

Healthcare IT, Patient Monitoring & Telemedicine

A White Paper



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Information technologies, advanced monitoring devices, and telemedicine solutions continue to emerge, leading some consumers to become overwhelmed with the array of choices and decisions on implementation of systems. Yet these technologies are now a necessity in the health field, and as technology has improved, users often have more questions than answers in this fast-moving environment. This White Paper will help to answer some of the common questions surrounding advanced information technologies in the health field, look at some of the drivers for the segment and discuss a few new uses for these advanced technologies.



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1. INTRODUCTION

Medical care providers in the United States and around the globe are reacting to socioeconomic changes and challenges that will affect the way healthcare is delivered. In developed nations like the U.S., increasing numbers of people are now aware of the need to lower healthcare costs. The governments are motivated to lower public health care costs by establishing more control via health system implementation or reform. Many industrialized regions are experiencing rising costs, and even historically healthy countries are seeing costs rise at significant rates. In Japan, for example, rising healthcare costs have been strong enough that the government is working to try to influence better choices among individuals in an effort to ward off increasing spending. Japan has often been cited as the benchmark for success in healthcare.

Even amid recent healthcare reform acts in the U.S., healthcare spending as a percent of GDP is expected to increase to almost 20 percent by the year 2021. This is due to more insured individuals, increased home health spending, higher health insurance costs, and cost-sharing subsidies.

There are three strategies, all with similar goals and benefits to patients, being used to control health costs at the consumer level:

- Adopting wireless technologies in healthcare.
- Upgrading and implementing advanced patient monitoring technologies.
- Expanding the telemedicine reach and recognizing the cost control benefits.

2. AN ENVIRONMENT FOR EXPANSION

The growth of the elderly population and related chronic conditions is influencing changes for efficiency in healthcare. While the prevalence of chronic diseases increases, the percentage of persons in the workforce decreases, leaving fewer healthcare personnel to care for more sick populations. Chronic diseases account for between 75 percent and 80 percent of all U.S. healthcare spending. The global population above age 65 is expected to increase by 279 percent between 2000 and 2050. In comparison, the total global population is expected to increase by 57 percent between 2000 and 2050. Life expectancy is also increasing, which can extend the length of care.

Wireless technologies represent a rapidly emerging area of growth and importance for providing access to the latest information for all communities. Wireless technologies are being adopted for many new applications, such as for computer connectivity, allowing remote monitoring and data acquisition, providing access control and security, and providing

solutions for environments where using wires may not be viable. Wireless technologies are continuing to impact the healthcare industry. These advanced technology solutions are becoming a necessity for highly mobile healthcare professionals who require frequent access to information. The application of wireless technologies in healthcare has led to patient care improvement, cost savings, streamlined processes, improved regulatory compliance, and a number of other benefits.

Advanced patient monitoring systems are focused on utilizing the technologies recently introduced to the healthcare field. Advances in remote patient monitoring include new peripherals, real-time audio and video for “face-to-face” interaction between clinicians and patients, wireless communication, systems that “sort” the vast amount of data collected in order to put it into the context of a patient’s condition, portable and ambulatory monitors, web-based access to the patient record, systems that transfer data to an electronic medical record (EMR), and full-service outsourcing that includes a clinician to evaluate data and send reports to attending physicians.

Telemedicine includes sending images to a specialist, live two-way video consultations between patient and provider, capturing and sending data from monitoring devices, and incorporating data and images into EMRs. Reasons for using telemedicine include improved access to healthcare for patients in distant locations; cost effectiveness; and patient demand.

3. WIRELESS TECHNOLOGIES IN HEALTHCARE

For making decisions at the point of action, doctors, nurses, clinicians, pharmacists and sales people alike need real-time access to data for enhancing their decision-making process. Patient management process, wireless monitoring, etc., are some of the applications of wireless technologies in healthcare.

The application of wireless technologies in healthcare is expected to succeed because of the following two reasons:

- Wireless technologies integrate well with the mobile workflow of the clinical environment, which is a prerequisite for successful adoption by physicians and hospitals personnel.
- The past experience with implementing clinical information systems can be leveraged upon and used to successfully implement wireless systems.

