

# The New World of Healthcare Work

*A Microsoft White Paper*

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## Global Challenges in the Delivery of Healthcare

“Health care 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 health care is not predetermined.”

**Redefining Health Care: Creating Value-Based Competition on Results**

Michael E. Porter and Elizabeth Olmsted Teisberg; Harvard Business School Publishing, May 2006

Healthcare costs are spiraling out of control across the globe. A rising percentage of healthcare budgets are being spent on the management of Chronic or Long Term Conditions such as Diabetes, COPD, and Cardiovascular diseases. Estimates from the International Diabetes Foundation are that costs from this single chronic condition could overwhelm most public healthcare systems by 2025.

This paper looks at the remarkably consistent global challenges for healthcare, offers some food for thought for the near term and longer term on where technology can help alleviate the mounting pressures on healthcare systems worldwide. It is intended as a document to spark conversation and thought rather than supply definitive answers. Towards the end of the document, Microsoft's approach to solving the issues discussed is briefly described along with descriptions of where to go for additional information.

The World Health Organization who rated 191 countries on the efficacy of their health systems showed that simply throwing money at the health delivery system as it stands today does not create better health and patient outcomes. If further proof were needed, the US, as the largest spender (net and per capita) on healthcare, is only ranked 72<sup>nd</sup> worldwide.

Worldwide, today---there are 260 million elders, 1 billion citizens are overweight, 860 million patients suffer from some type of chronic disease, 75-85% all spending on healthcare is on chronic diseases, and there are only 200,000 hospitals with 18 million hospital beds to treat the sick and wounded globally. There is an ever increasing shortage of doctors and nurses and skilled ancillary personnel, and an increasing demand by citizens for healthcare services.

Though new diagnostic modalities and new medication discoveries are occurring daily, the delivery of healthcare has not changed in a significant way in over 50 years. The industry delivers care in a way that is still largely manual and paper based. As there is an increased need to share clinical data in order to track new diseases, coordinated public health infrastructures will become more critical than ever.

Escalating costs, inconsistent quality of outcomes and therapies, an aging population, clinical research that does not get incorporated into the mainstream of medical practice for up to a decade on average, rampant inefficiencies due to lack of readily available clinical information that already exists causing redundancy of diagnostics, inappropriate hospitalizations, medication errors, and preventable deaths are all plaguing the global health industry. Despite significant differences in the delivery structure and payment methods for healthcare, the issues from healthcare customers are remarkably uniform. The need to improve patient safety, contain the spiraling increases in healthcare costs, and match the expectation levels of the citizen living in a connected and digital age are coming together in the perfect storm of challenges for healthcare providers and governments funding health delivery.

Empowering *clinicians* to work more efficiently and effectively in the “digital workstyle” of the new world of healthcare work should be at the center of any healthcare delivery organization's strategy as it addresses the coming era of rapid change and increasing global integration.

As we move toward a world of healthcare that must become more fluid, less centralized and less certain about old assumptions and old models, Information Technology is evolving in ways that will empower providers, teams and individuals citizens to realize their potentials in a new world of healthcare work.

# Challenges, Trends and Proposed Solutions in Healthcare IT

With spending on healthcare just in the United States projected to reach \$1.9 trillion in 2006, improving productivity and efficiency in the delivery of service is critical as an economic priority for patients, providers and payers. It is also key to improving healthcare outcomes, extending access and saving human lives.

Information Technology can already make a significant difference with tools like Instant messaging, email and rich application-sharing environments to 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 information management enable more efficient form design, team workspaces and presentation of data from closed legacy systems in better-integrated, user-friendly formats.

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

As President Bush said in a speech on April 27, 2004, "It's like IT, Information Technology, hasn't shown up in health care yet."

## *Key Challenges*

### **Interoperability of Healthcare Information**

The seamless transfer of clinical patient information between and amongst healthcare providers is one of the greatest challenges the health industry faces. Healthcare provider systems vary in terms of modernity and sophistication, from paper-based systems to highly sophisticated web-based integrated information management tools. Information needs vary amongst practitioners, and yet, there is more clinical and research information than ever. Care providers simply do not have systems that enable them to synthesize and apply that information at the time of decision making.

Despite many advances in healthcare over the past half century, on-demand access to clinical information continues to be inadequate in most settings, contributing to duplication of effort, excess costs, adverse events, and reduced efficiency. Indeed, medical errors have achieved much negative press since the release of the 1998 study by the Institute of Medicine. It was estimated that preventable medical errors cause the death of between 44,000 and 98,000 US 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 data show that up to 70% of the time, clinical data were available to avoid the medical error.

