

The People-Ready Business

Whitepaper

The Next Wave of Innovation in Healthcare

A Dialog About Knowledge Driven Health
in the New World of Work

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A Dialog About Knowledge Driven Health in the New World of Work

EXECUTIVE SUMMARY

Cost pressures, new innovations, demographics, new delivery models, and rising expectations are transforming health around the world. Information and Communication Technology (ICT) plays a central role in the way providers, patients, and payers will interact with the health ecosystem in the years to come. However, adoption of ICT has been slow, due in part to the nature of health and the culture of medicine.

This paper presents a vision of how health will be provided in the future. In this vision, technology supports and extends the capabilities of clinicians and healthcare facility administrators. It brings information smoothly into existing ways of working and uses ICT to reduce the complexity of burdensome processes.

In this New World of Healthcare Work, clinicians and administrators have pervasive access to the latest knowledge to improve outcomes. Hospitals, clinics, and doctors' offices can operate more efficiently and focus their resources on patient care. The latest innovations in medical science can spread immediately across the professional community and around the world. Providers can extend the reach of their skills to even remote, poorly served areas. Payers can align reimbursement plans to support preventative care and effective treatments without looming over the shoulders of providers and patients. Although medical information and records are standardized, portable, and universally accessible, privacy and confidentiality are protected by the strongest technologies and practices.

Microsoft® Corporation is committed to helping the health ecosystem achieve these and other benefits. We will continually create software and systems that empower people and bring the benefits of information into their daily lives through familiar tools and accessible devices. This paper looks at the remarkably consistent global challenges in the health ecosystem. It offers a vision for the near term and the longer term on where technology can help alleviate the mounting pressures on healthcare worldwide. The paper is intended to spark conversation and thought, rather than to supply definitive answers. Toward the end of the paper, Microsoft's approach to solving the relevant issues is briefly described. We also provide details of where to go for additional information.

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Exciting new developments in technology can help providers reduce the risks associated with uncertainty and take advantage of new opportunities in a changing world.

The New World of Work

Over the next 10 to 15 years, several forces will continue to shape the health ecosystem, creating uncertainties for providers, payers, patients, and society as a whole. At Microsoft, we have identified the following four key themes in the New World of Work that influence our approach to productivity:

- **One World of Business:** This includes the impact of globalization, increased competition, and global markets. It also includes the challenges of consolidation, scale, and decentralization that organizations face and the tensions that threaten the growth of integrated global markets.
- **Always On, Always Connected:** This includes the effects of pervasive networks, mobility, and connectivity on people and organizations. It also includes the implications for the way organizations function when employees can choose where and when they work.
- **Transparent Organizations:** This includes how organizations build trust, improve operations, and meet compliance requirements. It means proactively sharing information; balancing the demands of customers, governments, employees, markets, and partners for greater visibility; and simultaneously addressing concerns about security, privacy, and protection of intellectual property (IP).
- **Workforce Evolution:** This includes how demographic trends such as the aging of the Baby Boomers, the rise of the Millennials, and the role of social, ethnic, and educational factors are creating a workforce of unprecedented diversity.

This paper considers how the following themes may play out in the worldwide health ecosystem:

- How can Information Technology (IT) and the Internet be used to deliver health information and certain kinds of medical services in the most cost-effective and efficient ways?
- How will pervasive access to information and systems change the relationship between patients and providers?
- What are the best ways for health professionals to integrate data and evidence into their practice to improve diagnoses, treatments, and outcomes?
- How can healthcare networks extend access to quality care around the world and improve the health prospects for people in emerging economies?
- How will the health ecosystem respond to the pressures of aging populations around the world?
- How can pharma and life sciences sustain a pace of productive innovation while increasing transparency and facilitating regulatory compliance?
- What are the benefits and challenges to public health organizations, governments, and payers?

In all of these areas, exciting new developments in technology can help providers reduce the risks associated with uncertainty and take advantage of new opportunities in a changing world. This paper discusses how technologies available today intersect with the pressing needs of health professionals. It also examines how new innovations could be implemented within the mainstream technologies of the next decade and more. Although many of the technologies discussed in this paper do not yet appear in any product or any product roadmap, significant research and development investments mean they are maturing rapidly.

Global Challenges in the Delivery of Healthcare

“Healthcare is on a collision course with patient needs and economic reality. Without significant changes, the scale of the problem will only get worse. Rising costs, mounting evidence of quality problems, and increasing numbers of citizens without healthcare are unacceptable and unsustainable, but the future of healthcare is not predetermined.”ⁱ

In 2004, countries around the world spent a total of US\$4.1 trillion on healthcare, according to the World Health Organization (WHO). The WHO also found that among member countries of the Organization for Economic Cooperation and Development (OECD), governments and citizens spent an average of 11 percent of the gross domestic product (GDP) on health.ⁱⁱ Healthcare spending in the United States alone reached US\$2.7 trillion in 2007, consuming 16 percent of the country’s GDP. By the year 2016, these figures are expected to increase to US\$4.2 trillion or 20 percent of the nation’s GDP.ⁱⁱⁱ Despite such spending, healthcare in the United States—disturbingly—ranks only 37th among OECD countries.^{iv}

Access to care for at-risk populations is an ongoing, global priority. According to *Healthcare Informatics*, there are 260 million elders—people who are age 60 and older—in the world today; 300 million people across the globe are clinically obese, over 600 million are afflicted with chronic diseases, and the number of people 60 and older is expected to increase to 1.2 billion by 2025.^v An increasing shortage of doctors, nurses, and skilled health workers magnifies the growing demand by citizens. The WHO’s “World Health Report 2006” reveals a shortage of more than four million doctors, midwives, nurses, and support workers worldwide. There is a “serious shortage” of healthcare workers in 57 countries around the world (mostly in Africa, where needs are acute because of poverty and disease). At least 1.3 billion people worldwide lack access to the most basic healthcare.^{vi}

As populations in developed nations age and the impact of public health issues such as smoking, obesity, poor diet, and lack of exercise grows, healthcare-related costs will continue to rise. This increase will place a significant burden on governments that provide healthcare for their citizens and on employers that provide it for their workers. A rising percentage of healthcare budgets is being spent on the management of chronic or long-term conditions such as diabetes, chronic obstructive pulmonary disease (COPD), and cardiovascular diseases. The International Diabetes Foundation estimates that costs from this single chronic condition could overwhelm most public healthcare systems by 2025.

