

The Price of Mobility

Prepared by HealthCIO Inc
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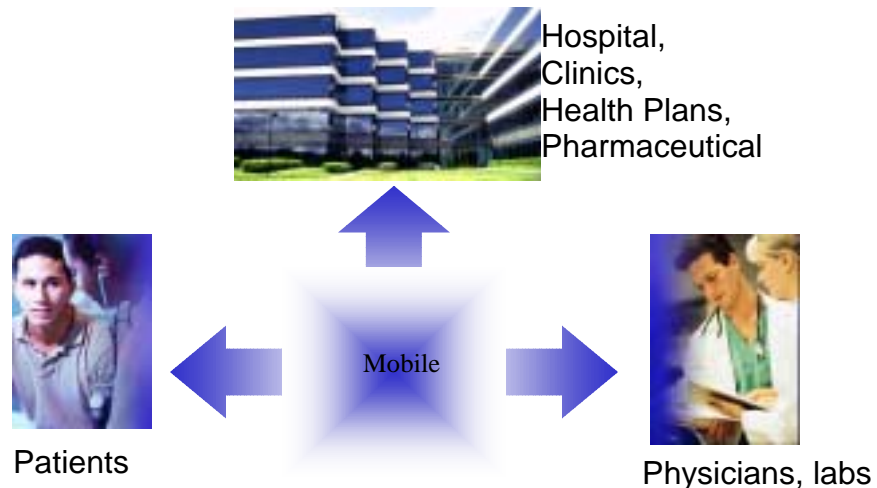
Multiple Stakeholders

One day, your physician will be able to write a prescription, access your medical history, order lab tests, dictate and quickly look up medical information, all while you put your clothes back on.

-WR Hambrecht & Co, October 2000 ¹

The US Healthcare system currently consumes about 13.5% of the nation's GDP (Gross Domestic Product). Few service industries have the need for mobility and access to mission critical information in real-time such as health care industry. **Healthcare is a most information-intensive industry.** There is a vast need for information and communication. Health care professionals need to be mobile and to access timely information. Mobile medicine through wireless technology offers the promise of improving the quality of care, reducing medical and medication errors. In addition, mobile medicine allows access to timely information which offers significant productivity improvements through immediate access to information and data capture at the point of care. Nevertheless with all the benefits of wireless, mobile medicine raises significant issues related to security and privacy of the medical information.

Multiple Stakeholders



The health care industry is composed of multiple stakeholders. Stakeholders include patients or consumers, employers, health plans, government, medical providers and other health professionals, and suppliers to the industry. Some of these stakeholders are spearheading campaigns to increase investment spending on healthcare information technology to improve the quality of care. In particular, some stakeholders are funding pilot projects using wireless technology. In this section, we profile a few wireless pilots among health plans, physicians, and employer groups.

Employers

Employers represent a powerful force in controlling access to healthcare services as well as driving quality improvements and necessary cost reductions. For instance, General Motors (GM) is piloting the use of handheld devices and Medscape's EMR (electronic medical record) software by subsidizing it for physicians who treat GM employees. GM spent \$4 billion last year to insure 1.2 million employees and their dependents covered under its 134 health maintenance organizations, according to a GM spokesperson.² According to Jim Cubbin of GM, there could be a "lot of improvements to health care quality if physicians use more modern IT."³ The hope is that better quality translates to lower costs for the company. In addition, since the publication of the Institute of Medicine's 1999 report on quality of medical care, the Leapfrog Group was formed consisting of 100 of the Fortune 500 companies that are pushing an agenda based on improving technology in healthcare to improve quality. The Institute of Medicine in their landmark 1999 report indicated that up to 98,000 U.S. hospital deaths may be potentially avoidable due to medical mistakes. Though the projected number of deaths due to medical mistakes has since been questioned, the report still served as a wake-up call to employers and other stakeholders.

Pursuing Perfection: Health Care Organizations

Health care organizations (HCOs) have been extremely dependent on the paper based handling of medical orders which can be sometimes unreadable. Computerized order entry can as in, Boston's Brigham and Womens Hospital, significantly reduce adverse drug events. However, the cost of such systems such as at Brigham and Womens can carry a high price tag and be impractical for some smaller community-based hospitals. According to a recent report sponsored by the Robert Wood Johnson foundation, 95% of physicians have witnessed a serious medication error and sadly, 61% accept medication errors as a common part of medical practice.⁴ With the modest title of "pursuing perfection" the Robert Wood Johnson foundation is soliciting proposals from organizations to provide the following: (1) Grants and technical assistance for health care providers to plan and implement programs that pursue perfection as a central business strategy; (2) A learning network, and (3) A communications campaign targeting providers and opinion leaders about the need and the opportunities to improve the quality of health care.

Health Plans

Pilot Project Explores Electronic Prescribing to Reduce Errors

Some 200 Tufts Health Plan physicians are participating in a six-month pilot program that will explore bringing the power of computerized prescribing into the exam room. The program, the aim of which is to reduce the possibility of errors in prescribing and to enhance the quality of patient care, is being conducted in conjunction with AdvancePCS[®] and PocketScript[™]. Using cutting-edge hand-held computers and a networked desktop computer, participating doctors can obtain updated prescription information and then pre-scribe medications electronically from the exam room. The hand-held computers allow doctors to quickly retrieve patient medication histories via a secure system, as well as to check for possible drug interactions. Physicians can print hard copies of the prescriptions or send prescriptions via secure fax directly to the patient's pharmacy. Participants in the pilot project were chosen based on prescription volume and geographical location. They agreed to take part to help assess the computerized system's full range of capabilities and its potential impact on provider prescribing and quality of patient care. Through this initial trial, Tufts Health Plan and our providers will have an opportunity to evaluate this new technology, measure its impact on the prescribing process, and set standards for the future.

**Tufts Health Plan Physician Newsletter,
October 1, 2001, Vol. 12.**

Project Objectives

This first phase of the study (i.e., Phase One) is a descriptive study of detailed qualitative data and market intelligence. In Phase Two, using the data and market intelligence along with input from Lucent, HealthCIO is prepared to develop the framework and background for a business model for selling wireless products and services into the health care market. The primary goals and objectives of the Phase One Project are to provide an overall description and framework of the various functional roles in the health care industry. This report is based solely on the results of the Phase One market research study.

Specific research questions addressed by the study include the following:

1. What are the different markets and products for wireless applications in healthcare (i.e., current and future opportunities in this market) segmented by type of organization, application type, and need addressed or problem solved?
2. What types of health care organizations (HCOs) are currently using or considering using wireless in the near term? How widespread is the use?
3. What are some applications for wireless in healthcare including speech recognition, medical telemetry, telehealth, and disease management?
4. What are the motivating factors or other business drivers for health care organizations to pursue a wireless implementation?
5. What are the barriers to the widespread adoption of wireless technologies in healthcare and how can wireless companies overcome these barriers, for example, negative perception of security problems and the misperception of cellular interference with other medical equipment?

Overview and Methods

There is a growing array of possible uses for wireless technology, however the business case in healthcare is not perfectly clear. Is the value of wireless in improving quality, improving access, improving productivity, or reducing costs? The healthcare industry traditionally is risk-adverse and a late-adopter of information technology. However, there are multiple healthcare markets that are potentially interested in wireless healthcare applications.

In today's business environment, multiple healthcare providers access health information from many different locations or health plans. However, this accessibility threatens the privacy and security of medical information. Information security is paramount to the future of any healthcare program.

To evaluate areas for research in the wireless market in Phase One, we conducted a thorough secondary market research study using public and proprietary literature sources, supplemented with personal interviews with health care professionals. The healthcare markets evaluated included hospitals, physicians, health plans, and the pharmaceutical application market. The project team consisted of Jonathan Bogen MS, MBA acting as Project Manager and lead author. The project was originally developed with assistance from Anita Karcz, MD, MBA.

