LaPlante (1997):

> "In 1990, more than 13.1 million Americans, about 5.3 percent of the population, were using assistive technology devices to accommodate physical impairments. Among that population of persons who use any assistive technology devices 52 percent are over 65 years in age, reflecting the higher rate of impairments in that demographic. Furthermore, the percent using assistive technology increases with age, from about 1 percent among persons less than 25 years of age to nearly 35 percent among persons 75 years of age and over."

Policymakers, researchers, practitioners, and entrepreneurs in many fields are increasingly interested in how to use assistive technology and home modifications to support older persons and promote their health. This increase in interest is being generated by demographic, theoretical, market, and other considerations.

Demographics of Aging

The size of the population of people 65 and over has increased far more rapidly than the rest of the population during the 20th Century. In 1900, only 3.1 million Americans were aged 65 or older, comprising only 4 percent of the population. By 1990, the elderly population had increased tenfold to 31 million people or 12 percent of the total population. The number of older Americans in 1997 has been measured at 34.1 million, about one person in every eight.

The older population will continue to grow significantly in the future, specifically between the years 2010 and 2030. It is during this time that the baby boom generation is expected to reach retirement age. Consequently, by the year 2030, the elderly population is projected to double. The number of Americans 65 and over is expected to be about 70 million.

The most dramatic increase in the population of older Americans has been among the very old (those aged 75 and over). By 2010, those 75 and over may constitute more than 40 percent of the elderly population. For the "oldest old" (those aged 85 and over) the increase has been exceptional. Between 1960 and 1994, their numbers grew 274 percent. From 1995 to 2010, this population is expected to grow by 56 percent from 3.6 million in 1995 to 5.7 million in 2010. The increase in the population of the "oldest old" is expected to continue to 8.5 million in 2030 and to 18.2 million in 2050.

The present and future profile of the population 65 and older has ramifications on social and

policy planning since older persons are at greater risk of disability and are more substantial users of health, medical, and other services than the general population. This is especially significant for the older persons who live in rural areas where access to services such as health and social services is either limited or deficient.

Additionally, the proportion of the U.S. population with disabilities has risen. This is largely due to demographic increases in the elderly population. Data from the National Health Interview Survey (NHIS) denotes the disability rate for women 65 and older at 39 percent and at 38 percent for men. A limitation to the instrument was a change in the survey in the 1980s that ask about self-care activities rather than work or housekeeping in relation to disabilities within the elderly population. Therefore, the percentages can be perceived as being higher than reported when considering other activities of daily living. Consequently, an increase in the numbers of persons requiring special services, such as health, recreation, housing, nutrition, financial, transportation and other services, can be expected to be limited in rural areas.

Theoretical Basis for Using Assistive Technology and Environmental Inventions with Older Persons

Human factors engineering focuses on the study of the person-environment relationship and their effects on human performance. According to McCormick (1970), human factors engineering is based on the proposition that "human use of virtually any man-made thing can be enhanced, or, conversely, degraded by its design." Some recent work in human factors has focused on the human performance characteristics of older populations in the context of tasks and activities of daily living.

Many authors have suggested that the older person's inability to function in various settings can be traced to disparities between the demands for action implicit in the design and structure of a particular environment and the capacity of the older person to meet these demands (Gelwicks & Newcomer, 1974; Lawton, 1977; Lawton & Nahemow, 1973). Much of the work in barrier-free design and other approaches to supportive environments flow from the view that levels of functioning might be improved through changes in environmental features which better recognize the reduced capacities for actions often associated with advanced age.
Two models have been proposed that support a view of the elderly individual's functioning in activities of daily living as a person-environment problem. The first has concentrated on developments of person-environment models of adaptive behavior of elderly persons (Lawton, 1977). Lawton (1977) states, "Whether emphasizing fit, competence, or adaptation, these person-environment models have emphasized an interactional or transactional view of the older person and the environment"

The occupational therapy literature offers models for conceptualizing the environment as a component of the assessment process. Dunning (1972) discusses the interaction of space, people, and tasks - placing these on an "Environmental Grid," which also combine the variables of givens, possibility of change, and preferences. Barris (1982) developed an environmental model that includes four hierarchical concepts: objects, tasks, social groups, and culture, all of which

impact task performance and social interaction. Altman (1973) describes the person-environment relationship in terms of three orientations: orientation to place, orientation to psychological and social processes, and orientation to design and practice. A fourth dimension, orientation to environmental policy was proposed by Lawton, Altman, & Wohlwill in 1984. Lawton (1990) proposed a hierarchy of behavior competence for understanding the house behaviors of the aged that included five gross categories: health, functional health, cognition, time use, and social behavior.

The Assistive Technology Marketplace and Recent Legislation

There is an increase in the number of assistive technologies and home modification solutions available to older persons. Currently the marketplace offers consumers more then 20,000 assistive devices. Many of these devices offer the promise of increased independence for elders. These items range from basic mobility devices such as wheelchairs and walkers to sophisticated communication systems.

The number of health professionals assisting with assistive technology and home modification solutions has grown, despite the lack of a national assistive technology and home modification policy or program. Over 600 local programs were identified in a recent study. Centers providing technical assistance and resources are increasing in number and scope (Albarede & Vellas, 1985).

The interest of building contractors in assistive technology and home modifications has increased in part because of these trends. The American Institute of Architects estimates that 99 percent of the housing that will be in use in the year 2000 existed in 1985 (Remodeling the Future, *Interiors*, 145, p. 147, August 1985). As a result, many builders are beginning to become knowledgeable about assistive technology and home modifications.

Another national trend is the growing sophistication of older persons in using technology. This will be especially true for the baby boomers. The evolution of the computer as an essential tool in our society coincides with the aging of the baby boomer generation. This will create a strong expectation among baby boomers for using technology during their retirement years. The use of assistive technology and home modifications to prevent disability and increase functional independence is linked to recent trends in promoting physical and mental health (Steinfeld & Shea, 1993; West, 1991).

Lastly, recent public policies emphasize the importance of increased access to assistive technology, e.g., the Americans with Disabilities Act of 1989, the Assistive Technology Act of 1998, the Rehabilitation Act Amendments of 1991, and the Individuals with Disabilities Education Act as amended in 1996. These laws have contributed to advancements in and increased availability of assistive technologies.

II. Summary of Research

So what does the research tell us about the potential of assistive technology now and in the future? The short answer is that a vast majority of observers agree that AT is and will continue to assist older persons to have a higher quality of life. In general, recent research suggests that assistive technology increases the independence of older persons and can slow the loss of functional abilities among frail elders. Other findings indicate that AT improves the safety of elders by preventing injury and has proven to increase home security. Other studies have documented that assistive technology can help older persons who experience memory loss or confusion or who display other forms of dementia. Emerging research illustrates that AT has the potential to lessen the burden of informal and formal caregivers. Several recent studies have suggested that older persons are now the fastest growing segment of the population using the Internet. Lastly, using AT can slow the rapidly increasingly cost of providing long-term health care to elders. These research findings suggests, that just as assistive technology has helped individuals with disabilities to be more independent for the past 25 years, there is no reason to believe that technology will not do the same for older persons.

III. Tech Act Projects

Funding made available under Title I of the Assistive Technology Act of 1998 supports State Assistive Technology Programs in 56 states and territories. The state grant program promotes access to assistive technology for people with disabilities and universal design of information technology so that people with disabilities will not be left out of the digital revolution. Together with the Protection and Advocacy services, these programs form a national infrastructure that ensures access to technology for people with disabilities. The state grant programs (also known as Tech Act Projects or AT Act projects) and the Protection and Advocacy Program offer an insurance policy so that people with disabilities will not be left on the wrong side of the digital divide.

The collective experiences of the 55 Tech Act projects have much to teach us about providing AT services to older persons. Even though these projects are mostly directed at serving individuals with disabilities, nearly every state conducts initiatives designed to promote the use of AT among older persons. For instance, the Idaho Assistive Technology Project provides statewide AT assessment services for older persons with complex technology-related needs. Most Tech Act projects operate alternative financing (loan) programs for the purchase of assistive technology. The loan program offers affordable financing to individuals with disabilities and older persons. Idaho and many other states operate equipment recycling programs that identify used assistive devices and advertise them statewide so that others might benefit from their use.

In North Dakota, the AT project has a contract with aging services to administer a program called Senior AT Services. The purpose of the program is to get assistive devices to elders so they can continue to live in their own homes. North Dakota also has a program funded by the State Pharmacy Association that is designed to provide a wide range of automated medication

dispensers to older persons who have problems managing their medications.

In Louisiana, people over 65 are able to get hearing aids through their telecommunications distribution program. Medicaid cuts have ended services in some states - Kansas no longer allows paying for eye glasses - a necessity for elders who have low vision. In a number of states, minimum building code requires visit-ability. In Missouri, Lifetime Home Bill allows $5,000 grant for any home to make it accessible. Missouri also has adopted legislation that allows tax credits for expenses to make homes accessible.

IV. The Challenges of Assistive Technology for Older Persons

In spite of the exciting potential of assistive technology and home modifications for increasing the independence of older persons, there remain significant barriers to its use. According to LaPlante et al. (1997) 2.5 million persons have unmet needs for assistive technology. Of this total, 1.1 million people over the age of 65 have unmet needs for assistive technology, almost 45 percent of the total. Estimates of the magnitude of need for home modifications suggest that up to 12 percent, or over two million elderly households, require home adaptations to support the needs of a family member with health or mobility problem (Struky, 1988; Newman, Zais & Struky, 1984; Struky, Turner & Ueno, 1988). According to the findings of a Robert Wood Johnson Foundation project, up to 30 percent of elderly households desire dwelling-related repair and/or modifications. These numbers are expected to rise as the population continues to age. Currently, the need is greatest for persons over 75 years, for women, for people of color, and for rural and low income individuals. As outlined next, older persons face many systemic barriers when attempting to acquire assistive technology.

A lack of funding for assistive technology: All questions about assistive technology ultimately lead to the question of how to pay for it. Currently, there are restrictive policies governing the funding for assistive technology. For instance, this is a lack of coverage for equipment that could benefit older persons with cognitive impairments. For older persons who work, vocational rehabilitation programs often are reluctant to provide assistance to elderly workers. Both Medicare and Medicaid have restrictive funding policy for durable medical equipment and there is a lack of private insurance funding for needed devices.

Lack of quality assistive technology services: There is a lack of community-based assistive technology services for elders and those services that do exist are fragmented. In particular, there is a shortage of assistive technology assessment services. This is important because, in order to avoid high rates of technology abandonment, as some researchers have warned against, it is critical that qualified individuals conduct these AT assessments using best practice protocols. Too often, an assistive device that is inappropriate for an older person is purchased and ends up not being used. There is also a shortage of senior programs capable of delivering quality "related" services, e.g., training and other supports needed to ensure elders know how to appropriately use, maintain, modify, and repair their technology. Additionally, there is a severe shortage of vendors who sell assistive technology in many rural areas.

Lack of Awareness: There is general a lack of awareness among older persons, their families, and professionals due to poor access to accurate and up-to-date information about assistive technology devices and services. Older persons frequently are not aware of what is available in the marketplace and don't know where to look.

Lack of Trained Professionals and Para-Professionals: There is a shortage of professionals and para-professionals working in the aging network who are capable of providing assistive technology services to elders. This includes a shortage of physical and occupational therapists, speech pathologists, physicians, nurses, aids, and other health professionals with the knowledge and skills needed to deliver quality assistive technology services. In part, this shortage of trained personnel is due to a lack of assistive technology training in the personnel preparation programs in our country's universities and community colleges.

Lack of Support for Family and Informal Caregivers: Assistive technology holds the promise of increasing opportunities for respite, reducing the physical and emotional stain of care giving, and decreasing the financial burden of providing care. Yet caregivers are not benefiting from its use because they do not have access to quality information about AT and often need help gaining access to AT services. Older persons who live in their own community and experience at least one limitation on their activities of daily living need a wide array of information and services, and so do their family and informal caregivers. This includes the provision of assistive technology devices and services.

V. Recommendations

A good first step toward addressing these barriers is to complete the re-authorization of the Assistive Technology Act of 1998. The Tech Act projects already provide an array of AT services to elders and Congress should do everything possible to increase their capacity to serve elders. Beyond this immediate step, information about the potential application of assistive technology for assisting older persons needs to be collected on a national level before action can be taken to address and ultimately eliminate these barriers. There is currently a paucity of comprehensive research findings with a nationwide scope to inform us about the potential of assistive technology for elders. To begin, the Senate Special Committee of Aging should implement the following three recommendations.

Recommendation One: Contact Senator Gregg, Chair of the Health, Education, Labor and Pensions (HELP) committee, and urge him to complete the re-authorization of the Assistive Technology Act of 1998.

Recommendation Two: Request that the General Accounting Office investigate the specific needs of older persons related to assistive technology.

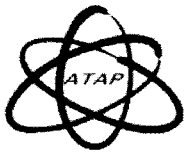
Recommendation Three: As part of the GAO investigation, hold field hearings in order to gather information about the potential of AT for meeting the needs of older persons from practitioners,

older persons and family members and other interested parties.

In conclusion, how older persons will be cared for with maximum independence, and at what cost, are two of the critical health care issues facing the country. Most observers now agree that assistive technology has an important role to play in the provision of long-term health care; however, it is still uncertain how this can be accomplished on a nationwide level and what the appropriate role of the federal government should be. By examining the potential *Opportunities and Challenges of Assistive Technology for an Aging Population*, the U.S. Senate has taken an important first step toward developing a national policy that will ultimately lead to more independent and productive older persons through the use of assistive technology.

The CHAIRMAN. Ron, thank you very much, and that addition will be made a part of the committee record.

[The comments from the Association of Tech Act Projects follow:]



Association of Tech Act Projects

April 22, 2004

U.S. Senate Special
Committee on Aging
G31 Dirksen Senate
Office Building
Washington, DC 20510

Honorable Chairman Craig and Senate Committee on Aging Members:

On behalf of the Association of Tech Act Projects (ATAP) I would like to highly commend you for your forward thinking approach to learning about assistive technology and how it assists individuals to remain independent in their own homes and communities. As you well know, the needs of the aging population are growing faster than the service system's ability to keep up. Not only is the number of older U.S. citizens growing at a tremendous rate, these individuals are living longer than ever before. As we age, our ability to engage in functional activities decreases. Changes in vision, hearing, smelling, and touch may result in decreased sensitivity to stimuli. The ability of individuals to be mobile and to care for themselves also decreases. Assistive technology represents a vital support whose main function is to help people gain and/or maintain independence.

Federally funded assistive technology programs in each state and territory have developed relationships with their respective State Units on Aging to promote the use of assistive technology by the elderly and their caregivers. For example, the Nebraska Assistive Technology Program, through a contract with the Nebraska State Unit on Aging, provides in-home assessment to develop interventions to maintain elderly individuals in their own homes and communities rather than to be institutionalized. Data suggest that the average dollar amount spent on assistive technology and home modifications can be recaptured by preventing institutionalization in as little as two months. That is, the average cost of providing accommodations and assistive technology is approximately $3,400 per person. Other states, such as South Dakota, Iowa, Florida, and Idaho have reported similar cost benefits of providing simple, low-tech assistive technology to help people remain as independent as possible.

Simple low-end technology available for individuals who are aging include things such as sock pulls, bath chairs, hand-held shower heads, adapted eating utensils for easier grip, bathroom lifts, chair lifts, modified canes and other mobility aid devices, and so on. Research indicates that

individuals who use this type of technology live independently for a longer period of time, are relatively less prone to injury and secondary disabling conditions, and have higher affective scores and less depression.

In 1998, the U.S. Department of Education conducted regional hearings on assistive technology. One of the major findings of these hearings was that a fragmentation of services exists across the lifespan. In May 2000, the National Council on Disability published Federal Policy Barriers to Assistive Technology. One major barrier identified in this report is that persons who are elderly and who might benefit from durable medical equipment and other assistive technology are not able to remain in their homes and communities. There are no lifespan systems in place to help these individuals acquire the technology they need as they age. Most importantly, the lack of specific reference to the Administration on Aging in this report indicates a broken link in the chain of appropriate assistive technology services for people who need them in order to be independent.

Public policy must be based on sound research. Federal funds used to develop national initiatives must be based on models that have been proven to be effective in the lives of the individuals they are designed to serve. Research on assistive technology and its benefit to individuals who are aging is relatively new. However, the research that is being published describes a clear cost benefit to federal, state and local providers of services to individuals who have lost functional capability due to disability. Further, it supports the notion that assistive technology is a primary tool for enhancing independence and dignity of individuals while enabling them to remain in their homes for a longer period of time. Several initiatives should be undertaken to promote a national assistive technology agenda. These are listed below:

1. Research must be conducted in order to verify the benefits and appropriate applications of assistive technology for individuals who are aging. The formal application of assistive technology to the needs of the elderly is relatively recent. Preliminary research data indicates that assistive technology provides functional benefits to individuals who are aging. It creates greater independence, enhances safety of the individual and his or her caregiver, and enables caregivers to provide personal assistance in a dignified manner.

2. Enhance the visibility of assistive technology in national initiatives. This may include developing technical assistance briefs for State Units on Aging and Area Agencies on Aging as well as providing regional assistive technology forums. Training resources for the national aging network could be modeled on the excellent work of state assistive technology grant programs funded under Title I of the Assistive Technology Act of 1998. Assistive technology-related competencies could be developed and maintained by those service workers who are involved in the aging services network nationwide.

3. Form collaborative relationships among federal agencies and national organizations who deal with aging and assistive technology issues. Partners in this effort may include the Association of University Centers on Disability, Association of Tech Act Projects, Paralyzed Veterans Association, United Cerebral Palsy Association, National Council on Disability, the Easter Seal Society, and others. Most importantly, groups working with aging issues throughout the United States must participate in this growing effort. The Administration on Aging, the State

Units on Aging, Area Agencies on Aging, and local senior citizen centers are the first line of information regarding assistive technology for the elderly. Community centers should also be a part of this information dissemination effort, as many already are through collaboration with state assistive technology grant programs.

4. Develop a national clearinghouse of training and technical assistance information designed to focus on the combined issues of technology, aging and disability. Existing centers deal with parts of these issues. However, there is not a single source devoted to pulling these three issues together for the purposes of research, training, technical assistance, and information dissemination.

5. Maintain existing statewide assistive technology programs that are responsive to statewide, consumer assistive technology needs. These programs, funded under Title I of the Assistive Technology Act of 1998, focus on state and local assistive technology issues by providing services such as outreach, public awareness, training and technical assistance, equipment demonstration and interagency coordination. This initiative may be as simple as supporting the existing Assistive Technology Act programs in each state and territory while expecting them to enhance their focus on the needs of the elderly. Information on what many states are already doing in this area is included in the attached document, "at act and aging.doc".

The inevitable union of assistive technology and aging services must be promoted by federal agencies and national associations to ensure that individuals who are aging have the information they need to make informed decisions about ways to enhance their dignity and independence, and to develop strategies to age in place. Thanks again for your leadership in this area. If you have any questions or need further information, please contact me at 435.797.3886 or meblair@cc.usu.edu, or our Washington, DC representative, Jane West at 202.289.3909 or jwest@wpllc.net.

Sincerely,

Martin Blair, Chair of Board
Association of Tech Act Projects.