Many of the growing costs associated with healthcare come from challenges in managing vast amounts of clinical data—defined as any information that is required for medical decision-making at the time of patient interaction, including text data, lab data, image data, and radiology data. Healthcare has long been an information-driven industry. We are all familiar with the image of a doctor making rounds with a clipboard. But software has not kept up with the deluge of data that healthcare providers now struggle with. Important patient information lives in too many different “silos.” It is locked into systems that cannot easily communicate with each other, and too much of it is still captured on paper and dumped into filing cabinets. To get a complete picture of patients’ health—and to make sound medical decisions—healthcare providers must synthesize information from many different sources. The collection of such disparate data for analysis is fast becoming an excessive burden.

In addition, while new diagnostic modalities and new medication discoveries are occurring daily, the delivery of healthcare has not changed in a significant way in more than 50 years. It is still largely manual and paper-

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based. As the need to track and share clinical data increases—to monitor new and recurring diseases, for example—the health ecosystem will need to modernize its service delivery structure. Coordinated public health infrastructures are one of the possible solutions.

Among the other challenges that plague the health ecosystem are the following: Escalating costs; inconsistent quality in therapies and outcomes; an aging population; clinical research that does not find its way into the mainstream of medical practice for up to a decade, on average; rampant inefficiencies due to a lack of readily available clinical data, which causes redundancy in diagnostics; inappropriate hospitalizations; medication errors; and preventable deaths.

Despite significant differences in the care and services delivery and payment systems used throughout the health

ecosystem, provider and patient issues are remarkably uniform: Improve patient safety; contain spiraling cost increases; and match the expectation levels of citizens who live in a connected and digital age.

Empowering *clinicians* to work more efficiently and effectively in the “digital workstyle” of the New World of Work should be at the center of the health ecosystem’s strategy, as the industry as a whole addresses the coming era of rapid change and increasing global integration.

As we move toward a health ecosystem that is more fluid, less centralized, and less certain about old assumptions and old models, evolving Information Technology will empower providers, teams, and individuals to realize their potential in the New World of Work.

The Future of Health: A Glimpse Ahead

As prediabetic patient Sabrina Reyant jogs across the countryside, she occasionally glances down at her next-generation Spot Watch. Sensors in the wearable device measure a variety of physiological parameters, including heart rate, respiration, temperature, and PO₂, while Sabrina runs. From such data, the watch’s computer is able to calculate, display, store, and send caloric burn and exercise performance parameters. Sabrina also notes that “secure data sharing” is turned on.

With data sharing and Sabrina’s permission, her healthcare coordinator, James Wittrell, is able to monitor her progress. He notes that she qualifies for a clinical study and sends her a secure message about the study. When Sabrina returns home from her run, she reviews a summary of information from her exercise program. She also sees the message from Mr. Wittrell and joins him for a “virtual meeting,” where he details the new clinical study. Mr. Wittrell suggests that Sabrina schedule a review of this opportunity with her endocrinologist, Dr. Christian Kemp.

The Future of Health: A Glimpse Ahead *(continued)*

Dr. Kemp is beginning his daily rounds at the hospital when Sabrina's meeting request is delivered. He pulls a palmtop PC from the pocket of his white lab coat, checks his appointment calendar, and accepts the meeting. Sabrina's consultation automatically inserts itself into Dr. Kemp's schedule immediately following an inpatient visit with Alex Roland.

Using radio-frequency identification (RFID) and the hospital's internal wireless sensor network, Dr. Kemp's palmtop PC provides optimal routing information for his rounds and directions within the facility. As he approaches Alex's hospital room, Dr. Kemp realizes that he will need an ophthalmoscope to examine Alex's retinal fields. He uses his palmtop PC to identify and pick up the nearest available scope and then continues to the patient's room.

Meanwhile, Alex relaxes in his hospital bed. He is watching television when he receives a reminder that it is time to take one of his medications. With the aid of monitoring and display technologies, Alex is directed to the medication he needs. As he takes it, the appropriate information is entered into his medical record.

Dr. Kemp greets Alex and begins his examination, using the wireless "smart" ophthalmoscope to study Alex's retinas. He is doing this because Alex has Type 1 diabetes, which can cause changes to the small blood vessels that are seen as nicks and "exudates" in the back of the eye. These changes are not only a risk for blindness but also an indicator of other vascular disease in the body. The ophthalmoscope takes digital photos of Alex's retinas and transmits them to his medical record. Dr. Kemp uses his palmtop PC to retrieve a sequential series of Alex's digital retinal images for comparison. He notes that improved control of his patient's diabetes has slowed, and perhaps improved, previously noted retinal changes.

After completing Alex's examination, Dr. Kemp proceeds to a special conference room where he can chat with Sabrina Reyant and clinical research coordinator Wei Yu. Using unified communications and contextual display technologies in the form of a Tablet PC, Dr. Kemp shows his patient how she might benefit by joining the proposed clinical trial. He suggests that she visit a Mini-Clinic for some laboratory testing. Dr. Kemp then closes the "virtual visit." As he leaves the conference room, he hangs up the Tablet PC on the wall, where it starts recharging and assumes the function of a room-number sign.

Miles away, Sabrina approaches the self-service kiosk at her community Mini-Clinic. She authenticates to her digital credit card using her fingerprint, finds her Mini-Clinic card, and securely logs in to the kiosk. Using the advanced touch-screen display, Sabrina selects the laboratory test that her doctor recommended. She also picks up a prescription that is waiting for her at the Mini-Clinic.

Challenges, Trends, and Proposed Solutions in Healthcare IT

Despite many advances in healthcare over the past half century, on-demand access to clinical data remains inadequate in most settings.

With healthcare spending in the United States alone estimated at over US\$2 trillion and rising, improving productivity and efficiency in the delivery of services are critical economic priorities for patients, providers, and payers. These improvements will also enhance health outcomes, extend access, and help save human lives.

ICT is already making a significant difference. Tools like Instant Messaging, e-mail, and rich application-sharing environments diminish the need for travel and face-to-face consultations. Mobility solutions enable convenient access to information at a patient's bedside. And tools for better clinical data management mean more efficient form designs, team workspaces, and data presentation from closed legacy systems in better integrated, user-friendly formats.

Electronic medical records represent the first front in the battle for improved medical productivity. It is estimated that the widespread use of standardized electronic records by itself could save up to 20 percent of all healthcare costs, reduce the alarming number of medical mistakes, and drastically improve the quality of healthcare. But the transition from paper-based to digital data is only the beginning. New information work technologies will drive numerous innovations to help doctors, hospitals, payers, and government agencies provide higher levels of care at a lower cost.^{vii}

Key Challenges

Interoperability of Health

Information—The seamless transfer of clinical patient data between healthcare providers is one of the greatest challenges the health ecosystem faces. The systems used by healthcare providers vary in terms of modernity and sophistication. Some systems are paper-based while others are highly sophisticated, Web-based, and include integrated data management tools. There is more

clinical and research data than ever, and information needs vary among practitioners. And yet care providers simply do not have systems that enable them to synthesize and apply the appropriate data at the time of decision-making.