It is often cited that these errors are not necessarily due to negligence on the part of individual caregivers. They arise because delivering care is a complex process. Individual care providers are often isolated from core clinical information; clinical care teams lack collaborative tools and instead rely 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 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 information from fragmented and incomplete sources, both electronic and paper based, with a high risk that important information, being hard to find, will be overlooked. Poor clinical data access results in poor clinical decision support leading to errors of commission and omission, worsening the cost burden for governments worldwide.

### **Clinician Adoption**

A secondary key challenge is that, though a government or hospital may provide core IT systems, none can force the clinical staff to use these systems. As long as computers in health and care processes remain separate, clinical staff will see recording care as secondary to providing care. A response to this natural and expected clinician behavior is that some governments are forcing their clinicians to deliver key patient clinical

data elements in electronic form for reimbursement purposes as a strategy to improve the adoption of these systems. This approach is doomed to fail—if a clinical system is so complicated that it takes hours of training and creates inefficiencies and potentially harmful errors due to the complexity of the software, the clinician is correct in refusing to use these systems.

A clinical system should be as simple to learn as electronic banking, or buying an airline ticket online. The most successful deployments of clinical information systems for clinicians will little or no formal training, allowing the clinician to be efficient shortly after working with the system. Functions necessary for clinical care should be easy to remember after a hiatus in system use, or traveling from one hospital to another. The less intuitive a system is, the more it is prone to human factors breakdowns. The need for significant amounts of clinician training may be an indication of poor system design and should be avoided.

The primary purpose of a clinical information system must be straightforward: show all relevant clinical information. Make this information available on any device, at any time, in any place, to anyone that is appropriately authorized to see this information. The information should be available quickly, and easy to find. A network of clinical information systems should be the basis for global solutions that ultimately will 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.

### ***Key Trends***

Patients and citizens have increasing expectations on how healthcare should be delivered, especially in developed economies where they are used to having instant access to information and knowledge via digital media. Increased access to online information on health topics is common. Information on the performance of healthcare delivery institutions and doctors is now being seen by patients and fundors.

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

### **Mobile Computing**

The benefits of mobility in the delivery of healthcare services are readily apparent. Doctors and nurses spend most of the 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 life saving and mission critical. This demand for mobility in healthcare operations is evident in the fact that hospitals and medical practitioners were among the early adopters of paging.

Today, over 95% practitioners in the US use mobile devices of some kind: pagers, cell phones, PDAs, and various mobile computing devices. More than 90 percent of clinicians interviewed under the age of 35 use some form of reference application on a daily basis. Grass roots initiatives are inciting large numbers of medical clinicians to purchase handheld devices that are being used primarily for drug reference databases, reference manuals and medical calculators.

Mobility solutions are a key element in providing real-time access to patient information, decision support and collaboration tools, while ensuring information security and allowing for 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. Finally, by giving nurses, doctors and administrators the tools to access critical information and remain more accessible to patients and peers, mobility solutions enhance job satisfaction by allowing staff to spend more time on patient care and less time chasing clinical information.

What if doctors could access clinical information databases from the patient's bedside? 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 into electronic charts at mobile carts and reduce duplicate work? A key opportunity in healthcare is using technology to bring information to the appropriate people – anytime and anywhere – expediting care decisions. Mobility solutions blend a combination of wired and wireless data services that give clinicians access to powerful information and resources no matter where they are located in the hospital.

Widely accessible Wi-Fi and Wi-Max devices and a myriad of other devices that take advantage of the bandwidth can transform the capability to access information at the point of care, and anywhere else it is needed. Similarly, mobile nurse carts, tablet PCs, PDAs and laptops connected to the wireless LAN (WLAN) network allow clinicians to immediately record medical information 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 monitoring systems, tele-consultations, personalized care, and individualized treatments.

### Consumer Driven Health

Consumer driven healthcare is a shift in how to deliver health—focusing 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 consumers to work with their physicians and health care providers to create a better health care outcome for themselves and their families. By doing so, health care usage is more cost efficient with empowered and knowledgeable consumers who use information tools, and ultimately consume fewer health resources due to their improved health. Price and quality transparency about health care professionals is a key method for effective consumer health care choices.