Snapshot: Assistive Technology Projects and Aging in the United States

Information gathered April 8-21, 2004

State	Activities/Initiative	Contact
Alabama	STAR (Statewide Technology Access and Response) System for Alabamians with Disabilities, implemented a "train-the-trainer" program for seniors in 1993 in collaboration with the Alabama Department of Senior Services. The ***small changes...BIG DIFFERENCES*** program was implemented to inform seniors about the benefits of using simple, low-tech devices to enhance independence and safety and increase their overall quality of life. The SCBD workshops are still conducted at senior centers, assisted living facilities, senior church groups, AARP groups, etc. The devices are demonstrated to seniors, healthcare professionals, etc. and provide a "hands-on" opportunity to see how the devices can be used to complete everyday tasks such as personal care, homemaking, vocational/work, and leisure activities. Funding and other resource information is also provided to guide them through the process of obtaining devices for their individual needs. This program impacts (directly and indirectly) more than 6000 seniors per year and is "always" welcomed in the rural and underserved areas of the state.	Helen Baker hbaker@rehab.state.al.us 334-613-3482
Arizona	The Arizona Technology Access Program (AzTAP) collaborates with the Arizona Administration on Adults and Aging on a grant awarded by the National Association of Home Builders Research Center. The goal of the program is to strengthen the capacity of the Aging Services Network to support older adults who wish to age in place through the increased use of assistive technology in the delivery of services within the home setting. Major project activities include publication/dissemination of a series of aging-	Jill Sherman Oberstein jill.oberstein@nau.edu 602-728-9532

State	Activities/Initiative	Contact
	related assistive technology articles, quarterly training and demonstration to aging services providers and an assistive technology interdisciplinary design projects at Northern Arizona University, to enhance engineering and allied health students awareness about the role and use of assistive technology for older adults.	
California	California is currently conducting outreach to the aging community. Two focus groups were conducted in the Sacramento area, one at an active adult community to homeowners and one at a low income affordable senior apartment complex to gain more information about where seniors access their AT information, how they view AT and disability and the most effective way to do marketing.	California Foundation for Independent Living Centers Steven LeVene steven@atnet.org 916-325-1690
Connecticut	We've conducted a lot of outreach to seniors focused primarily on low cost technology to help seniors with tasks of daily living. We developed a demonstration kit (modeled on Iowa's program) and put together a presentation package that could be used for someone with little or no familiarity with the specific devices. This was extremely popular with seniors since many discovered there were simple items that could help them with everyday tasks essential to their independence. We've also provided presentations to people who provide services to seniors to make them aware of some simple solutions to everyday common issues. At its peak, we were doing several presentations per week. Funding cuts have severely curtailed this activity.	John M. Ficarro DrJohnF@aol.com 860-424-4881
Delaware	We stock a lot of items in our AT Resource Centers that are very popular among seniors. The ADL items are popular; we can't keep the assistive listening devices, CCTVs and other vision aids on the shelves. Many seniors purchase items like these out-of-pocket after the trial use period. They experience the benefits of AT use. We often see family	Beth Mineo dati@asel.udel.edu 302-651-6790

State	Activities/Initiative	Contact
	members purchasing CCTVs and ADL devices for their loved ones for birthdays, Christmas, etc. We are permanent fixture at senior fairs, senior center events, etc. Over the last year, our relationship with the state AARP has resulted in several joint trainings. We are preparing for a statewide blitz on the subject of home modifications in the fall that will be kicked off with a series of AARP workshops, in which our staff will participate. We also recently hosted a symposium on universal design in housing that was attended by local and national AARP representatives. This has led to a coalition that is building a model universally-designed home.	
District of Columbia	The DC Assistive Technology Program recently provided an assistive technology loan for a family member to purchase a stair lift for her elderly mother. The mother is able to stay in her own home instead of a nursing home. W recently linked an elderly consumer with an equipment reutilization program to obtain an electric wheelchair at no cost. Over the years we have participated in annual events sponsored by the DC Department Of Aging including Senior Health/Wellness Events. We have demonstrated ADL and safety devices to large audiences of seniors and service providers.	Alicia C. Johns ajohns@uls-dc.com 202 547-0198
Florida	At the request of a state legislator, we recently provided 13 elderly women in the Tallahassee area with refurbished computers so they could access the Internet and communicate with one another via email. Most of them are homebound and unless someone visits or calls, they don't have much outside contact. One of the women explained that she wasn't afraid of dying, she was afraid to smell (if she died and days passed before someone knew). Now that they are "wired" these ladies stay in touch daily with one another, their families and the	Jane E. Johnson faast@faast.org 850-487-3278

State	Activities/Initiative	Contact
	outside world. Seniors use our demonstration center to try out the various assistive devices and are always amazed at how liberating small tools like jar openers, dressing aids, adapted cutting boards, reachers, etc. can be. They also try out the vision aids such as video magnifiers, screen readers, reading pens, etc. We receive calls and referrals daily from seniors who need home modifications. We provide home assessments and maintain a database of credentialed contractors who can do the modifications. We also assist them in accessing the various funding sources available to pay for the modifications, including the FAAST Alternative Financing Program.	
Hawaii	We average over 45 calls per month from people over age 50 requesting information about assistive technology: what to purchase, where to purchase it and how to fund it. We have an assistive technology lab as well as equipment loan sites across the state. Individuals over age 50 are regular borrowers as this group likes to try out AT before purchasing it. We present regularly to support groups for post polio, Parkinson's, MS, and Hospice and participate in fairs and conferences designed to meet the needs and interest of seniors. We provide information and resource supports for independent living, social service agencies and family members seeking ways to keep aging family members at home. The HAT Loan Program (low interest) provides financial assistance to complete home modifications. We publish and distribute "The Kupuna Guide" *Helpful Tools for Senior Citizens*; an easy to read guide that describes various AT devices and shows pictures of seniors using the products.	Barbara Fischlowitz-Leong barbara@atrc.org 808-532-7112
Illinois	The Illinois Assistive Technology Project (IATP) reaches out to Older Americans	Willie Gunther wgunther@iltech.org

State	Activities/Initiative	Contact
	through Senior Fairs sponsored throughout the state by the Department on Aging. In addition, IATP conducts AT training workshops for Area Agencies on Aging and other providers that serve Older Americans. IATP's demonstration center features many assistive technology devices that benefit seniors to continue to live independently. IATP's device loan program makes ADLs, CCTVs, FM systems and many other devices available for seniors to try out in their home to ensure that the device is appropriate. IATP also develops resource materials that focus on technology solutions for seniors.	217-522-7985
Iowa	The Iowa Program For Assistive Technology (IPAT) has worked closely with the Area Agencies on Aging for the past 12 years We developed the original AT awareness kits, ***small changes... BIG DIFFERENCES*** and trained the AAA staff and volunteers in how to use it with their clients and their families at the community level. We continue to provide continuing education for AAA staff and other community providers. This program has been replicated in over 15 other State Tech Act programs, thus demonstrating the national network's effectiveness in sharing best practices. Currently, IPAT and the State Association of AAAs is funded by the National Association of Home Builders to: (a) train staff at the AAA, Family Caregiver Association and other community or home based health services to do home assessments; (b) provide awareness materials about AT and home modification for use by the AAA. Including a booklet about UD in housing; (c) recruit, train and provide TA to community contractors and home remodelers about Universal Design, Accessible Housing and Home Modifications; and, (d) provide referral of families to these trained contractors.	Jane Gay infotech@uiowa.edu 319-356-4463

State	Activities/Initiative	Contact
	We work closely with the Iowa Department of Elder Affairs to implement the Olmstead Decision in Iowa by working on changes to policy and funding options, developing needed community based services (especially around AT and home modification), development of screening and assessment tools to prevent institutionalization or implement transition to community settings.	
Kansas	In the past year, Assistive Technology for Kansans responded to 773 requests from Kansas seniors who needed information on devices, assistance in locating funding and/or to learn how to use a specific assistive technology device. ATK also collaborates with the Kansas Department on Aging to provide assistive services on the HCBS Frail Elderly Waiver. Services covered on the waiver generally address home modifications and other inexpensive assistive technology devices that enable Kansas seniors to age in place.	Sara Sack ssack@ku.edu 620-421-8367
Louisiana	LATAN has developed two AT resource manuals for service providers and caregivers of the elderly and demonstrates aids for daily living at senior focused information fairs. We have developed several new AT handouts (TechNotes) with simple low cost solutions to some common barriers to independent living and are designing several "senior appeal" web pages for our web site. We recently presented the DOORS to Inclusion: Universal Access Conference, co-sponsored by AARP Louisiana, and publicized the event in the AARP network. These developments are the result of an increased number of Individual Advocacy contacts from older adults.	Cyndi Mabry cmabry@latan.org 225-925-9560
Minnesota	We collaborate with Minnesota's Aging and Adult Services Division to develop community services and resources for older persons and adults with special needs. We provided an AT display at the state Gerontology Conference on 4/16/04.	Chuck Rassbach chuck.rassbach@state.mn.us 651-297-1554

Information gathered by Association of Tech Act Projects (ATAP) April 8-21, 2004

State	Activities/Initiative	Contact
Missouri	Effective telephone access is critical for elders to remain independent in their homes and communities. Unfortunately, many elders become unable to effectively utilize the telephone due to hearing, vision or motor limitations associated with the aging process and need assistive technology. Last year, through the state telephone equipment distribution program, we provided 3,747 adaptive telephones to Missourians over the age of 60 (304 to individuals over the age of 90.) Survey data from these consumers indicate that 22% had been unable to use the telephone for more than 10 years and 62% had used the adaptive telephone equipment to make an emergency call.	Diane Golden dcgolden@swbell.net 816-350-5280
Nebraska	Nebraska's Assistive Technology Partnership has been providing assessments for the Aged and Disabled Medicaid Waiver program since late 1998. Just over half the individuals served are above age 50. Specifically: 12% are 61-70; 11% are 71-80; and 11% are 81 or older. During that time, 2,733 projects have been completed utilizing $5,471,332 of Medicaid Waiver funds and leveraging an additional $1,423,750 of other resources for a total of $6,895,082. We can document that the average cost spent on assistive technology and home modifications can be recaptured by preventing institutionalization for as little as two months.	Mark Schultz mschultz@atp.state.ne.us 402-471-0734
North Carolina	The NC Assistive Technology Program (NCATP) has worked closely with public and private agencies to increase the assistive technology services to older adults and their family caregivers by almost 200% over the last few years. We worked to ensure that AT was incorporated into the Healthy North Carolinian State Plan by the NC Division of Aging and Adult Services. Representatives from the aging community assist with statewide planning as members of our Advisory Council and our staff	Ricki Hiatt rhiatt@ncatp.org 919-850-2787

State	Activities/Initiative	Contact
	participate on many aging-related groups and committees. The annual statewide AT conference includes workshop sessions on AT issues for older adults and an AARP-NC representative serves on the AT Expo program committee.	
North Dakota	North Dakota administers 2 programs for Aging Services. First, the Senior AT Safety Program helps people remain safe in their homes through the use of assistive technology. The target audience is North Dakota residents who are 60 years and older and not living in a nursing facility. The Medication Management Program helps people take medications as prescribed to maintain health and safety—we provide information on a wide range of medication devices to help people organize and appropriately use their medications. Second, the Telecommunication Equipment Distribution Program provides assessments, training and distributes telecommunication equipment to disadvantaged individuals.	Judie Lee jlee@polarcomm.com 701-239-7247
Oklahoma	Oklahoma ABLE Tech has provided all Area Agencies on Aging (AAA) and Home and Community Based Waiver Advantage programs with ***small changes....BIG DIFFERENCES***, a train-the-trainer assistive technology (AT) program and kit of low tech devices. We established regional AT loan closets at AAA sites. Additionally, ABLE Tech's Oklahoma Equipment Connection, an equipment recycling program, provides an inexpensive, much needed alternative for elderly citizens needing to purchase AT. Lastly, ABLE Tech's Alternative Financing Program, a low interest loan guarantee program, provides many elderly with loans to purchase needed AT, especially for hearing aids, adapted vehicles and home modifications.	Linda Jaco mljwell@okstate.edu 800-257-1705
South Carolina	The SC Assistive Technology Project (SCATP) provides a Resource, Demonstration and	Evelyn Evans evelyne@cdd.sc.edu

State	Activities/Initiative	Contact
	Equipment Loan Center for people with disabilities and age-related limitations to see and try equipment before purchase. AT staff provides consultation and technical assistance to determine AT needs to individuals with disabilities. Therapists and other key people in the person's life are included in these consultations.	803-935-5340
South Dakota	DakotaLink's most recent effort to help aging citizens gain access to assistive technology has been entering into a contractual relationship with the South Dakota Services to the Blind and Visually Impaired to operate and manage a lease/loan program, making it easier for senior citizens with vision problems to acquire closed circuit televisions for personal use in their homes.	Dave Scherer dscherer@tie.net 605-394-1876
Utah	The Utah Assistive Technology Program is currently involved in a statewide/regionwide collaboration with the state Division of Aging and Adult Services and the university Extension program to provide AT and home safety related information to seniors, senior center staff, aging specialists in AAAs, and extension specialists. We co-present at live conferences and training activities presented via the states distance education television network. This is in addition to the development of 40 senior-focused AT demonstration kits that have been placed in senior centers and centers for independent living statewide.	Marty Blair meblair@cc.usu.edu 435-797-3886
Virginia	We established a statewide interagency taskforce on assistive technology and aging with major stakeholders. This included a series of statewide training initiatives targeting this population. Recently, we developed a handbook on AT & Aging modeled on the Idaho initiative. We made a presentation on AT and aging at the recent Governor's Conference on Aging and have partnered with the Virginia Department for the Aging,	Ken Knorr KnorrKH@DRS.State.VA.US 804-662-9995

Information gathered by Association of Tech Act Projects (ATAP) April 8-21, 2004

State	Activities/Initiative	Contact
	Department of Motor Vehicles, AARP & AAA on the GrandDriver Program, an education and awareness campaign about the effects of aging on driving.	
Washington	We provide equipment loan through a Traveling Library where seniors and individuals who are homebound can borrow wide range of low tech devices. We serve approximately 500 people per year. In addition, we provide annual training on selection and use of AT to Area Agency on Aging staff.	Debbie Cook debcook@u.washington.edu 206-685-4181

The CHAIRMAN. Let me thank you all, and now let us turn to those who had products to demonstrate. Let me see, Eric, I believe you and Martha and who else? Lydia. All right.

Mr. DISHMAN. I am going to have to stand to do this, so they will not all be recorded. Let me see if I can actually get it to work. Everybody loves it when the Intel guy brings technology and it does not work.

The CHAIRMAN. I will never let you forget it.

Mr. DISHMAN. That is right. [Laughter.]

Actually, this is a project from Oregon Health and Science University, who are part of CAST, and I brought this along with me. Everyday Cane has the mote technology that I mentioned before, which was developed at Intel Research in Berkeley, at the University of California at Berkeley. It is a little tiny computer here attached to the cane, wirelessly transmitting. These little leads here all go to some really simple cheap sensors. Let me bring this up so you can all see the screen here from my laptop. Hopefully it will come up. There we go. Now you can see it. When I press down on the cane, what you are seeing on the screen here is the amount of force as I walk with the cane, and it is being wirelessly transmitted back to my laptop.

The importance of this in the near term, this just could mean simply knowing that Mom has not used her cane today might be very interesting in and of itself, just knowing that little bit of information. But what Dr. Pavel at Oregon Health and Sciences University is doing is taking this raw data over time and looking at the patterns of somebody who would be using a cane to see if you are starting to notice an early indicator that they may be moving into a period of their life or a period of time where they are more likely to fall in time to intervene well before they actually start to fall.

Longer term the hope of this is that you could actually start to detect diseases like Parkinson's and other neurological conditions by capturing this real-world, real-time sensor data, and catch it long before other diagnostic means of today.

So this is just a very simple example that shows some of the core technologies and how you might embed that.

Longer term this could actually go into shoes, this would not necessarily go into a cane. There is a possibility that everyday footwear could actually start to do this kind of analysis.

The second demo I am going to ask my colleague from Intel Research in Seattle, Matthai here, to show you. This goes back to the photo of Barbara before I showed you. Barbara had mentioned that her husband would come down and tell us the highlight of Barbara's day, when she is actually able to make a cup of tea by herself. So we are starting on this research project that says, how can we track the everyday activities of somebody like Barbara and intervene?

So back in our labs in Oregon we have a system that can know, for example, through just simple sensors that are part of a home security network, whether or not Barbara has gone into the kitchen today to get something to drink. If it is 2 o'clock or 3 o'clock in the afternoon, we find her on whatever device she is closest to and most familiar with—it may be the television—and actually put a prompt in there that says, "You need to get something to drink,"

because if she does not, dehydration actually leads to memory loss as well, and now you do not know whether it is her Alzheimer's or whether it is the memory loss from dehydration that is causing the problem.

Once she gets to the kitchen, it is not clear that she is still going to be able to remember the steps of walking through just the simple task of making tea. So what Matthai is going to show you here is again, little tiny tags. These are RFID tags. They have been in the news a lot lately because major retailers are starting to talk about putting these into every single product that is on the shelves. We are using it, once that product gets home, to have the system track everyday objects that they may be interacting with.

So Matthai is going to put on a glove here. Today it is a glove. Research will actually make this eventually the size of something that could go into a watch, and it is literally, based on the object that he is picking up, the tea cup, noticing that that is the object that he picked up because of these little tags that are basically glorified bar codes. Or he picks up the carafe and starts to make tea out of it. The system, based on this little reader that he is wearing on his wrist and the objects that he is interacting with, is starting to guess that he is going about the process of making tea. This is very primitive today, and obviously this is just a starting point.

The possibility of this, if we can start to make it work, is that you could develop a system such as that it could play little video clips for Barbara on her kitchen television, on whatever device she likes that says, "Here is the tea. Here is the steps to go about it." It would not intervene until she started to have a breakdown, until she needed help from the system.

This could actually be even valuable to people in nursing facilities who have to track everyday activities of living. We watched this today where these nurses are doing a great job, and frankly, at the end of the day they are trying to remember what was the person able to do by themselves? That is part of their record that gets sent up to CMS. This same core technology that could help Barbara stay in her own home longer, has the potential, if she moves into a facility, to automatically capture all of that data that so many of the nurses that we have observed in study are exhausted by trying to capture on paper today.

So that is the long-term vision of where this research would need to go. Again, it is not computers as we know them. It is tiny computers that are embedded and are unobtrusive in our environment.

The CHAIRMAN. Eric, thank you very much. All of that is fascinating.

Martha.

Ms. POLLACK. I am going to have to come up here.

The CHAIRMAN. Please do.

Ms. POLLACK. This is Jared Glover from Carnegie Mellon, who is going to help me get set up.

While he is setting up, let me remind you that I described two technologies to you earlier this morning. One was a technology for helping people with memory deficits by providing them with reminders of their daily activities, and that is a technology very much like what Eric described, so I am not going to demonstrate that here.

What I am going to demonstrate is a walker for people who are disoriented. Now, while Jared is getting the batteries unplugged, let me say that we also brought Pearl. Pearl is a futuristic mobile robot, and both the Autominder technology, the reminder technology, and the orientation technology, can run on Pearl. Basically Pearl can speak. She has a voice synthesizer. She can display large messages on her screen. But calibrating Pearl to a room is actually a fairly time-intensive process, and so we are not going to run her live today.

Additionally, Pearl is extremely expensive. This is a one-off robot. It costs close to $100,000 to build. It is obviously not something that is going to be in the homes of older adults in the near future. Our other technologies are much more cost effective and much more likely to make it into homes in the near term.

The CHAIRMAN. This is taking walkers to a high level. [Laughter.]

My mother-in-law was in a retirement community, and it was the battle of the Cadillacs vs. the Chevrolet walkers. I think they are losing style now.

Ms. POLLACK. This is the Lamborghini.

The CHAIRMAN. That is the Lamborghini, all right. [Laughter.]

Ms. POLLACK. This walker is intended for someone, particularly someone living in a nursing home or an assisted living facility, who has become disoriented and maybe has a hard time remembering how to get to the cafeteria or how to get to the exercise room. This walker has a simple device with a very simple interface; you can see on the screen that it says, "Where do you want to go to? Here's where you are." Now, we have mapped this room out, so we have just two locations, the floor and the walkway. Of course, in an assisted living facility there would be much more. Now we will say, "Go", and the interface will give us the various options of places we can go. If someone could not read, you could of course have little pictures. I am going to say that I want to go to the walkway, and now what happens is a map appears to guide me—to the walkway. If I start to go the wrong way, you see the arrow turns and guides me in the right direction.

So all I have to do is follow this arrow to get to where I want to go.

The CHAIRMAN. Is that GPS?

Ms. POLLACK. No. It has actually got a laser range finder on here. Partly what makes this expensive is just the laser range finder technology.

Because of the crowding in this room, We have only mapped two areas. Some people were at the demo here on Capitol Hill last month and they saw many more areas.

The other thing that this system can do, although because of crowding again, we will not demonstrate it here, is park. So if you have ever been at a restaurant, for example, with an older adult using a walker, there is often a problem. They sit down and can't get the walker to a safe location. This walker can automatically move to a parking location and then be retrieved when needed.

The CHAIRMAN. It will come back.

Ms. POLLACK. It will come back. Thank you very much.

The CHAIRMAN. I was going to say a walker with an attitude. [Laughter.]

How fascinating. Martha, and please, Senator Dole, enter in, one question of that. Obviously, the person using the walker who has forgotten his or her way needs to remember how to activate the system to tell it where to go.

Ms. POLLACK. That is right.

The CHAIRMAN. How do we do that if they are in that state of mind?

Ms. POLLACK. That is right. We are actually in the process of beginning field tests to see how well this actually works, but the idea is to make the interface incredibly simple. Here we have words written out, but you could replace that with pictures, and often someone might be able to reason, "I know this is a picture of a cafeteria. I can touch that," even if they cannot remember how to get there.

But you are right, after a certain point of dementia it will not be feasible.

The CHAIRMAN. OK. Thank you very much.

Ms. POLLACK. Thank you.

The CHAIRMAN. Any comment or question at this point?

Senator DOLE. I have some questions, but I think you want to——

The CHAIRMAN. Let us finish if we can with Lydia, and then we will move to questions.

Senator DOLE. Right.

The CHAIRMAN. Yes, please.