4. GROWTH IN WIRELESS HEALTHCARE

More than \$4 billion is spent annually in the United States for implementing and operating wireless technologies in the healthcare segment. This includes revenue generated from network operations, software upgrades, and medical devices utilizing wireless technologies. Growth is expected to remain strong at 16 percent annually.

The 2009 initiation of the American Recovery and Reinvestment Act (ARRA) affected the IT portion of the healthcare system with the HITECH Act, which allocated \$19.2 billion in funding toward healthcare IT. Additional assistance for meeting government requirements, including meaningful use criteria, has contributed to a growing market segment.

5. WHAT IS PATIENT MONITORING AND WHAT IS IT USED FOR?

While the full spectrum of the patient monitoring segment includes basic, non-advanced equipment, the area of interest is “advanced” monitoring equipment and devices with advanced features. More specifically, the focus is now on the technologically advanced (including wireless and remote) patient monitors; monitors with patient data processing applications; and monitors which are capable of data transfer to an EMR system—including equipment and peripherals which coordinate the flow of data to hospital electronic medical record systems. Patient monitoring parameters range from basic vital signs to electrocardiograms (ECGs). Picture-archiving and communications systems (PACs) allow for images, such as radiology imagery, to be scanned into an EMR. Disease state management kits or systems include those for asthma, cancer, cardiovascular disease, COPD, and diabetes.

The major users of patient monitoring technologies are hospitals, home care providers, nursing homes, first responders, physician’s offices, institutions, and military providers. These end-users have a vastly different level of requirement but there is overlap in the technologies that allows some companies to serve several end-users at a time.

Hospitals are concerned with the ability to access patient data within the hospital, during transport and at ancillary facilities. The benefit of having the data sorted for a clinician to access direct patient data quickly and from all departments is far reaching.

Home healthcare can be ordered by hospitals or physicians and can range from monitoring basic temperature, weight, and vital signs, to specific disease state management of conditions such as chronic obstructive pulmonary disorder (COPD), asthma, cardiovascular conditions; respiratory conditions; perinatal monitoring; sleep apnea, or diabetes. In this segment of the market, the end-user performs some of the work in monitoring their own health, which can translate to better outcomes. In these cases, patient monitors are user-friendly, often connect to a central hub, and transmit data via telephone lines or with cellular connections. The concern in the homecare setting is that the numerous devices available (and their connectivity options) will not fully work together or meet the requirements of outside systems such as when communicating with software like an EMR.

Nursing homes, including skilled nursing homes, rehabilitation nursing homes, and assisted living facilities, have needs somewhere between those of hospitals and home healthcare. Patient monitoring needs can range from basic monitoring of vital signs for rehabilitative patients or relatively mobile patients to monitoring of chronic conditions. In this setting,

a healthcare kiosk can be used to serve not only the residents of a nursing home but to provide oversight for the caregivers and the resident's family. Kiosks feature customizable options, but might include password protected accounts, health measurement abilities, and built-in health records.

Other strong markets for patient monitoring include first responders, institutions (such as correctional institutions), and the military. These users may require more robust systems, and better mobility or communication range.

6. ADVANCED PATIENT MONITORING IS ABOUT EFFICIENCY AND IMPROVED CARE

Two of the leading questions in the industry are:

- Are patient monitoring technologies really better and which ones are the most cost-effective?
- How are they going to be integrated with current and future systems while maintaining patient confidentiality?

Hospitals want to improve the level of care and efficiency at the same time because there are opportunities for both. There are an approximately 100,000 deaths per year in the U.S. due to preventable medical errors. If hospitals have an opportunity to save costs and improve care at the same time they are generally more open to these systems. Additionally, the prevention of medical errors is a cost-saving in terms of reduced hospital stay, and malpractice or legal claims.

The case studies concerning patient monitoring technologies have described a high patient satisfaction ratio, a reduced readmission rate for recently discharged patients, and a level of increased efficiency for staff. Some of the most widely reported concerns from healthcare facilities involve standardization, data security, and future technology integration. The complexity of the healthcare system is providing opportunities in patient monitoring solutions in a wide range of specialties from emergency responders to chronic care providers.

Both companies and healthcare providers continue to work to achieve the benefits of these technologies but there is still work to be done. Unfortunately, there are significant barriers to implementation, including initial costs, technological incompatibility, privacy and security issues, and education of healthcare personnel in use protocols. Through the efforts of federal agencies, international agencies, and industry groups, these concerns are being addressed and will likely continue to be overcome, resulting in a more efficient, more productive, and more cost-efficient healthcare system.

