IBM Healthcare Industry
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Future of healthcare: 2012

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Executive overview

An IBM white paper on how e-business and information technology will have a profound impact upon healthcare and the practice of medicine during the next decade.

It is the year 2012. Over the past 10 years, consumerism and technology have merged. In the healthcare arena, consumers are in charge of selecting benefits and deciding the level of risk versus benefits they desire. More options are afforded employees through employer-sponsored healthcare plans. In addition, consumers maintain their personal health record on a secured Web page, and data from all relevant healthcare providers is included. Pharmaceuticals are increasingly biologically engineered and custom fit to an individual's genetic makeup.

Security and privacy issues have been resolved. The question of medical record ownership has totally shifted as consumers have embraced ownership of their own Personal Health Records (PHRs) through secured Web sites. While physicians and hospitals maintain their own medical records, consumers now routinely grant limited access to their complete medical records, and can include alternative and home care. Most important, information technology has revolutionized how care is delivered.

Case scenarios

Harry

Instead of swallowing a nasty endoscope for a doctor to look into his gastrointestinal tract, Harry swallows a wireless digital camera the size of a vitamin. Complete with its own light source, the camera takes high-quality images as it navigates his digestive tract before being excreted in a few days. No muss, no fuss, and the stored digital images on the PC produce short video clips that are used by doctors to diagnosis his condition. These images are stored both in his hospital-maintained computerized patient record, and in Harry's personal health record Web site.

Ginger

Ginger keeps her medical records with her at all times. She has several options, but has chosen to have a microchip implanted in her arm. She maintains her own personal health record on her computer, which automatically updates her microchip, whenever she is in close proximity. When she visits her care provider, her data is downloaded to her physician's computer by granting access when she schedules her own appointment over the Web. In her doctor's office, both Ginger and her doctor update her personal health record at the time of the visit.

As blood work and other test results from her visit become available, they are updated in her personal health record automatically. Her implanted microchip also has a GPS, which can be used for emergencies, such as backcountry hiking trips if she and her party were to lose their way.

Ginger's best friend, Ann, has chosen a different option, and maintains her medical records on a universal personal identification card she carries in her purse. This one encrypted card serves as her medical record and driver's license, and allows her to use any of her credit cards. Her card includes the identical features and functions, including a GPS option.

Herbert

Herbert has diabetes. He is pleased with his artificial implanted pancreas. A sensor implanted in his vein measures glucose levels in his blood and transmits the readings via radio waves directly to his implanted insulin pump to release the precise amount of insulin. The readings are also sent to his wristwatch display, which Herbert uses to check his blood glucose level averages, sensor implant diagnostics, as well as to perform wireless data transmissions to his physician.

Herbert's health plan uses an automated system that generates push e-mails to his personal health record to remind him to follow up with his retinal exams, notifies the health plan, and updates a restricted portion of his electronic medical record Web page each time he visits his physician.

Mary Beth

Mary Beth is having a breast biopsy with robotics that includes a "smart probe." She is relieved that her biopsy will involve little more than a prick of a needle. Once inserted, the tip of the probe emits light beams that bounce off tissue. Based on the optical, electrical and chemical measurements, the probe zeros in on suspicious tissue. The probe can also deliver laser heat or radioactive seeds if treatment is needed.

Dr. Amos

Dr. Amos receives her patient's laboratory results back via her computer. The results are automatically correlated to her patient's electronic medical record Web page. The laboratory report is an "intelligent report." It suggests further tests that Dr. Amos may need to order, and medications she might want to prescribe. Dr. Amos can view selected portions of her patient's information from the computer on her desk, from a large screen digital television at home, or from a handheld PC/organizer/telephone combination device at any location. All medical records and images are synched up automatically and appropriately secured.