Ms. LUNDBERG. So what you are looking at here is what we call the family portal.

The CHAIRMAN. This is in your current facility in Milwaukie, OR?

Ms. LUNDBERG. That is correct. This is live. I spoke to this particular house——

The CHAIRMAN. Wait a moment. This is live?

Ms. LUNDBERG. Yes.

The CHAIRMAN. So we are connecting to your facility in Milwaukie at this moment?

Ms. LUNDBERG. Correct. This is via the Internet. it is a secure, password-protected connection. I am pretending to be Marian—who is the lady that we are following around—I am assuming to be her daughter because this access is for family and management only. But I did speak to them this morning, and they are all very excited to be part of this demonstration.

So you can see that Marian is in her room right now, and so I am looking at this and I can tell what the temperature is in her room. I can tell that the door is closed. That is all I know right now, because she is in her room and there are no cameras or anything involved, so it is strictly giving me an idea of where she is. If you look at the top here it also tells me——

The CHAIRMAN. How do you know that she is in her room. What sensor does she have on herself that would indicate that?

Ms. LUNDBERG. She wears a badge.

The CHAIRMAN. OK.

Ms. LUNDBERG. We have sensors wired into all the rooms so we know which room she is in. It also tells me, if you look up here,

that she has been there for 47 seconds, so I get an idea of where she has been. If she were to sit on her bed, I could actually get an instant weight reading, but she is not on her bed.

Then I can go back and I can do some historical because we are collecting all this data, so I can do some historical checking and I can see who has been in her room, so I can see that this morning Genevieve was in her room for 5 minutes. Kay came in several times through the night to check on Marian.

Then if I want to see where Marian has been historically for the last day or so, I go to this screen. I brought this up earlier because of time reasons.

The CHAIRMAN. This is the result of each one of those who entered the facility or that location also having a badge on?

Ms. LUNDBERG. That is correct, yes. All our staff wear badges.

So I can tell that Marian went, if I look on the 26th at 19 hours, which is 7 o'clock I believe, she went to her room and stayed there basically for the night. But if I wanted to, I can go through here and see where she has been spending her time. I can go back as far as 6 months. We are keeping this data on file.

One of the other things that is very critical, and there is some research that is being done with Oregon Health Sciences Unit on load sensors, weight scale. This would be now the load cells for Marian's bed for the period of just one day. It takes a minute. So I can see that she was in bed from a little after 9, so from 9:30 on basically until about 5:20 this morning. I can also see that during the day she maybe just sat on her bed.

Now, if I would like to see how she has been doing 5 months ago, I can go to a different screen, and unfortunately it reset itself so this will take me a minute. I want to see how she did in December, because oftentimes you can tell when medication changes, sleep patterns change. Maybe she was upset about something, maybe depression, all kinds of things. Those are some of the things that Dr. Pavel actually is trying to work on some algorithms so we can get some actionable data on some of these things.

So now it is going back into the data base, and again, this is live from Oatfield Estates. I can see that she actually was sleeping a lot less restful, and I can actually zoom in to get an idea how much she was tossing and turning.

Again, this can be used for many different things. The big——

The CHAIRMAN. So it not only detects her presence on the bed but her movement while on the bed?

Ms. LUNDBERG. It is actual weight data, yes. Then finally, here, this locator here, this is a different house. This happens to be Rainier House on the second floor, and this gives an indication of what I can see is management. I can see who all is in the common area, and it is 8 o'clock there in the morning, so they are all pretty much gathered for breakfast. Some people are still in bed, and you can see this one person actually moving around in bed. This is real live. Maybe they are getting ready to get up. Susan, the caregiver, is in the room with Frances, so my guess is that is what they are doing, they are getting ready for the day.

Thank you very much.

The CHAIRMAN. Thank you very much. Now, you mentioned this woman's daughter, I believe, did you not?

Ms. LUNDBERG. Yes.

The CHAIRMAN. I am thinking of a play on words here that maybe is not too appropriate. We have always heard of Big Brother. This is taking Big Daughter to a whole new level. [Laughter.]

Ms. LUNDBERG. Actually, initially we wanted to call the system Daughter 1 because daughter usually is the one that worries about how mother or father are doing in the later years, and is the memory of, "Mom, you know, is not moving around as much. Mom lost weight." With this system we are trying to create that type of memory to the benefit of the resident.

The CHAIRMAN. Thank you. That was a fascinating demonstration, and to have it live, show that kind of interconnectivity is phenomenal.

Let us start with our questions, and Senator Dole, you have mentioned you have some so why do we not start with you? Please proceed.

Senator DOLE. Let me ask Ms. Lundberg. I know that some families have expressed concerns with some sensor technology because of the privacy issue. This committee has addressed numerous times in the past the growing concerns regarding crimes that target older individuals. Are there safeguards in place that protect a senior's privacy, and would you recommend any specific safeguards? Because obviously this is tracking all of the movements, as well as the visitors. How would you address that privacy aspect?

Ms. LUNDBERG. The access to the information is password protected. You have to know how to get there to begin with, and then it is password protected.

The type of information we are gathering is not medical information. It would seem to me that—I cannot visualize how that would benefit somebody that would try to do harm to an elder. It has helped actually. When there is suspicion of any wrongdoing, it has helped in the investigation to actually protect our elders. So it has been a benefit to have that information. Did I answer that well enough?

Senator DOLE. That is good. With the systems that your company is developing, is it possible for those who suffer from cognitive decline, who would traditionally be institutionalized, to continue to live an otherwise normal life with assistance from community based technology? Could your Extended Family Residence be the new model for long-term care in the United States?

Ms. LUNDBERG. Actually, that is what we are hoping. We feel that we have been very successful in accommodating residents with Alzheimer's and other dementias. The campus, it is not just the technology in this case, it is also the design of the buildings, and how it is being operated.

A good example is one of our residents named Bob, who has quite a bit of dementia, the other day he was telling me that he used to play for the youth symphony, and it was based on some interaction that we had. He also goes around walking quite a bit, and he checks on the organic garden that we have, and he went back to tell the chef that there were fresh brussel sprouts, and so then the chef went and picked them and cooked them. So those are some of the normal things that people experience. Because we have the

technology, we do not have to worry about Bob wandering off and getting into areas where he would be at danger.

Another example of technology that is a little bit hard to demonstrate here is we are kind of on a hill, and at the top of the driveway that would exit to the neighborhood, we have a sprinkler because what we have found is that anybody, regardless of their cognitive ability, pretty much knows that they do not want to get wet. So when you get too close to the driveway, the sprinkler goes on, and people turn around. That has been extremely successful.

Senator DOLE. Very interesting.

Mr. Dishman, Eric, if I may.

Mr. DISHMAN. Sure.

Senator DOLE. North Carolina has many low-income seniors in rural areas, who want to live at home, but they require, as my mother, assisted living. In fact, I think 85 of our 100 counties in North Carolina are designated as rural. These rural areas lack the technology, the infrastructure that is enjoyed in other parts of our State. For instance, they may lack high-speed Internet. Obviously, that is something that we are hoping to correct, or the health care workers may not be trained in the newest technology. Do you foresee these technologies developing to the point where they are both financially accessible and able to be integrated and implemented in these more remote areas for this sector of the population?

Mr. DISHMAN. That is a great question. I was thrilled to see President Bush yesterday actually out talking about wanting to have affordable broadband available to every home in the United States by 2007. There are some particular technologies that we could at some point go into detail on, and there are probably FCC and other regulations around a technology called WiMAX, which is really a technology about bringing high-speed wireless interconnectivity to every part of the Nation, and I think that is going to be an exciting technology that is really going to open up that potential for people over the coming three, four, maybe even sooner than that, if there are things that we can help to work on. I am not a WiMAX expert so I should not go too deep into policy issues.

I think the magic of what a lot happening here technologically is, and with my own grandfather, he is not able to use a PC, but we are basically taking consumer electronic devices and putting PC functionality onto a TV, which he is very comfortable with, and what we are really trying to do is to figure out how to make consumer electronic devices that are in many people's homes, part of this home health care technology network. No need to go buy your own separate $2,000 box. Use the infrastructure that you are familiar with and comfortable with, and some new really quite cheap technologies that help to interconnect those things and make them useful for people.

Senator DOLE. You just anticipated my next question, because I was going to say that seniors obviously have not had a lifetime of using computers and cutting edge technology, and obviously, some have difficulty adjusting their lifestyles to incorporate all of these new advances. So helping our seniors with education and information that helps them be more receptive to technology is so impor-

tant, and outreach that will help to push assistive technology to areas that are fairly removed is very important I think.

Mr. DISHMAN. I wanted to just comment on the privacy question as well.

Senator DOLE. Yes.

Mr. DISHMAN. We have been testing these concept prototypes and we are actually testing some of the actual technologies here today with a whole range of seniors. The overwhelming response is that, "Let me make that choice. Give me the ability to decide who gets that data," "me" being the senior if they are still cognitively capable. "Give me that choice." We have found the privacy issue is almost like the fingerprint. Everybody has one, but they are all different. Some people do not want to share how many steps they take a day with somebody else. Others are like, "I will share that data with anybody." Others say, "I will share my medication compliance data with my daughter but not with my doctor."

We have to develop the system to make it easy enough and robust enough, and to do the training so that people can make the choice about who gets the data and how they are going to use the system, and I really agree with the issue of training people on using it so they can do that.

Senator DOLE. That is very helpful. Thank you.

Just one final question to Mr. McConnell, please.

There is much discussion about the impact of Alzheimer's on the aging community, but it is often accompanied by conditions that lead to physical complications. Have you been able to quantify the financial impact of Alzheimer's as an isolated condition? If so, what is its annual cost to the Medicare and Medicaid system?

Mr. MCCONNELL. We have not separated it out, because most people that have Alzheimer's disease are very elderly and they have other chronic conditions.

Senator DOLE. Physical conditions, right.

Mr. MCCONNELL. We know that when Alzheimer's is present and other physical disabilities are present, it costs Medicare three times as much to care for them. The reason for that is that the care is much more complicated. It is more difficult. Our system really is not set up to deal with people, as you know, that have multiple chronic conditions, particularly with cognitive impairment. So I think some of these technologies can help in providing better care, which will result in better quality of life and lower costs to Medicare.

Senator DOLE. All right. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Elizabeth, thank you, and thank you for your time with the committee today.

Senator DOLE. Yes, indeed.

The CHAIRMAN. The questions I am going to ask, anyone of you can respond to, if you feel you have—I may direct it at one, but certainly all can respond to it.

Lydia, the kind of visual locator, the technology that we sought, you demonstrate today, is that experimental or is that now available for direct application in facilities like yours?

Ms. LUNDBERG. It is a prototype at our facility. However, we are in the process of trying to develop a package that can be purchased

by other facilities. One of the big issues at this time is the hardware cost because we have to wire IR sensors into every room. We are actually working on a system, if it is successful, which would really take us the next step where we would only need four antennas for about a six-acre campus to locate people within one foot of each other. If that is successful, that would make it a lot easier.

The CHAIRMAN. Does anyone else wish to respond to that particular question?

Mr. DISHMAN. I often get questions about is this technology here now or is it 10 years off, and I think the answer is both/and I will give you a simple example.

The load cell sensors in the bed in Elite Care or the sensors that we are using just to know whether or not Mom opened her coffee cabinet, knowing that Mom did not get coffee today, might be a best indicator. Those are off the shelf, simple to use, here and now. The wireless connectivity is here and now.

The research to figure out whether the way in which Mom is rolling around at night and the restlessness is an indicator of this particular disease. That may take 5, 7, possibly even 10 years, because there are really hard computer science problems as well as clinical research that needs to be done.

I think with almost all these systems, there is some low-hanging fruit, to use the phrase, where elders could get value out of it today. People have seen our wireless technologies. I have gotten 30,000 e-mails from consumers in the last 6 months who have seen this and said, "I could use that simple cabinet switch sensor now or the simple sensor that lets me know whether Dad has gotten up out of his chair or not, because he sits in the same chair most of the day." That is here and now.

There are some things to do to get the market going and get the companies who are starting to productize those to focus it on this domain and somehow figure out a way to have it be assistive technology without calling it that, because nobody wants an assistive technology. It is just a technology that is part of their life.

The CHAIRMAN. Yes?

Mr. MCCONNELL. Mr. Chairman, I think also that this will become more affordable as it is used more widely. For example, we are working with Joe and the MIT AgeLab on electronic tracking technology. We now have a safe return program, in which people register. It is a bracelet and a registry. You have to be found in order to be brought back home. We have just put out bids for companies to help us develop technology that will track people when they wander. That technology is likely to be relatively expensive now, but over time as the demand increases, we know that the cost will come down. So we are likely to see that the technology becomes more accessible in the future.

The CHAIRMAN. Anyone else wish to respond to that?

Mr. COUGHLIN. Mr. Chairman, one of the things I would also like to address, particularly picking upon Eric's point of affordability and reaching different populations, is not only do people not want assistive devices in their homes or have to purchase assistive technologies because of what that may mean to them symbolically, companies do not necessarily want to be in that market.

The CHAIRMAN. Well, I was heading in that direction, so expand on that, and any other individual on the panel who has had that experience, why are companies resisting this?

Mr. COUGHLIN. OK. Let me give one example of, for instance, the technology of making a cup of tea or not necessarily monitoring where people are in their facility or their home, but the idea of opening a cabinet or using the toilet or something like that would be very useful. We need to redefine these things as not just assistive technologies, but actually redefine them as lifestyle services that, in fact, many companies out there would be very interested to be able to do home delivery and know you are out of a product before you know you are out of a product, and try to reinvent the fact that people are out of milk in the refrigerator or they haven't touched their meds to be a way of triggering a CVS or a Walgreen's or triggering Wal-Mart to know that a home delivery is needed or something like. Extending the supply chain of industry to the shelf in the home is a way of making these things pay for thank you very much. Because if we continue to define these—frankly, as you know in politics and in markets, symbols and words are the currency of politics. If we continue to use the phrase "assistive technology," this will go nowhere very quickly.

To your question on why business is not interested, I came to the aging area because of my interest and research in older drivers, and the adage goes that you cannot create an old man's car, because a young man will never buy it and neither will an old man. The fact of the matter is today's older generation does not know that they are older; tomorrow's older generation, most of us at this table and behind us, will not accept that they are older. The fact of the matter is that corporate executives and the consumer themselves do not think that, A, they will ever need something called assistive technology, that is something my mother or grandmother needed; and, second, I am selling a lifestyle, not just a product.

So really what we need to do is to think innovatively by stealth in trying to reinvent how people live at age, say, 45 and 50 so that these things are in place when they are 75 and 80. Therefore, then companies will find this of more interest and will invest as well.

The CHAIRMAN. One of the things that I think, Eric, you alluded to and possibly you did, Martha, as it relates to application and how seniors may or may not use a certain technology, while a lot of this is coming online, there will be a substantial transition of time into the baby-boomer population that is growing rapidly smarter when it comes to technology. We have watched now the demographics or the numbers of the senior population going to the Internet. Why? So they can communicate with their grandkids. What was once a hurdle is no longer a hurdle, or it is but it is a necessity that they hurdle it. I am not so sure that we need to be terribly afraid of its application, more so the ability of the individual at the time to apply it or to use it, because that is going to be changing very rapidly over the next decade, as a lot of this comes online.

Would you wish to respond to that, any of you? Martha?

Ms. POLLACK. Yes, I think you are absolutely right. I think there is a myth, a clear myth that older adults are afraid of technology. I can tell you when we have taken Pearl out to a nursing home,

many of the residents there were just thrilled, just loved to interact with her. In fact, if I can share a quick anecdote, we were there one day. We were doing some field tests, and partway through the day, the battery died, completely died, and we had to cancel the field tests. The people who were scheduled and did not get their opportunity to interact with the robot were just sorely disappointed.

So I don't think we have to worry as much about people being afraid of technology as we do about the very important issue you mentioned, which is making sure the technology is completely transparent, completely easy to learn, and perhaps making sure that it gets introduced at an earlier age so that by the time people begin to have cognitive decline, they are already familiar with the technology. Some of the kinds of systems I have talked about, reminder systems, frankly would be very valuable for many of us who are not yet older but who have very busy lives. If you get used to using this technology earlier on, you can continue to use it for a longer span.

The CHAIRMAN. Certainly the staff has probably heard this analogy or observation one too many times. My mother-in-law lives in a retirement community in Tucson. The pool room that was once built into that retirement center for those who played pool disappeared. It is now a computer center. The reason was nobody played pool. But you go by there now, we were a small part of helping educate and move people in that direction because my wife is a bit more literate with computers than I and started teaching. Now the room is full at almost all hours of the day and night because, instead of having a computer in their residence, they go to the room and they interact, whether they are surfing the Net or if they are talking to their children or their grandchildren or e-mailing. It is absolutely a transition that I have watched, you know, visually and physically in the last decade as we visited that community and watched that transition go on. I find it really very fascinating.

Affordability, again—excuse me, yes.

Ms. LUNDBERG. If I could speak just a little bit to acceptance of technology.

The CHAIRMAN. Yes.

Ms. LUNDBERG. We have found that it is very accepted by our residents. We have the occasional person who refuses to have load sensors under the bed for varying reasons. But other than that, people like the idea that they can be located anywhere, if they have any issues, problems. Then we also have computers in every person's room, and they do like to take advantage of the e-mail to stay in touch with their grandkids and also do some videoconferencing.

The CHAIRMAN. Ron, the disability community is in many respects further ahead than the aging community in probably understanding and applying assistive technology. What do you believe are the major lessons that we might draw from the experience of the disability community in this area?

Mr. SEILER. Well, I think the major lesson is, first of all, that it works. Assistive technology can have a significant impact, and I often point to my son as an example. Larkin, my 23-year-old son, with cerebral palsy, is probably getting ready to go to work this

morning and, you know, is using a variety of technologies that allow him to work.

Collectively, though, I think in terms of the assistive technology projects, what we have learned is that technology, again, can be very effective, but the trick is you have got to have those support services in place. You just cannot throw the technology out there and expect people to be successful in its use.

In particular, with older people, I think, again, we are talking about this transition and this acceptance of technology. I think with older persons we have to be particularly sensitive to that issue, that, in fact, there is a lot of education that has to take place. The family members have to be educated. Clearly, the professionals and paraprofessionals who work with elders have to be familiar with how the technology works.

So, again, I think the major message here is that technology is wonderful, it is fabulous, it works. But without those support services, it will not be successful. The thing that concerns me—and we found this early on, way back in the early 1990's when we started these projects—is that technology often is abandoned. Early studies show that up to one out of three devices that were purchased ended up sitting on a shelf collecting dust.

So we have to be very cautious, and one of the things that I have really been focused on is the front end of the process; that when we go through that selection of the device, the assessment, the evaluation to determine what device is appropriate for that person, that we do a good job there, that we use appropriate best practice protocols to do that. Because, in fact, if we don't pick the technology that matches the needs of that person, they will not use it. You know, this is expensive stuff, and if we buy things that are not used, then we are wasting an awful lot of resources.

So, for me, that front end, the assessment and evaluation is very critical, and there are some issues there because, in fact, you know, at this point it is very fragmented. Who is performing these evaluations? Who is going out and matching the person with that technology? It is a real mixed bag right now. In many cases, you know, the medical professionals that are involved do a fine job. But in many cases, we have vendors that are involved with that assessment process, and sometimes I don't know that that is appropriate.

So I do get concerned about the abandonment rates that we saw early in the 1990's that that not be repeated with the older population.

The CHAIRMAN. Let me ask, Eric, do you wish to respond to that?

Mr. DISHMAN. Mr. Chairman, I wanted to add one thing. I think we are at a big transition point here in the research of these kinds of devices in that we are actually moving from devices to systems. We are not very good at doing this kind of research in our Nation. Most of the disability research that has been done has been on a particular device, and you can do your controlled study. You put the device in this house and the device into this house—or you do not put it into this house, and you compare them.

The research challenge as we go forward in this kind of more connected world where the medication caddy can speak to the cell phone, can speak to the TV, this is just enormously difficult research to do. It takes more researchers coming together because

there are multiple touch points that people are interacting with, not just a single device, which also means it is very difficult to know what part of that whole system was the magic for that particular consumer. It may have been getting the medication reminders on their TV.

This is a new frontier of research that traditionally the U.S. has not funded a lot of systems research. We fund API going and looking at a device as opposed to bringing multiple principal investigators together to build all the pieces, get them all working together, and test the value of the whole system as opposed to the single device.

Mr. COUGHLIN. I would also encourage the committee to really consider the idea of even going beyond systems and looking at solutions. In fact, in part of the research that needs to be done on whether these technologies are efficacious and whether they will continue to be adopted or go the way of my treadmill as a sweater dryer is whether or not they connect to what. What is the value? You mentioned the older adults using computers now. They are using the computers because they can contact their grandkids, they can find health care information and the like. There was a value that was worth overcoming the usability dilemma.

