governmental levels, nonprofit and for-profit healthcare organizations, and insurance payers have all been impacted by technology (eJobDescription, 2016). Technological advances have been blamed, in part, for the continued rise of healthcare expenditures, but the results of technological advances cannot be disputed.

Electronic Health Records

History

The Institute of Medicine (IOM) has published a series of reports over the past several years that focus on improving the quality of health care in the United States. In 2001, it published the report *Crossing the Quality Chasm: A New Health System for the 21st Century*, which stresses the importance of improving IT infrastructure. The IOM emphasized the importance of an electronic health record (EHR), an electronic record of patients' medical history. The report also discussed the importance of patient safety by establishing data standards for collecting patient information (IOM, 2001).

In 1991 and 1997, the IOM issued reports that focused on the impact of computer-based patients' records as important technology for improving health care (Vreeman, Taggard, Rhine, & Wornell, 2006). There are two concepts in electronic patient records that are used interchangeably but are different—the **electronic medical record (EMR/EHR)** and the **electronic health record (EHR)**. The **National Alliance for Health Information Technology (NAHIT)** defines the EMR as the electronic record of health-related information on an individual that is accumulated from one health system and is utilized by the health organization that is providing patient care while the EHR accumulates more patient medical information from many health organizations that have been involved in the patient care. Simply, the EMR is an EHR that can be integrated with other systems (MNT, 2016b). The IOM has been urging the healthcare industry to adopt the electronic patient record but initially costs were too high and the health community did not embrace the recommendation. This discussion will focus on the EHR.

As software costs have declined, more healthcare providers have adopted the use of the EHR system. The EHR system can be used in hospitals, healthcare providers' offices, and other types of healthcare facilities. It enables healthcare organizations to monitor patient safety and care. In 2003, the U.S. Department of Health and Human Services (DHHS) began to promote the use of HIT, including the use of the EHR. The IOM was asked to identify essential elements for the establishment of an EHR. The IOM broadly defined an EHR to include (IOM, 2016):

- The collection of longitudinal data on a person's health;
- Immediate electronic access to this information; and
- Establishment of a system that provides decision support to ensure the quality, safety, and efficiency of patient care.

According to the DHHS, the Health Information Technology for Economic and Clinical Health (HITECH) Act, which was enacted as part of the 2009 American Recovery and Reinvestment Act, was designed to stimulate the adoption of health information technology in the United States. The Office of the National Coordinator (ONC) for Health Information Technology is responsible for implementing the incentives and penalties program. The ONC has developed "meaningful use" guidelines for physicians and others that will help them receive incentive payments and avoid penalties in the future (DHHS, 2016).

Incentives to Use Electronic Health Records: Meaningful Use

In accordance with the HITECH Act, the Centers for Medicaid and Medicare Services (CMS) established incentives to encourage "**meaningful use**" of EHRs to increase patient care quality and safety. Meaningful use, as defined by the CMS, has established core measures that healthcare providers must meet to determine the EHR system is being adequately used. Stage 1, defined in 2010, focused on patient data and medical history. Stage 2, effective in 2014, increased the physician use of computerized physician order entry and clinical decision support to improve patient health outcomes.

Beginning in 2016, penalties will be issued to providers that fail to meet the program's requirements in the preceding year. Stage 3 objectives are focused on improving the interoperability of EHR systems in different practices. Prior to moving to Stage 3, the CMS established a "Modified Stage 2" (2015–2017), which combined the requirements of stage 1 and 2 for physicians. This modification was to reduce reporting requirements and assist with the transition to stage 3. Both healthcare professionals and hospitals are eligible for the program. They can participate in the Medicare, Medicare Advantage, or Medicaid program but cannot receive incentives for all of the programs. They must choose which program for which to receive the incentives.

Eligible healthcare professionals could participate for up to five continuous years and receive up to $44,000 for those years. Providers must demonstrate

meaningful use on an annual basis. The last year for provider enrollment was 2014; however, to receive maximum participation, providers must have enrolled by 2012. Effective 2015, providers who did not demonstrate meaningful use were subjected to a fine up to 5% of their incentive amount. Medicaid professionals can also be involved in the meaningful use of the EHR system. Nearly all states are administering the program. The federal government will pay 90% of the state's cost for implementing this type of electronic system. Medicaid incentives are higher than the Medicare program—up to $63,750 over six years.

