Intel's Approach to Innovation and Healthcare

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The world is facing the convergence of three forces that will transform the global health landscape in the next few years: disruptive demographics that are straining healthcare systems to the breaking point; disruptive economics that will render today's model of medical care unsustainable; and emerging disruptive technologies, which will enable an entirely new paradigm of care.

The greatest force that is reshaping the healthcare environment is demographics. The global population is aging rapidly, thanks to declining birthrates and to medical advances that have increased average life expectancy. In 2002, about 10% of the world's population was 60 years of age or older. By 2050, that percentage will more than double, to 21%, or nearly two billion people.[1]

This rapidly advancing age wave will place an enormous burden on the world's healthcare systems. As the population ages, healthcare costs will soar. On average, 40-50% of healthcare spending in developed countries is used to treat diseases and conditions of the elderly. Globally, per capita healthcare costs for those over 65 are three to five times higher than for younger age groups.[2] In the United States, spending on healthcare is an unsustainable 15% of GDP and is expected to rise to 25% in the next ten years, as the Baby Boomer generation moves into retirement. As the cost of care increases, the number of uninsured will grow as well, adding to the financial burden of global healthcare systems.

Those who can afford insurance will face another challenge in the coming years: a critical shortage of healthcare professionals worldwide. Professional caregivers are increasingly frustrated by the healthcare bureaucracy and their inability to spend quality time with patients. They are challenged by working in multiple locations, campuses and clinics, and they are often forced to make life critical decisions on inadequate and sometimes incorrect data. Given this environment, it's no wonder that by 2020, the US is expected to have a shortage of more than one million nurses[3] and as many as 200,000 doctors.[4]

[1] United Nations, "Population Aging 2002."
[2] Stephane Jacobzone and Howard Oxley, "Ageing and Health Care Costs," *International Politics and Society,* January 2002.
[3] Health Resources and Services Administration, April 2006.
[4] Richard A. Cooper, M.D., "Weighing the Evidence for Expanding Physician Supply," *Annals of Internal Medicine*, November 2, 2004.

While these trends point to adversity, they also present an opportunity to rethink the way that healthcare is delivered, to replace today's unsustainable approach to care and ensure a sustainable future. We believe that technology—including some affordable technologies that exist today—could be an important part of a solution to the healthcare challenges the world is facing.

Intel Addresses the Healthcare Challenge

Intel is making a substantial investment in research and development to address the global healthcare challenges with the help of technology. Research began in 1999, when Intel launched two ethnographic studies, to understand the needs of doctors and nurses working in clinical settings, and of seniors—especially those struggling with Alzheimer's disease and other forms of cognitive decline—and their family caregivers. In 2002, Intel established its Proactive Health Lab to explore new technologies to help people proactively manage their health and wellness and prevent or delay the onset of disease. The lab's research focused on physical and cognitive decline, especially on technologies that will help tomorrow's elderly population to age in place from wherever they and their families choose.

The Proactive Health Lab evolved into the **Health Research and Innovation (HRI)** group within **Intel's Digital Health Group (DHeG)**, established in 2005 to develop platforms for proactive healthcare. Intel's HRI group is a close collaboration among social scientists who conduct basic exploratory research on human needs and values; engineers who build new technologies based on the research; and designers who invent new ways of interacting with technology. Their emphasis is on solutions that address the healthcare needs uncovered through field research, and on proactive rather than reactive healthcare (the current model of care).

The mission of HRI is to explore, invent, and prove the potential for new health technologies. To achieve their mission, HRI researchers are developing an integrated, deep understanding of people and practices, technologies, and business needs across the continuum of care, from hospital to clinic to ambulance to home.[5] Viewing the continuum of care as a horizontal axis, with *home* being the leftmost point on the axis and *hospital* the endpoint on the right, a key objective is to help people to "shift left" along the continuum—for instance, to enable a person to

[5] The American Association of Homes and Services for the Aging defines "continuum of care" as a complete range of housing, health care and supportive services for older adults. These include, but are not limited to, senior housing, assisted living, skilled nursing, and home and community-based services, such as home health care, adult day services, transportation, meals, and other programs. Few aging-services organizations provide every type of service, but many retirement communities and other organized systems of care do provide multiple levels of service for older adults and may be called continuums of care.

move from assisted to independent living, or to transition from the hospital to the home as quickly as possible. Helping people to "shift left and stay left" reduces costs in an already overburdened healthcare system, while improving quality of life for patients.

Personal and Distributed Care

The technologies that HRI is exploring will support a new model of healthcare that is *personal* and *distributed*. Under this model of care, diagnostics, intervention and treatment will be distributed throughout the continuum of care, not restricted to costly clinical settings. Healthcare data will be accessible to formal healthcare providers and informal caregivers wherever they are located. Patients will have access to tools they can use to manage their own health proactively, using familiar technology platforms, such as cell phones, TVs, and MP3 players.