Having talking houses and sensors talk to each other and having someone monitor remotely has a certain value. It has more value, however, for those who are not yet in the position where they are required to use these if it connects to local commercial providers or Government agencies that provide services.

So I would say this is now a research agenda, not on devices, not on systems, but how it connects to all those institutions and total solutions that are out there.

I would also suggest that we need to have a greater sense of urgency. We don't have the luxury any longer of digging deep into the research. We need to move forward quickly because it will take years, if you will, to deploy these things into people's homes, cars, retail stores, and the like. The average car, for instance, we keep our average car about 8.3 to 9 years. That means even if you had everything necessary today for safety in an older driver, it will take at least 10 to 15 years before it actually impacts the fleet.

One last comment and I will stop. The issue on usability, we like to talk about older adults and whether they like technology or not or whether they can use it. The fact of the matter is that in about 20 to 30 years, our children will be sitting at these tables and be talking about why is it that my parents seem enamored with the use of icons, and why does everything look like something they used to call a PalmPilot? The fact of the matter is technology continues to change, and our mental model of how things actually work is formed early on. The technology keeps moving. We need to move with it and, incredibly enough, make design more usable not just for our parents, but we are going to need that as well.

The CHAIRMAN. A variety of you have offered suggestions, and we appreciate that a great deal. Let me ask this question. Joe, you had mentioned in one instance that probably it was better that Government got out of the way in some respects. Yet Government can be a tremendous facilitator if it approaches it right.

We are having a debate on the floor right now about taxing the Internet, and we are not going to go any further than to suggest that Government really did create the Internet and then it kind of got out of the way. It was initially Government dollars that got there, but then it was Government who got out of the way, and the private sector took it over and ran with it. Now we are trying to get back in the way for a variety of different reasons because this technology has matured to a level where it is now being used in ways that were probably not originally anticipated. That is all well and good.

So now the great debate going on over there is: Should we get back in the way? Or should we stay out of the way and let this marketplace work and continue to work?

The question I am going to ask all of you is: If the Government today, this Government, this Senate, Judd Gregg's committee—who mentioned Senator Gregg? All right, Ron—had half a billion dollars to spend in your area, your area of interest, whether it be in tax credits, incentivizing, or whether it be in actual program, whether it be in grants, where would you recommend that money get spent if that money were available? Because we all know how scarce resources are. They always are scarce, and especially if an advocate like myself would suggest as a member of the Appropriations Committee that it get spent in a new area, it is much less likely to go there because we are habitual people and we like to spend in areas that we traditionally know about.

Eric, let me start with you.

Mr. DISHMAN. Well, if you are asking where would the money—where should the money be housed, I think one of the important things that we have determined in CAST is that the right way to house a bucket of money like that is to actually do a cross-agency funding initiative. There are great technologies in DARPA and DOD, and before 9/11, there used to be a lot of attention from those folks on issues of aging in place and home health care and those kinds of sensor technologies.

What we really need is to bring together places like NIST and NSF and NIH where we bring the clinical, the systems, you know, the future sensors that they are working on the battlefield, bring all of that together in one domain focused on the aging-in-place challenge. Then outside of that, I think we ought to be identifying the top conditions, if you will, or the top behavioral changes that these technologies could help do.

The only way we are really going to solve the aging challenge and the economic challenge is to actually change people's behavior before they start having some of these problems, some of the ones that are in the news today of medication errors and compliance, but in the home not just the hospital. Obesity, we are doing little experiments with some of these technologies to help know when your walking buddy—if you are 80 and you are at home alone, is your walking buddy going out for a walk now because they have picked their shoes and their jacket up and that might be a good time for you to go with them.

I believe that there are ways to use these technologies to connect people with other people outside of the institutional care setting, and that is where we are going to get the huge economic cost sav-

ings. So identifying some of those things like how do we get people to go out and actually walk 10,000 steps a day. We have said we want them to do that. How can technology be deployed to actually do that? How can we help reduction medication errors in the home? How can we help people with cognitive decline and mobility? Those would be four of the big areas.

Chairman Craig. Thank you.

Martha.

Ms. POLLACK. Yes, largely I want to echo what Eric has said. I think incentivizing companies is fine for relatively short-term solutions, but most of our companies have relatively short-term sights. When you look at the kind of technology that many of us are trying to build, the end product may look simple—in fact, it has to look simple if people with cognitive impairment are going to use it. But the design is anything but, and it requires the collaboration of large groups of multidisciplinary folks. It is difficult at this point to get sustainable funding for that.

There are two other quick points I want to make. First, I want to stress that the hope of many people like myself is that while there is a reasonably sizable investment to be made up front, enabling people to age in place longer, to stay out of institutions, is an economic win. It is a win-win situation because virtually all studies show that people want to remain at home longer. There is an enormous cost savings in enabling them to do that.

The final thing I would like to say is if I had a huge pot of money at my disposal, I would like to reserve at least a little bit of it to get some folks who are not technologists but who are policy experts to consider the policy implications of privacy. I agree with my fellow panelists that, by and large——

Chairman Craig. Policy implications of privacy.

Ms. POLLACK. I am sorry. I meant the development of policies that would help protect the privacy of people using this technology. Many older adults whom we have talked with are willing to trade some concern about privacy for the ability to have technology that can help them stay at home longer. But I am concerned that as this technology becomes widespread, there are potentials for abuse. We can solve some of that technologically, with techniques like encryption, but some of that has to be done at a policy level.

Chairman Craig. I don't disagree with that.

Yes, Lydia?

Ms. LUNDBERG. Being from private industry, obviously I would like to see more funding for grants to private companies. Currently it is very difficult to get any kind of research dollars. We did apply for the NIST grant, and I don't know if that will go anywhere. Because with the type of system that we have, there are a lot of things that can be developed. For instance, we are working toward having more tutorial information to the caregivers to make them smarter through the PDA, which may be extinct at some point, but right now it is the hot thing, where we could actually tutor them specific to the resident that has implications across not just in facilities but also in people's homes for non-traditional caregivers.

Then also to make that easier for companies to work together with grant money. Right now I think that is very hard to do.

The CHAIRMAN. OK. Joe?

Mr. COUGHLIN. Two things that Government does best is not necessarily spending money but agenda setting and creating an environment of innovation. So this committee hearing is part of the agenda-setting issue of getting this on people's screens.

Second, though, I really do think if I had that bucket of money, would be to create the markets that business is not sure exist. I think the money will come for research from other sources other than Government if, in fact, they believe that there is something that someone will buy and that there are people out there to buy it. So in that sense, we need to set the personal agendas of families to think about how they invest in their own homes and the homes of their parents with respect to technology and related services. We also need to have companies incented, whether it is a tax credit or otherwise, to create the innovations necessary to get these products out there.

Today, unfortunately, we are confronted by reimbursement paralysis or what I like to call "innovation by regulation." The devices or the specifically, if you will, of innovation is now based upon whether CMS will reimburse it. We need to convince industry and all those other places of innovation that there is another revenue stream that they can aim for. I would say that the research dollars that we have today in places like U.S. Department of Transportation Research Centers, the Department of Education, and certainly NIH have done a very good job of creating the seed corn. Now what we need to make sure that these things become affordable over time and move quickly is to make sure that people have the money and the incentive to do so.

Chairman Craig. Thank you.

Steve?

Mr. MCCONNELL. Mr. Chairman, it seems that the Government has a stake in at least four things: first, the cost of Medicare and Medicaid, and there ought to be some investment in preventing some of the diseases like Alzheimer's that contribute to the need for the issues we are talking about today.

Second is in the protection of people's rights. I think this is a whole new area. We are talking about people with cognitive impairments where decisions about privacy will probably be made, certainly for people in later stages of Alzheimer's, by a family member or a surrogate. We have done a lot of work in that area regarding participation in research, but we need to develop those ideas and help people understand what are the tradeoffs I think people are willing to make tradeoffs but we have not defined that area very well.

Third is creating awareness, this hearing and other kinds of things that help people just know about these issues. Most Americans don't know even the little bit we are talking about here today, and this hearing can help, especially with the presence of C-SPAN.

Finally, I think some incentives for industry—I mentioned the imaging initiative where you have the Government, NIH, and private industry working together. There are ways that we can incentivize industry to invest in this area.

The CHAIRMAN.. Ron.

Mr. SEILER. This will come as no surprise, but, of course, I would endorse that some of those dollars go to the Tech Act projects. At

this point we have got a huge mandate with not a lot of funds to accomplish that. But maybe beyond that, I would like to see some dollars to increase the capacity of the aging networks in all the States to provide AT services, and Idaho is a perfect example, working with our aging network over the past 10 years. Their capacity to deliver AT services to elders in rural areas has really increased as a result of that interagency collaboration between the Tech Project and the aging network. I would like to see that encouraged in whatever way would be appropriate.

Obviously, to echo some of the previous comments, increasing awareness about assistive technology, in particular that focus on rural areas where those things are so difficult to deliver. Also, training, education, training of older folks, obviously their family members, but in particular, with professionals. We don't see a lot of pre-service training programs in this country that talk about assistive technology, at least in my neck of the woods. So I would like to see a lot more training take place at the pre-service and in-service level related to assistive technology.

I guess in closing, what I would like to do is maybe put in a notion about low technology. For me, it is very—and I am the first one to admit I can be very seduced by some of the high-tech wonderful solutions that we see. But we should never overlook the role of low-tech solutions, simple devices that can help older folks to function in the kitchen, in the bathroom, those kind of things. You know, in this current economic climate, I just see that as being very viable and somehow we should stimulate the use of low-tech devices and not just, you know, focus on the high-tech stuff.

The last one, I would like to see some resources go into tech transfer, and we have heard this earlier, just getting the—again, as Eric mentioned, all these wonderful technologies that are in the lab, how do we get these out to real people in the real world? In particular, how do we provide, you know, those solutions into the rural areas? That is the lens that I always look through. How do we get it out to the people living in the rural areas?

The CHAIRMAN. Well, I thank you all very, very much for your time before the committee today, your presentations, your demonstrations, your suggestions.

I will say I recently introduced a piece of legislation recognizing that a major part of caregiving is done by families and individuals and not by institutions. Yet we have not—we are trying to recognize through tax credits and by lifting that cap dramatically that by doing so and in an identifiable way you actually are creating a greater marketplace that will incentivize that individual who is giving the care to begin to look at some of these technologies that may assist her, dominantly—his or her responsibility as it relates to the burden involved. That is the toughest one of all. It is a burden of responsibility and love that gives us those statistics that I think you had mentioned, Joe, and others, that are pretty dramatic out there and yet very real.

It is my great hope that not only will that assist, but it also continues to recognize what most Americans really do want to do and what we should continue down through our culture in time is that families care for families and work to continue to do that connectivity where it exists and where we can help further that

kind of caregiving. So that is one thing that we have looked at, and there will be others along the way. But I must tell you, we thank you very much for being here today, taking time from your schedules to add to this committee's record. We hope it will be valuable, if you will, in creating that, first of all, awareness agenda and ultimately then the environment in which some of your ideas and thoughts can flourish.

Thank you all, and the committee will stand adjourned.

[Whereupon, at 11:40 a.m., the committee was adjourned.]

A P P E N D I X

Statement for the Record

of the

American Foundation for the Blind

prepared for the

United States Senate Special Committee on Aging

regarding

Assistive Technologies for Independent Living: Opportunities and Challenges

April 27, 2004 hearing
(submitted for the record on May 11, 2004)

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The American Foundation for the Blind (AFB) is pleased to have this opportunity to submit this statement for the record of the hearing on "Assistive Technologies for Independent Aging: Opportunities and Challenges." We applaud the initiative of Senator Larry Craig and the members of this Committee in presenting a forum for this discussion.

Clearly, advances in technology have already brought about remarkable improvement in the quality of life for older people, especially those with disabilities. Unfortunately, important technologies designed to meet specific needs are not reliably covered under the Medicare/Medicaid systems and access for older persons with disabling conditions is not assured in mainstream technologies. As a consequence, technology devices and services available today have yet to be brought into the homes of the 6.5 million Americans over age 55 that experience severe vision loss.

AFB is committed to leveling the playing field for the 10 million blind or visually impaired Americans. A non-profit organization founded in 1921 and recognized as Helen Keller's cause in the United States, AFB is a leading national resource for people who are blind or visually impaired, the organizations that serve them, and the general public. AFB has worked to address the most important issues facing visually impaired older Americans through our National Aging Program, including our recently launched initiative to create a National Aging Center. In addition, through AFB TECH, our nationally recognized center on technology, we have examined a range of mainstream and assistive technology of importance to older Americans. These efforts have included analyses of the accessibility of health monitoring devices (such as blood glucose meters) and communications devices such as cell phones.

Before outlining the opportunities and challenges, as we see them, we encourage the Committee to consider the following:

- In the rush to embrace exciting new technologies, it is the older individual whose functional ability is at the heart of the matter.
- For older Americans with disabilities, particularly those with severe vision loss, both marketplace and Medicare/Medicaid solutions are uneven to non-existent.

Facts about Older Americans Who Experience Severe Vision Loss

- One in six or 6.5 million Americans age 55 and older experience severe vision loss. This number will double in 2030 as baby boomers age and the older population climbs to 78 million or 20% of the overall population.
- Four of the five major causes of blindness and vision impairment are age-related: macular degeneration, cataracts, glaucoma, and diabetic retinopathy.
- The National Eye Institute points out that the problem is even more severe for African-Americans where glaucoma rates are almost three times higher.
- For the general population, one in every twelve people with diabetes age 40 and older has vision-threatening diabetic retinopathy.

The Importance of Access to Technology for Older Americans with Impaired Vision

Accessible technology is especially important to older Americans with severe vision loss. Assistive technology such as a computer screen reader or video magnifier is often the only way an older individual with impaired vision can read important health-related information. Just as important, essential health monitoring equipment such as blood glucose meters are not generally designed to be accessible for a individuals who are blind or visually impaired, this despite the fact that diabetes retinopathy is a leading cause of blindness.

These devices, and others, have further important uses. They can magnify print pages and can be used where access to printed or visually displayed information is critical to independent functioning. For example, utilizing CCTV, essentially a video magnifier which utilizes a TV screen to magnify or change contrast for printed information, a person who is blind can access prescription label information along with the important patient package inserts usually delivered with these medications. These devices can also be used to access information necessary to pay bills. The most popular version of CCTV is a desktop system with a movable table for reading and either a video monitor or connection to a TV screen. These devices are particularly useful for older individuals because they generally feature simple controls. However, none of these devices is routinely reimbursable through Medicare.

Efforts to Expand the Availability of Technology Must Focus on Human Needs

The Committee is quite correct in focusing on the challenges involved in harnessing the potential of assistive technology, bringing it out of the lab, into the marketplace, and into the homes of older Americans. However, it is equally important to work to ensure that technology devices and services actually are accessible and usable. Whatever the device is, however it is hooked up, whatever its marvelous function, it will fail if an individual with a disability cannot operate the device or access the service independently. The key is to develop technology that an older individual with a disability really needs and would find easy to use. An example of this would be technology which would allow independent monitoring of health status or access to health-related information.

We hope the Committee will encourage the development of technology that is designed to be accessible to and usable by people with disabilities, including those who are blind or visually impaired. Standards have already been developed to address access to technology devices and services. In particular, we call the Committee's attention to the work of the United States Access Board which has developed "Electronic and Information Technology Access Standards" to implement Section 508 of the Rehabilitation Act. These standards address input, output and operation of technology devices and we encourage the Committee to explore ways to promote the further inclusion of these accessibility approaches in technologies aimed at the older market.

Furthermore, guidance and training in the use of technology devices and services must be provided. Our experience suggests that training for consumers, especially older consumers, is very often overlooked. It is of particular importance to provide training and information targeted to address the specific needs of older people with disabilities with compromised vision, hearing, or touch.

There are some useful collaborative efforts which should be encouraged:

- It is apparent from our own research and contacts with industry, that assistive technology development is significantly hampered by limited investor interest in a small market. The Committee should encourage the Commerce Department to convene a summit of technology investors and assistive technology manufacturers to develop an investment agenda, including a reinstatement of the National Institute of Standards and Technology advanced technology program.

- Foster collaboration between the National Institute on Aging, National Institute on Disability and Rehabilitation Research, and the initiatives of the Centers for Disease Control to encourage more assistive technology outcomes-based research in aging.

- Work with the Senate Committee on Finance to insure that the Center for Medicare and Medicaid Services begins a review of durable medical equipment reimbursement standards in light of the need to more adequately reflect the needs of older Americans with disabilities to have access to assistive technology equipment and services.

Improvements Are Needed to Cover Technology in Health Care Reimbursement Systems

Unfortunately, neither Medicare nor Medicaid reliably covers the provision of accessible technology devices or services. Many of these devices – screen readers for personal computers, video magnifiers ranging from hand held cameras to those that plug into a television – are not advanced technology. However, they are not covered by Medicare. As a result, older Americans with severe vision loss spend thousands of dollars out of pocket for a screen reader that would allow them to access on line discounts for prescription drugs, or nearly $1,000 for a partially accessible device which would enable an older American with severe vision loss resulting from diabetes to independently monitor blood glucose levels.

We encourage the Committee to develop policies that would foster coverage of accessible technology devices and services under existing or modified durable medical equipment reimbursement rules.

We very much appreciate the time the Committee has taken to examine this critical need and look forward to working with the Committee to undertake these recommendations.

Statement of

Dr. Gregory L. Goodrich
President-Elect
Association for Education and Rehabilitation of the Blind and Visually Impaired

Before the

Senate Special Committee on Aging

RE: Hearing on Aging and Assistive Technology, April 27, 2004

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Mr. Chairman and members of the committee, I am Gregory L. Goodrich, Ph.D. president-elect of the Association for Education and Rehabilitation of the Blind and Visually Impaired. I am a vision rehabilitation researcher at the U.S. Department of Veterans Affairs Palo Alto Health Care System and an Assistant Clinical Professor, School of Optometry, University of California. In my professional activities I edit, with Aries Arditi, Ph.D., the world's largest bibliography on low vision (available through the Internet at no cost through Lighthouse International's Vision Connection website http://www.visionconnection.org/VisionConnection/default.htm). I am an internationally recognized researcher in low vision technology, mobility, and vision rehabilitation research. I have authored or co-authored over 150 book chapters or articles that have appeared in professional journals. I also serve as a peer reviewer for numerous journals and Federal funding agencies research advisory panels, as well as serving on boards and committees of various private rehabilitation agencies. Thank you for the opportunity to submit the following testimony.

Severe visual impairment is a rapidly growing problem affecting over 3.4 million Americans aged 40 years and older, with almost 3% of that age group impacted by a visual impairment [1-3]. While effective treatments for the eye diseases that cause vision loss are the subject of extensive and comprehensive research no cures are on the horizon, and the expectation is that during the coming decades the number of elderly visually impaired individuals will increase. The National Eye Institute estimates that 8 million Americans, aged 55 years and older, are at high risk to develop advanced age-related macular degeneration [4] and diabetic retinopathy, glaucoma, and other prevalent eye diseases will substantially increase that number. Research to develop devices to restore vision to the blind, such as artificial retinas or devices to directly link the brain with the visual world via a camera [5, 6], are unlikely to fully restore vision and may necessitate

rehabilitation not unlike that already used in low vision rehabilitation clinics.

Vision loss late in life can be accurately characterized as having negative impacts on the quality of life, health, and mortality of the individual, and an additional impairment, such as hearing loss, compounds the effect [7]. It also negatively impacts the patient's family and creates an economic burden on society with more than $4 billion lost in benefits and unrecognized taxable income [2]. Additional costs, exceeding $26 billion per year, are incurred due to extended hospitalizations, admission to rehabilitation facilities, or other expenses attributable to the visual impairment [8-12]. Many of these expenses are avoidable provided the individual receives adequate rehabilitation and vision rehabilitation devices.

Low vision typically restricts the individual's ability to read and travel independently with concomitant losses of independence in areas such as the ability to visually recognize others, self-medicate, prepare meals, exercise, socialize, and to generally perform the activities of daily living that Americans take for granted [13-52]. Even sleep disturbances are more frequent in the elderly visually impaired compared to those not visually impaired [53-58] and such disturbances are thought to exacerbate other effects of vision loss.

While recent changes in Medicare do improve services for elderly Americans who have a visual impairment [59] these services are limited and do not address the visually impaired individual's need for rehabilitative devices. Low vision devices are effective in restoring visual function to the majority with low vision, and devices designed for blind users can also help these individuals maintain independence and reduce the risk of acquiring co-morbidities [60-62]. In many cases low vision devices can, with proper training, remove the effect of the visual disability; for example in restoring reading speeds to those expected in the patient's age group [63] and they improve quality of life and increase life expectancy [64, 65].