Proponents of consumer driven health understand that funders of health will have to focus on outputs and outcomes of health expenditures, rather than inputs to the current health delivery system (diagnostic tests, visits to the doctor). This paradigm shift can only be accomplished when the patient is intimately involved in his or her 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 the patient is the owner of all relevant clinical information for the purpose of healthy outcomes. The PHR will be a driver of better health and better health information systems overall.

According to IDC data, spending on personal health records is sub .5% of the overall IT spend. Despite this spending trend, there is recognition by funders of healthcare delivery systems that an additional factor in cost reduction is to involve the patient fully in the management of their health, for both acute and chronic conditions.

### Microsoft Capability in Healthcare

#### 1. Applications & Devices Capability

Enable healthcare staff anywhere to work productively and effectively using PCs, PDAs, tablets, phones and notebooks. Applications developed on Microsoft Windows XP and .NET provide an adaptive, responsive and rich interactive experience by leveraging resources on the device and intelligently connecting to data services. Microsoft Office 2003 provides an extensible environment for managing information, collaborating and connecting.

*Technologies: Microsoft® Windows XP, Microsoft Office 2003*

#### 2. Network Capability

Provide a unifying layer of common services across your entire IT infrastructure - from an enterprise data centre, to a hospital, remote surgery or medical centre. The Windows Server 2003 family provides file and print services, terminal services, storage, remote access and virtual private network services, streaming media, collaboration services and wireless networking.

*Technologies: Microsoft® Windows Server 2003, Microsoft® Virtual Server, Microsoft® Storage Server*

#### 3. Security Capability

Provide end-to-end protection so that you can confidently implement networked solutions across your health organization. Microsoft Active Directory provides pervasive identity management, authentication, authorization and secure communication across your entire organization - devices, users and systems. This is complemented with technologies like Internet Security & Acceleration Server 2004, an advanced application-layer firewall; Virtual Private Network and Web cache solutions; and Identity Integration Server, a technology that enables easy identity management across disparate platforms and applications.

*Technologies: Microsoft® Windows Server, Microsoft® Identity Integration Server 2004, Microsoft® ISA (Internet Security and Acceleration) Server 2004, Sybari*

#### 4. Data Capability

Put your finger right on the pulse with accurate, up-to-the minute data analysis of occupancy rates, resource usage, true costs, staff overheads, etc. Predict needs and price services accurately to improve productivity and reduce overheads. Microsoft SQL Server 2005, a data management and analysis solution enables information to be shared across platforms, applications, and devices, making it easier to connect internal and external systems. Not only is it highly secure and available, it also makes IT professionals more efficient by reducing the time it takes to build, deploy and manage scalable enterprise data and analytical applications.

*Technologies: Microsoft® SQL Server 2005, Microsoft® Visual Studio 2005*

## Retail Healthcare

Commoditization of healthcare services is becoming more accepted by consumers. The idea of retail healthcare, or healthcare clinics in airports, shopping malls, department stores, with services paid in cash and delivered by nurse practitioners, physician assistants, or GPs to help consumers with simple health problems makes good common sense. Waiting times to see doctors in many countries are getting longer and longer, and if the mass marketization of simple health problems can occur with good supporting clinical intelligence engines, and there are clear cost parameters for the consumer, then these pressures can be alleviated; producing a positive outcome for the consumers themselves and the governments they elect. This is a new area of healthcare delivery transformation, and is taking off in urban markets where it is otherwise difficult and time consuming to see a clinician. Most simple health problems can be treated economically by following strict clinical best practice protocols. As consumers are forced to pay more out of pocket for healthcare services and as information becomes more widely accessible, retail markets can emerge. Medical service providers can begin to compete more based on price, convenience, high tech, and high touch.

## Worldwide access to the healthcare economy

Information technology can enable globalization of the healthcare economy. If medical services can be provided remotely, they will be. Services such as radiology and pathology are already being performed for remote and rural locations. Maritime medicine services provide healthcare to sailors who are often in remote locations for months at a time. Increasingly, the phenomenon of *medical tourism* is growing as people facing higher deductible coverage or no coverage at all seek medical procedures at a lower cost in countries such as India, Thailand, and Mexico.

## Coping with shortages of qualified professionals

Aging baby boomers are beginning to affect the healthcare system at the very time that labor shortages of providers and other healthcare workers are becoming more acute. Price pressures on the industry can demand lower-paid workers, causing more reliance on mid-level and low-level providers of service. Whilst this can create short-term positive effects both in terms of cost savings and improved care for the countries benefiting from this emigration of health workers, the longer term effects on the source countries for these workers must be considered.