7. MARKET OPPORTUNITY FOR ADVANCED PATIENT MONITORING

The global advanced patient monitoring market has seen some recent growth with the United States and many European countries at the forefront of implementation. The total global market is estimated at nearly \$22 billion, inclusive of devices, peripherals, software and other applications. In 2017 the market is expected to be worth \$46 billion.

8. IS AN ADVANCED MONITORING SYSTEM REALLY MORE EFFICIENT?

The case studies to date provide various levels of costs and measurements of success. Some studies did not report return on investment (ROI), but found that clinical outcomes improved significantly. Other institutions have jumped from small pilot programs to large-scale rollouts of advanced monitoring systems due to the cost savings or efficiency improvements.

Several of the early studies reported fewer technologies, less interoperability, and reduced numbers of solutions providers. For example, newer systems offer better interoperability, such as consistently using Wi-Fi or Bluetooth connectivity, and complete turn-key systems from a single company. Patients and clinicians are now also more familiar with mobile technologies such as smart-phones or tablets, which has translated to better implementation of advanced health technologies.

Prisons have successfully implemented telehealth systems and reported reduced costs and better access. Certain U.S. state correctional systems have reported implementing cloud-based EMR and telehealth systems to cut costs. One U.S. state reported cutting up to \$100 million per year for total correctional health care costs when using a widespread remote telehealth system in connection with digital EMR's. Another state reported that with limited rollout it saved approximately \$15 million in one year by using a telehealth system.

9. PATIENT MONITORING SOLUTIONS: ESTIMATED SAVINGS AND BENEFITS

Studies in the United States and Europe have proven the cost benefits of patient monitoring, despite initial costs of implementation. The Home-Care Management Systems study was partially sponsored by the European Commission under the Trans-European Network initiative. The study, known as TEN-HMS, was the world's first large-scale, randomized prospective telemonitoring trial. The study showed that the use of home-based telemonitoring reduced the number of hospital days by 26 percent and led to an overall cost savings of ten percent compared with nurse telephone support. Home telemonitoring also increased both patient survival and patient satisfaction.

According to a *Wall Street Journal* report, annual savings from remote monitoring could amount to as much as \$10.1 billion for U.S. residents with congestive heart failure; \$6.1 billion for patients with diabetes; and \$4.9 billion for patients with chronic obstructive pulmonary disease.

10. EFFICIENCY IN ADVANCED ELECTRONIC MEDICAL RECORDS (EMRS)

In February 2012, the analysis unit of Healthcare Information and Management Systems Society (HIMSS) reported that hospitals with advanced EMR systems reported benefits in several areas of care. Hospitals are rated by HIMSS Analytics on a scale up to stage seven. Stage seven hospitals have the most complete EMR systems. Stage six and seven hospitals were surveyed to find out what specific benefits were achieved.

Survey results were collected from chief information officers from 33 hospitals across the U.S. These respondents targeted greater clinical success, specifically to reduce adverse drug events (ADEs) and increase treatment quality. All hospitals that responded found at least one core measure benefit and a safety measure benefit from advanced EMR adoption. Hospitals that targeted improvements in care often achieved the benefits they focused on. More than 75 percent saw an improvement in pediatric asthma, pregnancy, AMI, CHF and VTE due to targeting these areas of care.

Around 75 percent of hospitals that targeted ADE reductions reported seeing improvements in this area. Additionally, two hospitals that did not target ADEs also saw improvements in this area.

Other than clinical improvements, hospitals reported operational benefits. The following benefits are shown along with the percent of respondents that experienced them.

- Reduction in order turnaround times (76%)
- Improved drug order to administration times (73%)
- Decreased cost of paper forms (67%)
- Improved charge capture (64%)
- Decreased transcription costs (61%)
- Reduction in duplicate lab testing (58%)
- Reduction in antibiotic start times (58%)
- Improved documentation quality (55%)
- Improved quality of coding (46%)
- Medical record staff reduction (42%)
- Improved reimbursement (42%)
- Reduced payment denials (39%)
- Pharmacist time savings (33%)
- Reduced drug use or cost (30%)
- Clinical cost reduction (24%)
- Length-of-stay reduction (18%)

- Nursing staff time savings (15%)
- Increased use of preventative care (12%)
- Reduced staff (9%)
- Other (6%)
- Don't know (3%)
- No additional benefits (3%)

Surveys for this analysis were sent to 180 hospitals in late 2011. Of the mailed surveys 18 percent or 33, were returned. The average bed size of the hospitals was 376, but the number of beds ranged from 25 to 900 per hospital. The majority of hospitals, 82 percent, were rated a stage 6 EMR hospital.