The importance of investing in IT

Investment in information technology is critical to a healthcare organization's survival, now and in the next 10 years. These scenarios are not just idle dreams. Overwhelming evidence exists that investments in information technology (IT) and business transformation (BT) have impressive payoffs throughout the healthcare system. In fact, technology investments and deployments are distinguishing factors between hospitals and health systems that are economic winners and those that are faltering. Hospitals and health systems that invest in IT and BT "have better control of expenses, higher productivity, and more efficient utilization management."[1] As these high-tech hospitals and health systems financially outdistance their low-tech peers, the gap between the two widens and becomes more pronounced. Having a healthier bottom line enables the high-tech hospitals to reinvest in and introduce more technology, such as Internet services to patients.

Gartner predicts, "By 2005, the automation of healthcare will be a requirement, not a differentiator."

Investments in IT and BT are no longer an option. These investments are a business necessity. Indeed, Gartner declares a state of emergency for the healthcare industry, stating, "The imperative for the healthcare industry: Nothing less than complete business transformation." Gartner predicts, "By 2005, the automation of healthcare will be a requirement, not a differentiator.[2]"

Everyone agrees that this 10-year scenario must happen. Healthcare providers, governmental regulators, members of Congress, vendors, and technology firms agree that increased use of advanced technologies is the only way to make healthcare services affordable and available to the greater populace. The use

of technology is necessary to realize sufficient productivity gains for caregivers to enable care for the ever-increasing and aging population. Technology will fuel the research discoveries that must occur through the correlation and extrapolation of massive amounts of data.

Given the imperative to immediately embrace IT, healthcare organizations will seek leadership from experts they know and trust – such as IBM. Over the past several years, IBM has developed an impressive cadre of clinical, financial, and administrative IT experts culled from all sectors of the healthcare industry. With this exceptional team, IBM can serve all segments of the healthcare industry with extensive IT and BT leadership – beyond what other vendors can offer. IBM represents end-to-end – conception to maturity – solutions and is the single name most often thought of in the e-business space that is so vital in solving healthcare's information and technology conundrum.

"There is no question that the only way to reduce the number of [patient] deaths is through automation and computerization – through the use of clinical systems."

Better clinical outcomes and reduced medical errors are highly dependent on clinical information systems that provide decision support and automated process tools capable of improving caregiver productivity. According to Daren Marhula, an analyst with U.S. Bancorp Piper Jaffray, "There is no question that the *only* way to reduce the number of [patient] deaths is through automation and computerization – through the use of clinical systems."[3] Now, and in the next 10 years, IBM's healthcare organization is well positioned to serve its healthcare customers in the clinical and administrative areas where they need help the most. According to a market intelligence report released after the 2002 HIMSS [Healthcare Information and Management Systems Society], "Clinical systems, HIPAA [the Health Insurance Portability and Accountability Act], mobile computing and security are the top provider issues."[4]

Why IBM is offering a healthcare 2012 vision

Why is IBM offering a healthcare vision for 2012 today – and why is it a 10-year view? IBM is convinced that information technology is the answer to helping solve crucial problems facing the industry. Because of information technology, the future of healthcare in the U.S. and other countries has the potential for tremendous gains in helping more people lead richer and longer lives. But this gain can only happen if decision makers throughout the industry commit to beginning implementation now.

Creating a long-term vision now demonstrates IBM's commitment to becoming a trusted thought leader in the healthcare industry and to helping providers, payors and pharmaceutical companies engage in the necessary strategic planning and implementation efforts.

With respect to the role of leading technology companies, Gary Aballa says in the February 2002 issue of *E-Commerce Times*, "The strong are getting stronger. It's ironic: A few years ago established companies felt threatened by dot-coms and were criticized for not developing online operations. But, they were wise to let the dot-coms make mistakes and then move in."[5]

After the dot-com shakeup, IBM has emerged in a stronger position as a trusted and knowledgeable resource for leadership in a rapidly changing healthcare industry. Leadership from IBM will include subject matter expertise that focuses on the technical requirements of HIPAA, systems integration, collaborating with leading software application providers, IT outsourcing, security, and clinical technical infrastructure requirements. These clinical infrastructure requirements will include controlled medical vocabularies and structured data capture. Controlled medical vocabularies are essential to clinical information systems and their ability to increase quality, reduce medical errors, ensure quality outcomes, and support best practices or evidence-based medicine.