Current Applications of Wireless Devices

Wireless technology disrupts existing physician practice patterns less than anything I've seen-it's really a logical extension of how medicine is practiced.

-Dr. Peter Schock, MD, Bellevue Family Medicine and advisor to Allscripts⁵

There are many promising applications for wireless technology in the healthcare industry. Some of the most promising applications are charge capture, telemetry, disease management, emergency response and prescription management. Some of the more popular applications being used or piloted are discussed in this section.

Point of Care Applications

Hospital Emergency Room

Immediate access to patient information at the point-of-care remains a major focus of the application of wireless. A number of hospitals are piloting the use of wireless in emergency departments of major hospitals. Hospitals piloting the use of wireless handheld devices to record patient information and for order entry include Boston's CareGroup hospitals, Sentara Leigh Hospital of Norfolk, VA and University of Illinois Hospital at the Chicago Medical Center.

Hospital Inpatient Units

That is a revolutionary development, and is a major step toward overcoming the biggest obstacles in healthcare - communications gaps created by incompatible computer systems, the overdependency on paper systems for documentation and inefficiencies in daily communications.

-Richard Schrushy, CEO, HealthSouth on the planned all digital hospital

Wireless devices are perceived as increasing the productivity of caregivers, but few studies report verifiable results such as return on investment or cost-benefit ratio. At the point of care such as the patient's bedside, the information can be charted on a digital device and immediately fed into a centralized clinical data repository for alerts. Wireless provides the ideal data capture device. Also telemetry monitoring without wires offers many advantages e.g., improving the movement and comfort of patients. In a workflow re-design project, a hospital utilizing wireless phones and laptop computers documented improvements. Regional Memorial Hospital of

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Hollywood, FL reported significant time saved and patient care substantially improved by reengineering how and where nurses place orders for medications, retrieve lab results, and make contact with physicians and other caregivers.⁶

Other ongoing wireless uses in hospitals include the following applications:

Current Sampling of Wireless Projects

| Hospital | Location | Wireless Application |
|------------------------------|-----------------|--------------------------------|
| Sentara Hospital | Norfolk, VA | Mobile Workstation |
| Advocate South Suburban | Chicago, Ill | Mobile Patient Labs (StatView) |
| Detroit Medical Center | Detroit, MI. | EMRs |
| Southside Hospital | Long Island, NY | Connection to HIS* |
| Continuum Health | Long Island, NY | Web based PDA to Cerner HIS* |
| Saint Luke's Shawnee Mission | Kansas | Cardiac Telemetry |
| Children's Hospital | Miami, FL | Cardiac Tracking via PDAs |

**HIS: hospital information system.*

HealthSouth Corporation (Atlanta, GA) with 1,900 facilities is the largest owner of Rehabilitation, chronic care facilities, and outpatient surgical centers has announced the building of all digital hospitals using the latest in wireless technology. Oracle has entered into a partnership to develop an integrated hospital information system. The hospital technology features patient beds with display screens connected to the Internet, electronic medical records, digital imaging instead of traditional X-ray film, and a wireless communications network that will permit doctors, nurses and other healthcare professionals, with portable computers or PDAs, to securely update and access patients' medical records from anywhere in the hospital.

Healthcare Market for Wireless Devices



As more and more devices have the capability for wireless communication, what do healthcare users need in their business? Is it the “chicken or egg” problem with wireless technology, in terms of technology driving a perceived demand that does not really exist? What technology will solve problems in the health care industry or does it create other problems? Wireless represents one of those areas where users have a need for mobile devices to serve both personal and business needs. Will businesses pay for wireless Web access, so employees can continually update stock trades on their “smart” phone or an interactive messenger? As one mobile operator’s video promised with a “smart” refrigerator, do we really need a reminder sent to our smart phone that we are out of milk?

Let’s explore the addressable market in healthcare in hopes of providing answers.

Voice Still the “Killer App”

Cellular/PCS Services. According to a CherryTree report forecasting wireless use in various professional services, the Yankee Group projected the greatest number of users or 12 million users in the healthcare market as compared to other vertical industries.⁷ For example, cell/PCS phones have generally replaced pagers and are carried by a majority of physicians, over 86 percent. The “killer app” for cell phones remains voice. It is likely that with improvements in speech recognition that voice portals will become increasingly popular to avoid the use of tiny screens of the cell phone. If voice portals combine the ability for natural language processing similar to an Ask Jeeves customer portal, many possible healthcare applications can be envisioned.

Because of concerns regarding EMI (electromagnetic interference) with medical equipment and telemetry, some hospitals have banned the use of cellular phones in a number of patient areas. Stanford University Medical Center of Palo Alto bars cell phone use in a large number of research buildings. EMI interference is discussed later in greater detail.

Handheld Computer Market

PDA's. A recent Harris Interactive poll found 26% of physicians using handheld devices, a number which is expected to increase to 50% by 2005.⁸ For internists, the percent using handhelds computers is even higher. Forty-seven percent of those surveyed are currently using handhelds and the ACP (American College of Physicians) projected that 67% will be using them by 2002.⁹ PDA's very similar to palm-sized computers and gaining more acceptance are the tablet computers. Nine major computer makers have developed tablet PCs which are becoming very popular because within each device weighs less than six pounds but supplies the functionality of a mobile personal computer. The Microsoft Windows XP tablet OS is available for these as well as a vastly improved handwriting program. Devices like this cannot only be held and used, but can also be equipped to mount on a cart and/or pop into a docking station when a user wants to do more keyboard entry of a clinical note or similar information. Organizations may look seriously into these devices if they have many existing applications and do not want to have to redesign their applications to fit a small screen typical of most handheld computers or PDA devices.



The makers of both cell phones and handhelds are in the process of converging technologies to produce smart phones or handhelds with phone capabilities. This makes sense to reduce the clutter of mobile devices that healthcare users carry. Nevertheless, surveys of business users indicate the primary use of handhelds is for an address book and calendar. Since users want a phone to be hassle free while they demand a handheld with a bright, large screen, it may be difficult to economically deliver the best of both.

Wireless Internet Protocols and Services

WAP, SMS, iMode. The wireless Internet category includes iMode, SMS (short messaging service), and WAP. WAP (wireless application protocol) and are a set of protocols that lets users of mobile phones and other digital wireless devices access Internet content, check voicemail, e-mail, faxes and conduct some transactions. WAP can work with multiple standards, including CDMA and GSM. i-Mode developed by NTT DoCoMo in Japan is an alternative to WAP and is used primarily by consumers for such things as games, retrieving information, and sending messages.

Estimates of approximately half of the US population have access to the Internet either at home or at work.¹⁰ Worldwide estimate of the wireless Internet access is relatively small (e.g. about a million) today but it is expected to grow. With the large

number of cell phones users which outnumber PC users, the wireless Internet access is predicted to spur the growth of a new class of mobile eHealth applications for both providers and consumers. The trend toward non-PC-centric access (e.g., PDAs, handheld communication devices, Web-enabled phones, interactive TV, Web and email clients) will encourage health developers to cater to wider audience segments and spur development for a variety of access devices and formats. While 3G cellular mode proposes better speeds and bandwidth for Web services, it's future is uncertain according to a recent report.¹¹ Will 3G provide much of an improvement in service over 2.5G service? The worldwide economic outlook has hindered the huge investment in 3G networks required by telecomm companies.¹² The turnover of cell phones required to fully utilize 3G has not happened. More importantly, the lack of wireless standards in the US will hamper future growth of 3G.