## The Central Role of Information for Clinical Workers

Improvements in clinical information acquisition, storage, retrieval, sharing, and presentation must be a primary goal in any nation's health care strategy. The first and most pressing problem is that already existing information typically residing on old generation legacy systems generally is not available when and where and in the manner it is needed. Information that often is not readily available include test results, images,

### 5. Applications Services Capability

Reduce the time it takes to develop and deploy the smart client, Web, mobile or Microsoft Office-based applications you need. Together, Visual Studio 2005 and Windows Server 2003 provide a unified application platform with a consistent programming model that enables developers to deliver dependable applications that perform across multiple devices, and which interoperate with your existing business applications. An integrated programming model through the .NET Framework enables an unprecedented level of software integration using XML Web services, while Internet Information Services within Windows Server 2003 delivers Web security, reliability and speed. Visual Studio 2005 Team System provides integrated and extensible software lifecycle tools that improve communication, collaboration and productivity.

*Technologies: Microsoft® Commerce Server 2004, Microsoft® Speech Server 2004, Microsoft .NET framework, Microsoft® Visual Studio 2005*

### 6. Business Process Integration Capability

Integrate your healthcare systems, employees and partners more efficiently and effectively. Business activity monitoring tracks business processes while sophisticated workflow technology automates the flow of documents, streamlining activity sequences and interpersonal interactions. The result is that your business processes are tightly managed and interactions are automated in a highly flexible manner. The combination of BizTalk Server 2004 and the BizTalk Accelerator for HL7 lowers the cost of business process integration by reducing complexity and leveraging XML Web Services.

*Technologies: Microsoft® BizTalk 2004, Microsoft® Host Integration Server 2004, Microsoft® Visual Studio 2005*

### 7. Business Intelligence Capability

Provide an integrated real-time, in-depth view of business data to every level of your healthcare organization to support daily operations and drive decisions. SQL Server Data Mining can reveal patterns and trends in patient treatment quality, safety, outcomes and efficiency so that you can plan, predict and deploy resources more accurately and cost-efficiently. Microsoft Reporting Services give you the option of paper, interactive or web-based reports to suit your management style.

*Technologies: Microsoft® SQL Server 2005, Microsoft® Office 2003, Microsoft® Business Scorecards Manager*

medication and allergy information, chart notes or entire charts, and information about the care process itself. As we move toward a future in which comprehensive electronic medical records are globally accessible, the most important first step is simply to get all existing data into the hands of clinicians and other end users.

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

Given the great variability that exists in the types and forms of medical data, the urgency of the problem, and the impossibility of modifying or replacing all existing legacy systems within a reasonable amount of time, what is needed today are data platforms that can aggregate all types of information and make it available in a unified context. Most data are not entered de novo by physicians or nurses but are scavenged from existing sources or captured by sensors.

The primary requirement today is for comprehensive data systems that deliver seamless access to all existing clinical and management information, regardless of 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 and authenticated user. Clinical data can be defined as any data required for medical decision making at the time of patient interaction, to include text data, lab data, image data, and radiology data.

## The Way We Will Deliver Healthcare

Comprehensive clinical information systems that provide unified access to all existing data are an important solution to the immediate problem of fragmented healthcare data islands as well as an important platform to support future decision support and data entry functions. Such systems offer tremendous potential value by reducing the frequency of medical errors and adverse events, improving diagnostic accuracy, and reducing 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 Dialtone*

Healthcare dialtone is the concept of health information as a utility—as ubiquitous in its availability as a phone signal. The transformative power of information in the medical arena has little or nothing to do with making doctors and nurses type new data into the system and everything to do with making the existing data widely available to those decision makers caring for patients. The Center for Information Technology projected \$88 Billion in savings per year from ubiquitous health information technology in the US alone.

### **8. Collaboration Capability**

Connect healthcare workers and teams with the information and resources they need to work more efficiently. SharePoint Portal Server 2003 aggregates information from diverse systems into one intelligent portal with a single sign-on and search capabilities so that staff can access relevant information quickly. Flexible deployment options and management tools enable IT staff to distribute information to audiences based on their role, interest, security group or other membership criteria. Healthcare workers can personalize the portal content and customize the layout to suit their needs.