Besides technology, IBM contributes another critical success factor to enabling the 10-year vision for healthcare – business transformation. Recognized as a business transformation leader in other industries, healthcare payors, providers and pharmaceutical companies are also now turning to IBM for advice, direction and solutions. Technology by itself lacks business focus; business transformation is essential to the success of any healthcare technology solution. Yet, when IT is combined with clinical process transformation, there is great promise not only for productivity improvement but also for innovation. The concept of "paving the cow path" applies. That is, taking a broken manual process and automating it often retains the inherent inefficiencies. Careful attention to evaluating current clinical processes and understanding the potential process improvements sets the stage for achieving dramatic results – streamlining processes, eliminating redundancies, reducing operating cost, and enhancing quality.

The healthcare industry is turning to established technology leaders such as IBM because:

Information technology (IT) will be increasingly used for all areas of healthcare
Information technology will be used in all areas of healthcare. Indeed, IT will be used in medical instrumentation and devices, diagnostic devices, home monitoring, pharmacy, implanted devices, and in both ambulatory and outpatient care delivery settings. The pervasive use of technology is driven by:

An aging population—According to the U.S. Census Bureau, the population of people 85 years and older that numbered three million in 1994 is expected to reach 19 million in 2050. The aging population will create greater demand for healthcare services.

Demand for clinical data—There will be demand for more clinical data outcomes as a business and an outcomes management imperative. Evidenced-based medicine is empowered by IT. Clinical information systems that contain codified data elements are the cornerstone of determining medical efficacy. That is, in 10 years when the majority of clinical data is captured and stored in a data warehouse, powerful algorithmic calculations can be performed. These calculations can advise clinicians as to the most efficacious medical management, at the right time, given the set of clinical diagnoses. People with multiple chronic disease diagnoses can benefit from the creation of individual treatment plans that are based on predictive outcome models derived from large data sets from patients with similar diagnoses.

Healthcare needs IT to curb costs and improve care

Advanced IT such as Web-based systems and pervasive computing technologies will be widely deployed in healthcare. IBM, as the world's premier IT company, is ideally positioned to be a healthcare IT leader by developing solutions, which improve healthcare services and cut costs.

Technology, in the form of clinical information systems, can reduce costs and reduce medical errors. Manual paper-based systems are no longer viable. The costs and inefficiencies associated with paper-based chart record systems are ridiculously high and the risk of error is unacceptable. The very structure of a paper-based system promotes problems. Patient care decisions are made by providers who may have only a portion of the patient's information. Pieces of paper can be lost or placed in the wrong patient chart. Handwritten orders and notes can be illegible, added late or altered.

Improved medical care requires assisted intelligence in the form of IT-generated decision-support systems. With the vast improvements in diagnostic, surgical, clinical and medical devices, and pharmaceuticals occurring every day, it is impossible for a clinician to be aware of or to retain these important new findings. Decision-support software provides the bridge between the art and science of medicine.

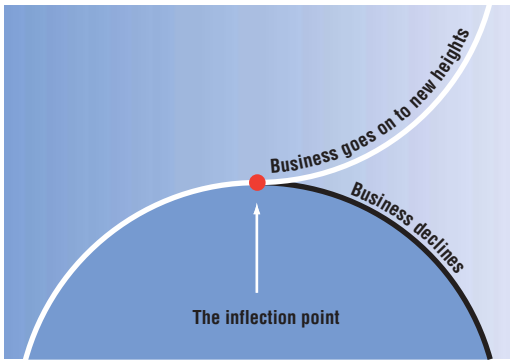
Technology advancements will fuel life sciences breakthroughs

The life sciences industry will use advanced IT tools to accelerate research breakthroughs in genomics and biotechnology. IBM's commitment to life sciences, combined with strong research and development and technological innovations provides a unique opportunity to contribute to the convergence of IT and life sciences.