11. DEFINING TELEHEALTH AND TELEMEDICINE: A NEW TOOL IN DELIVERING HIGH-QUALITY PATIENT CARE

A new leading segment of patient monitoring is telehealth, sometimes called telemedicine and e-health. This form of care involves delivering quality healthcare via telecommunications devices and services. The American Telemedicine Association defines telemedicine as follows:

“Telemedicine is the use of medical information exchanged from one site to another via electronic communications to improve patients’ health status.”

Telemedicine includes sending images to a specialist, live two-way video consultations between patient and provider, capturing and sending data from monitoring devices, and incorporating data and images into EMRs. Reasons for using telemedicine include improved access to healthcare for patients in distant locations; cost effectiveness; and patient demand.

12. TELEHEALTH: A GROWING MARKET OPPORTUNITY

Already, health providers in rural communities or those with a large number of individuals in a home care setting, have reported cost savings when implementing remote monitoring solutions. Some of these cost savings involve less patient travel, less nursing travel, reduced readmissions, and time savings. One health clinic reported that it saved patients 2-3 hours on average per telehealth visit plus saved significant travel miles, compared to a traditional office visit. This was in addition to maintaining a high level of patient satisfaction and healthcare services.

The market opportunity for telehealth and telemedicine is significant. The current global market is valued at about \$10 billion with double-digit growth expected throughout the next five years. The telemedicine segment of the market is continuing to gain a larger portion of patient monitoring sales with the trend to continue care at offsite locations becoming more popular. The telemedicine market is similar to the home health market but requires a more direct link to the patient with the health provider. Home care is major driver to the growth of the patient monitoring market as the demand for aging patients to be treated at home continues to climb.

13. SORTING OUT TELEHEALTH REIMBURSEMENT IN THE U.S.

The availability of reimbursement is a significant driver for the growth of healthcare monitoring. Medicare and Medicaid have separate descriptions and billing systems for telemedicine. Medicaid does not recognize telemedicine as a distinct service but describes telemedicine as “a cost-effective alternative to the more traditional face-to-face way of providing medical care (e.g., face-to-face consultations or examinations between provider and patient) that states can choose to cover under Medicaid.”

Medicare provides support described under 42 CFR 410.78. The general services for telemedicine under Medicare’s rule is:

Medicare Part B pays for office or other outpatient visits, and subsequent hospital care services, but limited to one telehealth visit every 3 days. It also allows subsequent nursing facility care services (not including the Federally-mandated periodic visits with the limitation of one telehealth visit every 30 days). Certain other stipulations must also be met including:

- *The physician or practitioner at the distant site must be licensed to furnish the service under State law.*
- *The services are furnished to a beneficiary at an originating site including:*
 - *The office of a physician or practitioner.*
 - *A critical access hospital.*
 - *A rural health clinic.*
 - *A Federally qualified health center.*
 - *A hospital.*
 - *A hospital-based or critical access hospital-based renal dialysis center (including satellites).*
 - *A skilled nursing facility.*
 - *A community mental health center.*

14. MENTAL HEALTH AND TELEMEDICINE: TELEPSYCHIATRY AND TELEMENTAL HEALTH

Telemental health or telepsychiatry is a form of remote medical care that may be used to serve areas with potentially low provider distribution. Specifically in the case of telemental health, it is being looked to as a method of providing long-term support, structured information management, improved communication, and increased efficiency. Medicare provides reimbursement for mental health via telemedicine as long as the criteria for service are met.

There has been an increased focus in mental healthcare in the U.S., especially in locations affected by life-altering events such as mass shooting by perpetrators with a history of mental illness.

Budget cuts in the developed nations have resulted in reduced funding for mental health centers. In the U.S. an estimated \$4 billion has been cut from spending on mental care between 2009 and 2012. The burden of mental illness has been estimated in the U.S. at \$300 billion. The amount spent on mental health in the U.S. is between 5% and 6% of healthcare dollars. Internationally, this is average or slightly above average in most cases.