What are healthcare users willing to pay for in accessing the wireless Web? Will users pay for 3G services, to conduct their necessary business functions? Internet usage by healthcare users is largely for two reasons, one email, and two, research. Mission critical functioning implies an always-on connection. Pagers provided this service at a relatively low cost. The impact of being always on was evident with disruption of the pager networks due to satellite problems of past years. Therefore, text-messaging services such as SMS will be in demand as it addresses a mission-critical need. SMS has proven quite popular in Europe using the GSM standard and is expected to be used more in the US with the Blackberry device to send short text messages. While many of the cell phones carriers in NYC were down in the aftermath of 9/11, mobile text communication was facilitated by use of the RIM

devices. Tenet Healthcare is currently using Motient devices to send SMS messages to administrative and management staff. In terms of Web-based research, it is unlikely with the daily demands on most caregivers that they need immediate “always-on” access to research. Some caregivers may prefer to access the Web from home to perform research. Nevertheless, many of the tiny handheld devices or smart phones are not adequate for Web research because of small screens and slow download speeds.

Wireless LAN/WAN Networks. The major use of wireless computing today in healthcare is via wireless LAN (local area network). The IEEE standard, 802.3 for Ethernet networks and 802.5 for Token Ring style networks have been largely replaced with the 802.11b variation for high speeds. It is expected that the 802.11a adopted protocol will soon be replaced 802.11b because it is even faster. LANs (using 802.11) include such major equipment manufacturers as Lucent, Nortel, Intel, 3Com, Cisco, etc. Transmission speeds of 10 to 100 Mbps can be achieved by many organizations. This technology uses direct-sequence spread spectrum technology where the data is sent at one frequency but uses bit patterns to scramble the signal keeping it secure. Speeds as high as 22Mbps are more common for these devices, and there is room for higher speeds in the future. The 802 standard allows enough bandwidth for these higher speeds, which will enable more devices to communicate on the same transceiver. This standard will also allow more data to be transmitted such as dense images and even voice. The 802.11 protocol can eventually support voice over IP which allows organizations to consider a single network for all voice, data, and video transmissions. The proposed 802.11g protocol operating in the 2.4-GHz band could boost transmission speeds to as much as 54M bit/sec. There has been some concern that interference in the 2.4-GHz range with Bluetooth devices could result.

We are seeing the emergence of a trend towards Web access via wireless WAN (wide area network) and LAN networks similar to those installed in some airport lounges or that planned for Starbucks shops. Public access LAN and WAN are a relatively inexpensive way to offer high-speed Web access than the charges normally associated with wireless Web access which is a largely a novelty technology at this point. That trend makes tremendous sense in healthcare facilities which have few Web access points today for employees to conduct research and training (e.g., elearning). Instead of having a few PC's in a training room or library, health care facilities can provide access to multiple employees via wireless network devices in multiple locations. In fact, some of the wireless networks could support VoIP (voice over IP), and eliminate the use of loudspeakers and pagers to alert caregivers.

Bluetooth. Bluetooth was developed and supported by many hardware and software suppliers as a low cost wireless technology that would provide multiple portable devices Web access within a short range. Bluetooth is a replacement technology to wires and can act as a modem to the Internet. Bluetooth which has a shorter range than the 802.11 but is longer range than infrared. It is not expected to be of much impact in healthcare due to concerns of lack of security standards today. It was expected to replace 802.11b on handheld PDA's. However, unless vendors provide support for Bluetooth in their devices and the price of Bluetooth components are reduced to the supposed cost of \$5 as more vendors provide support, it is unlikely to gain wide acceptance.¹³ Microsoft will be providing support for Bluetooth in its Windows CE.Net system. Bluetooth's future will probably remain as a niche product.



Technology Assessment

What's unique about healthcare compared to other industries is the need for technology to supply access to people and information as mission critical. A matrix of wireless technologies compares the strengths and weaknesses of options:

Comparison of Wireless Options

| | Pros | Cons |
|--|--|---|
| Synched-Up PDAs | Implementation simple and low cost. Useful for mobile data capture applications. | Not always on. Not for mission critical access. Easy to compromise security of PDAs. |
| Wireless LANs | Based on 802.11 standard Always-on connection. Avoids physical connections and messy wires. Relatively low cost and scalable. | Low latency Can be hacked. Slower than wired connections (2-54 Mbps). |
| Bluetooth | Niche product. Easy to connect various devices. "Expected" low cost of \$5. | Short-range (better than IR). Very insecure. |
| Interactive Messaging (SMS, Instant Messaging, RIM, etc.) | Simple to use. Always on. Content can be "pushed." Secure..can be encrypted. | Small screens. Only short messages displayed. Can be out-of-range. |
| 3G | Developed to support voice, data, video. Voice is the "killer app." Represents a technology to integrate wireless to Web services on a device. Always on connection. | Availability a few years away. Will require a high-cost to upgrade current wireless infrastructure to accommodate 3G. |

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If wireless technology can address the problem of access to mission-critical data and systems, then buyers will be more interested in making the investment. Additionally, if wireless systems cannot provide affordable access, then few HCOs will make the needed investment. It seems that LANs, voice applications as well as SMS meet a number of criteria for wireless applications in healthcare.

IT Spending

A recent survey of 100 Most Wired Hospitals found significant cost-efficiency and higher profit margins at the most “wired” hospitals compared to those that spent much less on IT.¹⁴ A recent survey of (N=953) members of HIMSS (Health Information Management Systems Society) and Chime (College of Health Information Management Executives) in December 2000 to February 2001 was conducted to gauge issues and trends on IT spending among its members.¹⁵ Members included healthcare provider organizations, healthcare industry consultants, and healthcare IT vendors or suppliers. The organizations represent the views of senior IT and telecommunications leaders.

Budgets for information technology spending will increase in 2001 over 2000. More than 68% of information system managers indicated an increase in spending on IT during the next 12 months compared to 63% in 2000. The primary reason for this increase was the overall growth in the number of systems and technologies that healthcare organizations are dealing with.

Projected Change in IT Budgets

| Change | Percent responded affirmatively |
|--------------------------|--|
| Will definitely increase | 35% |
| Will probably increase | 33% |
| No change | 15% |
| Decrease | 14% |

Source: HIMSS 2001 Leadership Survey (N=953)

Technology Adoption

Research [is needed] on user-interface hardware and software to promote the development of better solutions to the problem of human-computer interaction in health care. Advances are needed in embedded intelligent agents, hands-free computing environments, natural language processing, speech understanding, handwriting recognition, and notepad inputting schemes.

-President's Information Technology Advisory Committee, February 9, 2001¹⁶

Wireless devices, migrating transactions to the Internet, and voice recognition were the technologies of most interest to the 2001 HIMSS survey participants. In terms of technology trends, wireless technology is planned more than other surveyed technology. This is being fueled by the abundance of PDA as well as the increased use of wireless LANs in health care facilities. From the 2001 survey, wireless info appliances represented the greatest increase in planned use.

Technology Adoption of 2001 vs. 2000

| | 2000* | 2001* |
|--|------------|------------|
| Wireless Information Appliances | 29% | 50% |
| Web Enabled transactions | 46 | 48 |
| Handheld PDAs | 25 | 47 |
| Voice recognition | 35 | 46 |

* Planned use in the next two years according to the year they were first surveyed.

Additionally, wireless represents a big increase in planned use when compared to current usage.