Major market forces are merging to create momentous changes in healthcare

Remarkable change can only occur when a variety of market forces recognize a common problem and then converge in mutual agreement to solve the problem. The release of the two Institute of Medicine reports, the first in November 1999, "To Err is Human: Building a Safer Healthcare System" and the March 2001 report, "Crossing the Quality Chasm: A New Health System for the 21st Century," alerted the public to grave quality concerns in hospitals. The two reports have galvanized the employer and payor communities to put pressure on providers – individual clinicians and the hospitals and institutions they serve – to improve patient safety and reduce medical errors with a combination of policy, procedures and technology. The resulting monumental shift can be described as an inflection point. In the field of mathematics, the inflection point signifies a point of momentous shift.

The inflection curve



Source: The Millenium Health Initiative 2001

There are multiple forces that are melding together to create a shift in our future direction. These forces are arising from employers, consumers, economics, healthcare, politics, pharmaceutical/life sciences, and medical as well as information technology.

Major forces are:

- *Increased cost of healthcare*
- *Growth in population and aging of the population*
- *Greater awareness of public safety issues and bioterrorism*

Major technological advancements are:

- *Increases in bandwidth*
- *Advancements in wireless technologies*
- *Improvements in storage capacity*
- *Enhancements in screen resolution*
- *Advances in decision-support systems*
- *Improvements in Web acceptance and extension into common life*
- *Integrated clinical and business application software*
- *Advances in telemedicine*
- *Improvements in e-business transactions*
- *Enhancements in data warehouses and data mining*
- *Advances in mapping the human genome*

The major market forces and trends that will stimulate changes in healthcare by 2012 are:

Employer forces

From 2002 to 2012, employers will remain a strong force. They will continue to lead the charge for transformation and the use of technology in healthcare. They will be driven by ever-increasing costs of providing healthcare coverage for their employees. IBM was a founding member of The Leapfrog Group, which became active shortly after the first Institute of Medicine (IOM) report was published.

The Leapfrog Group is growing in membership, which is now well above the original cadre of the nation's largest employers. From the initial three IOM recommendations they started – 1) electronic order entry; 2) use of intensivists in ICUs; and 3) high volume for high-risk procedures – Leapfrog continues to push for compliance with other recommendations. Using their significant economic clout, employers will continue to play the role they have established for themselves – urging implementation of the Institute of Medicine (IOM) recommendations.

Consumer forces

Consumerism – Consumers are demanding quality and choice. Fed up with limited choices and bickering with HMOs, the trend for decreased enrollments in HMOs that first began in 2002[6] is likely to continue. Unfortunately, greater choice often comes at the expense of the pocketbook. Consumers are likely to shoulder larger portions of healthcare costs as they customize their health benefit plans to fit their unique needs.

Healthcare literacy – The overall healthcare IQ of consumers is rising. The use of Personal Health Records (PHR) will increase. Consumers will maintain their own electronic health and medical records and update them as they seek care. Providers will increase their preventive healthcare role as consultants, advising the patients about their care and treatment options.

Discretionary healthcare spending – The consumer is likely to elect discretionary healthcare spending, such as genetic tests or wellness panels. In addition, consumers are likely to observe the quality indicators for their providers, monitoring quality report cards and physician profiles.

Healthcare forces

Medical technology and genetic breakthroughs – Medical technology will continue to snowball, growing, and gaining speed and momentum. Genetic breakthroughs will be remarkable. The use of electronic order entry with decision support, alerts and reminders will reduce medical errors and enhance healthcare quality.

Quality incentives – Quality outcomes will be monitored and measured. The newly emerging trend of rewarding providers on the basis of quality outcomes will replace the practice of rewarding providers on how much money they saved the health plan. As has been shown in other industries (e.g., Toyota Production System), addressing quality is the first step toward improving the bottom line. In healthcare, adherence to evidence-based medicine and use of decision-support tools will be included in quality incentives by the year 2012.