In 2013, lawmakers have reported that they are being asked to provide more services in mental health as a 'necessity'. Parents of young children with autism are writing to ask for new ways to care for their children because they feel ill-equipped to do the work themselves or they don't have the insurance to help provide care. Because budget constraints are listed as the primary inhibitor to mental healthcare, a more efficient system is being reviewed for help in this area.

14.1 Mental Disorder Statistics

In the U.S. around 25 percent of people suffer from some form of diagnosable mental disorder during a given year. This translates to approximately 75 million people. The core number of people that suffer from the more serious forms of mental illness is much smaller, around 6 percent or 18 million people. Approximately 45 percent of those with one disorder also meet the criteria for two or more disorders.

15. CASE STUDIES: HEALTHCARE IT, MONITORING AND TELEMEDICINE

Case studies in patient monitoring have been conducted by technology providers, government agencies, and healthcare centers. The results of the studies in general have indicated that there are numerous advantages when implementing systems with careful planning and preparation.

15.1 Veterans Health Administration and Telehealth

The Veterans Health Administration (VHA) is a large national health network that serves approximately 6 million military veterans and spends upwards of \$50 billion a year on healthcare. One early telehealth study pushed the VHA to implement future systems based on the early levels of success. Between 2000 and 2003, the VHA implemented a regional telehealth pilot program that served 28 clinics and 900 patients. After three years they reported a 40 percent reduction in emergency room visits, a 63 percent reduction in hospital admissions, 88 percent reduction in nursing home bed days of care and a 94 percent level of patient satisfaction. By 2010, there were 300,000 patients enrolled in a form of VHA care coordination/telehealth program and 70,000 with home telehealth technologies. The VHA has reported good results, strong patient satisfaction, and 40 percent reduction in bed days of care compared to pre-enrollment.

15.2 Honeywell's LifeStream View

In Portland, Maine, the Visiting Nurses Association (VNA) Home Health & Hospice has an established monitoring system using Honeywell's Genesis DM and Genesis Touch remote patient monitoring devices. The devices are used for moderate to high-risk patients in hospice and post-acute care. Founded in 1921, the Southern Maine Chapter VNA is affiliated with Mercy Hospital of Maine.

In an effort to improve care, VNA added the ability for physicians to track a patient's health status using the LifeStream View system. View is one of five LifeStream software applications. The software allows an authorized user to view patient health information via the internet. This system supports family member, patient, and caregiver access wherever they have an internet connection. The center has plans to add access for family members in the future.

The result of the care center of adding a connectivity solution for physicians has been a reduced level of paperwork, and increased efficiency. The care facility reported a reduction of around 90% in its paperwork and a big part of it was that faxing was no longer required.

15.3 St. Alexius Medical Center (SAMC) Telehealth Project

In 2011, St. Alexius Medical Center (SAMC) and the Great Plains Telehealth Resource and Assistance Center (gpTRAC) worked in collaboration to assess a telehealth program using Honeywell's Genesis DM monitors and the LifeStream Management Suite. The hospital has 306 beds and offers inpatient and outpatient services, including home health and hospice. The medical center collected biometric data in addition to recording data from regular conversations with patients to better assess the health project. Following health services gpTRAC analyzed the data to measure the quality of care. The program included:

- A total of 38 patients enrolled for program duration;
- An average patient age of 79 years;
- Patient enrollment time of 97.4 days on average; and
- All patients had one or more chronic condition.

The medical center faces an issue with a widespread patient base. It conducts the majority of its care in North Dakota, South Dakota, and Montana which are dominated by rural houses and farms. This makes any follow-up care more difficult and costly. The medical center wanted to improve care, reduce costs, reduce readmissions, and improve access to care. Specifically, the hospital's goal was to create efficiencies in the system to reduce miles traveled, save time per visit, and allow more visits from its nursing staff.