The HRI group's research is focused in four strategic areas: prevention of illness and injury; earlier detection of disease and other health problems; support for adherence to health regimens and for positive behavioral change; and support for care giving, both informal and professional. These four areas hold out the most promise for reducing costs and rescuing the planet from an impending global healthcare crisis.

While the Proactive Health Lab addressed the needs of older adults, the HRI group is developing healthcare technologies to enable people of all ages to live independently. And while Proactive Health researchers focused mainly on home care in the US, HRI's research addresses the entire continuum of care, and it is international in scope.

Gaining Global Understanding

To gain a more global understanding of healthcare needs, and how they vary in different parts of the world, Intel recently established a research group in Dublin, Ireland. Like their US counterpart, the research group at the Intel Ireland lab includes social scientists, engineers and designers. The group conducts research throughout the European Union, focusing on aging, independent living and assistive technologies, and is a major contributor to the work of the **Technology Research for Independent Living (TRIL) Centre** (see box), which is helping to expand the health technologies research ecosystem in Europe.

Intel's Approach

Intel's approach to healthcare comprises three interrelated components: ethnographic field studies, evidence-based technology research, and ecosystem development. Ethnographic researchers conduct field studies to understand the healthcare needs of people around the world. That knowledge is used by Intel designers and engineers to build, demonstrate and evaluate new health

technologies. Intel also cultivates collaborations with business, academic, government and consumer organizations to jointly tackle healthcare challenges—challenges that no organization can solve on its own.

Ethnographic Research: Understanding Needs

Intel's healthcare research begins with ethnographic field studies—open-ended interviews, observations, and other techniques that help us to understand people's needs on a first-hand basis. This type of research is the key to understanding people's needs, environments and practices in sufficient detail to develop innovative and relevant technology. Intel employs the largest group of social scientists–anthropologists, sociologists, communications scholars, physicians and psychologists—in the technology industry.

Our social scientists travel the world, observing and interviewing people where they live, work and play. We examine health from many angles, from ordinary people's understanding of health to the complex world of medical institutions and technology-intensive practices. The goal is to find those places where the introduction of information technology can improve people's health or the quality of their care.

This research involves more than just asking people what they want or

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Intel and the Irish Government Launch TRIL Centre in Dublin

Intel and the Irish government jointly invested $30 million to launch the **Technology Research for Independent Living (TRIL) Centre** in Dublin, Ireland in 2007. The TRIL Centre research addresses the physical, cognitive and social consequences of aging. TRIL is the largest research center in the world that is focusing on technology to help people live independently at home.

Through the TRIL Centre, researchers at Intel Ireland, working in collaboration with three Irish universities and Intel's US-based research teams, aim to deploy technology and new approaches to provide unobtrusive care to seniors living independent lives. As part of this effort, Intel is helping to develop the TRIL Technology Platform (TTP)— a pool of hardware and software components that researchers can use to create their own healthcare solutions. Each hardware component is low-cost, small and unobtrusive, easy to combine with other components, and directly applicable to clinical and in-home research. Key components of the TTP include sensors, communications technology and data analysis tools, as well as software that makes it easy to assemble research solutions from the hardware components. The TTP was designed with an open architecture, to further encourage re-use and interconnection of components.

need. Health is a collaborative accomplishment. Not only patients themselves, but also physicians, nurses, therapists, family members and a host of others must contribute to a patient's health. Each participant in this system will have his or her own needs, perspectives and ways of contributing. That is why our research approach is holistic; the focus is not just on one person but on the entire care network, and how these complex systems function as a whole. Since 1999, ethnographers from the Digital Health Group have conducted research in hundreds of households and clinical settings, piecing together an understanding of these complex, collaborative systems and the people who belong to them.

Our current research portfolio looks at four key areas: The Global Aging Experience project is exploring social and cultural differences in the experience of aging around the world. Another research initiative focuses on how technology might provide support for doctors, nurses and other clinical professionals as they deliver care. A third area emphasizes prevention, and ways of embedding health assessment and feedback into daily life. Finally, recognizing that the majority of the world's population lacks access to adequate medical care, a fourth project looks at the role of technology in bringing health to underserved regions. This far-ranging research has generated a huge amount of useful data about the needs of many different types of people in the world of health.