Expected Adoption: Increase in Expected Use

| | Current Use | Planned Use |
|---------------------------------|-------------|-------------|
| Wireless Information Appliances | 37% | 50% |
| Web Enabled transactions | 23 | 48 |
| Handheld PDAs | 31 | 47 |
| Voice recognition | 20 | 46 |

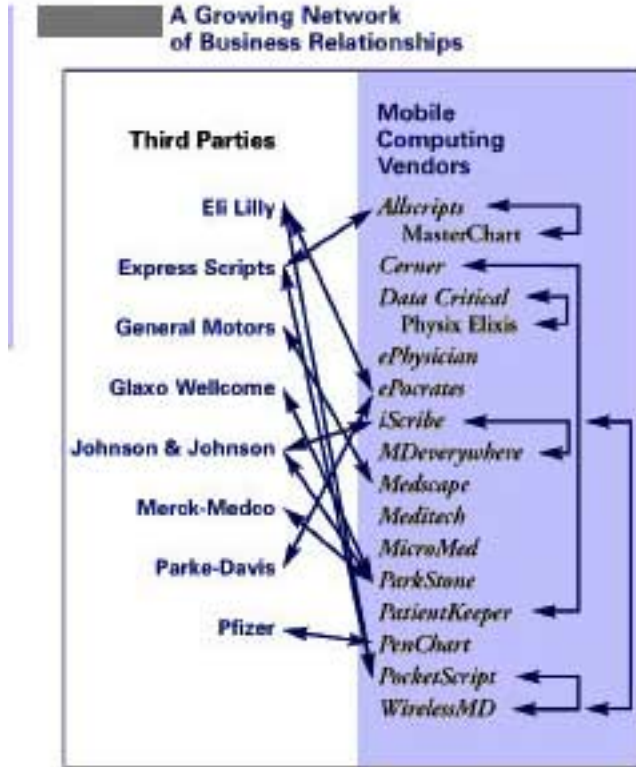
Source: HIMSS 2001 Leadership Survey

Market Leaders

A number of companies have taken the lead position in developing mobile/wireless applications for the healthcare market (see Appendix for more details). Amicore is new venture in which Microsoft has partnered with IBM and Pfizer to target the large and diverse medical practice market of small to medium size physician practices. (*the majority of physician practices consist of three or less providers*). Pfizer currently offers its PenChart EMR software via wireless devices. WebMD, one of the leading Internet health companies, was hoping to convert its large physician subscriber base to users of its Ultra handheld device, but Microsoft's shift to IBM now calls this into question. Employers (e.g., GM) and employer coalitions (e.g., [Leapfrog Group](#)) increasingly are promoting the use of technology to reduce medical errors, such as those caused by illegible handwritten prescriptions. Microsoft's new servers based on the Windows 2000 operating system tie into the company's "Microsoft. NET" Internet strategy. Microsoft is hoping that this program to Web-enable some of its existing products and develop new, Internet-based services that can run on personal computers and other devices, such as cell phones and hand-held computers.

Companies such as WebMD have struggled because doctors have been slow to adopt such technologies in their daily practices, and it has often been difficult to link up incompatible systems. Many ISPs and other companies have stumbled in trying to cost-effectively provide Internet service to the "last-mile." With the collapse of many DSL companies and the re-emergence of the phone companies' monopoly of bandwidth, "business class" DSL may prove not to be affordable to many, small independent health care providers. In addition, privacy concerns have been raised by medical groups regarding electronic transmission of PHI (protected health information) on the Internet (see HIPAA below).

One of the more controversial business relationships among technology vendors and other third parties is in the area of pharmaceutical sponsorship. As pharmaceutical companies seek new channels to influence the physician "gate-keeper" for sales, a number of intricate business relationships have developed. The contractual relationship between the health plan and medical provider has been interceded by large employers (GM), pharmaceutical companies, PBMs (pharmacy benefit managers) and vendors.



Source: Reprinted with permission, California Healthcare Foundation, copyright 2001.¹⁷

A Compelling Business Case

Research in advanced networking services including: techniques for assuring quality of service across the Internet to assure that information will be delivered to its destination quickly and accurately; multicast capability to make more efficient use of available bandwidth to distribute information simultaneously from one user to a number of specific recipients; symmetric or dynamically reconfigurable broadband technologies for the "last mile" (i.e., connections between the Internet and homes or offices); and wireless technologies to support untethered access to computers and information.

-President's Information Technology Advisory Committee, February 9, 2001

The US health care industry is the largest information business in the world. Billions are spent generating new information including for research, patient records, and medical tests. But despite the volume of health care information and its importance to care delivery, it is poorly organized and managed. For example, 40% of patient information is missing when needed; some 10% of x-ray films are unavailable, and physicians often disagree on treatments and cannot track the outcomes of their decisions.

The healthcare service industry's information flow can be roughly categorized into the administrative side of health care or the clinical side of medicine. The medical loss ratio in the US is approximately 84% meaning of every dollar spent on healthcare, 84 cents are spent in the delivery of healthcare services and 16 cents are consumed in the administrative aspects of healthcare. The administrative aspects of healthcare involve the provision and maintenance of insurance and transaction systems to pay for healthcare services. The amount spent on healthcare delivery and services also involves clinical encounters, medical supplies, treatments and operations. Though the percentage spent of the 1.2 trillion dollar industry is substantial, the prevailing use of IT is in processing transactions. In fact, one stated purpose of the sweeping Administrative Simplification Act (i.e., under Health Insurance Portability and Accountability Act of 1996) was to simplify the various administrative processes and procedures into standardized electronic formats.

While IT may be viewed as a profit or revenue center in other industries, IT departments have traditionally been viewed as cost centers in the health care industry. This is due to the fact that traditionally most IT was a function of the legacy systems that were part of the administrative apparatus of medicine. Few HCOs made any substantial investments in clinical systems to improve quality. Tight budgets under cost-containment forced health executives to examine department budgets with

a narrow focus on reducing expenditures. Some HCOs such as The Partners Healthcare System in Boston or Henry Ford Hospital in Detroit realized that investments in IT would be required to improve the quality of care as well as reduce the administrative burden.

Keep It Simple

Many healthcare organizations first implemented wireless equipment in isolated areas or departments - usually where maximum mobility was required, such as the emergency room. Some IT managers installed wireless nodes throughout their healthcare facility, figuring that the demand would expand. In addition, the advent of standards (802.11 wireless communications protocol) and WEP (wired equivalency protocol) for encryption have allowed some of the barriers to adoption of wireless to fall. Cost has also been a driving factor. Wireless devices and technology have declined in price while speeds have increased. Since IT is perceived as a cost center, health CIOs must be convinced about gains in quality, productivity increases, or ROI or in order to justify any new technology spending. In general, it is less expensive to install a wireless network and handheld devices, than installing networked PC's in most exam or hospital rooms.

All major health IT vendors with large installed customer bases have developed wireless interfaces for their applications. Since many of these are already in use (e.g., EMRs, order entry, e-prescribing, and practice management) it has been easy to provide a wireless interface to these applications. VoIP (voice over IP) wireless phones have simplified the communication backbone of many hospitals. The same communication backbone that supports wireless handheld devices can now have other uses such as telemetry and even voice. The healthcare industry has been slowly adopting new technology but many HCOs have limited projects to either Web based initiatives or wireless rather than seeing convergence of the two technologies. Ultimately, what the health care industry needs must be simple to use and install. The average caregiver is not averse to being more productive in their job, just they don't have a lot of time for staff training or a staff pool of IT resources.

Improving Healthcare

..the degree to which health services for individuals and populations increase the likelihood of desired outcomes and are consistent with current professional knowledge.

-Institute of Medicine, Crossing the Quality Chasm¹⁸

The IOM (Institute of Medicine) recommended to the US Congress that they establish a Health Care Quality Innovation Fund. Crossing the Quality Chasm. The IOM recommended that Congress create a \$1 billion “innovation fund” to transform the health care system. The lead author described our reimbursement system as “toxic... in terms of improving quality of care.” The recommended call to upgrade the information technology system of our health care system will certainly carry a much higher price than \$1 billion. The suggested spending was largely targeted at new clinical information systems including computerized order entry and decision support tools.