*Technologies: Microsoft Office® SharePoint Portal Server 2003, Microsoft Office® Project Server 2003, Microsoft® Content Management Server 2002, Microsoft Office 2003*

### **9. Communications Capability**

Enable healthcare workers to confer and consult in the way that suits their work style by seamlessly switching between video-conferencing, telephone, email and instant messaging. Microsoft Live Communications Server 2005 and Office Communicator Live Communications Server 2005 combine to provide a scalable, enterprise-class solution capable of delivering instant messaging as well as converged voice, video and data on multiple devices. Microsoft Exchange Server 2003 ensures the robust security, availability and reliability needed to provide healthcare workers with access to critical business communications wherever and whenever they need it.

*Technologies: Microsoft® Exchange Server 2003, Microsoft Office® Live Communications Server 2005, Microsoft Office® Communicator 2005*

### **10. Systems Management Capability**

Deploy a highly secure, integrated operations infrastructure that is easy to implement and cost efficient to manage. Microsoft Systems Management Server 2003 provides centralized provisioning and management of desktops and servers, including the distribution of security patches, right across the healthcare organization. This reduces your administration overhead and makes it easy to scale. Microsoft Operations Manager 2005 reduces support costs for healthcare applications and services by providing comprehensive event management, proactive monitoring and alerting, reporting and trend analysis. System Centre Reporting Manager 2005 provides management reports which consolidate change, configuration, event and performance information from the previous two applications.

*Technologies: Microsoft® Systems Management Server 2003, Microsoft® Operations Manager 2005, Microsoft® System Centre Reporting Manager 2005.*

In an age of ubiquitous computing in healthcare, clinical information systems will make all data and computer-supported activities available wherever and whenever needed. The ability to access clinical data by consumers, by family members, by teams of providers, given the appropriate policy and systems to ensure privacy and consent will benefit patients and reduce costs. Rural and remote communities will benefit from clinical best practice guideline availability in an instant. Telemedicine will become the norm as clinicians could use consumer products like Smartphones or the XBOX to communicate with patients.

### ***The right information at the right time***

With the amount of clinical data continuing to increase at an exponential rate, data presentation technologies for the clinician and public health providers will become critically important. Clinical systems will be designed to help clinicians see the right amount of the right type of data wherever and whenever needed. Data presentation will be context-driven and patient centric and clinicians will be able to change what the system shows them in any given context, showing or hiding specific data elements to meet current data needs, on the fly in real time.

### **Non Intrusive Alerts**

**Realizing the Vision of Population based medicine.**

### ***Instant communication among care providers***

It's often joked that "no one goes into medicine for the paperwork," but paperwork and other low-level tasks compose a significant portion of most healthcare professionals' daily routines. Nurses spend only 25 percent of their time engaged in face-to-face patient care; the bulk of their time is administrative or information-seeking.

E-mail, IM, the Internet, electronic forms and other current-day technologies can dramatically reduce the volume of actual paper and improve control over information. Their wider adoption in the healthcare industry will doubtless produce many needed efficiencies. But each of these technologies also brings with it new practices that can add complexity and potentially replace one set of administrative chores with another. Smarter, more adaptive IW tools can help break the cycle of escalating complexity and substantially reduce the time healthcare workers spend managing, finding, routing and prioritizing information. Relieved of this burden, they will be free to bring their expertise and judgment to bear on tasks that can't be automated, and practice the art as well as the science of medicine.

### ***Team Collaboration***

Healthcare (globally) needs an infrastructure where healthcare professionals can access and share clinical records and information. Healthcare organizations also need to collaborate with one another in a seamless manner that revolves around a patient throughout the continuum of care. Standards based tools from Microsoft and its industry partners, can potentially streamline the way medical information is created, collected, accessed and stored, allowing clinicians, physicians, researchers and administrators to work together in integrated collaborative teams.

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

Health delivery during a natural or malevolent human caused disaster will likely occur in scenarios 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 when care is delivered in these areas. In the future, clinical 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 a new disease and its identification protocols. Clinical systems will also be capable of receiving and displaying alerts from public health authorities, such that doctors have real-time situational awareness of their health and disease environment. This will enable clinicians for the first time to identify consistently when an outbreak is occurring in a community, even for an outbreak as routine as the flu. Earlier identification of these events promotes early Systems in the future will focus on creating situational awareness in which clinicians naturally have a shared awareness of community health trends on a daily basis.