The benefits of low vision devices are important as preventative tools. Elderly individuals who experience vision loss late in life are more likely to develop other diseases than their sighted peers. The loss of vision can begin a downward spiral due to the inactivity, poor nutrition, social isolation, and depression that is symptomatic of this disability. The loss of vision can lead to an increase in untreated periodontal disease [66, 67] and prevent the individual from detecting potentially severe podiatric complications [68] probably due to the inability to see the problem before it becomes serious. Untreated periodontal disease can lead to further health problems, while undetected podiatric complications, particularly for diabetics, can lead to systemic infection and/or amputations. Low vision aids can compensate and allow individuals to perform personal health screenings.

Heart disease and some cancers are also more likely to occur in elderly visually impaired individuals [69-71] due, in part at least, to lack of exercise and poor nutrition. Visually impaired elders often experience difficulty dialing a phone, writing letters, paying bills, maintaining checking accounts, paying bills, getting groceries, walking outside their

home, visually identifying friends and neighbors, and often experience feelings of social isolation. As a result the incidence of depression and suicidal ideation is increased in this population [27, 39, 40, 72-85]. Low vision devices allow these elders to more easily perform routine activities.

Visually impaired elders also often reduce their mobility due to the fear of falling [86], a fear which is well founded since some 18% of falls resulting in hip fractures are attributable to the individual's visual impairment [87-93]. Whether the result of depression, impaired mobility, or other cause, visually impaired individuals often do not routinely return to their eye care physician for eye health exams [7, 94-97]. This lack of compliance leads to increased disability directly and indirectly related to the eye pathology. Proper training strategies combined with appropriate low vision devices and long canes can increase confidence while promoting safe travel [98-103].

Given the health risks associated with severe visual impairment it is little wonder that mortality is also increased in this population, although the mortality is not caused by the visual impairment per se [104]. Mortality in elderly visually impaired individuals results from an unhealthy life style resulting from the social isolation and lack of compensatory devices and skills associated with visual impairment. The mortality risk of being elderly and visually impaired is significant and is estimated to be between 1.7 and 1.9 that of non-visually impaired elders [104-112], and those having a co-morbid loss of hearing have a mortality risk of about 2.5 that of their age-matched peers. In short, severe visual impairment presents substantive health and mortality risks to America's seniors, risks that bring personal and societal costs. While there are no studies that demonstrate that vision rehabilitation devices will reduce the risk of mortality, it is logical to conclude that the increased ability to safely carry out activities of daily and to lead a normal lifestyle will have a positive impact in reducing the risk of mortality.

There are substantial gaps in our knowledge and understanding of the extent and causes of injuries and diseases occurring to people with visual impairments, as well as in our knowledge of interventions to reduce or prevent these injuries [89]. In large part these gaps are due to two factors: the relatively recent aging trend in the population and the concomitantly recent recognition that the aging population is prone to severe, disabling vision loss. Vision rehabilitation has emerged as a rigorous discipline only within the past quarter century and its early emphasis was on determining methods to successfully provide vision rehabilitation [113]. As the field has matured, and the effects of visual impairments on an aging population have become understood, it has become increasingly clear that effective interventions would reduce individual suffering, promote personal independence, increase longevity, and decrease costly injuries resulting in admissions to hospitals, rehabilitation facilities, and nursing homes. In summary, timely interventions with demonstrably effective devices and rehabilitation techniques have shown promise in promoting healthy and safe lifestyles among visually impaired elders. These techniques also show promise for greatly reducing personal and societal costs associated with the diseases and injuries that visual disabilities foster. In May 2002 Medicare promulgated policy guidance clarifying the application of current law to the provision of rehabilitation services for visually disabled seniors. However, current law merely provides limited

services and does not address the need for low vision devices. These devices are critical elements in providing independence through rehabilitation and to not provide them negates much of the beneficial effect of the current Medicare policy. The development of policy that would allow the vision rehabilitation professions to provide badly needed vision rehabilitation devices is a cost-effective way to reduce disease and accidents in our growing elderly population who develop severe visual impairments.

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Testimony for the Senate Special Committee on Aging

The Opportunities and Challenges of Assistive Technology

April 27, 2004

Submitted by:
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This testimony is being submitted on behalf of the ITEM Coalition, which is an acronym for Independence Through Enhancement of Medicare and Medicaid. The ITEM Coalition was formed in 2003, and its over 70 member organizations include a diverse set of disability organizations, aging organizations, other consumer groups, labor organizations, voluntary health associations and non-profit provider associations.

The ITEM Coalition's purpose is to raise awareness and build support for policies that will improve access to assistive devices, technologies and related services for people of all ages with disabilities and chronic conditions. From coverage for hearing aids to augmentative communication devices (AACs) to advanced artificial limbs to screen readers for people with vision impairments, the Coalition's mission is a broad one with implications for virtually every person with a disability who relies on assistive devices to be healthy, functional and independent.

We would like to commend the Special Committee on Aging for holding this hearing. Assistive technology assists million of Americans everyday, and this Committee's interest in improving coverage of and services around assistive technology is of the utmost importance. It is our hope that this hearing will continue to highlight the need and build the case for better coverage policies for assistive technology by public programs and private payers of health care services.

Assistive Devices, Technologies and Related Services

The ITEM Coalition uses the term "assistive devices, technologies and related services" because it encompasses an expansive range of items and related services that assist people with disabilities and chronic conditions in virtually all aspects of their lives. These devices range from low technology mobility aids such as canes and handheld magnifiers to high technology speech synthesizers and other augmentative communication devices. Assistive technology can be medical in nature, e.g., a prosthetic

limb, or completely non-medical but important to full function of the individual, e.g., a modified work station or an accessible van.

Additionally, assistive devices and services that train people to use them play a critical role in preventing injuries in persons with disabilities and chronic conditions, thereby helping to maintain good health. For instance, a modest investment in safety devices such as grab bars for the shower and bathtub can prevent costly hospitalization and rehabilitation due to slips and falls.

According to the National Institute on Disability and Rehabilitation Research (NIDRR), in 2001 over 15 million Americans with disabilities reported using assistive devices or technologies.[1] The American Association of Retired Persons (AARP) conducted a survey in 2003 in which they found that a third of persons 50 and over use some type of special equipment or assistive technology in their daily activities.[2] Based on 1994-95 data, it is estimated that 6.8 million Americans use some kind of assistive device for mobility, including approximately 1.7 million who use wheelchairs or scooters.[3] The number of wheelchair users today has grown to approximately 2.1 million.[4] Millions of Americans report living in homes and using cars or vans that have been modified to meet their special needs.[5]

While the demand for assistive technology is significant, the greatest barrier to access is affordability. More than 2.5 million Americans report they need assistive technology that they do not have, with about 70% citing cost as the primary reason.[6] Almost one-quarter of persons 50 and older with disabilities, who do not use any special equipment said that

---

[1] Carlson, D., Ehrlich, N., Berland, B.J., and Bailey, N., Assistive Technology Survey Results: Continued Benefits and Needs Reported by Americans with Disabilities, National Institute on Disability and Rehabilitation Research, 2001.
[2] AARP, Beyond 50.03: A Report to the Nation on Independent Living and Disability, 2003 (using data collected as part of AARP/Harris Interactive Survey of Persons Age 50+ with disabilities, 2002)
[3] National Health Interview Survey on Disability, Phase I file, National Center for Health Statistics, 1994-1995.
[4] United States Census Bureau, Americans with Disabilities: Household Economic Studies, 2001 (using 1997 data).
[5] Calrson, D., et. al. National Institute on Disability Rehabilitation and Research. (2001)
[6] National Health Interview Survey on Disability, Data File Documentation, National Center for Health Statistics, 1992.

equipment such as a hearing aid, wheelchair, cane or walker would improve their lives[2] and between 1994 and 1997, 1.3 million Americans with disabilities working at the time reported needing one or more additional assistive devices.[7] Less than 20% of the estimated 28 million Americans who could benefit from hearing devices currently have them.[8] In fact, 50% of assistive technology users and 75% of those with home modifications paid for this assistive technology themselves or with the help of family members, with no help from third party payers.[9] The barriers to access to assistive devices, technologies and related services have been documented to result in physical consequences, such as a general deterioration in health and a risk of secondary injuries, as well as strained relationships with family, friends, and colleagues, financial strain, decreased independence, and limitations in social participation.[10]

Changing Society, Changing Benefits

The ITEM Coalition appreciates the timeliness of this hearing and the Committee's attention to this issue. As our society changes demographically, our society's perception of and policies regarding people with disabilities are progressing and improving as well. Never before has there been such an intense need to develop proper services, coverage and understanding of assistive devices, technologies and related services. Indeed, technology will inevitably prove to be a driving force behind the inclusion of people with disabilities of all ages into society.

The New Freedom Initiative

Unveiled in February, 2001, the President's *New Freedom Initiative* (NFI) is intended to help Americans with disabilities by increasing access to assistive technologies, expanding educational opportunities, increasing the ability of Americans with disabilities to

[7] Carlson, D., et. al. National Institute on Disability Rehabilitation and Research (2001).
[8] Kochkin, S. and Rogin, C., Quantifying the Obvious: The Impact of Hearing Instruments on Quality of Life, *The Hearing Review* 7(1): 6-35 (2000).
[9] National Health Interview Survey on Disability, Data File Documentation, National Center for Health Statistics, 1992 (using survey data collected in 1990).
[10] Neri, M.T., and Kroll, T., Understanding the Consequences of Access Barriers to Health Care: Experiences of Adults with Disabilities, *Disability and Rehabilitation* 25(2): 85-96 (2003).

integrate into the workforce and promoting increased access into daily community life. The ITEM Coalition commends this Administration for taking on this agenda, which reflects the full potential and progress of people with disabilities. However, while the NFI focuses heavily on assistive technology issues, the proposals within the NFI are limited to funding increases in research and development of assistive technologies and alternative financing mechanisms administered through the state Tech Act programs. Missing from the NFI is any proposal to coordinate vocational rehabilitation programs with other education, labor, and health programs to enhance access to assistive technologies. Also missing from the NFI is a serious assessment and process for making recommendations to improve third party payer coverage of health-related assistive devices, technologies, and related services.

Many publicly financed health programs (Medicare, Medicaid, the VA, FEHBP, and TRICARE) as well as private health plans routinely cover varying amounts of durable medical equipment, orthotics, prosthetics and supplies, but coverage policies are in need of review and revision. In addition, coverage policies need to be created for many health-related assistive, sensory and communication technologies, and other devices and related services. In the spirit of which the NFI was created, the federal health coverage programs must progress and set an example of thorough coverage of assistive devices, technologies and related services so people with disabilities are able to fully participate in their work and in the community.

Movement Toward Home and Community Based Services

As society's perception of with disabilities has progressed, there has been a significant shift in the way in which services to people with disabilities have been delivered. Historically, people with disabilities have often received their personal care services in the institutional setting, requiring many individuals to be removed from their homes and communities. However, as a result of the disability rights movement, as well as the 1999 Supreme Court decision in Olmstead vs. L.C. that found unnecessary institutionalization of people with disabilities to be discriminatory under the Americans with Disabilities Act, policymakers have begun to increase the opportunities for people with disabilities to

receive "home and community based services." There is a strong preference, particularly with individuals ages 50-64, to live independently in the homes or community based settings.[11]

Access to assistive devices, technologies and related services is an essential component for the success of home and community based services. However, currently there are contradictions between coverage policies for assistive technologies and the policies and decisions that embody the home and community based services programs. For example, Medicare's coverage of power mobility, such as power wheelchairs, is based on the "in the home" and "bed or chair confined" criteria. The program provides access to mobility devices if needed for use "in the home" – within the four walls of one's home – and not if one needs them to fully participate in work, school, and the community outside of the home. Additionally, Medicare only provides access to those who are "bed or chair confined," and not to those who can get out of bed but have limited mobility without a wheelchair, scooter or similar device. If people with disabilities are not given the tools necessary to be functional and independent in society, then the goal of home and community based services will inevitably be lost.

Aging Population

As our population continues to age, improvements in coverage of assistive devices, technologies and related services become more and more imperative. Currently there are 76 million people over the age of 50 and by 2020 there will be 116 million people, or 36% of the population, over 50.[12] Additionally, it is estimated that 33% of people 50 and over use some type of special equipment or assistive technology.[13] Ages that were once considered "elderly" are now inching their way closer and closer to our country's median age. Given that such an enormous number of lives could be significantly improved and prolonged by enhancing access to wheelchairs, hearing aids, reading devices and other assistive technologies, the achievement of the goal is essential.

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[11] AARP (2003)
[12] Security Industries Association.. http://www.sia.com/springboard/html/whos_there.html (2004)
[13] AARP (2003)

As the population ages, so does the workforce. The labor force between the ages of 45-64 will grow faster than the labor force of any other age group as the baby boom generation born 1946-64 continues to age.[14] Numerous government programs are in place to allow older workers and workers with disabilities to remain active in the workforce and billions of dollars are rightfully placed into these services every year. However, again, contradictions between health programs' coverage criteria for assistive technology and federal initiatives and programs for those with disabilities exist. In order for employment services to be successful for people with disabilities, it is crucial that there is sufficient access to assistive devices, technologies and related services.

The Next Frontier

In December, 2003, as a result of pharmaceuticals improvements and costs increases, President Bush signed into law the *Medicare Prescription Drug, Improvement and Modernization Act of 2003.* For the first time in history, the Medicare Program will help cover the costs of prescription drugs for all Medicare beneficiaries. The addition of a prescription drug benefit illustrates a reevaluation of health coverage policies as a result of scientific advancements in pharmaceuticals.

The ITEM Coalition strongly believes that improving coverage of assistive devices, technologies and related services is the next frontier for policy change, and current regulations, specifically those under Medicare, are ripe for reevaluation. Scientists, engineers and manufactures have developed, and continue to produce, technologies that allow people in wheelchairs to climb stairs, people with artificial legs to complete marathons, people with extensive hearing loss to appreciate symphonies and people who are blind to access visual presentations. Strict conceptions of "medical necessity" that fail to take into account improvements in function and quality of life are no longer appropriate standards for assistive devices. Furthermore, in the end, access to assistive technologies has the potential for cost savings, as technological innovations unleash

[14] Bureau of Labor Statistics, Employment Projections, 1999.

unprecedented levels of workforce improvements, independent living and community participation among the population of people with physical, cognitive, sensory and communication disabilities.

Thank you for the opportunity to submit testimony at this important hearing. If you have any questions, please feel free to contact us at (202) 349-4260.

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Center for Independent Living Inc., Berkeley, California

Center for Medicare Advocacy, Inc.

Christopher Reeve Paralysis Foundation

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The Miami Project to Cure Paralysis

National Association for Home Care and Hospice

National Association for the Advancement of Orthotics and Prosthetics

National Association of Councils on Developmental Disabilities

National Association of Protection and Advocacy Systems

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National Coalition for Disability Rights
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Research Institute for Independent Living

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Self Help for Hard of Hearing People

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United Spinal Association

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Microsoft

April 2004

On behalf of Microsoft, I am pleased to submit the following documents for the record of the upcoming hearing on Assistive Technology for an Aging Population, to be held on Tuesday, April 27, 2004, by the U.S. Senate Special Committee on Aging.

> *(1) The Wide Range of Abilities and It's Impact on Computer Technology: A Research Study Commissioned by Microsoft Corporation and Conducted by Forrester Research, Inc., in 2003*
>
> *(2) The Convergence of the Aging Workforce and Accessible Technology: Thelimplications for Commerce, Business and Policy*

For 15 years, Microsoft has worked to make its own products accessible to people with disabilities and to provide a platform that other companies can use to develop a wide range of accessible and assistive technology. That work continues with more energy and urgency than ever.

Recently, however, a new research study commissioned by Microsoft and conducted by Forrester Data has revealed an expanded need for technology solutions that can help people mitigate the effects of a wide range of mild-to-severe physical and cognitive difficulties and impairments, successfully pursue education and employment, and keep their competitive edge. According to the new research, 60 percent of working-age adults and 57 percent of working-age computer users could benefit from accessible technology—and the need becomes greater as people age.

Clearly, the number of people who could benefit from accessible technology (AT) is much larger than anyone previously thought, and this new perspective calls for a fresh look at how accessible technology can help keep American workers and American businesses competitive. As the U.S. workforce continues to age, the need for accessible technology as a widespread and mainstream business resource will increase even more. By 2010, more than half the U.S. population will be 45 or older, age-related impairments will affect more people, and employers will need resources to help workers maintain peak performance.

Accessible technology solutions can help people of all abilities realize their full potential. As the need for AT increases, it will be vital to establish a seamless network of resources

and training that can meet people's evolving needs at every stage of life and ensure that all Americans have the help they need with education, employment and independent living.

To address the needs of aging workers who have not traditionally been acknowledged as likely beneficiaries of accessible technology, Microsoft is highlighting an array of resources (www.microsoft.com/aging) through an educational campaign to help aging workers and businesses learn how AT can make them more productive and competitive.

We are pleased that the U.S. Senate Special Committee on Aging is calling attention to a topic of such vital importance to millions of American citizens and our national economy. We look forward to working with you to spread the word as we continue to address the accessibility and technology needs of all Americans. Thank you.

Laura Ruby /gk

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The Wide Range of Abilities and Its Impact on Computer Technology

A Research Study Commissioned by Microsoft Corporation and Conducted by Forrester Research, Inc., in 2003

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Overview

In 2003, Microsoft Corporation commissioned Forrester Research, Inc., to conduct a study to measure the potential market of people in the United States who are most likely to benefit from the use of accessible technology for computers. Accessible technology enables individuals to adjust their computers to meet their visual, hearing, dexterity, cognitive, and speech needs. It includes both accessibility options built into products as well as specialty hardware and software products (assistive technology products[1]) that help individuals interact with a computer.

The goals of this study were to identify the range of physical and cognitive abilities among working-age adults and current computer users in the United States, the types of difficulties and impairments that limit the scope of activities and their degree of severity, and the number of people who could potentially benefit from using accessible technology. This information, coupled with aging population trends, can help to explain the aging population's impact on computer use and need for accessible technology.

This report contains a summary of the study and presents its findings about individuals who are likely to benefit from the use of accessible technology. It also includes findings about working-age adults and computer users and presents data about the aging population in the US and its impact on computer use. This report concludes with statements about how these findings affect the information technology (IT) industry.

[1] For more information about assistive technology products, see www.microsoft.com/enable/at/.

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Identifying Who Is Likely to Benefit from the Use of Accessible Technology

The main goal of this study was to identify the number of individuals who could potentially benefit from the use of accessible technology. The study was designed to identify individuals who have physical or cognitive difficulties or impairments that restrict their performance of daily tasks and determine who could most likely benefit from using accessible technology. The study identified individuals who considered themselves to have an impairment as well as those who did not but did report having difficulty performing daily tasks. This approach allowed the study to capture information about individuals who "self-identify" as having a disability or impairment as well as individuals who have difficulty with certain tasks but who do not identify themselves as having a disability or impairment.

The study consisted of a nationwide survey conducted by phone and mail. Participants were asked a range of questions designed to assess a variety of difficulties and impairments and degrees of severity to determine how they may impact the individual's use of computers.

The survey covered the five types of difficulties and impairments that would most likely impact computer use: visual, dexterity, hearing, speech, and cognitive.[2] For each type of difficulty and impairment, the survey contained the following types of questions:

- **Difficulties with daily tasks** to identify individuals who have difficulty performing daily tasks in each of the five types of difficulties and impairments.
- **Direct questions about impairments** to assess the proportion of the population who self-identify as having an impairment.
- **Direct questions about impact on employment** to allow individuals to communicate their assessment of the restrictions imposed by an impairment.

Participants were also asked a range of lifestyle and demographic questions. For more information about the study's methodology, see Appendix A: Methodology.

[2] Cognitive difficulties and impairments refer to an inability to appropriately respond to information presented by sight or sound.

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Defining Who Is Likely to Benefit from the Use of Accessible Technology

Based on answers to the survey questions, survey respondents were placed into one of the following three groups according to the likelihood of benefiting from the use of accessible technology:

- **Not likely to benefit from the use of accessible technology due to no or minimal difficulties or impairments.** This group includes:
  - Individuals who had trouble performing two or fewer daily tasks in a difficulty/impairment type only some of the time or who never had trouble with any assessed task.
  - Individuals who did not self-identify as having any type of impairment or report having a difficulty or impairment that impacts employment.

- **Likely to benefit from the use of accessible technology due to mild difficulties or impairments.** This group includes:
  - Individuals who self-identified as having a difficulty/impairment that did not limit their employment and daily life.
  - Individuals who reported difficulty with more than one daily task[3] within a particular difficulty/impairment type some or most of the time.

  Examples of mild difficulties and impairments include being slightly hard of hearing or having difficulty hearing conversation some, but not most, of the time and experiencing pain in hands, arms, or wrists that limits activities some, but not most, of the time. These individuals are likely to benefit from the ability to customize accessibility options built into software such as increasing font size, turning up volume on computers, and using keyboard shortcuts instead of a mouse.