Immediate access to health care information is a vital requirement of quality healthcare according to the recent IOM Report. While the IOM report did not explicitly call for use of electronic medical records, it strongly advocated for electronic systems for order entry and other automation practices. A mobile EMR could provide access to patient records (e.g., medication history, allergies, etc.) and support the needs for clinical decision support at the point of care. With a WAP enabled phone, a provider has immediate access to information such as patient reports, medication lists, and allergy lists - creating greater mobility for physicians and their office staff. An example of such a use is given in the Appendix.

Electronic Medical Records

Automated tailoring of information access and summaries to accommodate variations in culture, language, literacy, health-related goals, and reliability of information. Such capabilities are motivated by the need for seamless access to patient-specific and general medical information at the point of care, specifically when relevant to an individual's immediate care and when context-sensitive to a provider's prior knowledge and history of prior system use.

-President's Information Technology Advisory Committee, February 9, 2001

Price of Mobility

The holy grail of health information management is the use of the EMR (Electronic Medical record). With the expected increase in the number of caregivers using handheld computers, application of mobile EMRs will undoubtedly increase as well. Though not in common use in most small group medical practices, many hospitals maintain some form of clinical data repositories. About 17% of practicing physicians surveyed by Harris indicate EMR use. Also, the survey indicate that the use of EMRs and electronic prescribing by physicians in Britain far exceed that of the US. An EMR is a database driven repository of patient information which can supply alerts (e.g., medication alerts) and reminders (e.g., patient due for a test or screening) as well as for patient tracking. The ideal front-end “client” side device is a handheld computer although laptops or PC’s can be connected as well. The ACP has developed a portal for physicians to download clinical references to their PDAs. Using a wireless LAN or WAP phone, a healthcare provider can access patient information and update it at the point of care.

| Physicians Using Electronic Records and Prescriptions | | |
|---|-----|---------------|
| Country | EMR | e-Prescribing |
| US | 17% | 9% |
| Canada | 14% | 8% |
| Australia | 25% | 44% |
| New Zealand | 52% | 52% |
| Britain | 59% | 87% |

Source: Harris Interactive as reported in CIO, October 5, 2001

Fewer Medication Errors and Adverse Drug Events

e-Prescribing. e-Prescribing enables physicians to electronically write, order, and renew prescriptions and review information related to the selected drug on a real-time basis. In addition, with more restrictions placed on prescribing an increasing array of new, more expensive medications, providers need access to up-to-date formulary information on alternative medications.

Combined with an electronic medical record, patient medication histories can be tracked and checked for allergies (see Southside Family Medicine case study)—enables hosting of patient medication histories and presentation to physicians, enabling physicians to conduct services specific to the patient and health plan-specific rules. E-prescribing is an application that boasts immediate quality improvements along verified cost savings. In a study commissioned by vendor Allscripts, a \$.75 to \$3.20 savings per prescription could result in a large savings to a health plan if you

consider the large number of prescriptions that are filled by plan members. The savings were produced from a combination of increased prescribing of generic medication and secondly, enhanced formulary compliance.¹⁹ Additional savings can also be achieved by prompting or highlighting the health plan “preferred” prescription choices. The ability of wireless devices to prompt the prescriber is an area especially appealing to pharmaceutical companies. In other cases, pharmaceutical firms offered to give away free mobile devices and provide free wireless services to physicians. Using WAP phones or other Internet interactive messaging technology to connect physicians to company data sources, the pharmaceutical company could “push” personalized messages aimed at particular medical specialties or diseases. AOL, Cingular, RIM, Motient, and many other companies have developed ways to push sport scores, news, alerts which are already personalized to the user’s profile.

TeleHealth

However, the main problem in telemedicine is not a lack of technology; rather, it is the organizational problem of knowing how to take advantage of the technology. For example, how do the health services change their delivery practices to take advantage of what the technology can do? In this respect, the increasing availability of new forms of technology, such as the Internet, smart cards, and satellite communication makes this irrelevant.

-Richard Wooten, Telemedicine²⁰

A number of telehealth applications to monitor patients remotely using wireless technology are gaining wider acceptance and applicability. Remote telehealth applications include a number of areas; telemedicine, telesensing, telemetry, and disease management. Over the next ten years, new wireless technologies will support new programs for patient monitoring and disease management in the home according to a recent forecasts of the future of the healthcare industry.²¹

For example, a number of patient applications in non-acute settings could monitor patients and record vital medical information at a central recording station. From a February 9th report to the President from the Information Technology Council “a significant number of people who reside in nursing homes are there more for health ‘security’ reasons than for health care ‘needs.’ Many residents in extended-care facilities could be cared for at home at significantly reduced costs if the appropriate telemedicine tools were available to enable remote monitoring. Additionally, many of the home-health visits conducted today are based on the need to observe or monitor a patient’s status, a function that could be accomplished through interactive video systems coupled with the appropriate instrumentation and a simple-to-use interface.”

Other telehealth applications include battlefield recordings of vital signs and ECGs via a portable or handheld computers, they can be send wirelessly to a central monitoring station for interpretation. A number of vendors have wireless interfaces to their medical devices including ECG, spirometers, peak flow meters, vital sign recordings, blood pressure, stethoscopes, etc. Some of the wireless devices collect a patient's data in the device's memory while others require a computer as a recording device.

A number of other companies have developed similar applications, a few with funding by telecommunications companies. Nokia has invested in LifeChart (see Appendix for more details). LifeChart plans to use WAP-ready phones (Nokia 7190) to send asthma monitoring results and Nokia WAP server to receive results. In addition, Lifechart is working with Omron Healthcare and Stanford University School of Medicine, to pilot the use of WAP phones to capture blood pressure recordings for hypertensive patients and upload to the LifeChart personal website.

Emergency Services and Disaster Response

Since the terrorist attack on the US of September 11, 2001, a lot of attention has focused on the use of wireless to aid in the recovery of victims and for disaster response. Wireless has been used by EMS for a number of years and is already in use in California to connect hospitals in the event of earthquakes. The Internet and email would not be useful in the event of a natural disaster that disrupts key access points and Internet service providers. In the case of New York's September 11th disaster, cellular networks and phone lines were disrupted as well. Packet-radio technology which transmit packet based digital in the radio spectrum is unaffected by downed phone lines or clogged Internet servers. Hospitals and emergency personnel that are connected to this type of system can utilize this system to communicate in the event of a major disaster.

Reducing the Paper Chase

A critical issue facing the industry and helping to drive more wireless technology to the point of care is the worldwide shortage of nursing staff. Facilities everywhere have no choice but to place more and more demands on their already overworked staff, while at the same time trying to figure out how to meet those demands with fewer and fewer people. Several other industries have improved workflow and productivity by providing employees with wireless handheld devices. The package express services are certainly an example of the use of wireless for data capture at the point of service that greatly aids tracking and customer service. Similarly some hospitals are using bar coding and location services to track patients within their facility or to record medication information.

The Medical “Killer App”

Charge Capture. This is generally acknowledged to be the medical “killer” application in mobile healthcare. Charge capture is the recording of medical charges by documenting each service that is reimbursable under HCFA coding guidelines including necessary fee schedules and required CPT, ICD-9cm, HCPCS codes, etc. Charge capture basically produces a Superbill in the physicians’ hand.

Industry studies and HCFA data indicate that practicing physicians are currently losing in excess of \$25 billion per year in denied or reduced fee-for-service claims. These lost billings are a direct result of physicians having inadequate documentation for their patient encounters; providing inaccurate, invalid, or mutually exclusive codes for various procedures or tests; and failing to bill for services rendered outside of their office setting. In addition, administrative expenses for practicing physicians, much of which relate to tasks necessary for claims submission and collection, often consume in excess of 40% of gross physician revenues.

Estimates of a typical physician with average annual billings of \$650,000 is currently losing an estimated \$35,000 to \$100,000 in annual collected revenues due to claim denials. Lost billings average approximately \$60,000 per year for each of the roughly 450,000 physicians in active clinical practice in the United States. An example of this is given in the case studies of MedAptus’s mobile charge capture.