### ***Enable individual control of healthcare***

We live in an age of reactive, bricks and mortar health care. Most of us only come into contact with sophisticated medical instrumentation when something has gone seriously wrong with us, or if we've gone to a doctor's office or other facility to undergo some sort of test. 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 the concert schedule and theater tickets, but instead have home libraries, on-demand online access to more options that were inconceivable just ten years ago. Healthcare delivery in the future will entail significantly greater personal responsibility. With continued rising costs expected in every sector of health, and increased cost burdens being placed on individuals, as governments and employers cost shift to contain increases in their health delivery costs, individual citizens will need to be proactive to maintain health and wellness, prevent disease and admissions to hospitals, and incur fewer healthcare costs. In some countries, we are starting to see governments propose to recompense health care payments or tax citizens based on their own responsibility for their personal health.

To facilitate this greater control, individuals will need to have greater real time communication with providers such that they are better equipped to maintain their health. Individuals will have systems that improve chronic disease management, using real time tools to prevent exacerbations. Citizens worldwide will daily use systems that improve prevention and education for in-home therapy to avoid costly hospitalizations. Additionally, as the population ages, technologies will enable seniors to live at home more safely, and for longer periods of time. This will avoid the costs associated with long term care.

## **New Technologies for Clinical Systems to incorporate**

The following technologies are interesting indicators of new capabilities that will impact the way in which healthcare will be delivered in the upcoming decades. The following are descriptions of technologies that are not yet widely used. Clinical systems will need to be forward thinking in designing ways to incorporate the additional patient data created by these systems that are not yet deployed today.

### *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 fastest growing demographic population is citizens over the age of 80; the second fastest demographic are people over the age of 100. Unless more effective and less costly models of delivering healthcare services to seniors are deployed, nations will find themselves in the midst of a public health crisis that may threaten the health of economies worldwide.

Technology companies today including Microsoft are exploring digital home solutions that would enable the shift of care from traditional clinical settings to the home; and a responsibility shift for care from formal providers to individuals and their care network, usually family and friends:

Sensor networks are powerful new tools that can assist with caregiving across the continuum of care. These solutions will be enabled by a range of computing technologies that utilize wireless sensors within the home to automatically capture and record data on patterns of behavior; continually monitoring safety of an older adult, compliance with medications, diet and daily exercise or 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 recorded the activities of the senior, sending an alert for any adverse circumstance. These digital home technologies have the potential to improve elder health and significantly lower costs by maintaining health for longer duration, deferring more costly institutional care as long as possible.

Enabling the home to provide medical assistance requires that the home be equipped with distributed, cooperative computers, physiological and environmental sensors, and both wired and wireless communication capabilities. Furthermore, applications that provide medical assistance will require high reliability and must work with very energy-constrained, battery-operated devices that can be worn by the home's occupants or placed discretely throughout the home. These specialized sensor networks are vital to obtain data about the home's occupants as well as the external environment of the home.

Next-generation monitors, or even ingestible or implanted RFID (radio frequency identification) devices combined with powerful non intrusive computing will provide rich real-time information on patient health, monitor the quality and regulate the release of medication, and communicate with other IT devices in inpatient

or outpatient environments to reduce errors, assist nurses and clinicians, and provide data for more accurate diagnosis and treatment. Outpatients also could be monitored remotely, with care dispatched automatically in the event of an emergency. These devices are already being developed and tested with home sensor networks.

## ***RFID***

With RFID adoption, healthcare organizations can automate manual processes, increase operational efficiency, and improve the quality of patient care delivery by automatically capturing a variety of data necessary for patient safety, tracking of assets and patients, and materials management for healthcare providers. RFID enables the positive identification of patients, the ability to accurately track mobile assets and patients, and optimize inventory management and logistics.

For maximal 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 join-up care and processes. Active tags on objects and people that enter a 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 their digital photograph added to an electronic record. The photograph allows the clinical team to confirm they have the right patient and the electronic record ensures they perform the right procedure.

Automatic, accurate and reliable, RFID tracking will have many uses in healthcare:

- RFID-enabled tracking systems reduce inventory losses
- Enable the staff to locate a piece of tagged equipment by using a PC or mobile device, allowing for more time at the patient bedside
- Tagged surgical instruments are monitored for location and maintenance
- Staff and patients are located easily due to the tagged bracelets that they wear
- Tracking pharmaceutical product is a vital safeguard measure since it is estimated that upwards of 10% of pharmaceuticals distributed worldwide are fraudulent

## ***Robotics***

Today's robots can monitor the elderly, record the pattern of their daily life, watch for variations, and send alerts to the provider of care, increasing safety for elders. Robots are increasingly being enhanced with new sensors that could impact patient care in the home or the hospital setting, and this is the trend in robotic development. Using visual, ultrasonic and floor sensors, robots can recognize their environment. Moving with the aid of an eye camera and using kinaesthetic sensors, robots can give and take objects. Remote presence robots can allow a clinician to drive the robot to a patient's bedside, control movements of the robot's head, and even take a closer look at the patient or nearby monitoring systems. In very select healthcare organizations today, clinicians are using robots for remote video interactions with patients.