Despite many advances in healthcare over the past half century, on-demand access to clinical data remains inadequate in most settings. This inadequacy contributes to duplication of effort, excess costs, adverse events, and reduced efficiency. Indeed, a 1998 study conducted by the Institute of Medicine found that preventable medical errors cause the death of between 44,000 and 98,000 U.S. citizens annually. In fact, there are more deaths in hospitals each year from preventable medical mistakes than there are from vehicle accidents, breast cancer, and AIDS combined, according to this report. The study also shows that up to 70 percent of the time, clinical data that could have helped avoid the medical error was available.

Many of these errors are not necessarily because delivering healthcare is a complex process. Individual care providers are often isolated from core clinical data, and clinical care teams can lack collaborative tools—instead relying on antiquated technologies and manual handoff processes. Despite time constraints and an ever-increasing patient load, care providers are expected to instantly have access to reams of patient data and to apply an enormous and rapidly expanding body of clinical knowledge to clinical decisions.

One of the key problems facing clinicians today is that too much time is spent gathering clinical data from fragmented and incomplete sources, both electronic and paper-based. Without a single, reliable source of data, the risk of overlooking important, hard-to-find information increases. Poor access to clinical data also results in poor clinical decision support, which leads to errors of commission

and omission in addition to worsening the cost burden for governments and other payers worldwide.

Clinician Adoption—A secondary challenge is that, although a government or hospital may provide core IT systems, neither can force the clinical staff to use these systems. As long as computers within the health ecosystem remain separate, clinical staff will see recording care as secondary to providing care.

Effective information tools in any industry must provide easy access to data, processes, and people anywhere and anytime it is needed. But in the health ecosystem, timely delivery of the accurate data is absolutely crucial to providing effective care. In fact, this need for just-in-time information is such a priority that many health professionals have stayed with tried-and-true analog tools like the pen and clipboard, intercom, dictation device, and personal memory, because of their simplicity, familiarity, and immediacy. These professionals stick with “the devil they know,” despite the many problems such methods present to data collection, storage, retrieval, and sharing.

As a response to this natural and expected clinician behavior and as a strategy to improve the adoption of clinical information systems, some governments are requiring their clinicians, for reimbursement purposes, to only deliver key elements of patient data electronically. However, this approach is doomed to fail. If a clinical information system is so complicated that it takes hours of training and creates inefficiencies and potentially harmful errors, the clinician is correct in refusing to use the system.

Any technology solution that seeks to replace traditional practices must conform first and foremost to the needs for simplicity, speed, and portability. A clinical information system should be as simple to learn as electronic banking or buying an airline ticket online. The most successful deployments of clinical

information systems will require little or no formal training, and users will be proficient following a short introduction to the system. These clinical information systems must embrace a variety of data-entry modalities that fit clinicians’ workflow. These options should include keyboard, “point and click,” digital ink, voice, and gesture, and they should perhaps be capable of integrating some modalities not invented yet. Functions necessary for clinical care, such as ordering a test or requesting a consultation, should be easy to remember after a hiatus in system use or when traveling from one hospital to another. Ideally, clinical information systems should look and work like the Web-based environments that most people already know and use outside of work. The less intuitive a system is, the more it is prone to failure caused by human factors. The need for significant amounts of training may be an indication of poor system design, and it should be avoided.

Accessibility and ease of use are just two of the challenges holding back software innovations in healthcare. Many first-generation software products for healthcare were based on closed, proprietary technology that was accessible only through dedicated applications with difficult, inflexible interfaces. Because of incompatible systems, practitioners had to manually aggregate and synthesize data from many different sources—spending more time organizing and processing information than caring for patients directly. Today’s solutions must be able to pull data from these closed systems and integrate it in meaningful ways. The information should be easy to find and available quickly. A network of clinical information systems should be the basis for global solutions that ultimately provide instant access to all prior patient history, automate capture of all possible new clinical information, enable fast and easy documentation of the patient encounter, and foster decision support that is smart but not intrusive. Future clinical information systems should be fully interoperable and interconnected. Using a highly

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Provider automation has been shown to improve patient safety and outcomes and to reduce costs.

distributed model, these systems should seamlessly and securely share information within and between hospitals, clinics, and physicians' offices, and they should fully integrate with insurers and other payers.

Additionally, ICT systems for healthcare must be affordable. The health ecosystem already has many costly resources—from highly paid specialists to advanced diagnostic equipment—and these are perceived as more central to the core mission of providing care than are computers and software. In addition, dedicated proprietary systems are beyond the financial reach of many physicians, especially those engaged in primary care, and small clinics. Software that drives better outcomes, greater efficiency, and broader access to care must be based on a proven, standardized, and affordable platform for information work. This platform must also provide the speed, simplicity, mobility, and interoperability that the health ecosystem demands.

The Information Glut—Practitioners also face another issue: The amount of data being generated by researchers is increasing faster than any individual can absorb it. This data deluge makes it difficult for doctors to keep up with the latest treatments and practices. One long hoped for innovation is something like a "GPS system for clinical practice"—a tool to help clinicians navigate through the massive amount of data. The tool should also alert them to what is important, what is not important, what needs to be done now, and what can wait. It should provide clinicians a more global view of what is occurring in the population of patients under their care. Such functionality is still slightly beyond the capabilities of today's clinical information systems (although context-aware systems are getting better every day); consequently, health workers themselves remain the point of integration for the flood of information.

Given these demands for synthesized information from affordable and easy-to-use systems, it is ironic that the health industry in many developed countries has been among the slowest to adopt the kinds of ICT solutions that have driven efficiencies and productivity improvements in so many other industries.

Although many health innovations will be supported by back-end systems and infrastructures that integrate diverse data sources and provide the technological foundation for process improvement, most people will experience these innovations personally—as practitioners, administrators, and patients. ICT is critical, because nearly every participant in the health ecosystem epitomizes the role of "information worker." Everyone from practitioners to administrators to support staff depends on having access to the right data at the right time, and in an optimal format that enables quick, effective decision-making in what can literally be life-or-death situations.

Key Trends

Patients and taxpayers have increasing expectations on how healthcare should be delivered, especially in developed economies, where people are used to having instant access to information and knowledge via digital media. Increased access to online information on health and healthcare topics is common. Information on the performance of healthcare delivery institutions and doctors is readily available to patients and payers.