- **Very likely to benefit from the use of accessible technology due to severe difficulties or impairments.** This group includes:
  - Individuals who reported having an impairment that limits employment.
  - Individuals who reported difficulty with all of the tasks within a difficulty/impairment type some of the time and report having an impairment.
  - Individuals who reported difficulty with most of the tasks within a difficulty/impairment type most of the time.

  Examples of severe difficulties and impairments include being blind or deaf, experiencing pain in the hands, arms, or wrists that limits activities most of the time, and having non-correctable vision problems that cause difficulty performing many vision-related tasks. These individuals are likely to benefit both from using the accessibility options built into software (as described above) as well as specialty assistive technology software and hardware designed for specific difficulties and impairments (such as screen readers and voice recognition software).

[3] To ensure a conservative estimate, those who only reported some difficulty with one daily task in an impairment type were not included.

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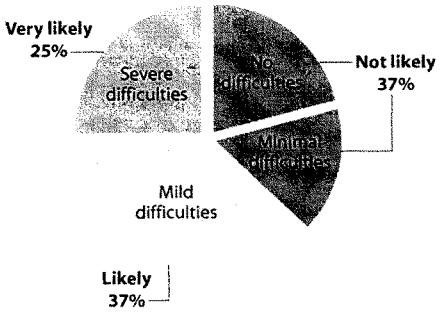
Individuals Likely to Benefit from the Use of Accessible Technology

Figure 1 correlates the degree of severity of difficulties with the three groups of likelihood to benefit from the use of accessible technology—not likely, likely, and very likely:

- Individuals who did not have difficulties or impairments, or who have only minimal difficulties, are not likely to benefit from the use of accessible technology.
- Individuals who have mild or severe difficulties or impairments are likely or very likely to benefit from the use of accessible technology.

Figure 1: Incidence of Difficulties and Likelihood to Benefit from the Use of Accessible Technology



Base: US adults age 18 and older

Source: Source: Study commissioned by Microsoft, conducted by Forrester Research, Inc., 2003

The remainder of this report focuses on the two groups of individuals who are likely or very likely to benefit from the use of accessible technology.

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Findings about Working-Age Adults

The findings in this section contain information about working-age adults in the US who range from 18 to 64 years old and are likely or very likely to benefit from the use of accessible technology due to mild or severe difficulties and impairments.

Difficulties and Impairments among Working-Age Adults

The bar graph in Figure 2 shows the percentages of working-age adults who reported having each type of difficulty or impairment defined in the survey. Visual, dexterity, and hearing difficulties and impairments are the most common types of difficulties or impairments among working-age adults:

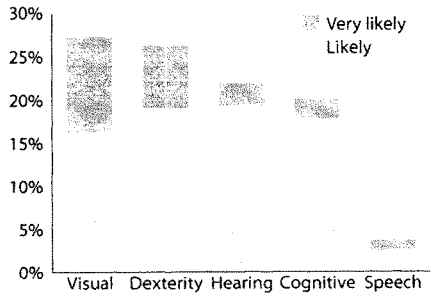
- Approximately one in four (27%) have a visual difficulty or impairment.
- One in four (26%) have a dexterity difficulty or impairment.
- One in five (21%) have a hearing difficulty or impairment.

Somewhat fewer working-age adults have a cognitive difficulty or impairment (20%) and very few (4%) have a speech difficulty or impairment.

The table in Figure 2 represents the numbers of working-age adults (in millions) who have each type of difficulty or impairment defined in the survey. For the top three difficulties and impairments:

- 16% (27.4 million) of working-age adults have a mild visual difficulty or impairment, and 11% (18.5 million) of working-age adults have a severe visual difficulty or impairment.
- 19% (31.7 million) of working-age adults have a mild dexterity difficulty or impairment, and 7% (12.0 million) of working-age adults have a severe dexterity difficulty or impairment.
- 19% (32.0 million) of working-age adults have a mild hearing difficulty or impairment, and 3% (4.3 million) of working-age adults have a severe hearing difficulty or impairment.

Figure 2: Likelihood to Benefit from the Use of Accessible Technology by Type of Difficulty/Impairment among Working-Age Adults



	Likely (millions)	Very likely (millions)	Total
Visual	27.4	18.5	**45.9**
Dexterity	31.7	12.0	**43.7**
Hearing	32.0	4.3	**36.3**
Cognitive	29.7	3.8	**33.5**
Speech	4.3	1.9	**6.2**

Base: US 18- to 64-year-olds

Source: Study commissioned by Microsoft, conducted by Forrester Research, Inc., 2003

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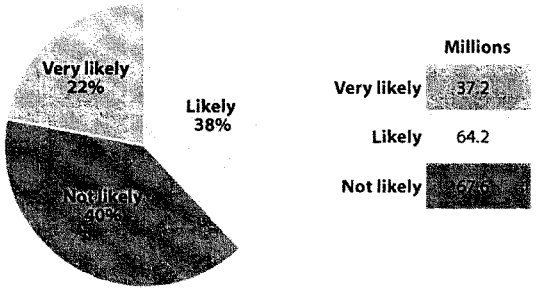
Majority of Working-Age Adults Likely to Benefit from the Use of Accessible Technology

The findings in this study show that the majority of working-age adults are likely to benefit from the use of accessible technology. As shown in the chart in Figure 3, 60% (101.4 million) of working-age adults are likely or very likely to benefit from the use of accessible technology.

The chart in Figure 3 also shows the percentages of working-age adults who are likely or very likely to benefit from the use of accessible technology due to a range of mild to severe difficulties and impairments:

- 38% (64.2 million) of working-age adults are likely to benefit from the use of accessible technology due to a mild difficulties and impairments.
- 22% (37.2 million) of working-age adults are very likely to benefit from the use of accessible technology due to a severe difficulties and impairments.
- 40% (67.6 million) of working-age adults are not likely to benefit due to a no or minimal difficulties or impairments.

Figure 3: Majority of Working-Age Adults Likely to Benefit from the Use of Accessible Technology



Base: US 18- to 64-year-olds

Source: Study commissioned by Microsoft, conducted by Forrester Research, Inc., 2003

The fact that a large percentage of working-age adults have difficulties or impairments of varying degrees may surprise many people. However, this study uniquely identifies individuals who are not measured in other studies as "disabled" but who do experience difficulty in performing daily tasks and could benefit from the use of accessible technology.

Note that many or most of the individuals who have mild difficulties and impairments do not self-identify as having an impairment or disability. In fact, the difficulties they have are not likely to be noticeable to many of their colleagues.

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Findings about Computer Users

This section contains information about working-age computer users in the United States (those who currently use computers either at home, at work, or both, who range from 18 to 64 years old). Information about computer users who are likely or very likely to benefit from the use of accessible technology due to mild or severe difficulties and impairments, the prevalence of different types of difficulties and impairments among computer users, and the impact that difficulties and impairments have on computer use is provided.

Difficulties and Impairments among Computer Users

The incidence of types of difficulties and impairments among computer users is shown in Figure 4. Visual, dexterity, and hearing difficulties and impairments are the most common types among computer users.

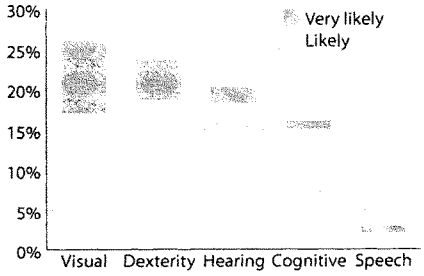
- Approximately one in four (25%) computer users have a visual difficulty or impairment.
- Nearly one in four (24%) computer users have a dexterity difficulty or impairment.
- One in five (20%) computer users have a hearing difficulty or impairment.

Somewhat fewer computer users have a cognitive difficulty or impairment (16%), and few (3%) have a speech difficulty or impairment.

The table in Figure 4 represents the number of computer users (in millions) who have each type of difficulty or impairment defined in the survey. For the top three difficulties and impairments:

- 17% (21.9 million) of computer users have a mild visual difficulty or impairment, and 9% (11.1 million) of computer users have a severe visual difficulty or impairment.
- 19% (24.4 million) of computer users have a mild dexterity difficulty or impairment, and 5% (6.8 million) of computer users have a severe dexterity difficulty or impairment.
- 18% (24.0 million) of computer users have a mild hearing difficulty or impairment, and 2% (2.5 million) of computer users have a severe hearing difficulty or impairment.

Figure 4: Likelihood to Benefit from the Use of Accessible Technology by Type of Difficulty/Impairment among Computer Users



	Likely (millions)	Very likely (millions)	Total
Visual	21.9	11.1	33.0
Dexterity	24.4	6.8	31.2
Hearing	24.0	2.5	26.5
Cognitive	19.5	1.7	21.2
Speech	2.5	1.1	3.6

Base: US 18- to 64-year-old computer users

Source: Study commissioned by Microsoft, conducted by Forrester Research, Inc., 2003

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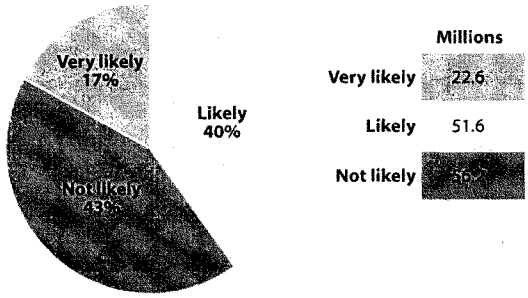
Majority of Computer Users Likely to Benefit from the Use of Accessible Technology

The findings of this study show that the majority of computer users are likely or very likely to benefit from the use of accessible technology. As shown in Figure 5, 57% (74.2 million) of computer users are likely or very likely to benefit from the use of accessible technology due to experiencing mild to severe difficulties or impairments.

The chart in Figure 5 also shows the percentages of computer users who are likely or very likely to benefit from the use of accessible technology due to a range of mild to severe difficulties and impairments:

- 40% (51.6 million) of computer users are likely to benefit from the use of accessible technology due to experiencing mild difficulties or impairments.
- 17% (22.6 million) of computer users are very likely to benefit from the use of accessible technology due to experiencing severe difficulties or impairments.
- 43% (56.2 million) of computer users are not likely to benefit from the use of accessible technology due to experiencing no or minimal difficulties or impairments.

Figure 5: Majority of Computer Users Likely to Benefit from the Use of Accessible Technology



Base: US 18- to 64-year-old computer users

Source: Study commissioned by Microsoft, conducted by Forrester Research, Inc., 2003

Computer users are as likely as working-age adults to have mild difficulties or impairments, but they are less likely to have severe difficulties or impairments. Among computer users who range from 18 to 64 years old, 40% have a mild difficulty or impairment, compared to 38% of the overall working-age adult population. However, 17% of computer users who range from 18 to 64 years old have a severe difficulty or impairment, compared to 22% of the overall working-age adult population.

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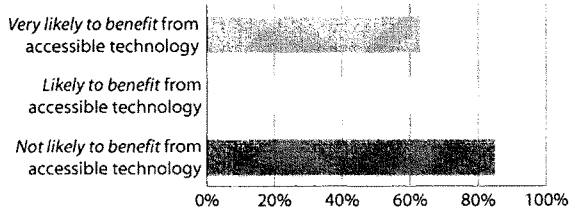
Difficulties and Impairments Reduce Computer Use

The data confirms that the degree of severity of a difficulty or impairment is an important factor that influences computer use.

Figure 6 shows that computer use is lower among individuals who are likely or very likely to benefit from the use of accessible technology. While 85% of individuals who have no or minimal difficulties or impairments use computers, computer usage drops to 80% among those who have mild difficulties/impairments and who are likely to benefit from the use of accessible technology. It drops even further to 63% among individuals who have severe difficulties/impairments and who are very likely to benefit from the use of accessible technology.

Figure 6: Computer Use Lower Among Those Likely to Benefit from the Use of Accessible Technology

Percent who use a computer among those:



Base: US 18- to 64-year-olds in each category

Source: Study commissioned by Microsoft, conducted by Forrester Research, Inc., 2003

This data suggests that difficulties and impairments are factors that reduce computer use among some individuals and that a large audience for accessible technology exists among today's computer users. By creating technology that is more accessible to individuals who have difficulties and impairments, it is reasonable to assume that computer use among those with impairments and difficulties will rise.

Difficulties and Impairments Reduce Technology Optimism

The level of technology optimism by each group is examined below to better understand how those likely and very likely to benefit from the use of accessible technology view technology. Technology optimism[4] is a proprietary measure (created by Forrester Research, Inc.) used to measure optimism about the role of technology in one's life.

Figure 7 illustrates that computer users who are more likely to benefit from the use of accessible technology, due to having difficulties and impairments, are less likely to be "technology optimists."

[4] Technology optimism is measured by examining survey respondents answers to questions such as "I like technology" and "Technology is important to me."

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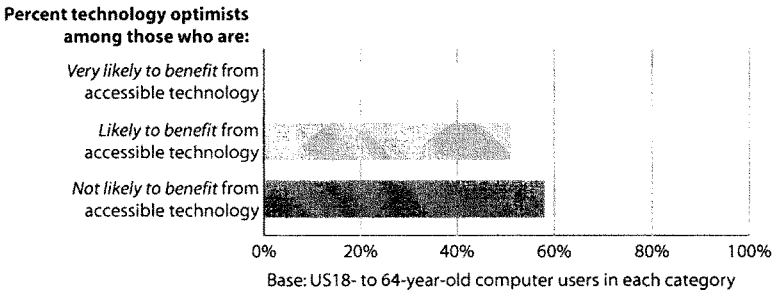
Only 51% of computer users who are likely and very likely to benefit from the use of accessible technology (due to having mild to severe difficulties and impairments) are technology optimists, compared to 58% of computer users who are not likely to benefit from the use of accessible technology.

Figure 7: Technology Optimism Lower among Those Likely to Benefit from the Use of Accessible Technology



Source: Source: Study commissioned by Microsoft, conducted by Forrester Research, Inc., 2003

One possible explanation for the difference could be that individuals who are likely to benefit from the use of accessible technology have found that using computers is more challenging because the technology is not accessible. This illustrates the potential for accessible technology to improve an individual's satisfaction with computers and optimism about technology.

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The Aging of the US Population and Its Impact on Computer Use

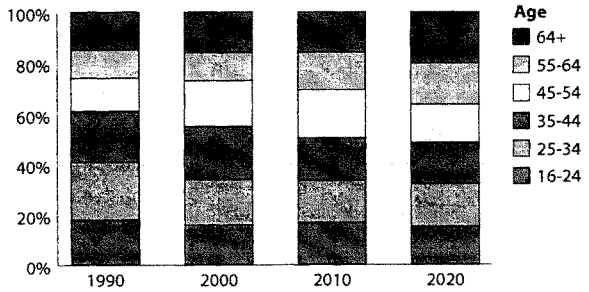
All of the findings presented so far have focused on current working-age adults and computer users who range from 18 to 64 years old. In this section, the findings of the survey are expanded to the entire US population and population trends are considered. Existing data about the rapidly aging US population, the increasing average age of computer users, and the rising occurrence of difficulties and impairments in the population are also presented.

US Population Is Aging

Figure 8 presents data from an existing study (*Monthly Labor Review*, 2000[5]) that found that the average age of the US population is increasing, beginning in 1990 and rising until 2020. In 1990, 40% of the US population was younger than 35 years old; by 2010, only a third will be younger than 35. In 2010, the majority of the US population will be 45 years and older, a change that represents a major turning point for the US population demographic.

This increase will change the profile of the US labor force. With more people being 45 years and older, combined with a growing tendency toward delayed retirement, the labor force will shift toward older workers. This shift will occur slowly, but steadily, over the next several years. By 2020, one in five workers will be 55 years and older. This represents a more than 50% increase over 2000, in which 13% of the labor force was made up of the 55-and-older age group.[6] The aging labor force is likely to mean greater pressure from businesses to help keep their aging employees as productive as possible throughout their careers.

Figure 8: Aging US Population



Source: Monthly Labor Review; Study commissioned by Microsoft, conducted by Forrester Research, Inc., 2003

[5] Mitra Toossi, "A century of change: the US labor force, 1950-2050" (table 4). *Monthly Labor Review*, May 2000.
[6] Toossi, 2002, page 15

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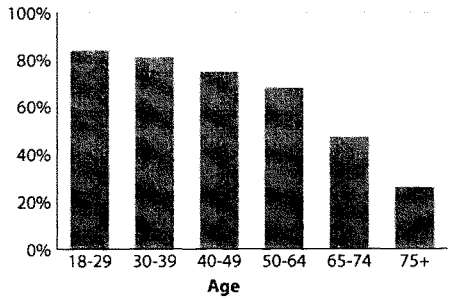
Average Age of Computer Users Is Rising

Figure 9 presents data that shows the rising average age of computer users. People who range from 55 to 64 years old are 44% more likely to use a computer than those who range from 65 to 74. While some of this may be explained by retirement, most of it is driven by a generational divide in computer use. People who range from 55 to 64 years old today currently use computers in the workplace at a higher rate than people in their 60s and 70s did at earlier ages. As current 55- to 64-year-olds mature into their 60s and 70s, they will continue to use computers. Therefore, in 10 years, there will be 2.5 times as many adults who range from 65 to 74 years old using computers as there are today. This growth comes from two areas: the greater use of computers by older individuals (the generational wave of computer use) and the increased total number of people in each group (population dynamics).

Figure 9: Generational Wave of Computer Adoption



Source: Study commissioned by Microsoft, conducted by Forrester Research, Inc., 2003

Difficulties and Impairments Increase with Age

Figure 10 presents data that shows that most of the increase in severe difficulties and impairments occurs among people in their 60s and early 70s. More than a third of people in the United States are 65 years and older and have severe difficulties and impairments. In fact, those who range from 65 to 74 years old are just as likely to have a severe difficulty or impairment as individuals who are 65 years and older.

Aging brings about the need for accessible technology in two ways. First, as people age, existing mild difficulties and impairments can become more severe. Second, people are likely to develop new difficulties and impairments as they age. In a population in which the age profile is shifting rapidly toward those most likely to have difficulties and impairments, the total number of people with difficulties and impairments will increase.

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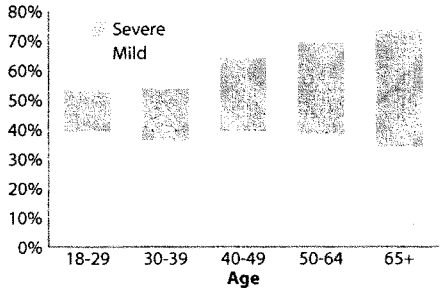
Figure 10: Difficulties and Impairments Increase with Age



Base: US adults, 18 and older

Source: Study commissioned by Microsoft, conducted by Forrester Research, Inc., 2003

The combined effect of Figures 8, 9, and 10 underscores the importance for the IT industry to understand the wide range of difficulties and impairments that people have today. The need for accessible technology is great now and will intensify over the next decade.

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Summary

This report demonstrates that there is an increasing need for accessible technology to allow individuals to customize their computers to help overcome physical and cognitive difficulties and impairments. In the United States, 60% (101.4 million) of working-age adults who range from 18 to 64 years old are likely or very likely to benefit from the use of accessible technology due to difficulties and impairments that may impact computer use. Among current US computer users who range from 18 to 64 years old, 57% (74.2 million) are likely or very likely to benefit from the use of accessible technology due to difficulties and impairments that may impact computer use.

As the US population ages, more US workers and computer users will notice changes in their abilities and experience difficulties and impairments. At the same time, older US workers will remain in the workforce long past previously expected retirement ages. Maintaining productivity among US workers—regardless of abilities, difficulties, and impairments—will become an increasingly vital economic issue for US businesses as the population continues to age. Add to these trends the growing use of computers for work, information, and communication, and it becomes clear that future computer users will demand and expect greater accessibility in computers—regardless of their abilities. There is a strategic business opportunity for IT companies to improve technology optimism, and perhaps customer satisfaction with their own products, by developing more accessible technology for computers.

The Wide Range of Abilities

Addressing the growing need for accessible technology requires accepting the fact that the concept of "disability" may have limited the understanding of the need for accessible technology. Instead of assuming that accessible technology is only useful to a distinct group of people with disabilities, the IT industry must consider the wide range of people who could benefit from using accessible technology.

For computer technology to be most effective and accessible, however, it is essential to understand the type and the degree of severity of difficulties and impairments people are experiencing, how frequently they occur among current and potential computer users, and the specific ways accessible technology may help people overcome those difficulties and impairments. Forrester Research recommends that further research be done to explore these issues.

Continued Innovation Needed

The findings in this study indicate that that technology currently aimed at people with severe difficulties and impairments can also improve the computing experience for the vast majority of computer users. A large and growing potential market for accessible technology exists to serve individuals who have some degree of difficulty or impairment that impacts their ability to use a computer. Further innovation should be done to make technology even more accessible.