Barriers

Administrative Simplification

If the technology is not HIPAA compliant, it has a very slim chance of wide-adoption by HCOs.

–J. Bogen, HIPAA IT Handbook ²²

In 1996, the Health Insurance Portability and Accountability Act (HIPAA Public Law 104-191) was passed with provisions subtitled Administrative Simplification.²³ The purpose of this Act was to improve Medicare under Title XVIII and XIX of the Social Security Act as well as the efficiency and effectiveness of the healthcare system through the development of a health information system with established standards and requirements for the electronic transmission of health information. HIPAA is the first national regulation on medical privacy and the most encompassing federal legislation involving health information management, which affects the use, release, and transmission of private medical data. “Covered entities” include most healthcare providers which will need to be in compliance with HIPAA.

HIPAA mandates that security standards must be applied to preserve health information confidentiality and privacy in four main areas:*

- ❑ Administrative Procedures: (personnel procedures, etc.)
- ❑ Physical Safeguards: (e.g., locks, etc.)
- ❑ Technical Security Services: To protect data at rest.
- ❑ Technical Security Mechanisms: To protect data in transit.

HIPAA was developed to facilitate the use of electronic transactions in the health, industry while assuring privacy and security in order to make electronic data interchange a viable alternative to paper processing. HIPAA does this through encouraging the adoption of lower cost Internet technology and the standardization of financial and administrative transactions. HIPAA does not specifically advocate or ban specific technology. Nevertheless, the security of wireless is a mounting concern.

**HIPAA Security NPRM is still in draft form but planned to be finalized by year-end 2001.*

InSecurity

The use of handheld devices to order prescriptions, capture charges, and store appointments is becoming increasingly common. Both wireless LAN and PDA's offer the ease of mobility without wires however securing these devices is a concern.

As more and more healthcare providers use PDA (personal digital assistants) or handheld computers to store their appointments, patient information, and prescription data, the likelihood of security threats increases. Many providers "synch-up" their PDAs in the morning with their appointment schedule and may download information from home to a central server. PDA are notoriously insecure as few of them have any built in security features. In fact, one HCO requires all their caregivers to sign a consent form and review the necessary system policies before they can use their handheld PDA on the network.

Many of the same security issues apply to wireless networks as applied to wired except that wireless is a less mature and secure technology. Password, machine authentication, and encryption are required. There have been many stories and anecdotes about hackers easily being able to read wireless transmissions by being near enough to the LAN and having the "spoofing" software. Unlike wired networks, it is hard to control the distance that wireless can be transmitted. The WEP (wired equivalent privacy) standard for wireless transmission was thought as a fairly safe standard, until recently a computer consultant and a University programmer managed to crack into a wireless network and read WEP-protected traffic. Therefore even with the use of WEP, it would be a good idea to add an additional layer of authentication. In addition, a number of technology vendors are providing PDA add-ons which add stronger authentication such as digital signature or fingerprint recognition. There is no one right solution to secure wireless networking. A CIO from a large organization recently reported that he views it as fundamentally insecure and keeps all wireless users outside the corporate network.

Wireless Interference of Medical Equipment

In June 2000, FCC established the WMTS (Wireless Medical Telemetry Service) to offer life-critical equipment on an interference protected basis.²⁴ The frequency allocation for WMTS provides a spectrum that will increase the reliability of the equipment. The FCC allocated 14MHz of spectrum for use by medical telemetry in the 608-614 MHz, 1395-1400 MHz and 1429-1432 MHz bands. Some of the representative studies reporting interference are given below. The findings indicate that shielding of sensitive medical devices may prevent some interference.

Selected Studies on Wireless Devices and Interference of Medical Devices.

| Test Site | Description | Findings |
|--|---|--|
| Mayo Clinic, Rochester, MN, 2001 | Tested interference with cellular phones and cardiopulmonary equipment. | Interference in 7% of the time between selected cell phones and cardiopulmonary equipment. The interference was directly related to the proximity of the cell phones to the medical equipment. ²⁵ |
| Department of Anesthesiology, College of Medicine, Gainesville, Florida, 1997 | Studied whether an electrosurgery device interferes with the operation of a low-power spread-spectrum wireless network adapter. | At a distance of 150 feet, no discernible effect on network communications was found, suggesting that if other obstructions are minimal, within a wide range on one floor of an operating suite, network communications may be maintained using the technology of this wireless spread spectrum network adapter. ²⁶ |
| Medical Devices Bureau, Therapeutic Products Programme, Health Canada, Ottawa, Ontario, 2000 | Investigated the susceptibility of 65 electromedical devices to a wireless LAN (WLAN) system and a telemetry system in preselected areas of a hospital. The wireless LAN system operated at 2.42 GHz with an output power of 100 mW. The telemetry system operated at 466 MHz with an output power of 4 mW. | Placed within 10 cm of the LAN system in standby mode, both WLAN units emitted periodic high-pitched beating sounds, which could be misinterpreted as normal beating sounds from the patient. The findings suggested that wireless LAN systems and telemetry systems can be acceptable for use in hospitals within acceptable proximity distances. ²⁷ |

The process of implementing a wireless network can be complex depending on the number of users, typed of devices used, coverage locations, access points, etc. Other barriers include user acceptance of new technology. Traditionally healthcare users are perceived as late adopters of information technology, even though most healthcare enterprises employ complex medical devices. The key to success of any healthcare information technology project is to start small, preferably in pilot projects. Other strategies are discussed below:

Strategy for Successful Technology Adoption in Health Care

- ✓ Start small
- ✓ Understand the business, clinical and cost drivers.
- ✓ Focus on business issues first...technology second.
- ✓ Conduct a critical analysis and needs assessment for new technology.
- ✓ Introduce pilots with short-term achievable outcomes.
- ✓ Need both clinical and financial department buy-in.

Selected Case Studies

1. Medical Education and Training (MyCourses™ Harvard Medical School)

The Harvard Medical School's use of wireless technologies is a perfect example of the convergence of the Web to Wireless. The project went live in August 2001 and has been quite successful according to one of its developers, John Halamka, MD. Harvard Medical School has the reputation for one of the technology leaders and as a preeminent medical school. HMS includes 8,000 faculty and 42 clinical departments based at 17 affiliated hospitals and research centers. In addition, as medical interns, many students record patient information in order to present cases and record the types of patients treated for review by their supervisors. Medical students are quite mobile and may travel to many health care facilities in the course of their internship.

The MyCourses™ project was to provide easy access to the Harvard Medical School (HMS) servers over the Web for all the mobile devices typically used by Harvard Medical students. AvantGo software was used for downloading and to re-purpose all the Web content into the required form factor needed for handheld computing. Each handheld device has its own requirements for viewing Web content.

The requirements of the MyCourses™ project were that:

- it was easy to use
- interoperable on multiple mobile devices,
- wireless and offline capability
- allows for rapid deployment,
- Integrated with existing infrastructure,
- Security meets HIPAA standards (encryption, authentication, and authorization).

The information needs to be recorded in a secure manner that meets or exceeds the requirements of HIPAA. While in the hospital, they can log important casebook procedures and observations with these same devices. The faculty can then easily retrieve these electronic casebook logs, enabling them to better monitor and evaluate students' progress. The project has resulted in increased response rates by students of around 70% on electronic surveys over paper based surveys and overall the project has shown high satisfaction among its users. In addition, it resulted in improved data to monitor and evaluate a student's progress and performance. Most critically the MyCourses™ mobile solutions reduced educational costs to HMS.

Further details contact: Dr. John Halamka, CIO, Beth Israel Deaconess CareGroup and Harvard Medical School. Ken Dracknik, VP. Sales, AvantGo.