Increasingly complicated medical procedures are being conducted using surgical robots. Robotic surgery has been shown to reduce morbidity for complicated procedures and improved outcomes. Though a robotic surgery requires human remote control, it aids the surgeon with longer, more complicated operations.

## ***The Virtual Operating Theatre***

Rich, remote presence - voice, video, data and real-time application sharing - already is being used to deliver better healthcare in areas where medical professionals are scarce or unevenly-distributed. Technology is appearing today to support virtual operating theatres, where doctors can perform procedures remotely using natural-gesture interfaces to control servo-operated instruments while monitoring conditions in real time over the network. Similar technologies could also be used to enable doctors to collaborate on procedures in real time from remote locations. The motion data captured by these applications could also be used in training the next generation of healthcare 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, as well as the DNA and RNA, proteins, and small molecules that keep human bodies functioning.

Technology companies in health 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 improved understanding of human disease, drug discovery and variable drug reaction. This is the start of a new era in medicine - one where a more profound understanding of the biological and genetic basis of disease will pave the way for more effective ways to diagnose, treat and prevent illness.

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 respond well to a drug, or avoid toxic side effects. A targeted approach to treatment can ensure that each patient receives the right medicine at the right time. About a dozen of such treatments are in use today, and the field is growing rapidly. Since 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 shift the focus of medical care from "disease treatment" to "health care management."

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

## **How can Microsoft Contribute?**

How can Microsoft help with the exciting yet troubling future of healthcare delivery? Technology today can improve access to clinical data for clinicians and patients; improve adoption of clinical systems by clinicians via focus on common user interfaces that reduce training time; securely share patient records and enable collaboration, enable integration despite legacy systems, and enable data capture for disease surveillance, and health alert networks.

Our vision for healthcare workers and healthcare delivery in the future is expressed as *Seamless Healthcare*.

**Seamless Healthcare. We are making the vision a reality.  
Our healthier future is already taking shape; it has already started**

To translate the seamless healthcare vision into reality, today's diverse systems and technologies need to be interwoven with software that enriches relationships and transcends boundaries to enhance the way that healthcare practitioners work.

In a seamless healthcare environment, smart devices, software and systems are combined to create a unified system that works on behalf of and under the control of the people within it. Personal, care provider and government connections are enhanced through rich communication and powerful, flexible collaboration tools. Diverse technologies, groups and organizations collaborate using flexible and intuitive solutions which enhance the ways they normally work.

In hospitals, seamless healthcare offers powerful and capable systems that dynamically organize and manage themselves so that the burden of implementation and management is no longer a barrier to technology adoption. New software and services offer exciting ways to improve the quality and safety of care and forge deeper connections with patients. In healthcare organizations, seamless healthcare connects people and groups, catalyses and connects business processes, and empowers managers with clinical and business intelligence. In the home, seamless healthcare empowers people with the communication tools to participate in decisions affecting their health and manage their own well being.

To implement successful patient-centric services through multiple channels requires seamless integration and secure information sharing across all tiers of government and the entire network of healthcare service providers. This will require changes to working practices, processes and cultures as well as the tools which enable employees to access, analyze and act on information, share and collaborate on documents, and manage business processes. Successfully implemented, seamless healthcare will bridge the digital divide and improve the quality and safety of healthcare services.

In the world of Seamless Healthcare Delivery:

Case notes travel with patients to ensure continuity and improve quality of care. Practitioners can wirelessly access patient records, drug databases and imaging. More accurate triage and diagnoses will save paperwork and lives.

Test results and medical images can be shared online while practitioners confer using video-conferencing or real-time text. Enable faster diagnoses without travel delays or expenses.

Administrators have a complete view of staff availability, equipment, beds, theatres, etc. Increased efficiencies result, reducing costs and maximizing use of facilities and resources. Efficient sharing of data enables admissions and discharges to be processed efficiently. Beds are freed up faster.

Residents can access wired and wireless nurse-call services. Surveillance and unobtrusive monitoring of shower times or lighting detects abnormal patterns and triggers alerts. Competitively priced satellite TV, IP telephony. Internet and Video on Demand provide entertainment and care options. This results in safer and better quality care.