The discrepancy between spending, outcomes, and overall patient health is causing governments and employers that fund healthcare to take a tougher stance on automating the health ecosystem. The health industry is typically 15 to 20 years behind other global industries with similar complexity in deploying and benefiting from automation. Provider automation has been shown to improve patient safety and outcomes and to reduce costs.

Mobile Computing—The benefits of mobility in the delivery of healthcare services are readily apparent. Doctors and nurses spend most of their time on their feet, working in teams to ensure the health and safety of patients. The ability to alert staff quickly and obtain medical information from any location within the hospital is lifesaving and mission-critical. The increasing demand for mobility in healthcare operations is evident in the fact that hospitals and medical practitioners were among the early adopters of paging.

Today, more than 95 percent of practitioners in the United States use mobile devices of some kind—pagers, cell phones, PDAs, and various mobile-computing devices. More than 90 percent of clinicians under the age of 35 use some form of reference application on a daily basis. Grassroots initiatives are encouraging clinicians to purchase handheld devices that they can use primarily for drug databases, manuals, and medical calculators.^{viii}

Mobility solutions are also a key element in providing real-time access to patient information, decision support, and collaboration tools. At the same time, they allow for better information security and the personalization of patient care. Advanced mobility solutions assist in the reduction of errors by capturing and delivering critical medical data at the point of care. Such solutions also give nurses, doctors, and administrators the tools they need to access critical information while remaining more accessible to patients and peers. Because staff is able to spend more time on patient care and less time chasing clinical data, mobility solutions enhance job satisfaction.

What if doctors could access clinical information databases from the bedside of a patient? Or access a patient's complete medical record on a wireless-enabled Tablet computer? What improvements and savings would be possible if nurses could enter medical information directly into electronic charts at mobile carts and avoid duplicate work? Technology offers a key opportunity to bring information

to the appropriate people—anytime and anywhere—thus expediting care decisions. Mobility solutions blend a combination of wired and wireless data services that give clinicians access to critical information and powerful resources no matter where in the hospital they are located.

Widely accessible Wi-Fi and WiMAX devices, and myriad other devices that take advantage of bandwidth, can transform information access at the point of care, and anywhere else it is needed. A growing range of medical devices—from exercise equipment to glucometers—digitally collect valuable information about an individual's health status. Similarly, mobile nurse carts, Tablet PCs, PDAs, and laptops connected to the wireless LAN (WLAN) allow clinicians to immediately record medical data in electronic format, order tests, and prescribe medication at the patient's bedside—from the device of their choosing.

Consumers can benefit from advanced home-based monitoring systems, teleconsultations, personalized care, and individualized treatments.

Consumer-Driven Health—

Consumer-driven health is a shift in how to deliver care. It focuses on wellness and disease prevention, rather than illness and episodic treatment, which is significantly more costly to consumers and governments.

The goals of consumer-focused health programs are for individuals to work with their physicians and other healthcare providers to create a better health outcome for themselves and their families. As consumers become more knowledgeable about their general health and are empowered to use information tools, they consume fewer health resources and their healthcare usage becomes more cost efficient as a result of their improved health. For consumers to make effective healthcare choices there must be price and quality transparency about health professionals and facilities.

Technology offers a key opportunity to bring information to the appropriate people—anytime and anywhere—thus expediting care decisions.

Most simple health problems may be treated economically by following strict, clinical best-practice protocols.

Proponents of consumer-driven health understand that funders of healthcare will need to focus on outputs for and outcomes of health-related expenditures, rather than inputs to the current healthcare delivery system (diagnostic tests, visits to the doctor). This paradigm shift can only be accomplished when patients are intimately involved in their own medical decision-making and follow-through.

A key factor in the success of consumer-driven health initiatives is the Personal Health Record (PHR). The PHR mandates that patients own all of their relevant clinical information for the purpose of a healthy outcome. PHRs will help drive better health and better health information systems.

Retail Healthcare—Commoditization of healthcare is becoming more accepted by consumers. The idea of retail healthcare—or healthcare clinics in airports, shopping malls, and department stores, with services paid in cash and delivered by nurse practitioners, physician assistants, or general practitioners—to help consumers with simple health problems makes sense. Waiting times to see doctors in many countries are becoming longer. If the mass marketing of simple health solutions coincides with solid supporting clinical intelligence engines and clear cost parameters for the consumer, these pressures can be alleviated. The result will be a positive outcome for both consumers and governments.

Retail healthcare is a new area in the transformation of healthcare delivery. It is taking off in urban markets, where it can be difficult and time-consuming to see a clinician. Most simple health problems may be treated economically by following strict, clinical best-practice protocols. As consumers are forced to pay more out of pocket for healthcare, and as information becomes more widely accessible, retail healthcare markets can emerge. Medical service providers may become more competitive on factors such as price, convenience, high-tech capabilities, and high touch.

As of March 2008, there are nearly 1,000 retail health clinics in the United States, according to a recent study by Verispan, a number that is expected to rise dramatically in the next few years as chains like Wal-Mart, CVS, Target, and Walgreens add more clinics. A 2007 poll by Knowledge Networks predicted that there will be around 2,000 retail clinics by the end of 2008.^{ix} There is also a significant resurgence of interest in workplace clinics by employers. This movement will dramatically impact the face of primary care in the United States. In addition, there is a significant shift to provide healthcare in outpatient settings including the home, rather than in acute care settings such as hospitals.

Worldwide Access to the Healthcare Economy—ICT can enable globalization of the health ecosystem. If medical services can be provided remotely, they will be. Services such as radiology and pathology are already performed in remote and rural locations. Maritime medicine services provide healthcare to sailors who are often at sea for months at a time. In addition, the phenomenon of *medical tourism* is growing. As people face higher insurance deductible liabilities or no insurance coverage at all, they will increasingly seek lower cost medical procedures in countries like India, Thailand, and Mexico.

Coping with Shortages of Qualified Professionals—Aging Baby Boomers are beginning to impact the healthcare system at the very time when labor shortages of providers and other health workers are becoming more acute. Cost pressures within the industry are forcing administrators to rely more on mid-level and low-level workers. While this can create a positive effect in the short term, in both immediate cost savings and improved care for the countries benefiting from the immigration of health workers, the longer term effects on the countries of origin for these workers must be considered. Doctors, nurses, and midwives are immigrating from developing countries to wealthier nations in pursuit of higher

wages. This worldwide migration is creating significant concern and leaving serious shortages of health professionals in developing countries. Many of the poorest countries struggle to provide even the most basic medical care. According to the World Health Organization, Canada, Britain, the United States, and New Zealand import a quarter or more of their physicians from countries such as Africa that face serious medical challenges.