2. E-Prescribing: Southside Medical Group

The Southside Family Medicine began writing electronic prescriptions in October 2000 on Compaq IPAQs using the Allscripts wireless prescription application. There are. The Southside medical group consists of four physicians and one physician assistant with about 20% pediatric and 25% geriatric patients, both demographic groups use a lot of medication. It is estimated that over a seven month period since newly implementing the system, that about 100-150 e-scripts are written each day. Originally the other physicians were somewhat dubious of changing their workflow and throwing out the prescription pad. According to Dr. Spikol, when the other physicians saw how easy it was to use the system, it quickly won converts. The system is based on a wireless LAN which uses Allscripts for prescriptions and Medscape Logician for encounter data and medical records. The records are stored on a SQL server database. The prescription is captured at the point of care, checked for contraindications, patient allergies, and printed out for the patient along with up-to-date patient educational material. The prescription is automatically faxed to the pharmacy of record since few pharmacies have the capability of accepting true electronic prescriptions.

According to Dr. Spikol, the system has resulted in increased physician satisfaction as well as increased patient satisfaction. The improved patient safety due to immediate clinical real time decision support is one of its greatest benefits along with elimination of handwriting mistakes. The e-prescribing can check for patient allergies, correct dosing, and incorrect medication. For instance, the Allscripts system has warned regarding *possible* incorrect medication 10 to 15 times per month. Insurance drug formularies are not presently available. Cost savings or ROI were not documented as the result of this application. However, the improved productivity is noted in faster prescriptions and reduced call-backs by pharmacists. Productivity gains will increase for pharmacies as well as they switch to EDI (electronic data interchange) from the e-prescription instead of fax transmission.

Further details contact: Dr. Louis Spikol, MD., Southside Family Medicine, Allentown, PA.

3. Charge Capture: MedAptus

The MedAptus Charges In Hand Mobile Coding Solution allows physicians to carry their professional and personal daily schedules, inpatient and outpatient patient demographic and selected insurance information, and a complete medical coding and billing knowledgebase on a handheld PocketPC. Using wireless technology, individual handheld PocketPCs are continuously updated with schedule changes, consult requests and other information. Physicians use the system to quickly enter procedure and diagnosis codes at the point of care. The codes are checked for consistency with an extensive set of federal and local rules that govern medical billing, helping ensure complete and accurate coding and increase the efficiency of the medical billing process.

In the case of a large family practice group affiliated with the University of Connecticut Health System, an increase in nine percent per physician in charges was attributed to the use of the MedAptus system (formerly sold as Medcompanion) over the previous paper based forms. According to information supplied by MedAptus, the reason for the increase in physician charges after using a point of care mobile solution are primarily due to the immediate capture of medical charges. Under paper based encounter systems, the information often is not transferred precisely to the billing system or in a timely manner either through human error or other workflow issue. Process improvement results from the immediate and less error prone, capture of charges immediately at the point of care when the medical service is rendered. Cost savings and productivity gains results from less re-work, better quality billing data, and immediate charge capture. According to Lance Baldo, MD, vice-president for product development, the results of using the charge capture application have produced additional revenues of \$15,000 to \$25,00 per physician.

Contact: Lance Baldo, MD, Vice-President or Jim Donahue, Product Manager, MedAptus.

4. Telehealth Application: Remote Asthma Monitoring, Medical Monitoring Technologies.

Asthma represents one of the most frequent causes of pediatric illnesses and visits to hospital emergency rooms. In the US, 18 million patients have asthma with about 6 million under the age of six. Not only is the condition debilitating but also can result in death without rapid treatment. Medical treatment for asthma consists of a number of different medications that have serious side effects. Unfortunately most family members cannot properly diagnose signs of asthma requiring treatment until it is too late and may require emergency treatment or in some cases unnecessary treatment with an inhaler. To manage this medical problem, some patients may use a peak flow or pulmonary function meter to measure lung condition. The peak flow meter when used by young children may be difficult to accurately use. Medical Monitoring Technologies, an early-stage research medical device firm and winner of Rhode Island's Technology business competition for new ventures, came up with a wireless medical device based on sound waves to record early problems with lung function. The results can be wirelessly sent to a handheld device and can be forwarded to a central monitoring station to supply medical alerts.

Contact: Dr. Nathan Intrator, Ph.D., CEO, Medical Monitoring Technologies.

Mobile Medicine not a “Silver Bullet.”

What will be the ultimate impact of emerging information and communication technologies on the future of health and health care?

Wireless technology is not a silver bullet. We all know that health care technology must be practical in terms of desired outcome and may involve a grand vision, but must start in small incremental steps. Major IT initiatives have failed that have not involved user input such as the physician or nurse, and grandiose patient benefits were never realized since no one bothered to ask the patient. With the bursting of the Internet bubble, reality has set in and visionary concepts such as Healtheon are gone and their acquirer WebMD is still struggling to turn a profit. What is needed are providers who have a clear vision of what information technology can and cannot do for their organization, the buy-in and commitment of executive leadership, and IT suppliers who are just as committed with improving the delivery of health care.

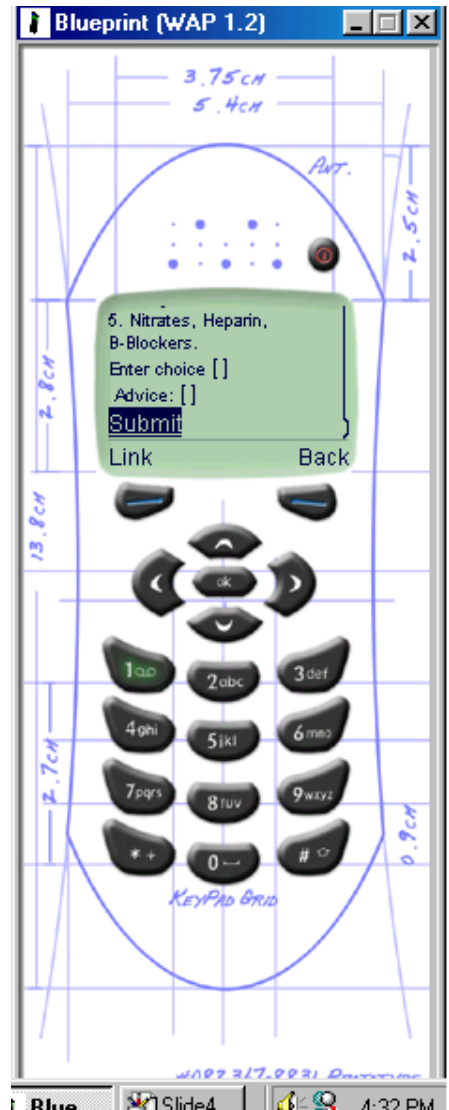
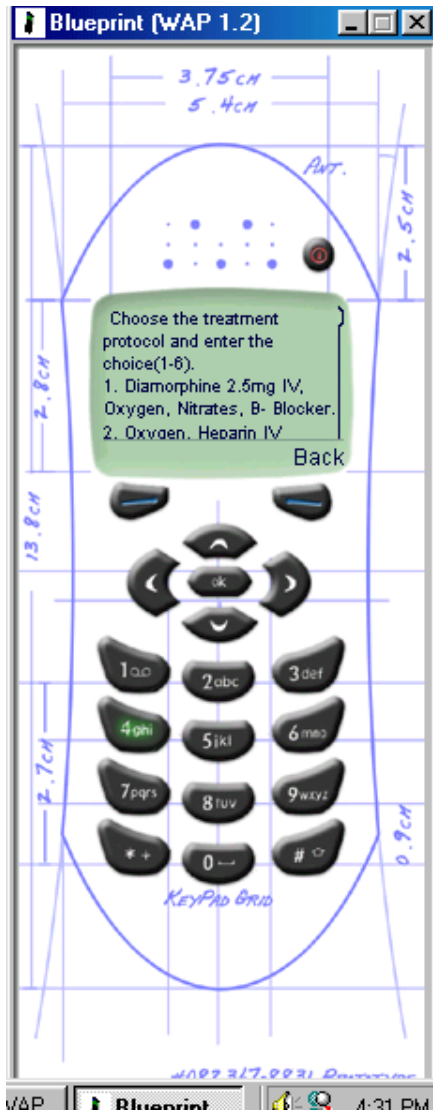
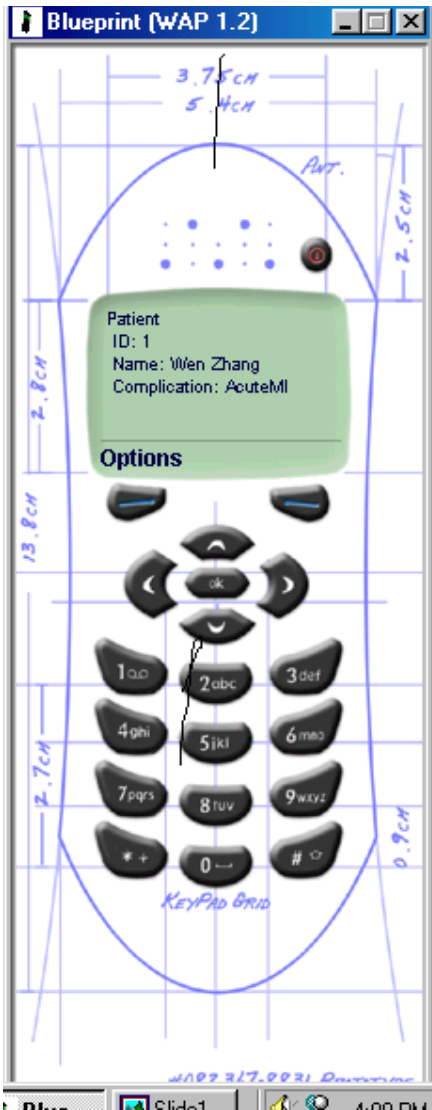
Though both public and private partnerships are calling for improvements in quality of care through new information technology spending and development, it will take visionary programs and adequate funding to accomplish these far-reaching goals. It is 100 years since Guglielmo Marconi first used a wireless messaging system (i.e., a key and kite/antenna) to receive Morse code from across the Atlantic. From the “war on cancer” of thirty years ago under the Nixon administration, we are only now realizing the investment in new information technologies such as bioinformatics and gene sequencing that have produced startlingly dramatic results.