Preventative and disease management – Disease management will morph into customer relationship management (CRM). The use of data warehouses and data marts will automatically trigger alerts and reminders for patients to perform and record care sequences. That is, if patients need to weigh themselves and take their blood pressure before taking medication, the computerized PHR home care system will remind them. An arsenal of home care monitoring devices will record, store and update their PHR and notify their provider electronically. Disease management will no longer include only the chronically ill. Lifestyle management and monitoring systems for healthy individuals are likely to become commonplace.

Alternative medicine – Alternative medicine will become known as "integrative medicine." The major health plans are likely to follow Humana and Kaiser Permanente's lead, including offering some alternative medicine in the total care of the patient. To be sure, these alternative/integrative practices will be closely monitored and included in outcomes measurement and management through the use of sophisticated electronic data collection and analysis. Alternative/integrative medicine practitioners will participate in computerized data reporting and will be included in team practice at hospitals. This will be driven by consumer demand, and will continue the trends started in the 1990s.

Skills shortages – Although there will be continued shortages of healthcare workers, there will be some easing of the problem in some fields. The shortage of nurses will ease slightly as nursing school enrollments, which had their first upturn in years in 2001, help with the supply component of the problem.

The retention side of the shortage problem can be reduced through the use of technology in the workplace. In nursing, automated process tools will greatly reduce the non-patient care portion of nurses' workloads. Currently, in the non-technologically automated world, non-patient care duties absorb over 75 percent of a nurse's time.[7] Technology, through the use of automated process tools, can dramatically reduce this percentage, allowing nurses more time to provide direct care. Greater job satisfaction is likely to ensue, diminishing the flight of nurses leaving the hospital setting. Automated process tools will become increasingly sophisticated, extending to automated supply requests (with automated charge capture and billing and reorder capabilities that communicate with the inventory control system and automatically reorder used items from the medical supply firms). These sophisticated automated process systems will produce decision-support information that determines nursing staff requirements.

Political forces

Larger government role – The government will play a more pronounced role in developing and maintaining healthcare's technological infrastructure. Over 50 percent of patients are over 65 years of age and are Medicare beneficiaries. Reimbursement is based on a formula of predetermined payment for diagnostic related groups (DRG) for inpatient services. The former practice of "cost shifting," in which hospitals made up the losses they incurred on Medicare reimbursements, was stymied long ago by aggressive contracting by managed care companies. Being subjected to price regulation and unable to set prices for services, many hospitals lack the funds to pay non-regulated technology vendors.

The inflection point where merging forces are coming together includes the role of the government. Just as the national highway system received funding after World War II to facilitate troop movement, an electronic communication infrastructure through the Centers for Disease Control (CDC) is now receiving funding post September 11 to enable rapid communication in case of terrorist or bioterrorism attacks.

Grants, which became available in 2001 for hospitals to use to purchase technology, are likely to grow to the point where they resemble the Hospital Survey and Construction Act, widely know as the Hill-Burton Act. When enacted by the federal government in 1946, this act provided US$4.6 billion in Hill-Burton grant funds to modernize hospitals, which had fallen into disrepair from a lack of capital investments throughout the Great Depression and World War II. Over 6,800 hospitals in 4,000 communities were beneficiaries of these grants. In the next 10 years, the government is likely to fund clinical information technology, rather than bricks and mortar, in hospitals.

Demands for drug price controls – Demands for drug price controls are likely to continue as the population ages and as U.S. medical care relies more heavily on prescription drugs. In addition to price controls, there will be continued pressure for the government to provide a prescription drug package. Currently, Medicare does not pay for pharmaceuticals. Direct-to-consumer advertising, which has increased the demand for expensive drugs, has some experts worried that unnecessary or inappropriate use of medication can result. The price controls will include formulary maintenance by states. States are likely to continue the trend to allow pharmaceutical companies to include their drugs on the state formulary in exchange for services such as disease state management and monitoring.