Table 1 - Results of St. Alexius Medical Center Telehealth Project

Findings	Specific Results
Reduced readmissions	There were 3,701 total patient/days for the project resulted in 10 re-hospitalizations and 1 within 30 days of enrollment.
Improved Patient Care	According to patients: • 92% agreed that telehealth can improve health. • 83% agreed it could reduce health costs • 84% thought the equipment was easy to use • 96% thought telehealth was a convenient form of healthcare delivery
Reduced costs due to lower number of patient/provider encounters	The hospital noted that remote patient communications from alerts reduced the travel of caregivers.
Increased access from better monitoring and patient alerts	Remote monitoring alerts increased the level of access for patients. This resulted in a greater stability of clinical indicators.

Source: Honeywell HomMed

15.4 Ottawa Hospital--Ottawa, Ontario

In July 2012, Ottawa Hospital announced the beginning of a collaboration to evaluate the integration and success of selected Philips cardiopulmonary monitors in critical care departments. The hospital's goal is to evaluate patients using mechanical ventilation and use the system to determine the readiness for discontinuation of mechanical ventilation equipment. This will likely improve patient comfort and subsequently is expected to improve patient long-term outcomes, including reducing complications related to mechanical ventilation such as ventilator-associated pneumonia. The hospital is also predicting a substantial cost savings by implementing this project.

15.5 Philips ICU Telehealth Program

In November 2011, Sisters of Mercy Health System implemented a telehealth service to its stroke patients. The system uses Philips eICU telehealth program which offers timely access to stroke neurologists to help support stroke victims.

By July 2012, the use of Philips eICU telehealth system grew to include a number of hospitals and acute care centers. Emory University along with a number of participating facilities (St. Joseph Hospital, Northeast Georgia Hospital and Southern Regional Medical

Center) implemented the system is currently evaluating the return on investment and life-saving benefits. Emory University expects the project to save more than \$18 million over the course of three years and provide invaluable services and monitoring to rural communities.

In September 2012, Philips again announced a major development and implementation in the eICU program. A stand-alone monitoring office, WakeMed, opened during the month to provide remote monitoring of ICU patients in the Raleigh and Cary, North Carolina. This facility is equipped with 24/7 experienced ICU nurses with monitoring capabilities which include video, real-time vital sign management, and access to the patient's medical record. This program is expected to provide services to the rural communities which would otherwise be limited, reduce complications, save lives, and reduce health care costs.

15.6 Southeast Alabama Medical Center--Dothan, Alabama

In June 2011, Southeast Alabama Medical Center announced that it will use the Draeger Infinity M300 patient-worn monitor in conjunction with its existing Wi-Fi system. The medical center purchased (200) M300 devices, making it the largest installation of the wireless monitors worldwide at the time, according to Draeger.

The legacy system at the health center was not wireless, restricting patients from the freedom to move around easily and limiting how the medical staff observed patients doing typical activities. The Director of Patient Care Services at the 420-bed medical center reported that it avoided increased costs because the hospital had total Wi-Fi coverage, so adding monitors to new areas required no additional expenses. Because the devices have visual and audible alarms and they offer more flexibility, it is expected to reduce costs due to increased workflow and response times.

15.7 Meridian Health—New Jersey

In February 2011, the New Jersey Hospital Association awarded Meridian At Home (part of Meridian Health) with its Excellence in Quality Improvements Award for a pilot program that was conducted with the Ocean Medical Center in Brick, NJ. The pilot program was conducted with patients that were treated for congestive heart failure (CHF) at Ocean Medical Center. After patients went home, they used a remote monitoring scale that would transmit their weight back to staff at the hospital. If a patient gained too much weight, staff at the hospital was alerted to take action. Alarming weight gain in CHF patients can trigger hospital readmission. The benefit of a remote solution is that a much larger number of patients can be monitored by one nurse.

The implementation of the program resulted in a readmission rate decrease from 14.9 percent of patients to 4.8 percent of patients in eight months.

Meridian is one of the 100 most wired hospital care providers in the U.S. Approximately 51 percent of medication orders are done electronically and over 50 percent of medication orders are matched at the bedside at these hospitals with Radio Frequency Identification (RFID) or bar coding.

15.8 Mount Sinai Hospital and the University Health Network (UHN)—New York, New York

Mount Sinai Hospital and the University Health Network combined resources to test BlackBerry devices for diabetes monitoring. The test included developing a specific software/hardware system that allowed patients (with type II diabetes) to monitor and report blood sugar and blood pressure readings from home to healthcare providers. An important component of the system had to be a user-friendly interface. Many patients, especially the elderly, would have a difficult time learning new or complicated hardware and software processes.