Practitioners can access patient records to ensure appropriate treatment. Practitioners can develop video content and stream it to patients in their homes to speed recovery. Patients can pay online or using a swipe card with all of their claims being settled for them, 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 can 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. Health care becomes high tech and high touch.

GPs are empowered with all 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 practice, trials and cautionary advice from drug companies, as well as complete connectivity to other health entities. Less paperwork, more informed diagnoses leads to improved patient safety and outcomes.

Pharmacists are able to retrieve prescriptions online from the GP. Dosage and details are recorded in the patient's health record, which minimizes waiting times and paperwork, and ensures accurate prescriptions with safe dosage, leading to a reduction in medical errors.

A complete view of the healthcare system across all entities and the ability to deploy applications and transmit information can be created. Educational material can be streamed into consumer devices using video, broadband, GPRS or other network technologies. This enables improved access to healthcare for citizens.

Health fundors are able to review trends and demographic information, and claims can be processed at the point of care. Both of these have the potential to improve public health planning.

## A Peek into the Future

*From the patient's perspective:* Upon arriving at the clinic or hospital, the patient will use a biometric identifier to grant access to his confidential electronic medical record. The hospital staff, equipped with handheld devices, will be able to access all relevant information about the patient at the point of care, and the

software will highlight any precautions - such as allergies or drug interactions - to reduce the chance of error. As the nurse takes readings with instruments, the data will automatically be entered into the patient's record without requiring time-consuming entry by hand, and the associated risk of error. Doctors will easily be able to compare specific patient information to the records of millions of others in the system to zero in on a likely diagnosis and recommend clinical best-practices based on evidence. All across the hospital, systems will communicate with each other behind the scenes to coordinate tests, reserve operating rooms, assemble teams, and track resources. These systems extend from the doctor's handheld device to the insurance company's payment systems and to the patient's choice of pharmacies to dispense prescriptions, all behind a robust shield of encryption and security at the document/data record level, and privacy protection for the consumer.

***Automating and Speeding Tasks:*** Pattern recognition technology will automate many of the mental steps that workers themselves must now perform. What documents do I need for my 1:00 pm consultation? Is this blood test the most current? "Smart documents" and advances in "presence" discussed elsewhere in this whitepaper will enable a user to identify others in the health-care system that have, or need, to be consulted regarding a decision, and then automatically determine the quickest way to contact them.

Today, nurses spend only 25% of their time engaged in face-to face patient care; a majority of their time is administrative or information seeking. Adaptive filtering based on machine learning and pattern recognition will soon be able to automate a great number of those actions, simplifying tasks like scheduling, record retrieval and status reporting.

New options for data input will make it easier and more natural for healthcare professionals to interact with information systems. These will include natural language and speech recognition for data input and dictation, biometric authentication for security and single sign-on, digital motion-capture tied to surgical instruments, and "smart" medical environments that can record and adjust environmental conditions.

***Privacy and Security in the Healthcare System:*** Keeping patient information confidential and secure has been one of the major stumbling blocks in the adoption of networked IT solutions for healthcare and public health. Evolving information rights management (IRM) technology will address this challenge by enabling rights management of content at a more granular level. Individual sections of documents, cells of spreadsheets and fields in data records could be tagged as hidden to users who lack proper security credentials. This will enable the maintenance of a single document for public and restricted audiences, and a single set of IRM policies that operate transparently to end-users by relying on credentials implicit in the user's identity management profile.

Biometrics will play an increasingly prominent role in the security and privacy policies of future information work tools, avoiding the inconveniences and compromises of password-based systems. As these tools evolve, authentication will become less of an explicit declaration of credentials (e.g., providing user-name and biometric). Instead, applications will gather biometric information implicitly in the course of routine interaction with the system and use pattern recognition that relies on a preponderance of evidence to authenticate users without intruding on their workflow.

Over the next decade, the kind of sophisticated applications and computing horsepower that enabled researchers to sequence the human genome and advance medical science through genomics and proteomics will come within reach of mainstream providers, small labs, clinics and pharmacies. The migration of these tasks from highly specialized and expensive systems to the standard information work platform will bring the promise of individualized therapy within reach and create new high-value IW roles for mainstream professionals.

Health care is an industry that has heretofore run predominantly on human expertise. Clearly, though, there are ways in which IT tools are converging to enable medical professionals to spend more productive hours applying their skills to problem-solving, help healthcare information workers feel more empowered and in control of their time, and make collaboration and communication with colleagues easy.