The Central Role of Information for Clinicians—Improvements in clinical data acquisition, storage, retrieval, sharing, and presentation must be a primary goal in any nation's healthcare strategy. The problem today is that existing information typically resides on legacy systems. As a result, it is generally not available when, where, or in the manner it is needed. This data includes test results, images, medication and allergy information, chart notes or entire charts, and details about the care process itself. As we move toward a future in which comprehensive electronic medical records are globally accessible, the first step is to get all existing data into the hands of clinicians and other end users.

Electronic data is essential, yet an electronic medical record is not the same as a clinical information system. And the mere existence of an electronic medical record does not guarantee that clinical data will be available when needed.

Given the variability in the types of medical data and the forms on which it is recorded, the urgency of the need for data availability, and the impossibility of modifying or replacing all existing legacy systems within a reasonable timeframe, what is needed today are data platforms that can aggregate all types of information and make it available in a unified context. Most patient data is not entered by physicians or nurses; rather, it is collected from existing sources or captured by sensors.

The primary requirement today is for comprehensive data systems that deliver seamless access to all existing clinical data and health management information, regardless of the source. Such systems must receive data from new sources as needed and must provide easy, fast, and open access to the data for any authorized user.

Clinical information systems will help clinicians reduce the frequency of medical errors and adverse events, improve diagnostic accuracy, and reduce duplication of effort.

The Way We Will Deliver Healthcare

Comprehensive clinical information systems that provide unified access to all existing patient data are an important solution to the immediate problem of fragmented healthcare data islands. But these systems are also an important foundation for future decision support and data-entry functions. They offer tremendous potential value. Clinical information systems will help clinicians reduce the frequency of medical errors and adverse events, improve diagnostic accuracy, and reduce duplication of effort and other causes of inefficiency. Instant, ubiquitous access to all clinical data is emerging as a minimum-practice standard for the future delivery of healthcare.

Healthcare Dial Tone

Healthcare dial tone is the concept of health information as a utility—as ubiquitous in its availability as a phone signal. The transformative power of information in medicine has little or nothing to do with making doctors and nurses enter new patient data into a clinical information system; rather, it has everything to do with making existing data widely available to those decision-makers who are caring for patients. The Center for Information Technology projected a savings of US\$88 billion per year from ubiquitous health information technology in the United States alone.

Smarter, more adaptive information work tools can substantially reduce the time health workers spend managing, finding, routing, and prioritizing information.

In an age of ubiquitous computing in healthcare, clinical information systems will make all data and computer-supported activities available wherever and whenever needed. Everyone involved in the healthcare process will benefit from the ability of patients, their family members, and their provider teams to access clinical data—given the appropriate policies and systems to ensure privacy and consent. In addition, such access will reduce costs. Rural and remote communities will benefit from the instant availability of clinical best-practice guidelines. Telemedicine will become the norm as clinicians opt to use consumer products like smartphones or the Microsoft® Xbox® video game system to communicate with appropriate parties.

Instant Communication Among Care Providers

A common joke in healthcare is that “no one goes into medicine for the paperwork.” But paperwork and other mundane tasks account for a significant portion of most health professionals’ daily routines. Studies have shown that often less than 20 percent to 30 percent of the hours budgeted per patient per day is time spent delivering direct care. Typically, nurses spend up to 50 percent of their time doing paperwork.^x E-mail, Instant Messaging, the Internet, electronic forms, and other current-day technologies can dramatically reduce the volume of actual paper and improve control over information. Wider adoption of these technologies in the health ecosystem will no doubt produce many needed efficiencies. But each of these technologies also brings new practices that can add complexity and may potentially replace one set of administrative chores with another. Smarter, more adaptive information work tools can help break the cycle of escalating complexity and substantially reduce the time health workers spend managing, finding, routing, and prioritizing information. Relieved of this burden, workers will be free to bring their expertise and judgment to bear on tasks that cannot be automated.

Team Collaboration

Communities of practice are an increasingly essential tool for health professionals. These virtual collaboration environments allow health professionals to share knowledge and validate findings. They are coming into wide use as a result of efforts by the medical establishment, governments, and non-government organizations (NGOs). A common issue with communities of practice is that they lack the social capital of trust and authority fostered naturally in face-to-face contact. Especially for older, more established professionals who did not grow up immersed in the digital world of real-time texting, Internet chats, and social networks, sharing information in an anonymous or semi-anonymous community can be culturally challenging. If participation is limited, the usefulness of the community is limited.

Today, standards-based applications from Microsoft and its industry partners have the potential to streamline the way medical data is created, collected, stored, and accessed. These tools allow clinicians, physicians, researchers, and administrators to work together in integrated, collaborative teams. New technologies such as telepresence, smart videoconferencing cameras, large-format displays, and context-aware collaborative workspaces reduce the artificial quality of online meetings. All of these options can make the experience of remote collaboration resemble ordinary face-to-face meetings. When virtual environments are more natural, they foster higher value, higher trust interactions.

Access to Evidence for Treatment and Diagnosis

Evidence-based medicine, which gives doctors access to the best current knowledge and experience of their peers, holds the promise of more consistent and effective healthcare. But even the most conscientious practitioners have trouble keeping abreast of all the latest innovations in their field, including new techniques and therapies that could help

their patients. Today's reputation systems are often manual—checking a box at the end of a knowledge-base entry that asks, “Did this answer your question?” or filling out a user-feedback form in a forum like those found on eBay.

As these systems become more sophisticated, they will become more transparent and pervasive. Reputation systems will work in the background to add perspective and relevance to mountains of medical data. By dynamically tracking the uses of data, the outcomes of person-to-person interactions, and the effectiveness of practices, these systems will push the best resources and processes to the surface quickly and automatically. As a result, consistently good-quality information will spread rapidly and that which is useless and irrelevant will be weeded out.

Real-Time Data Availability for Public Health and Bio-Surveillance

During a natural or manmade disaster, healthcare will likely be delivered outside of routine care areas such as hospitals and clinics, as many recent natural catastrophes have shown. Patient data must continue to be immediately accessible. In the future, clinical information systems will deliver real-time data as needed to support local, regional, and national bio-surveillance and public health needs. These systems will automate the tracking of reportable diseases and facilitate the process of adding new diseases and their identification protocols. Clinical information systems will also be capable of receiving and displaying alerts from public health authorities, so doctors and other medical personnel have real-time situational awareness of their health and disease environment. This knowledge will allow clinicians, for the first time, to consistently identify when an outbreak—even one as routine as influenza—occurs in a community. Earlier identification of these events can create greater awareness. In addition, it means that clinicians are more connected to health trends in their communities and the wider world.