Demands for tighter privacy and security – Security and privacy issues are likely to continue to be a high-profile area. The HIPAA regulations, which include provisions to protect the privacy and security of certain patient data, will continue to strengthen and grow. IBM projects industry and government will together make a national investment of US$50 billion in HIPAA compliance efforts in the next 10 years. Currently, HIPAA covers all major transactions such as eligibility, claims and claims status, remittance advice, benefits enrollments, and authorizations. Future standards may cover first report of injury, claim attachments, and electronic medical records (EMR). During the next 10 years, the HIPAA paradigm may be expanded to include requirements for EMR. In 10 years or less, the implementation of HIPAA-compliant systems will facilitate the creation of uniform comparable national data on utilization payments, especially epidemiology patterns and clinical practices.

Pharmaceutical/Life sciences forces

Genomics and genetic tests – Advancements in human genomics are spurred through greatly increased computing capacity. Computational capacity for terabytes of data is required to customize treatments specific to a person's DNA makeup. The availability of gene therapy will provide hope and promise for individuals whose genetic makeup indicates the presence of a genetically linked disease.

Molecular testing – Currently, molecular testing revolves around sophisticated methodologies and centralized testing, largely focused in specialized laboratories, where costs and turnaround times are high. Within 10 years, the lab testing market will move downstream. Distributed diagnoses will be, according

to Richard Smith with Coates & Jarratt, Inc., performed regularly and non-invasively in patients' homes.[8] Microfluid technologies such as "lab-on-a-chip," microelectro-mechanical systems, nano-electromechanical systems, and ultimately nanotechnology will drive the transition to having 80 percent of diagnoses available at the molecular level. One company is already driving toward a handheld DNA detection unit. The unit's bioelectronic detection chip can identify the bacteria causing an infection and determine the most effective antibiotic. The digital data can be transmitted wirelessly to a physician's pager or personal digital assistant (PDA) or to a laboratory.

In the next 10 years, DNA and RNA diagnostic testing devices will continue to shrink, in cost, size and complexity. These factors will drive a genomics race that will include infectious disease, oncology, genetic testing and pharmacogenomic diagnoses.

Medical technology forces

Microelectronics – Microelectronics advancements are nothing short of remarkable. Harry swallowed an endoscope the size of a pill, which contains its own light source to send back images of his digestive tract. Herbert's implanted artificial pancreas sensed his blood level before administering a dose of insulin. Retinal computer chips will be used to restore sight. A diagnostic toilet analyzes human waste for diseases, low fiber and pregnancy. It will even send an e-mail to the consumer's physician about potential medical problems. The new toilet will screen for such health problems as diabetes and colon cancer by examining urine and stool samples. A wearable defibrillator can sense erratic heart rates and rhythms and deliver a life-saving jolt. Wearable, "smart," shirts that

have 40 sensors woven into the fabric collect and send data 50 times per second via a cable imbedded in the shirt to a handheld computer located in the patient's belt. On the whole, medical electronic devices are decreasing in price and becoming smaller, lighter and more portable.

Telemetry – Telemetry takes on new emphasis in the coming years. It expands on the current trend of remote monitoring and helps hospitals meet the Institute of Medicine and Leapfrog quality goals. Originally used mostly for cardiac monitoring, telemetry is expanding to include new areas such as obstetrical monitoring. As the uses and applications for telemetry expand, these changes will spawn changes in hospitals. Planning for the future, new hospital construction is gearing up to telemetry enable all hospital rooms. Telemetry in hospital emergency departments is rapidly being addressed in both renovations and new construction. The latest emerging trend, which is expected to spawn improvements over the next 10 years, is "intelligent telemetry." These intelligent systems will support microchips that read and transmit the EKG patterns and offer immediate treatment in the form of defibrillation from a small wearable device. Safeguards will be built in to prevent erroneous jolts. Select telemetry data capture will be part of the electronic medical record. For example, the telemetry system will be able to be programmed to capture a sequence of data at defined intervals following dosages of various medications. Using the power of a data warehouse, this data can be correlated with larger sample sizes of patients to assist with understanding the efficacy of drugs.