Evidence-Based Research: Building, Demonstrating and Evaluating Technologies

Intel's HRI ethnographers bring back from their field work a wealth of photos, video, and observations. With this rich data, they conduct interdisciplinary harvesting sessions with HRI designers, engineers, and marketers to develop concepts for technologies that address health challenges discovered in the field. Intel engineers translate concepts into prototype technologies which are then piloted in real-world settings to assess their value. HRI's goal is to demonstrate that the concepts embodied in the prototypes produce measurable, beneficial outcomes. This evidence-based research will fuel new products and new usage models for the healthcare technology industry, and provide proof to the healthcare ecosystem that technology can benefit healthcare.

Several pilots of prototype technologies are currently underway at Intel. One pilot project is testing a context-aware medication prompting system designed to help aging patients to adhere to their medication regimens—and in the process, reduce the enormous costs (including $15.2 billion annually in hospital admissions) associated with lack of adherence. Researchers also are exploring mobile interventions that integrate biosensors to improve emotional and cardiovascular health. In addition, a study within Intel's HRI group in Europe is exploring the potential for diagnostic tools that will

allow the early detection of degenerative diseases that potentially could result in a fall, the identification of abnormal gait patterns as well as other biometric parameter, such as heart rate and respiration.

Ecosystem Development: Cultivating Collaboration

The complex problems being addressed by Intel's HRI group are beyond the capability of any one organization to solve. Since Intel began focusing on healthcare in 1999, we have been driving the development of an ecosystem of companies, government officials, universities and consumer groups to collaborate in finding solutions. The TRIL Centre, described earlier, is only the most recent example of Intel's commitment to collaboration; there are many others.

Since 1999, Intel has provided more than three dozen grants to universities in the US and Europe to focus on healthcare research. We also are helping to driving standards, to enable "plug and play" health-related technology products from a variety of vendors—a prerequisite for widespread adoption by consumers.

To spur research into technologies for an aging population, in 2003 Intel joined with a handful of other companies, universities and long-term care providers to form the **Center for Aging Services Technologies (CAST)**. The goal of this cross-industry consortium is to accelerate technology R&D of systems that enable wellness,

dignity, independence, choice, and quality of life for the aging.

In an early effort to catalyze an ecosystem for healthcare research, in 2003 Intel joined with the Alzheimer's Association to create the **Everyday Technologies for Alzheimer Care (ETAC)** initiative. The consortium is committed to the development of new technologies that may compensate for functional impairments, enhance care and treatment strategies, foster independence, and improve the quality of life for people with dementia and their caregivers.

Finally, Intel has launched an initiative called the Behavioral Assessment and Intervention Commons (BAIC), an academic-industrial collaboration with the **Oregon Health & Science University (OHSU)** that constructs a research commons—a shared pool of tools, technology and thinking— around behavioral markers and health outcomes. The goal is to accelerate research into the identification of behavioral markers of diseases such as Alzheimer's and Parkinson's disease, enabling earlier detection and treatment.

Intel awarded the first, $1 million BAIC grant to the **Oregon Center for Aging and Technology (ORCATECH)** at OHSU. The grant is funding a pilot to identify behavioral markers for disease detection, so that personalized interventions can be designed. These markers include (among others) changes in voice patterns that could indicate the onset of Parkinson's

disease, and changes in patterns of socializing that could signal Alzheimer's disease.

The Next Generation of Healthcare

The ultimate goal of Intel's healthcare research is to understand the needs of the next generation of healthcare consumers and caregivers, and to invent the next generation of systems to support them. By helping consumers to become more proactive in managing their health, and providing caregivers (both formal and informal) with the tools and information they need to deliver care in any setting, from the home to the hospital, Intel hopes to play an important role in addressing the needs of the coming age wave.

Technology is not a magic bullet, but we believe that it could be an integral part of the solution to the emerging global healthcare crisis. Intel researchers have already made discoveries that will improve the lives of people who are dealing with Alzheimer's and other diseases of aging. Eventually, technologies to monitor and manage health and prevent or delay the onset of disease might be integrated into everyday consumer electronics devices.

To achieve that future will require the efforts of a global ecosystem of partners working together, to move beyond today's reactive, costly healthcare model to a proactive, personalized model that focuses on prevention, detection, compliance, and care giving. Intel doesn't claim to have all the answers to the severe healthcare problems facing the planet, but we believe that we're asking the right question: How can we increase the quality of life for a global population that will double in size by 2050, while reducing the cost of medical care through innovative technologies? We invite other businesses, governments, technologists and users to join us in finding the answer.

More Information

Intel Digital Health Group (www.intel.com/healthcare)

Intel Health Research and Innovation (www.intel.com/healthcare/hri)

Center for Aging Services Technologies (CAST) (www.agingtech.org)

Technology Research for Independent Living (TRIL) Centre (www.trilcentre.org)

Oregon Center for Aging Technology (ORCATECH) (www.orcatech.org)

Learn more.

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