Enable Individual Control of Healthcare

We live in an age of reactive, brick-and-mortar healthcare that is usually provided in centralized facilities constructed at great expense. Most of us only come into contact with sophisticated medical instrumentation when something has gone seriously wrong, or if we have gone to a doctor's office or other facility to undergo testing. Medicine is probably the only area of our lives where we tolerate this lack of control. In entertainment, for example, we no longer rely solely on scheduled concerts and available theater tickets. Instead, we have home libraries and on-demand online access to entertainment options that were inconceivable just 10 years ago.

Healthcare delivery in the future will entail significantly greater personal responsibility. With the expectation of continued rising costs in every sector of the health ecosystem, with increased cost burdens placed on individuals, and with governments and employers cost-shifting to contain increases in their healthcare delivery costs, individual citizens will need to be proactive to maintain their health and wellness, prevent disease and hospital admissions, and incur fewer health-related costs. In some countries, we are starting to see government proposals to rebate some portion of citizens' healthcare payments, or increase those fees, depending on the level of responsibility individuals take for their personal health.

To facilitate this greater control, citizens will need to have greater real-time communication with healthcare providers, so that they are better equipped to maintain their own health. Individuals will also have systems that use real-time tools to improve chronic disease management and prevent exacerbations. Other systems in use daily will improve wellness and disease prevention and promote education for in-home therapies to avoid costly hospitalizations. In addition, as the population ages, technologies will enable seniors to live at home more safely, and for longer periods of time. This capability will help people avoid the costs associated with long-term care.

In the future, clinical information systems will deliver real-time data as needed to support local, regional, and national bio-surveillance and public health needs.

New Technologies for Clinical Systems

Such digital home technologies have the potential to improve elder health and well-being and to significantly lower costs.

The technologies discussed in the following sections are not yet in wide use. However, they are interesting indicators of new capabilities that will impact the way healthcare will be delivered in the upcoming decades. Tomorrow's clinical information systems will need to be designed in such a way as to incorporate the additional patient data created by those technologies that are not yet deployed.

Digital Home Technologies for Aging in Place

The world is facing a major challenge as an aging population threatens to strain nations' healthcare systems to the breaking point. The cost of caring for older adults will continue to escalate sharply, with no end in sight for this generation. Currently, the proportion of people aged 60 and over is the fastest growing demographic population worldwide. The very old age group (age 80+) is the fastest growing population in developed countries.^{xi} In the United States, centenarians (100+) are the fastest growing age group, and this trend is emerging around the world. Federal officials calculate within the next 25 years the number of centenarians will quintuple worldwide.^{xii}

Unless more effective and less costly models of delivering health services to seniors are deployed, nations will be in the midst of a public health crisis that may threaten the stability of economies worldwide.

Technology companies today, including Microsoft, are exploring digital home solutions that would enable care to be shifted from traditional clinical settings to the home. These solutions would also shift at least some of the responsibility for care from formal providers to individuals and their personal care network—usually family and friends.

Sensor networks are powerful new tools that can assist with care giving across the continuum of care. These networks

will be enabled by a range of computing technologies that utilize wireless sensors within the home to automatically capture and record data that measures patterns of behavior. Sensors will continually monitor the safety of older adults, in addition to their compliance with medication, diet, and daily exercise routines, among other indicators. These sensor networks could allow a family caregiver to remotely monitor an elder or even safely leave the home for a time while computers record the senior's activities, sending an alert in the event of an adverse circumstance. Such digital home technologies have the potential to improve elder health and well-being and to significantly lower costs by maintaining health for a longer duration and by deferring more expensive institutional care as long as possible.

For a home to provide medical assistance it must be equipped with distributed, cooperative computers, physiological and environmental sensors, and both wired and wireless communication capabilities. Furthermore, home-based systems that provide medical assistance must be highly reliable and work with highly energy-constrained, battery-operated devices that occupants can wear or that can be placed discreetly throughout the home. These specialized sensor networks are vital to obtaining data about the home's occupants and their external environment, such as the width of doors and the number of flights of stairs, in the event of an emergency.

Next-generation monitors, or even ingested or implanted RFID devices, combined with powerful non-intrusive computing will provide rich, real-time information on patient health in addition to monitoring the quality and regulating the release of medications. And the systems to which these monitors are attached must communicate with other IT devices in both inpatient and outpatient environments to reduce errors, assist nurses and clinicians, and provide data

for more accurate diagnosis and treatment. Patients could be released from facilities sooner and monitored remotely, with care dispatched automatically in the event of an emergency. These devices are already being developed and tested for home-based sensor networks.

Radio-Frequency Identification

With RFID adoption, healthcare organizations can automate manual processes, increase operational efficiency, and improve the delivery quality of patient care. RFID automatically captures a variety of data necessary for patient safety, asset and patient tracking, and materials management for healthcare providers.

For maximum medication safety, the five rights of patient care are often given as “right patient, right drug, right dose, right route, and right time.” By further integrating the digital and healthcare worlds, RFID offers a way to maintain those five rights and to better integrate care processes. Active tags on people and objects that enter an RFID reader’s field can set off an alert or automatically initiate other events or processes.

A combination of active and passive tags could allow staff, assets, patients, consumables—in fact, almost anything—to be tracked. As an example, envision the following process: Patients are tagged on arrival, and a digital photograph is taken and added to their electronic medical record. The photograph allows the clinical team to confirm that they have the right patient, and the electronic medical record ensures that they perform the right test or procedure.

Automatic, accurate, and reliable, RFID tracking will have many uses in healthcare, including: reducing inventory losses; locating tagged equipment by using a PC or mobile device, giving staff more time at the patient’s bedside; monitoring surgical instruments for location and maintenance; locating staff and patients easily by the tagged bracelets they wear; and tracking pharmaceutical products. Tracking pharmaceuticals is a vital safe-

guard. It is estimated that 10 percent of pharmaceuticals distributed worldwide are counterfeit, and that number rises as high as 30 percent in some developing countries. More alarming, 50 percent of all medicines purchased over the Internet are counterfeit when the physical address of the site is concealed.^{xiii}

Robotics

Today’s robots can monitor the elderly, record the pattern of their daily lives, watch for variations, and send alerts to caregivers, thereby improving elder safety. Robots increasingly are enhanced with new sensors that could impact patient care in the home or the hospital setting; indeed, this is the trend in robotic development.^{xiv} Using visual, ultrasonic, and floor sensors, robots can recognize their environment. Moving with the aid of an eye camera and using kinesthetic sensors, robots can give and take objects. Robots controlled by a remote clinician can be guided to a patient’s bedside and the robot’s head movements controlled to take a closer look at the patient or nearby monitoring systems. Today, there are a few healthcare organizations at which clinicians are using robots for remote video interactions with patients.