High-resolution diagnostic imaging – High-resolution diagnostic imaging will continue to progress. These systems will have three-dimensional viewing capabilities. Surgeons will be able to use these images to simulate surgeries prior to operating on the live patient. Combined with knowledge of tissue densities and resistance, procedures can be learned in the laboratory with realistic vision and sensitivity to touch. Probes that sense differences in tissue structure and heat sensitivity are likely to be used in conjunction with imaging to pinpoint suspicious areas for a guided view. Smaller cameras, such as the vitamin-sized endoscope, which have their own light supply, will increase and have broader uses.

Bionics – The area of bionics will be enhanced by additional information technology advances. Research is now underway to support the use of microchips to provide an electronic eye to restore vision in the blind. Computerized, man-made body parts will be enhanced by technology.

Telemedicine – The next-generation Internet will give telemedicine a huge boost. With the advent of an advanced Internet that can move data 1,000 times faster than the present Internet, radiological consultation workstations will emerge. These workstations will enable remote consultations from radiologists. Through the use of interactive image analysis via asynchronous transfer mode networks, patient data sets as large as 50 megabytes could be viewed. Another boost for telemedicine advancements will also come from the National Aeronautics and Space Administration (NASA). As NASA searches for efficient ways to provide healthcare for astronauts on the International Space Station, the earth-bound will also reap the benefits of their innovation. When the space station is

completed in 2004, it is expected to have the capacity to provide telemedicine services to astronauts. The telemedicine services will have two components: 1) a distributed medical network among the 16 partners of the International Space Station; and 2) next-generation devices and equipment that use artificial intelligence and other technologies to diagnose and provide treatment. For example, high-intensity ultrasound to perform noninvasive vascular surgery.

Information technology forces

Internet – The Internet will become more pervasive, spurring efforts to improve information-transfer speeds. Two research projects, Internet2 and Next Generation Internet, are working to develop and deploy advanced networking applications and technology. The National Institutes of Health has a number of initiatives in development for Next Generation Internet applications for healthcare. These initiatives include medical image reference libraries, radiology consultation workstations, and remote control medicine. Web applications will flourish. For example, Web-based applications such as robotic surgery, requiring speeds of 75 megabits per second, could be controlled from a distance. Application service providers (ASPs) use the Internet to provide service applications from a remote site. ASPs can get implementations up and running within weeks and provide an attractive financial option for healthcare organizations. Internet security will remain an area of concern. This concern will heighten as Web-based healthcare applications increase.

Mobile computing – Mobile computing makes sense for a healthcare workforce that is highly mobile. Mobile computing is beginning to take off and is expected to have rapid growth. In the inpatient area, a major concern was protecting wireless telemetry from interference. Last fall, the Federal Communications Commission (FCC) introduced a protected wireless telemetry service. By using this new frequency, data is kept off of the 802.11b frequency and television channels. In the next few years wireless telemetry vendors will update their wireless telemetry systems to the new frequency standard. With bandwidth increasing and costs decreasing, wireless solutions will steadily increase. More advanced standards, such as wireless application protocol (WAP) are likely to spur advancements in specialized content, provided that the current high price tag declines over time. Only time will tell if Bluetooth, a standard that allows the passage of data at high speeds within a "personal area network," will be accepted. Improvements in mobile devices will also promote greater appeal from and adoption by clinicians. Improvements in screen clarity and color enhancement along with greater data processing and storage capacity will enable devices to support a larger array of clinical applications. Mobile technology will be further buoyed as clinical information systems vendors add wireless components to their offerings.

IT outsourcing – IT outsourcing is expected to continue to be popular as healthcare organizations require a combination of technically advanced staff and sophisticated diagnostic and self-healing technology to support complex and highly integrated systems. Outsourcing options include a wide range of services that run the gamut from selective outsourcing to total outsourcing.