Accessible technology has the potential to powerfully extend, expand, and enhance user experience and productivity. Addressing the needs of those who are likely or very likely to benefit from the use of accessible technology requires an industry-wide effort.

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Appendix A: Methodology

Forrester conducted a nationwide survey in May through July 2003 to assess the incidence rates and the degree of severity of difficulties and impairments among US working-age adults and computer users. The survey was conducted by phone and mail, yielding a total of 15,477 respondents. Respondents were asked a range of questions about difficulties, impairments, computer use, and attitudes toward technology. Resulting data is representative of the adult US population.

Forrester created a survey, in conjunction with Microsoft's team, to be fielded to a representative selection of households within the US to assess incidence rates and the degree of severity for several difficulty/impairment types. The difficulty/impairment types are: visual, dexterity, hearing, speech, and cognition. To measure a range of potential demand for accessible technology, a three-pronged approach was developed asking questions about the respondents' level of functioning within a difficulty/ impairment type; assessing task-based limitations, self-assessed limitations, and difficulties/impairments effecting employment.

Survey questions: The survey was designed to identify individuals who self-identify as having a difficulty or impairment, as well as those who do not consider themselves to have an impairment but do report difficulty with tasks.

The survey contained the following three types of questions:

1. **Task-based questions:** Designed to understand difficulty with ordinary daily tasks in each of the difficulty/impairment types. The types of questions asked include: *"Please indicate how often, if ever, you have difficulty seeing the words and letters in ordinary newspaper print because of your eyesight. If you usually wear glasses or contacts, please indicate whether you have difficulty while wearing glasses or contacts," and "Please indicate how often, if ever, you have difficulty using a keypad on a phone/dialing the phone because of physical difficulties with your arms, hands, wrists or fingers."*
2. **Direct questions about impairments:** Designed to assess the proportion of the population who believe that they have an impairment. Individuals were also asked to assess the degree of severity of their impairment. The purpose of asking people for their own assessment was to understand the role of self-identification in seeking out solutions to difficulties with computer tasks. These questions were more direct, for example, "*Do you have a visual impairment?"*
3. **Direct questions about impact on employment:** Designed to allow individuals to communicate their assessment of the limitations imposed by their impairment. For example, people identified themselves to have a visual difficulty/impairment were asked directly: *"Do you have a visual impairment that limits the kind or amount of work you can do?"*

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In addition to a rigorous assessment of respondents' ability within a difficulty/impairment type, the survey assessed computer usage; technology, health, and life attitudes; employment; accessible technology use; and a range of demographic characteristics.

Sample size: A sample size of 15,000 ensured that the study would capture a large sample of computer users with various impairments. Additionally, this ensured that some low-incidence difficulty/impairment types (like severe hearing impairment) would be sufficiently represented.

Phone and mail surveys: Respondents were contacted by either mail or phone from May to July 2003; 10,464 respondents are members of the mail panel managed by National Family Opinion (NFO); the remaining 5,013 respondents were contacted by phone through random digital dial.

Fielding the surveys by phone and mail allowed us to take advantage of the benefits of each method, accurately capturing a representative sample of the US population while minimizing bias against specific difficulties/impairments that would have challenged answering phone or mail surveys alone. The benefits of the mail survey include that it was more accessible for people with hearing difficulties and impairments and that the panelists know the source of the questionnaire, making them feel more secure revealing private information. Additionally, the mail survey was supplemented with rich background data on panelists (this background data also allows consistency checks on answers like income, age, and gender). The benefits of the phone survey include that the RDD method is more likely to include less traditional household structures, it is more accessible for people with visual difficulties/impairments, and the survey is guided by an interviewer, which reduces errors in the answers.

US focus. Impairments will likely affect people similarly in other countries and our findings will be noteworthy outside of the US. As such, Microsoft made the decision to focus the survey in the US because of the high cost of a multi-country survey and because the survey couldn't be translated simply. The survey questions would need to be reconsidered to field the survey outside of the US, rather than directly translated, because of the sensitive nature of the research topic. Forrester Research believes that the survey design, and to some extent the research methodology, would need to be customized for each country. A key benefit of a US-only study is that the lessons from this experience can help ensure better execution of non-US versions, if Microsoft decides to invest in research on this topic in other countries.

Weighting the data. Forrester Research uses weights to ensure that the final group of survey respondents gathered through each method is representative of the general US population. Mail surveys were sent to a representative group of households, but the final data was weighted due to differing response rates. Similarly, phone surveying, while providing a random selection of households, creates a self-selected bias in the sample that requires weighting to correct. Weights were created by identifying target characteristics of US households from the *June 2003 Current Population Statistics*. Sampling was done at the household level, so the weights are designed to ensure that the data is representative of US households and the individuals within them, rather than all individuals.

Although phone-based and mail-based data was weighted along similar grounds and attributes, weights were developed separately to ensure representation across both groups. Each survey was weighted so

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that, when combined, it represented 50% of respondents. While the mail survey actually captured twice as many respondents as the phone survey, mail survey respondents were more likely to identify limitations/disabilities in many cases. As such, the decision to weight them equally provided more conservative estimates of difficulty/impairment rates.

How this study compared with the US Census SIPP. The US Census provides data on disability based on three primary sources: the Survey of Income and Program Participation (SIPP), the decennial census, and the Current Population Statistics (CPS). The SIPP is the only one of these with an extensive set of disability questions and is therefore identified by the Census as the preferred source for examining most disability issues. The following table shows data collected in the SIPP compared with data collected in our research study. Additionally, a question was asked to be comparable to the CPS and Census (*"Do you have a physical, mental, or other health condition which prevents you from working or limits the kind or amount of work you can do?"*).

Comparison of Question Types Asked in the US Census SIPP vs. This Study

SIPP	This Study
Used a wheelchair, cane, crutches, or walker	In the mail survey only; both surveys ask about mobility
Activities – seeing, hearing, speaking, lifting, carrying, using stairs, walking, grasping objects	Seeing, hearing, speaking, using stairs, grasping objects, mobility in general
Activities of daily living: getting around the home, in/out of bed, bathing, dressing, eating, toileting	Direct question about difficulty in getting around the house or ability to do work around the house
Instrumental activities of daily living: going outside the home, keeping track of finances, light housework, taking medication, using the telephone	Using the telephone, writing letters or email, concentrating, formulating thoughts, finding your way in unfamiliar environments
Have specific condition such as learning disability, mental retardation, developmental disability, Alzheimer's, or other mental or emotional condition	Learning disability, memory or reasoning difficulty or impairment
Mental/emotional condition that interferes with daily living, depressed, anxious, trouble getting along with others, trouble concentrating, trouble coping with stress	Concentrating
Condition that limits the ability to work around the house	Condition that limits the ability to work around the house
Condition that makes it difficult to work at a job or business	Condition that makes it difficult to work at a job or business

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--	Pain or shaking in hands, arms, or wrists and limitations from pain, shaking, or other difficulties with hands, arms, wrists
--	Self-defined impairment, by difficulty and impairment type

Accuracy of results: For results based on a randomly chosen sample of this size (N=15,477), there is 95% confidence that the results have a statistical precision of plus or minus 1% of what they would be if the entire adult population of US households had been polled. The phone survey is randomly sampled, but the mail sample is not a random sample; while individuals have been randomly sampled from NFO's panel for this survey, they have previously chosen to take part in the NFO mail panel.

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Appendix B: About Forrester Research, Inc.

About Forrester

Forrester Research identifies and analyzes trends in technology and their impact on business. It provides companies with practical ideas, rigorous research, and objective guidance to help them thrive on technology change.

In February 2003, Giga Information Group became a wholly owned subsidiary of Forrester Research, Inc. Giga provides objective research, pragmatic advice, and personalized consulting to global IT professionals.

Together, Forrester and Giga enable companies to make better strategic decisions that maximize technology investments and achieve identifiable business results.

The Forrester Project Team

Forrester's Custom Consumer Research team helps companies make strategic business decisions by providing analysis of consumer attitudes and behavior and helping to formulate market strategies. To gain a thorough understanding of consumers, the CCR designs, implements, and analyzes proprietary consumer surveys. Furthermore, the CCR may work with data proprietary to clients to provide the best possible assessment of current customer demand issues. In addition to data analysis and consumer research, senior research staff at Forrester combines the consumer analysis with relevant industry analysis. Senior research staff works together to find the best solution for clients' business problems.

The project team included:

- Betsey Stevenson, Ph.D. Custom Consumer Research Advisor, who was the lead researcher. Betsey has experience leading market research for established and nascent technologies and leads Forrester's Custom Consumer Research team.
- James McQuivey, Group Director of Consumer Data® in North America, supervised the execution of the program.

Betsey Stevenson, Ph.D., Custom Consumer Research Advisor

Betsey leads Forrester's Custom Consumer Research team, helping clients make strategic business decisions by designing, implementing, and analyzing proprietary consumer surveys. She has served as an analyst in Consumer Technographics®, covering a wide range of industries.

Before coming to Forrester, Betsey taught and conducted research in economics at Harvard University. Her work there focused on statistical analysis of individuals to predict behavior in a wide range of consumer, health, and family areas. Betsey also taught courses in applied econometrics at Harvard University. Her writings have appeared in a variety of publications, including *The Wall Street Journal.*

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Prior to her work at Harvard, Betsey was part of the International Finance group of the Federal Reserve Board, analyzing the financial situation of developing countries and debt restructuring packages.

Betsey graduated from Wellesley College and received an M.A. and Ph.D. in economics at Harvard University with an emphasis on econometric analysis and quantitative research design.

James L. McQuivey, Group Director
As the leader of Consumer Technographics® in North America, James directs a team of analysts and associates who track and analyze consumer use of technology products and services. His team conducts original research—surveying hundreds of thousands of households each year—on topics ranging from the spread of broadband to the adoption of wireless devices. This primary research is the largest and longest-running technology research effort in the world and provides Forrester and its clients with the most accurate view of emerging as well as established technologies.

James is regularly consulted for comment on the role of technology in our lives by *The Wall Street Journal, The New York Times, London Financial Times, Wired,* and *USA Today*. He has appeared on CNN and CNBC and has been interviewed for National Public Radio's "All Things Considered" and "Morning Edition."

Prior to joining Forrester, James conducted new media research and taught advertising at Syracuse University's prestigious S.I. Newhouse School of Public Communications. During his academic career, James has published articles in journals such as The Journal of Media Economics and The European Journal of Communication. He has presented research at the annual conferences of the International Communications Association, the American Association of Public Opinion Researchers, and the Association for Education in Journalism and Mass Communication.

James holds a Ph.D. (ABD) in mass communications research from Syracuse University and received a master of business administration degree from the University of South Carolina.

The Convergence of the Aging Workforce And Accessible Technology

The implications for commerce, business and policy

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July 2003

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I. Executive Summary

This paper discusses the effects of America's aging workforce on business growth and productivity and illustrates how accessible technology can equip employers and mature workers to face the challenges posed by this demographic trend. As the workforce ages, accessibility challenges and disabling conditions will escalate, increasing the need for employers to find ways to accommodate people with disabilities and age-related impairments. Changes in vision, hearing and manual dexterity will directly affect aging workers' ability to use computing devices and the Internet, tools that have become fixtures in today's economy.

The focus of this paper is the demographic sea change created by the aging workforce, the growing number of workers aged 40 or older (currently more than 69 million[1]), representing 48 percent of the total U.S. workforce. This trend sets up two distinct, but closely related, challenges for U.S. employers.

As the first wave of the baby boomers retire, certain industries and occupations will find the replacement pool of new and younger workers inadequate, just as schools saw their enrollments swell and then decline sharply as the baby boom generation moved from childhood to adulthood. Finding new ways to retain older workers will be essential for many businesses. At the same time, improved health and increased longevity will make it possible, and often necessary, for a record number of workers to continue working past the traditional retirement age.

Employers in all sectors must prepare for the forecasted decline in the number of younger replacement workers *and* the growing proportion of workers over the age of 40. If these issues are left unaddressed, the combined implications for U.S. productivity, commerce and economic growth will be significant.

The United States has become an information-based society, with two-thirds of the nation's workforce routinely using computing devices and/or the Internet. As workers increasingly depend on their ability to use and interact with technology, the standards, workplace environments and tools that are acceptable for younger workers may not meet the needs of the aging workforce.

Technology has served as an equalizer for people with disabilities, increasing opportunities for employment and independent living while reducing social isolation. Accessible technology provides workers with the ability to personalize their computing environment and adapt it to meet their specific needs, allowing employees of all ages and abilities to realize their full potential.

Hardware, software applications, Web sites and user interfaces must be both functionally usable and technically accessible. Focusing on accessibility will enhance usability and improve the computing and Web experience for users of all ages. Employers need to implement training programs in accessible technology and establish policies to ensure that accessibility is a criterion in the selection and procurement of information technology.

[1] U.S. Bureau of Labor Statistics, 2002 annual household averages

Government, the private sector and nonprofit organizations must prepare for the impact this demographic tidal wave will have on the future makeup of the workforce. Businesses need to institute training policies and accommodations to ensure maximum productivity in the workforce. This includes retooling their strategies for hiring, employee development, retention and transitions to attract and retain high-contributing employees, regardless of age. It also means ensuring that the workplace adapts to the ongoing physiological changes occurring in the workforce.

Proactively implementing accessible technology makes it clear that employability is not a function of age or physical abilities but of the employee's ability to contribute to business objectives. Planning for this inevitable population shift and recognizing the importance of the aging workforce will help employers achieve maximum productivity and commerce.

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II. Shifting Workplace Demographics and Delayed Retirement

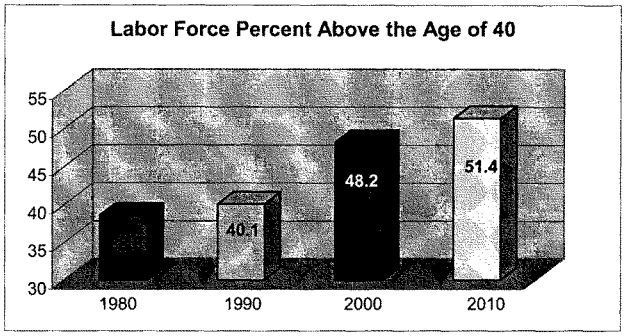
Since the mid-1940s the U.S. population has experienced several age "bubbles," or demographic shifts, all resulting from a disproportionately large segment of the population moving through their life stages. The magnitude of the baby boom population — the 76 million Americans born between 1946 and 1964 — has created significant changes affecting the construction of schools, the birth of new communities and the creation of new jobs and industries. As the boomers came of age, colleges expanded and enrollments soared, creating a highly educated workforce, swelling the consumer population that drove the economic growth of the '80s and '90s.

Amplifying this boomer effect is the increase in life expectancy. Since 1900, the average life expectancy has increased from 47 years to 77 years.[2] As people live longer, they also are likely to experience more age-related changes in their vision, hearing and dexterity, which can affect their capacity to use and interact with computing devices and environments.

As society has benefited from higher life expectancy and improved medical care, many people now need to work longer. Changes in savings, government policies, the economy and the structure of pension plans are all fueling a trend for many Americans to delay retirement and for many retirees to re-enter the workforce.

Since 1980, the number of U.S. workers over the age of 40 has increased significantly. By 2010, more than 51 percent of the workforce is expected to be 40 or older, a 33 percent increase since 1980, while the portion of the workforce aged 25 to 39 will decline 5.7 percent.[3] At the same time, the median age of U.S. workers has continued to rise and is expected to increase by six years, from 34.6 to 40.6, by 2010. The number of workers aged 55 and older will grow from 13 percent of the labor force in 2000 to 20 percent in 2020.[4]

Chart I



Due to the sheer magnitude of the baby boomer influence, increasing numbers of workers are leaving the workforce because of death, disability and retirement. The Bureau of Labor

[2] U.S. Administration on Aging, 2002
[3] Bureau of Labor Statistics, Monthly Labor Review, November 2001
[4] Bureau of Labor Statistics, Monthly Labor Review, May 2002

Statistics estimates that 25 million people will leave the workforce between 1998 and 2008; 22 million, or 88 percent, will be 45 or older. After 2008, as more workers reach retirement age, the impact of their retirements will continue to grow. Industries and occupations most affected include public administration, education and healthcare. In addition, more than 50 percent of all federal government workers will be eligible for retirement by 2005.[5] (See Table I.)

[5] Wall Street Journal, Sept. 19, 2002

Table I

Industry and Occupation % Workers 45+ leaving occupations 1998–2008	
Public Administration, Business	
Researchers, analysts	74.2%
Supervisors, police, detectives	70.9%
Postal workers	65.8%
Technical writers	59.0%
Dispatchers	55.4%
Personal clerks	53.4%
Supervisors, general office	48.2%
Administration, officials	41.7%
Education	
Secondary teachers	66.8%
Elementary teachers	54.4%
College and university teachers	50.1%
Counselors	48.4%
Administrators	47.1%
Librarians	46.4%
Health Care, Social Services	
Welfare service aids	65.1%
Dental and lab techs	64.7%
Licensed practical nurses	59.1%
Dieticians	57.3%
Registered nurses	47.2%
Source: BLS, *Monthly Labor Review*, July 2000, p 22–23	

Although people are retiring in greater numbers, there are many workers who need to remain employed. AARP reports that 69 percent of employees over the age of 45 plan to continue working past 65.[6] Americans are now staying in their jobs longer or, when downsized, finding new jobs, changing careers or becoming self-employed. The economic recession that began in 2001 is causing many retirees and "preretirees" to re-evaluate their plans and their lifestyles. Many are foregoing trips and major purchases, while others are shifting leisure activities to accommodate full- or part-time employment. Based on a July 2002 poll by the Gallup Organization, 46 percent of working adults expect to retire later due to the recent stock market decline.[7] Along with the need to restore their diminished savings, however, AARP reports that 65 percent of those over 45 cited health insurance and coverage for prescription drugs as key reasons for remaining employed.

Meanwhile, fewer younger workers are entering the workforce. According to the Employment Policy Foundation, the workforce will experience a shortfall of 7.4 million baccalaureate degree holders by 2012.[8] Left unaddressed, these work-force shortages threaten to stifle economic growth while likely increasing wages in high-demand occupations.

Computer skills are playing an ever-increasing role in the employability of workers. As baby boomers work into their later years, they will need to continue to embrace and invest in new skills and technologies to remain employable. The National Bureau of Economic Statistics

[6] AARP research report "Staying Ahead of the Curve," Sept. 23, 2002
[7] CNN/USA Today Gallup poll of 572 nonretirees conducted July 5–8, 2002
[8] "The American Workplace 2003: Realities, Challenges and Opportunities." Employment Policy Foundation, 2003, p. 48. http://www.epf.org/

has determined that employees who keep current on technology and computer skills retire later than those who don't use computers.[9] These findings revealed that computer usage is remarkably similar for employees aged 16 to 69. The conclusion is that workers acquire skills as they are needed, long after they graduate from college. This dispels the myth that older workers are either unwilling or unable to learn emerging technologies and adapt to their rapid rate of change. As workers delay retirement, the need for them to invest in technology-related skills will increase, along with the need for accessible and assistive technologies. This research provides validation for offering supplemental computer training to older workers, to maximize their computer use and develop expertise with new applications and online methodologies.

The table below illustrates the magnitude of the aging workforce of more than 69 million people, or 48 percent of the workforce.[10]

[9] National Bureau of Economic Research, "Impact of Technological Change on Older Workers," May 2001

[10] U.S. Bureau of Labor Statistics, Dec. 31, 2002, including an unemployment rate of 5.8 percent

Table II
2002 Annual Household Averages
Population, Labor Force and Employment by Age Band

Age band	Civilian population	Labor force	Total employed	Employ. % of population	% of labor force
16+	217,570	144,863	136,485	62.7%	
16–19	15,994	7,585	6,332	39.6%	4.4%
20–24	19,348	14,781	13,351	69.0%	9.2%
25–29	18,188	15,182	14,204	78.1%	9.8%
30–34	20,284	17,014	16,103	79.4%	11.1%
35–39	21,338	17,887	17,022	79.8%	11.8%
40–44	22,556	19,040	18,213	80.7%	12.6%
45–49	21,073	17,666	16,944	80.4%	11.7%
50–54	18,638	14,931	14,337	76.9%	9.9%
55–59	14,901	10,531	10,125	67.9%	7.0%
60–64	11,442	5,779	5,549	48.5%	3.8%
65–69	9,492	2,474	2,379	25.1%	1.6%
70–74	8,507	1,191	1,144	13.4%	0.8%
75+	15,809	804	783	5.0%	0.5%
Total	**217,570**	**144,865**	**136,486**		**94.2%**

48.0%
69.47 M

Source: BLS 3/03, Table 2, page 1 Household data annual averages, civilian, nonmilitary.
Based on CPS. Data in thousands (000s).