Increasingly, complicated medical procedures are performed using surgical robots. Robotic surgery has been shown to reduce morbidity from complicated procedures and to improve outcomes.^{xv} Although a robotic surgical procedure requires remote human control, the technique helps surgeons with longer, more complicated operations.

The Virtual Operating Theater

Rich, remote presence—voice, video, data, and real-time application sharing—is already being used to deliver better healthcare in areas where medical professionals are scarce or unevenly distributed. Technology is being developed today to support virtual operating theaters, where doctors can perform procedures remotely using natural-gesture interfaces to control servo-

With RFID adoption, healthcare organizations can automate manual processes, increase operational efficiency, and improve the delivery quality of patient care.

The emergence of personalized medicine will help shift the focus of medical care from “disease treatment” to “health management.”

operated instruments while monitoring conditions in real time over healthcare networks. Similar technologies could also be used to enable doctors in remote locations to collaborate on procedures in real time. And the motion data captured by these applications could be used in training the next generation of health professionals in vivid and detailed ways.

Biosensors

Home computers and the Internet serve as an interface between people and information. To both maintain and improve human health, the same sort of interface is needed between people and the microscopic world of microorganisms (bacteria, viruses, and fungi) that cause disease, along with the DNA, RNA, proteins, and small molecules that keep human bodies functioning.

Health-based technology companies are testing biosensors that would enable early detection of disease states and facilitate treatment using nanotechnology. These devices could provide rapid diagnosis and assessment in the clinic, the doctor’s office, and at home.

Personalized Medicine and Genomics

Genomics focuses on the *application* of gene-based approaches to improve the understanding of human diseases, drug discovery, and variable drug reactions. In this new era in medicine, clinicians will have a more profound understanding of the biological and genetic basis of disease that will pave the way for more effective ways to diagnose, treat, and prevent illness and disease.

Increasingly, the administration of new medicines will be guided by predictive evidence from genetic and other molecular tests. The expectation of

“personalized medicine” is that these tests will reveal whether an individual is likely to avoid toxic side effects or respond well to a drug. A targeted approach to treatment can ensure that each patient receives the right medication at the right time. About a dozen such treatments are in use today, and the field is growing rapidly. Because molecular diagnostic tests can reveal a patient’s susceptibility to disease, they can also guide preventive treatment before symptoms arise. The emergence of personalized medicine will help shift the focus of medical care from “disease treatment” to “health management.”

Over the next 10 years, the kinds of sophisticated applications and computing horsepower that enabled researchers to sequence the human genome and advance medical science through genomics and proteomics will move to within reach of mainstream providers, small labs, clinics, and pharmacies. New systems that enable computers to pool processing power over networks via distributed computing (as the Folding@Home project^{xvi} does today over the Internet) will enable information workers to model and visualize extremely complex data sets using everyday applications. The migration of these tasks from highly specialized and expensive systems to a standard information work platform will bring the promise of individualized therapy within reach and create new, high-value information worker roles for mainstream professionals.

In addition, researchers are developing genetic tests that can tell whether people are susceptible to certain types of cancer, atherosclerosis, stroke, osteoporosis, vision and hearing loss, or even oral cavities. The patient and physician may use this information to establish a program of health management, including monitoring, lifestyle changes, nutrition recommendations, or protective drug therapy.

Enabling Rapid Innovation for Pharma and Life Sciences

Pharma and life sciences depend on the ability to innovate rapidly and productively within the context of a structured, highly regulated environment. Such innovation produces new drugs and therapies, and it also helps this discipline compete effectively in the global economy. The dynamics of the New World of Work—globalization, transparency, connectivity, and workforce evolution—all demand that participants in the pharma and life sciences industry adopt a more collaborative, transparent approach to innovation that leverages new technologies and new workstyles.

Open Innovation

Pervasive networks are effecting a transformation of organizations from centralized command-and-control management to flat networks based on peer collaboration and access to common data and services. New technologies such as blogs, shared workspaces, subscription-based content services, and reputation systems enable end users (scientists, managers, medical professionals, regulators, and other interested parties) to collaborate and share knowledge using self-managed systems, without the extensive participation of IT or dedicated site managers. All of these emergent collaborative technologies allow users to determine which information is most useful to them, and they also speed the spread of effective practices and trusted data across the network by making this knowledge more visible to the entire user community. Experts including author and economist James Surowiecki (*The Wisdom of Crowds*^{xvii}) and business analysts Don Tapscott and Anthony Williams (*Wikinomics*^{xviii}) present compelling evidence that this open innovation model increases the speed and quality of knowledge creation while lowering costs.

Secure Collaboration

As collaboration becomes more open and global, the pharma and life sciences industry will be challenged to find ways to exploit the benefits of “crowd-sourcing” while guarding proprietary IP and maintaining visibility into the development process consistent with regulatory requirements. New developments in content-based security and next-generation information rights technology will allow organizations to set security policies around individual bits of data within documents (lines or words in a white paper, formulas in a spreadsheet, proprietary data and methodology in a lab report), rather than locking down entire documents or safeguarding everything within the perimeter of the firewall. This capability will simplify security management and enable broad sharing of non-proprietary data while ensuring that confidential information is restricted to those whose role permits access. All documents, including those related to product development, will carry rich metadata that not only allows them to be found and searched easily but also provides a chain of custody for validation and compliance.

Collaborating with Regulators

Open systems will make it faster and easier for pharma and life sciences companies to share information with regulatory agencies and peer-review boards to streamline time-consuming regulation and validation of test results. Shared digital project files can include documents; data taken directly from test instruments and lab equipment; rich-media data such as audio and video; clinical results in datasets that can be interpreted by sophisticated modeling and visualization systems to replicate experimental findings; metadata to validate that the investigators followed proper security and privacy policies in handling personal data; and other process information. And all of this data will be in a secure, accessible, and searchable format.

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Today's diverse health systems and technologies need to be interwoven with software that enriches relationships and transcends boundaries.

Microsoft's Vision

How might Microsoft help with the exciting, yet troubling, future of healthcare? Technology today can improve access to clinical data for clinicians and patients. It can improve adoption of clinical information systems by clinicians via common user interfaces that reduce training time. Technology can also allow secure sharing of patient records in addition to enabling

data capture for disease surveillance, health alert networks, and collaboration and integration despite legacy systems.

Our goal for the future of the health ecosystem is "improving health around the world through software innovation," and our strategy for achieving that vision is expressed as *Knowledge Driven Health*.