This particular trial studied 33 patients and 25 physicians. Patients were given a BlackBerry phone enabled for use on the University Health Network; a Bluetooth-enabled blood pressure monitor, and a glucometer. The system automatically sent blood pressure readings to the phone, and blood sugar readings were accompanied by a text message asking the patient if the reading was taken before or after a meal. All messages were sent to the network automatically. The back-end database measured the readings and determined if they were acceptable. Readings outside an acceptable range could be brought up to providers and patients through an alert system. The study found that:

- BlackBerry devices with Bluetooth offered easy-to-use connections with no wires.
- Security parameters were met.
- Implementation was cost effective.
- Patient's blood pressure readings improved. This was attributed to a more patient-interactive monitoring system.

15.9 Sentara Healthcare—Norfolk, Virginia

Sentara Healthcare is a leading health network in the U.S. and one of the most technologically advanced providers according to Modern Healthcare magazine. The group records annual revenues of around \$3 billion, and it has 19,000 personnel, 7 hospitals, 10 long-term care centers, and a 380,000 member health plan.¹

Sentara uses the eCare electronic medical record system that utilizes a number of technologies including wireless systems. Pharmacists use mobile wireless devices to stay connected within the Sentara network. Sentara Home Care offers a wireless telehealth option for patients in the home. Patients use wireless equipment to conduct measurement like oxygenation, blood pressure, pulse, temperature, blood glucose and weight. Caregivers and patients may also see and hear each other for “virtual visits”.

Within the first year using its complete efficiency system, Sentara reported that it had recorded \$17 million in annualized ROI benefits attributable to hospitals, health plan services, and home health. This is expected to increase to \$38 million for 2011. Also, at four of the group's hospitals for a six-month period, it recorded a reduction of 41,000 medication errors.

¹ 2011 Healthcare Information and Management Systems Society; Website-http://www.himssanalytics.org/hc_providers/stage7casestudies_Sentara.asp

Sentara Healthcare also installed an eICU program and has reported very favorable results with both patients and physicians. The facility reported it reduced intensive care mortality rates by 25 percent and shortened the average length of stay for patients in the eICU setting by 17 percent. In addition, the facility was able to significantly reduce costs while upgrading quality of care. Per patient costs dropped \$2,150 based on reduced patient expenses and increased ICU capacity, generating approximately \$3 million in savings for the facility.

15.10 Cardinal Health—Dublin, Ohio

Over the past decade, radio-frequency identification (RFID) implementation has become a focus for institutions looking to reduce long-term costs and address tracking issues. RFID is simply an identification (ID) system that can be used in various ways. It is a technology that offers some features that are not found in other systems, such as the ability for a reader and a product (with an RFID tag) to communicate at a relatively large distance. A basic healthcare application is the tracking of medications from the manufacturer to the consumer.

RFID offers various solutions for the main segments of the healthcare industry—hospitals and nursing homes, pharmaceutical manufacturers, distributors, and pharmacies. This report defines the market for RFID opportunities in the healthcare industry focusing on five general market segments:

- Pharmaceutical manufacturing and distribution/blood product distribution and tracking
- Medical staff identification and tracking and patient identification and tracking
- Medical asset tracking and locating
- Medical device RFID use
- Other areas including medical documents and patient records

In 2006, Cardinal Health reported results from an RFID pilot test. The pilot test was undertaken to determine if RFID tags could be placed, encoded and read during the normal production process when pharmaceuticals are packaged and distributed. The test was conducted to not only help improve safety by limiting counterfeit products, but to determine if the supply chain could work more efficiently with the technology.

Cardinal Health reported that the addition of RFID adds safety to the distribution process. Additionally, their pilot test proved that RFID could be added to units, cases and pallets. RFID tags can be added to existing label stock and encoded at normal production speeds with nominal alterations to the current process.

The company also found that improvements would be needed to help read unit stock when packaged in groupings such as at the pallet level or in tote containers. Totes are often used to deliver pharmaceutical containers to pharmacies.

Following the results of the pilot program, Cardinal announced that it would be integrating RFID into their Sacramento, Calif., distribution center. Today, Cardinal Health uses RFID technologies for a variety of tasks in their facilities and has noted several cost savings.

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