Smart cards – Smart cards are likely to improve as storage and security capabilities increase over time. These cards could be replaced by the implanted microchip that will contain a person's medical record. When combined with wireless technologies, an individual's PHR can be updated with current vital sign data generated from a wearable sensor-laden vest. Smart cards may remain as an alternative for consumers who are opposed to or for some reason are allergic to an implantable chip. These cards are likely to become universal cards that contain government data (e.g., driver's license), financial information, such as credit cards, and electronic health records.

Speech recognition – Speech recognition will get a lift from advancements in the areas of natural language processing (NLP) and through the use of "smart systems," which are capable of learning an individual's speech patterns over a period of usage. In healthcare, the use of dictation is likely to remain until such time as clinical applications can cover the range of medical-based descriptive terms required for progress notes and consultations. The new IBM WebSphere® Voice Server for Transcription uses IBM's award-winning ViaVoice® technology. Clinicians are able to dictate medical reports into a device or a telephone and have their work returned as text. Future advancements are likely to use NLP to recognize words and phrases and translate these into codified data. All of these advancements are already starting to show up on the market.

Data analysis tools – Advancements in clinical information systems will provide the data sources for feeding impressive data analysis tools. Data warehouses and data marts will offer the ability to rapidly find answers to clinical and business questions.

Healthcare data standards – In the future, as it is today, standards must constantly develop to keep pace with technology. Standards must assist rather than hamper developers. Health Level Seven (HL7) was founded in the mainframe-centric world of 1987. At the time, the primary computing focus was billing and management. Technology landscapes of today and in the future are much different. System architectures are vastly different. Systems are disaggregated to the point where functions of a single application can be split among several servers. Networks are ubiquitous and more easily programmed. Up until a few years ago, a handful of messages conveying patient demographics, basic orders and results were communicated in character syntax across asynchronous communication channels. Today and in the future, new applications and the latest technologies such as Extensible Markup Language (XML) and public key infrastructure (PKI) need to be supported. HL7 is being reengineered. The HL73 version will support messaging, and structured documents. As the standards advance, careful consideration of semantic precision will be important. The need for ensuring that data elements mean the same thing becomes paramount when data is used dynamically to diagnose and treat patients.

Conclusion

There are multiple forces coming together to form a new inflection point, resulting in a new direction for healthcare that will occur within the next 10 years. Changes in demographics, greater consumerism and rapid advancements in medical, biological, and information technology are converging with public and private mandates for improvements in patient safety, care delivery, and the protection of public health.

Over the next five to 10 years there will be a progressive rise in the practice of "biognosis." Biognosis is a Greek word that means "life knowledge." That is, it combines diagnosis of disease with predictive and preventable medicine. It will represent the extension of daily e-health interactions in the home from keyboard to monitoring devices. The individual's personal health record will be enabled by IT to deliver realtime, relevant, individual-centric solutions. Biognostic sensors will include optical devices for eyes and ears, advanced extended wavelength light detection for skin, and biomembrane bio-emission and fluorescence bio-electrical devices for the nervous system. The cardiovascular system will have rhythmic, volumetric, sound, pressure, and temperature sensing devices. Devices for molecular integrity detection will aid cancer detection.

In the next 10 years, improvements are likely to occur in three distinct phases. In the next four years, the first stage, *Activation*, will occur as providers scramble to implement clinical information systems and automated process tools and meet the HIPAA security and infrastructure standards. The drivers for this stage include employer healthcare purchasing groups, such as Leapfrog, and consumer and clinician demands for quality. Providers will gravitate

towards implementing clinical information systems because of financial and business reasons. Indeed, industry documentation of positive ROI for clinical information systems will lure even the technology laggards. The second stage, *Standardization*, will occur in four to seven years. The various clinical information systems will stabilize and adhere to standards generated by HIPAA, which will look to various standard-setting organizations to set *its* standards. The final stage, *Convergence*, will occur from seven to 10 years from today. During the convergence stage, the various individual-centric biognosis, monitoring, clinical information systems, decision-support technology, care delivery, and healthcare financing come together to provide an integrated and seamless approach to healthcare.

For more information

To learn more about IBM's Healthcare Services visit our Web site at:

ibm.com/solutions/healthcare

About the author

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