Knowledge Driven Health

Microsoft's Knowledge Driven Health helps organizations in the health ecosystem provide people with the information they need when they need it. As a result, people will be able to take Knowledge Driven action to improve their overall health and organizations will be able to take Knowledge Driven action to improve outcomes. Innovative approaches and flexible technology tools from Microsoft and its partners facilitate safer, higher quality patient/consumer-centric care, services, and products that are more accessible, time-efficient, and cost-efficient. And because Knowledge Driven Health solutions are lower cost, quick to implement, intuitive, and easy to use, return on investment can be quickly realized.

Making the Vision Real

The path to our healthier future is taking shape. To translate Knowledge Driven Health into reality, today's diverse health systems and technologies need to be interwoven with software that enriches relationships and transcends boundaries to enhance the way that health practitioners work.

In a Knowledge Driven Health environment, smart devices, software, and networks are combined to create a unified system that works on behalf of and under the control of the people within it. Connections among patients, providers, payers, and governments are enhanced through rich communication and powerful, flexible collaboration tools. Diverse technologies, groups, and organizations all collaborate using malleable and intuitive solutions that enhance the ways work is normally done.

In hospitals, Knowledge Driven Health offers powerful and capable systems that dynamically organize and man-

age themselves, so that the burden of implementation and management is no longer a barrier to adopting technology. New software and services offer exciting ways to improve the quality and safety of patient care. They also allow clinicians to forge deeper connections with patients. In health organizations, Knowledge Driven Health connects people and groups, catalyses and connects business processes, and empowers managers with clinical and business intelligence. In the home, Knowledge Driven Health empowers people with the communication tools necessary to participate in decisions affecting their health and to manage their own well-being.

Implementing successful patient-centric services through multiple channels requires seamless integration and secure information-sharing across the entire network of health service providers and all tiers of government. Working practices, processes, and cultures will need to change, as will the tools that enable employees to access, analyze, and

act on information, share and collaborate on documents, and manage business processes. Successfully implemented, Knowledge Driven Health will bridge the digital divide and improve the quality and safety of health services.

In the world of Knowledge Driven Health delivery, the following practices are common:

- Case notes travel with patients to ensure continuity and improve quality of care. Practitioners wirelessly access patient records, drug databases, and imaging. More accurate triage and diagnoses save paperwork and lives.
- Test results and medical images are shared online while practitioners confer using videoconferencing or real-time text chat, thus enabling faster diagnoses without travel delays or expenses.
- Administrators enjoy a complete view of staff availability, equipment, beds, operating theaters, and so on. The result is increased efficiencies, which will in turn reduce costs and maximize the use of facilities and resources. Efficient data sharing enables easy processing of patient admissions and discharges. Beds are available for new patients more quickly.
- Patients in facilities access wired and wireless nurse-call services. Unobtrusive monitoring detects abnormal patterns and triggers alerts. Competitively priced satellite TV, IP telephony, Internet services, and video-on-demand provide patients with entertainment equipment such as televisions in addition to care options. Technology results in safer and better quality care.
- Practitioners can access all relevant patient records to ensure appropriate treatment. Practitioners develop video content and stream it to patients in their homes to help speed the recovery process. Patients pay for services online, or use a swipe card, thereby minimizing paperwork. More effective care, increased consumer choices, and improved preventative measures are better for citizens.
- Health workers no longer need to start their day at the office. They upload their schedules wirelessly from home, and then access and update patient records as they go. Reducing duplication of paperwork leaves more time for patient care. Healthcare is high tech and high touch.
- General practitioners are empowered with all of the information they need to care for patients—a complete health record; access to online drug databases, medical breakthroughs, real-time information on clinical best practices, drug trials, and cautionary advice from drug companies; and complete connectivity to other health entities. More informed diagnoses lead to improved patient safety and outcomes.
- Pharmacists retrieve patient prescriptions online. Dosage and other details are recorded in the patient's medical record, thereby minimizing wait times and paperwork, ensuring safe and accurate prescriptions, and reducing medical errors.
- A complete view of the health ecosystem across all entities is implemented, as is the ability to deploy applications and transmit information. Educational material is streamed to consumer devices using video, broadband, GPRS, or other network technologies. This improves citizens' access to healthcare.
- Health funders are able to review trends and demographic information. Claims are processed at the point of care. Both of these capabilities have the potential to improve public health planning.

Knowledge Driven Health will bridge the digital divide and improve the quality and safety of health services.

We are moving rapidly toward the development of smart, simple, pervasive, and trustworthy information worker tools in the form of integrated and affordable software solutions.

Microsoft's Commitment to Health

Microsoft is committed to realizing this vision and its benefits for patients, the health ecosystem, and the economy overall. We are moving rapidly toward the development of smart, simple, pervasive, and trustworthy information worker tools that offer these capabilities in the form of integrated and affordable software solutions. We have taken the first step with the Microsoft® Office System, a set of interrelated desktop applications, servers, and services. Together with system integrators and partners, many health organizations today are achieving enormous efficiencies, greater productivity, and—best of all—better outcomes by using the information technology tools available now.

Some of the scenarios and examples discussed in this paper are in the early phases of adoption today. Others depend on the development of enabling technologies that will find their way into applications and solutions closer to the far end of a 10-year horizon. Almost all of the technology innovations are foreseeable, given today's capabilities and the expected incorporation of today's R&D into the mainstream software products of tomorrow. But adoption patterns, as always, will be uneven and hard to predict.

Microsoft's strategy is to build the capabilities that enable the vision described in this paper into the proven and familiar Microsoft Office tools that information workers use every day. This approach will provide a seamless transition from today's world of connected productivity to a new world and new possibilities for the health ecosystem.

Our commitment does not end with our technology offerings. The Microsoft Executive Briefing Center provides customers with the opportunity to engage in strategic dialogs on the future of their industries, from both a technology and a business perspective. Customers can experience the future for themselves with demonstrations of exciting new software and systems in the Center for Information Work. Microsoft also participates in trade and industry associations to find better ways to measure and produce results in the knowledge economy, and we support the efforts of the health ecosystem to succeed in a rapidly changing world.

Working together with a global ecosystem of partners, developers, and IT professionals, Microsoft delivers the software applications and platforms that can help health organizations become People-Ready Businesses.

The people ready business.

A people-ready business is one where people can apply their unique skills, insights and experience to create new products and services, work responsively with customers and partners, and drive operational excellence in every aspect of the business. People-Ready businesses support people with knowledge, practices and tools so that they can add the extra value that helps differentiate successful organizations in a competitive, fast-moving global economy.

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