Specified criteria for meaningful use for hospitals was established to review their EHR systems. As of October 2015, more than 479,000 healthcare providers received payment for participating in the Medicare and Medicaid EHR incentive programs. For Stage 3, the CMS will focus on advanced use of certified EHR technology to support health information exchange and interoperability, advanced quality measurement, and maximizing clinical effectiveness and efficiencies (CMS, 2016d).

Benefits of Electronic Health Records

Several studies have been performed to assess the impact of the EHR on healthcare delivery. Administrators of several healthcare delivery systems reported many benefits to the implementation of an EHR. Many administrators cited the capability of more comprehensive reporting that integrated both clinical and administrative data. It also provided an opportunity to analyze and review patient outcomes because of the standardization of the clinical assessments. Also noted was the development of electronic automated reports that improved the discharge of a patient. The reports also provided an opportunity for the administrator to assess the workload of a department. The EHR also improved operational efficiency. The EHR had excellent capabilities to process and store data. Administrators further reported that the computerized documentation took 30% less time than the previous handwritten notes (Shields et al., 2007).

Several studies indicated there was an improvement in interdepartmental communication. The EHR provided aggregate data in the patient records to other departments, and the information about the patient was legible. The actual design and implementation of an EHR system contributed to the development of a more interdisciplinary approach to patient care (Ventres & Shah, 2007; Whitman & David, 2007). The implementation of an EHR system led to improved data accuracy because it reduced the need to replicate data. The EHR system also provided a platform for routine data quality assessments, which was important to maintain the accuracy of the EHR data. The EHR system provides an opportunity for future research. The data captured in the database could be used to analyze outcomes and develop baseline data for future research.

Barriers to Electronic Health Record Implementation

From the perspective of a user such as a physician's office, a major issue with EHR implementation is the cost of implementing the system. Software purchases, hardware, network upgrades, training, and computer personnel must be considered in the purchase of the system. The average cost of installation for a practice is $55,000 (Daigrepont & McGrath, 2011).

According to Valerius (2007), migrating from a hard-copy system to an electronic system requires several components, including a physician order communication or results retrieval, electronic document control management, point-of-care charting, electronic physician order entry and prescribing, clinical decision support system, provider patient portals, personal health records, and population health. When an organization implements an electronic system, there are changes in the workflow because much of the process was previously manual. Training is required for both healthcare professionals and staff to fully utilize the system.

When purchasing a system for patient electronic records, sometimes there were equipment or software inadequacies that created a much slower system for processing data. If the system failed, it created frustration for healthcare professionals and administrators. Both of these problems emphasized the need for adequate training for both the providers and staff. Much of the initial training required overtime for the staff. Most of the training lasted approximately four months. Continued training was also required for maintenance of the system (Valerius, 2007).

The critical success factors medical practices need to consider for successful HIT implementation include the following (Daigrepont & McGrath, 2011):

- Uniform adoption of technology by all participants;
- Reliable HIT infrastructure;
- A system that is appropriate for the practice;
- A plan that details the milestones of the implementation of the system; and
- Ongoing training of all employees to ensure optimal use of the EHR.

A focus of EHR implementation is the development of standards for the type of data collected so it

can be exchanged between two systems. However, the American Academy of Pediatrics (AAP) has indicated that EHRs lack specific functions for pediatric patients such as child abuse reporting and newborn screening. The AAP has developed additional standards that EHR vendors could integrate into their products (Robeznieks, 2013).

In October 2008, Microsoft announced its **HealthVault** website (HealthVault, 2016) that enables patients to develop **electronic patient records** free of charge. These electronic health records are the patient component of the electronic health record. It is up to the individual as to how much medical information the person wants to store online with this website. The website also has links to several health websites that can assist with exercise programs, heart issues, drug reactions, software that allows users to share their medical information with their providers, and so on. In November 2008, the Cleveland Clinic agreed to pilot data exchanges between HealthVault and the Cleveland Clinic's personal health record system. The clinic enrolled 250 patients in the areas of diabetes, hypertension, and heart disease to test the system. The patients tested their health status at home using blood pressure monitors, weight scales, heart rate monitors, and glucometers. The patients tested themselves, and the reports were uploaded to the clinic using HealthVault. They were also able to access health education material on HealthVault regarding their diseases. This is the first pilot study in the country to assess this tool. The 2010 results of the pilot study indicated that there was a 26–71% increase in time intervals between doctor appointments. Heart patients made more appointments with their physicians as well (iMedicalApps, 2013). In 2010, Microsoft released a new version of HealthVault, Healthvault Community Connect, which allows patients to preregister for hospital procedures and admissions via the hospital's web portal. Patients can create a HealthVault personal e-health record account. When patients are discharged from the hospital, copies of their hospital care are uploaded to the patient's HealthVault account for the patient's accessibility. Microsoft HealthVault can now communicate with many healthcare websites, mobile applications, and personal health devices, which enable patients to more quickly upload their health data (HealthVault, 2016).