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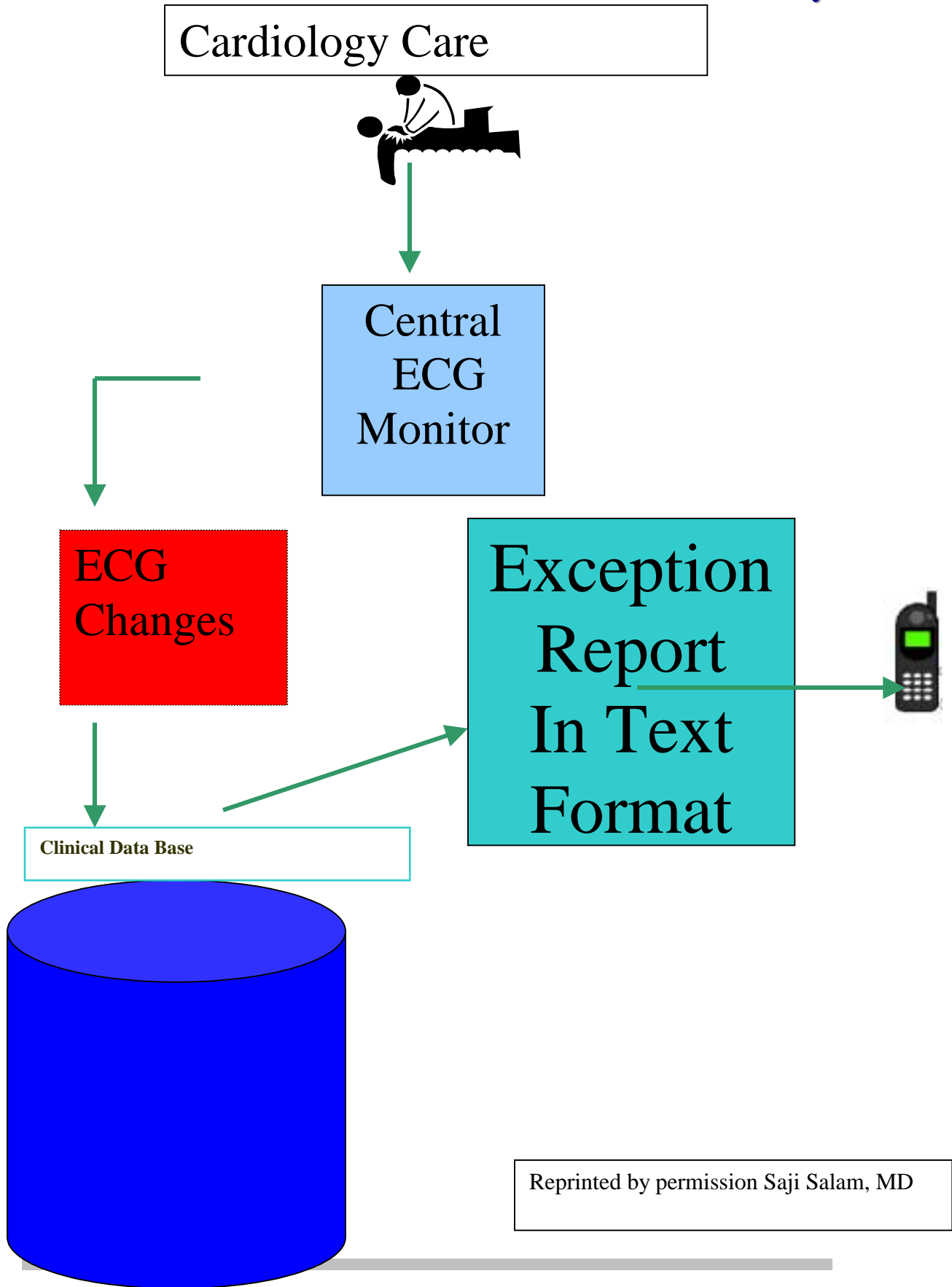
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Appendix A: Example of Cardiology Care Using A WAP-Enabled Phone



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Appendix B: Wireless Healthcare Standards Group

MOHCA: (Mobile Health Care Alliance)

“Communicate standard practices to healthcare professionals for mobile data management to assure patient trust.”

MOHCA Mission Statement 2001

Work Plan

- Promote increased confidence in the solutions that they provide to the healthcare market.
- Provide a central point for collection and dissemination of authoritative information.
- Provide market-building and visibility events.
- Improve communication between healthcare parties and mobile application suppliers.
- Pursue standards and compliance.

ISO TC 215: Ad Hoc Task Group on Mobile Health

This Ad Hoc Task group was formed to (1) Make an assessment of mobile healthcare applications, (2) Identify whether standards are needed, and (3) If additional standards are needed, recommend where they be developed.

The need for standards specific to mobile health was discussed at the August 2001 meeting. Some attendees indicated that mobile health does not require different standards than those for other technologies in health care, and others expressed the opinion that different standards for mobile health are needed in such areas as e-prescribing, order entry, results management, information capture, point-of-care applications (e.g., clinical documentation, alerts, disease management, drug-to-drug interaction, guidelines and protocols, decision support), and systems integration.

Contact: Claudia Tessier, Executive Director, MOHCA (202) 659-2216

<http://www.mohca.org/>