III. The Digital Workplace and the Information Worker

As the U.S. has become an information-dependent society, technology has rapidly become a common fixture in the workplace. More and more occupations are becoming information-based, opening new employment opportunities for many Americans. A 2001 survey by the Department of Commerce and the National Telecommunications Information Agency indicated that more than 57 percent of the U.S. workforce used personal computers. This study also indicated that use ranged from 80 percent for managerial positions and 70 percent for technical, sales and administrative support occupations to 20 percent in manufacturing environments.[11]

Workplace computing has expanded to include a variety of devices, applications and occupations. Use goes beyond the desktop to the production shop floor, the construction site, airport terminals and other occupations where workers need to be able to access and enter information. Fueling this is the growth in connectivity as evidenced by the proliferation of mobile devices such as personal digital assistants, wireless phones and public Wi-Fi Internet access. These workplace computing and Internet users, or information workers, are active participants in the process of business information flow. This information worker segment is significantly larger than that made up of those who rely only on standard desktop computers, as reported by a 2001 Department of Commerce study. Updating this definition to include both computing and Internet devices, it is estimated that 68 percent of the workforce, or 92.8 million people, are information workers. (See Table III.)[12]

Information workers are prevalent in most economic sectors and industries. Specific occupations range from air traffic controllers and financial analysts to front-line workers such

[11] A Nation Online, "How Americans Are Expanding Their Use of the Internet," U.S. Department of Commerce, ESA/NTIA, February 2002, pp. 59–61
[12] Bureau of Labor Statistics, Annual Occupation Forecast, January 2002, p. 174

as factory employees, field service representatives, rental car agents and delivery people who use wireless reporting and tracking devices. Examples include the following:

- A 42-year-old financial analyst at a Wall Street brokerage firm who uses spreadsheets to model financial projections and uses presentation software and word processing to create client presentations and reports
- A 56-year-old commercial airline pilot who uses a laptop to download flight manuals and who calculates flight plans based on weight and balance inputs
- A 51-year-old automotive assembly-line worker who inputs and tracks data from the factory floor using the corporate intranet and a Web browser interface
- A 63-year-old self-employed consultant who works from home and uses e-mail and productivity software to communicate with clients and manage business finances
- A 49-year-old nurse who enters patients' vital signs into a patient-tracking system on a wireless PDA
- A 53-year-old airport gate agent who enters passenger data and flight information on a proprietary airline flight system
- A 40-year-old car rental agent who checks in cars on a wireless device while reporting back to the system the car status and availability for the next rental
- A 49-year-old copier repair technician who reviews equipment history on a notebook computer, runs diagnostics, orders replacement parts and completes a repair ticket, generating a customer invoice

By the end of 2002, the U.S. Department of Labor was reporting that 48 percent of the workforce was over the age of 40 and given the definition of information workers, it is estimated by way of a straight-line extrapolation that the U.S. economy employs approximately 44.5 million aging information workers. (See Table III.)

Table III

Workforce Analysis, Ages 40+	
Total employment	136,485
% of information workers	68.0%
Total information workers	92,810
% of workforce aged 40+	48.0%
Graying IW work force	44,510

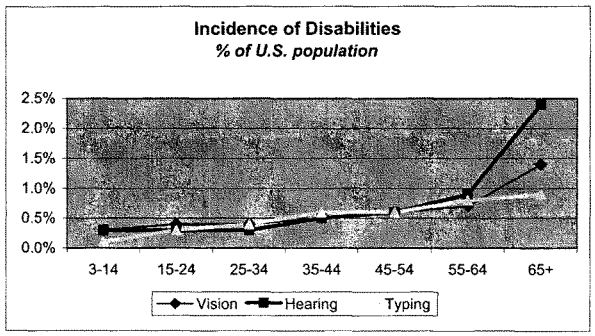
Source: BLS 3/03, Annual HH Averages CPS, & Microsoft research.

IV. Physiological Changes of Aging and Disabilities

Many of the 44.5 million aging information workers are beginning to experience age-related physiological changes. The likelihood of developing age-related impairments increases during middle age. According to a 2001 report from the National Organization on Disability, people aged 45 through 54 have an 11.5 percent chance of developing a disability. This figure nearly doubles to 21.9 percent for those aged 55 through 64. Chart II illustrates the

incidence of disabilities by age, including those related to hearing, vision and manual dexterity (typing).[13]

Chart II



Typically, these impairments include diminished vision, hearing, dexterity and flexibility. Some functional losses are accelerated by the onset of age-related degenerative diseases and ailments, including hypertension, osteoporosis, diabetes and macular degeneration. Disabling conditions, including arthritis and orthopedic impairments resulting from sports, vehicle and occupational injuries experienced earlier in life, tend to manifest themselves as the body ages.

There are many types and degrees of disability. Most research defines "disability" as a health problem or condition that currently keeps an individual from participating fully in work, school or other activities. Some disabilities are clearly visible, such as those that necessitate the use of a wheelchair or cane. Others, such as diabetes or a mild loss of hearing or vision, may not be so obvious.

Some people may not realize they have a disability, or they may be unwilling to admit its existence. Others may hide or mask a disability from their employer for fear of discrimination, negative perceptions about their performance, or the disability's becoming a threat to potential promotions or long-term employability. In other cases, the disability may have occurred so gradually that the person has compensated for it without realizing the effect on his or her everyday activities. Unfortunately, these workers prevent themselves from realizing the benefits of accessible technology, which for millions has proven to enhance their productivity, independence and employability.

The following represents a summary of the most typical age-related sensory and motor changes:

[13] Chart II is based on data derived from A Nation Online, Economic and Statistics Administration/National Telecommunications and Information Administration, U.S. Department of Commerce, February 2002, based on CPS of September 2001.

Vision. Ocular changes are the most frequent physiological changes associated with aging. Common vision changes include a decrease in one's ability to distinguish colors, an increased need for illumination in the workplace, decreased ability to adapt to changing light levels, and general eye fatigue. Eyestrain is amplified with the onset of preoperative cataracts and presbyopia ("aging eyes"), which can be experienced as early as age 35.[14]

Other workers may realize a loss in color perception or some degree of colorblindness.[15] A person with this condition may be unable to distinguish two colors that look distinct to an individual with normal color vision. A third major change is the shrinking of the pupil, resulting in the need for more light and a diminished ability to adjust to changing levels of illumination. According to the American Optometric Association, a 60-year-old's retina receives only 33 percent as much light as that of an average 20-year-old.

Mobility and Dexterity. Mobility impairments can be caused by a wide range of illnesses and accidents, such as arthritis, stroke, cerebral palsy, Parkinson's disease, multiple sclerosis, loss of limbs, spinal cord injuries and repetitive stress injury. As a result, individuals may be unable to use their arms or fingers to interact with their computers using the standard keyboard or mouse. People who have some motion impairments may be unable to type key combinations that require one key to be held down while pressing another. Others may strike multiple keys or repeat keys unintentionally. Some people may be able to use their hands and arms but have a limited range of motion. All these conditions make using a standard mouse or keyboard difficult, if not impossible.

Hearing. Hearing impairments range from slight tonal loss to total deafness. Typically, people have a loss in specific tonal ranges, which renders certain sounds or voices indistinguishable. Hearing loss is a major problem for older adults. According to the American Society on Aging, of the reported 38 million Americans with a hearing loss, 60 percent are over the age 55. Partial hearing loss can limit independence and affect the quality of life. Hearing loss restricts one's ability to interact with others; to get, receive and interpret information; and to use sounds to identify hazards in the environment, and functions of computers and equipment in the workplace.

V. Technology Solutions

Technology is serving as an equalizer for people with disabilities, removing workplace barriers and increasing employment opportunities while reducing social isolation. Monthly Internet use by members of the online disabled community exceeds that of the general population, yet connectivity and access for those with disabilities significantly trails the population at large, at 43 percent compared with 57 percent.[16] This gap has been narrowed over the past several years, with the increasing availability and affordability of computers and accessible technology.[17] This trend demonstrates how computing and the Internet are potentially valuable yet underutilized resources for the aging workforce and people with disabilities.

[14] Designing Web Sites for Users of All Ages http://www.agelight.com/humanfactors/humanfactors.htm
[15] Color deficiencies include absence of sensitivity to red, green and blue.
[16] Harris Poll #30, June 2000
[17] 2000 N.O.D./Harris Survey of Community Participation by People With Disabilities

Accessibility is about removing barriers and providing access, making products and services available to, and usable by, everyone. A more accessible environment benefits everyone, including those with disabilities. All people benefit from an environment in which it is easier and safer to move and function. Ensuring accessibility encourages diversity, in our society and in the workplace.

To be accessible, technology must be flexible enough to meet the needs and preferences of a diverse cross-section of people with varied experience and abilities. Fortunately, many of the physiological changes associated with aging can easily be accommodated with current computers and platforms such as the Microsoft® Windows® XP operating system. When considering technological solutions to accommodate an aging workforce, employers should first consider the accessibility features that may already be available (but not yet activated) in their existing hardware and software, as well as third-party add-on assistive technology products.[18]

Accessibility Features

Accessibility features are options in a product that allow users to adjust the product settings to accommodate their individual accessibility needs. Such usage and personalization can benefit all users by offering increased usability, productivity, efficiency and comfort. Specific features can accommodate a range of vision, hearing, mobility, language and learning needs. Examples of accessibility features include those that allow a user to increase font size, change font settings or choose different colors for their computer screen. Other examples are the option for users to receive announcements from their computer through sound notifications (a "ding" when new e-mail messages arrive), or visual notifications (a dialog box that appears, notifying users of new e-mail messages). While these features are included in commonly used technology and computer systems, they are not obvious to all users.

Numerous accessibility features built into standard computer operating systems can help people with mild age-related vision impairments use their computers and computing devices more comfortably and effectively. Accessibility solutions for visual impairments include simple user adjustments to the computer display, such as enlarging fonts and customizing color displays, and the use of screen-magnification aids.

Accessibility features built into standard operating systems such as Microsoft Windows XP also are useful to people with impaired mobility and include keyboard filters that help compensate for erratic motion, tremors, slow response time and similar conditions. One such example is Microsoft StickyKeys, which allow the user to enter key combinations sequentially without having to hold one key down while depressing a second. Other options allow users to adjust how quickly a letter appears on the screen when they hold down a key. Users can adjust mouse properties such as button configuration, double-click speed, pointer and cursor size, and how quickly the mouse pointer responds to movements of the mouse. Computer users can also increase the size of screen elements to provide a larger mouse target, which can benefit people who have impairments related to fine-motor skills.

Accessibility features for people with hearing loss include settings that allow the users to change sound notification to visual notification and to control volume. Microsoft Accessibility options include SoundSentry and ShowSounds, which allow users to receive visual warnings and text captions rather than audible messages to inform them of system events.

[18] See "Accessible Technology in Today's Business" published by Microsoft Press®, 2002

Assistive Technology

Assistive technology products are those that are designed to specifically accommodate an individual's disability (or multiple disabilities). Assistive technology products (also known as accessibility aids) are developed to work with a computer's operating system and software. Assistive technology can be anything from a different type of pointing device that takes the place of a mouse to a system equipped with a Braille display and screen reader. People with visual impairments can now have instant access to vast quantities of online information and "read" e-mail instantly without having to wait for documents to be converted to Braille or audiotape. Those with limited dexterity can use voice recognition software to perform work-related tasks such as writing documents and creating presentations and business analyses.

More than 100 companies offer hardware devices, accessories, aids and software applications that fall under the umbrella of assistive technology. These alternative input products include speech recognition systems, alternative keyboards, electronic pointing devices, sip-and-puff systems, wands, sticks, joysticks, trackballs and touch screens; and alternative output systems such as speech synthesizers, Braille embossers and displays, and screen readers.

In summary, accessible technology encompasses three elements: 1) accessibility features, 2) assistive technology products and 3) compatibility among the operating system, software and assistive technology products. The compatibility of the operating system is a critical component of accessible technology, ensuring that product innovation in mainstream products does not prevent users of varying physical capabilities from using the peripherals and interfaces that they rely on for their livelihoods.

VI. Accessibility Is Good Business

By making a commitment to accessibility, companies can reap the benefit of productivity gains and the value of retaining knowledgeable workers. Beyond that, businesses also need to ensure that they are complying with regulatory requirements that pertain to people with disabilities, technology procurement and the rights of older workers. Currently, the four most relevant regulations are the Americans with Disabilities Act (ADA), Section 508 of the Rehabilitation Act, Section 255 of the Telecommunications Act and the Age Discrimination in Employment Act of 1967.

Generally, the workplace is unprepared for the changing demographics outlined in this paper. Recent research reveals that although 61 percent of firms are aware of these demographic changes, 55 percent said they were not actively implementing strategies to either attract or retain workers over the age of 50.[19] With approximately 60 million baby boomers poised to leave the workforce over the next 15 years, this will likely be a significant problem for those companies.

The need to invest in the current workforce is being accelerated by the decline in the number of new workers. Interest in many occupations is at an all-time low. According to the National Science Foundation, interest in science, technology, engineering and mathematics has been declining for the past decade.[20]

Businesses are increasingly feeling the loss of seasoned and experienced managers. With organizational hierarchies and structures being thinned and flattened over the past decade, an unmanageable gap in skill levels may be created as this expertise and knowledge base dissipates and finding qualified replacements becomes more difficult.

The costs of direct and indirect workforce turnover can be significant. According to the American Management Association, these costs typically range from 25 percent to almost 200 percent of an employee's annual compensation. Businesses need to understand not only these hard costs but also the costs of disruption of customer service and the loss of experience, continuity and corporate knowledge.

A positive business benefit of this demographic shift is that several recent studies have shown that both older workers and workers with disabilities are significantly more loyal and dependable than their younger colleagues. Employers need to rethink their strategies for employee development, retention and transition with the goal of retaining long-term, high-contributing employees. They need to be proactive because workers may not self-identify their physical limitations or seek assistance. They need to recruit talent that possesses innovation, knowledge, skills and leadership, regardless of age. By aligning business policies and practices with the needs of the changing workforce, employers will retain valuable employees while maximizing productivity and, ultimately, competitiveness. Such investments send the message that employability is not a function of age but rather of each employee's ability to make a meaningful contribution to the employer's business goals and objectives.

[19] DBM research reported July 23, 2002, in a poll of 194 HR professionals in companies with 61 percent having fewer than 2,000 employees, 19 percent with 2,000 to 10,000 employees, and 20 percent with workforces of more than 10,000

[20] Science and Engineering Indicators 2002 report from the National Science Foundation

VII. Conclusion

Technology has rapidly become a workplace fixture and is increasingly being woven into our lives and lifestyles, providing new options for communication, personal productivity and community interaction, and expanding career and business opportunities. The capabilities of personal computing and the Internet are becoming remarkable tools to help people with disabilities overcome many of the challenges they face. Implementing accessible technology car amplify and accelerate these opportunities and serve as an equalizer.

The aging workforce of information workers includes more than 44 million workers aged 40 or older, nearly one-third of the entire U.S. workforce. With fewer younger cohorts entering the workforce and increasing numbers of retirements being significantly delayed, the proportion of older workers is growing, as is the importance of accessible and assistive technologies. Unless business and industry are proactive, they will miss the opportunity to tap the considerable value of aging workers, resulting in a decline of workplace productivity and a negative impact on U.S. business and the nation's overall economic growth.

In addition to the regulatory requirements related to older workers and people with disabilities, accessible technology is good business because it serves the interests of all stakeholders, including employees, co-workers, customers, partners and stockholders. Businesses must understand the value of retaining experienced and capable employees, particularly when weighed against the significant costs of employee turnover, which can reach 200 percent of the employee's annual salary. Recognizing the value of the aging workforce and the role of accessible technology in retaining older workers will help to alleviate the anticipated workforce shortage. It will slow this exodus from the workforce and the knowledge and talent drain while maximizing older workers' productivity.

The recommendations discussed in this paper are not onerous, but they do take continued awareness, education and participation by employers and employees. Embracing accessible technology will allow workers to customize and personalize their computing environments and will optimize the user experience on Web sites, allowing users of all ages to harness the power of personal computing and the Internet to realize their full potential.

In developing solutions and accommodations for the workforce, employers need to consider a comprehensive strategy that includes training policies, technology procurement policies, accommodations, ergonomics and healthy computing practices. By implementing a strategy for accessible technology, employers will be better equipped to recruit and retain productive and dedicated employees, regardless of age, while empowering all employees to realize their full potential.

Acknowledgements

About the Authors and Editors

Jim Emerman is senior vice president of the American Society on Aging (ASA), the largest association of professionals working with and on behalf of older adults and their families. Among his responsibilities are ASA's technology initiatives, including projects designed to encourage the use of information technology among professionals and older adults. He is liaison for two constituent groups addressing issues of business and technology: the Business Forum on Aging and the Network on Environments, Services and Technologies for Maximizing Independence.

Ellen Mosner is the public affairs manager in the Microsoft Accessible Technology Group, whose charter is to make accessibility integral to Microsoft's products, platforms and services. In addition, Microsoft tracks regulatory issues pertinent to accessibility and works closely with assistive technology vendors to ensure compatibility. As part of her responsibilities, she engages in government affairs and facilitates communication between Microsoft and the disabled community. A 15-year veteran at Microsoft, she has led technology initiatives in lifelong education, including usability training for parents, preschool educators, museums, K–12 students, families, teachers and seniors.

Craig Spiezle is the founder of AgeLight Marketing Consultancy, a strategic consultancy focused on life stage marketing, emerging demographics and business strategies for technology and early-stage companies. Spiezle is an advisory board member of the International Federation on Aging and has served in advisory roles with the American Society of Aging, the Family Caregiver Alliance, SeniorNet and the U.S. Administration on Aging.

During his eight-year tenure at Microsoft, he served in several senior management roles, including senior director of Emerging Markets, where he initiated companywide marketing initiatives to seniors, multicultural markets and other nontraditional markets. Other responsibilities have spanned international business development, channel strategies, relationship marketing, branding and public affairs. Since 1999, he has received numerous awards and recognition for his work from the United Nations, U.S. Administration on Aging and the U.S. Senate Special Committee on Aging.

The recommendations in this paper reflect the research and collaboration with many organizations, practitioners and researchers in the fields of disabilities, human factors and aging. The following organizations provided input for this paper: American Society on Aging; AARP, National Older Worker Career Center, U.S. Senate Special Committee on Aging, U.S. Administration on Aging, U.S. Department of Health and Human Resources and the U.S. Department of Labor.

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VIII. Resources

Government Agencies

Administration on Aging, http://www.aoa.gov/

Equal Employment Opportunity Commission, http://www.eeoc.gov/index.html

Environmental Protection Agency, Senior Environmental Employment (SEE) Program http://www.epa.gov/rtp/retirement/see.htm

The Americans with Disabilities Act: A Primer for Small Business, a practical handbook outlining the employment provisions of ADA, http://www.eeoc.gov/ada/adahandbook.html

Office of Disability Employment Policy, U.S. Dept of Labor, http://www.dol.gov/odep/

Department of Justice ADA, http://www.usdoj.gov/crt/ada/

Department of Labor, Employment and Training Administration, http://www.doleta.gov/usworkforce/

National Telecommunications and Information Administration, http://www.ntia.doc.gov/

The Senior Community Service Employment Program serves persons with low incomes who are 55 years old and older, http://wdsc.doleta.gov/seniors/

Industry and Nonprofit Organizations

"Accessible Technology in Today's Business, Case Studies for Success," Microsoft Press, Redmond, Wash., 2002.

AgeLight Marketing Consultancy provides business and management strategies to nonprofits, business and governmental agencies focusing on shifting demographics, public affairs, technologies and partner strategies. Web site features white papers on designing Web sites and interfaces for users of all ages and levels of reading ability. http://www.agelight.com/

Alliance for Technology Access, http://www.ataccess.org/

American Association of People with Disabilities, http://www.aapd.com/

American Society on Aging, a national organization that strives to enhance the skills of professionals working with older adults and families. ASA includes workplace, accessible environments and technologies constituent groups. http://www.asaging.org/

Assistive Technology Industry Association, http://www.atia.org/

Center for Organizational Research, http://www.cfor.org/

Healthy Computing Guide, Microsoft Web site for computer use and setup, www.microsoft.com/hardware/ergo/default.asp

National Older Worker Career Center (NOWCC). Expands employment opportunities for America's fast-growing population of workers aged 40 and over, http://www.nowcc.org/

Microsoft Corp. Accessibility Web site, "Accessibility Technology for Everyone," http://www.nowcc.org/ www.microsoft.com/enable/

National Organization on Disabilities (NOD), http://www.nowcc.org/ www.nod.org/

National Business & Disability Council (NBDC), http://www.nowcc.org/ www.nbdc.org/

Technology for Independence, http://www.asaging.org/ameritech/index.html