Computerized information systems that are seen in finance, manufacturing, and retail have not achieved the same penetration in health care. EHRs have captured the attention of politicians, insurance companies, and practitioners as a way to improve patient safety because patient information will be more complete and standardized, which will enhance the decision-making process of practitioners (Murer, 2007). Major barriers to EHR implementation have been discussed, including training and financial impacts on organizations as the system becomes integrated with daily operations. However, there are legal issues associated with the implementation of an EHR.

There may be medical malpractice concerns when a physician initially adopts an EHR due to errors when transferring patient data from a paper system to an electronic system. Another legal issue is the electronic definition of a legal patient record. A traditional patient record is a folder containing a paper trail of patient visits, prescriptions, and tests. During a trial, what constitutes an electronic patient record? A report is generated by the EHR software that does not look like the actual screen data of the patient. As with patients' paper files, there are certainly issues with medical errors related to entering the patient information into the system. For example, a family physician using an EHR system nearly prescribed the incorrect medication because of an incorrect click of the mouse. Lastly, the other issue is the protection of the data. Depending on who has access to the patient data in the healthcare facility, there may be breaches of confidentiality (Gamble, 2012).

Clinical Decision Support Systems

Artificial intelligence (AI) is a field of computerized methods and technologies created to imitate human decision making. A technique of AI is **expert systems** (ESs), which were developed to imitate experts' knowledge in decision making (Coiera, 2003). **Electronic clinical decision support systems** (CDSSs) are designed to integrate medical information, patient information, and a decision-making tool to generate information to assist with cases. They are a type of knowledge-base system. The key functions of a CDSS are (1) administrative, (2) case management, (3) cost control, and (4) decision support. Administrative protocols consist of clinical coding and documentation for procedure approval and patient referrals if necessary. Case management control focuses on the management of patients to ensure they are receiving timely interventions. Cost control is a focus because the system monitors orders for tests and medication, which reduces unnecessary interventions (Perreault & Metzger, 1999).

Specifically, ESs can be used to alert and remind healthcare providers of a patient's condition change or to have a laboratory test or an intervention performed. An ES can also assist with a diagnosis using the system's database. The system can expose any weaknesses

in a treatment plan or check for drug interactions and allergies. A system can also interpret imaging tests routinely to flag any abnormalities. It is important to note that the more complex duties of a system require the integration of an EHR system so the system can interface with the patient data (Coiera, 2003).

Research over the past several years has indicated that CDSSs have many potential benefits, which can be classified into three categories: (1) improved patient safety, (2) improved quality of care, and (3) improved efficiency in healthcare delivery. Although the barriers to implementation were identified previously, the benefits for many institutions have outweighed those barriers so they have found ways to utilize these CDSSs. More CDSSs are being developed to provide information for various types of diseases (Open Clinical, 2016).

Computerized Physician Order Entry

Computerized physician order entry (CPOE) systems are CDSSs that enable a patient's provider to enter a prescription order or order for a lab or diagnostic test in a computer system, which typically is now part of an electronic health record system. The order entry has four components: (1) information is entered from a handheld device, laptop, or desktop computer; (2) the provider orders a test, prescription, or procedure; (3) the device is connected to a decision support system that alerts providers to any problems with their orders; and (4) the system can be integrated into the overall computer system of the organization. The CPOE first appeared in 1971 when NASA Space Center and Lockheed Corporation developed a system for a hospital in California. It improves quality assurance in patient care, thus reducing medical errors (Ash, Gorman, Seshardri, & Hersch, 2004).

E-prescribing, a form of CPOE, consists of medication history, benefits information, and processing new and existing prescriptions. With an e-prescribing system, the user–clinician signs into a system with a password to verify identify. The user–clinician provides a patient identification code so the user–clinician can review the patient's medication list, prescribe a new drug and designate which pharmacy will fill the prescription (HRSA, 2016).

Over 90% of pharmacies can accept electronic prescriptions (Surescripts, 2016). Errors can occur in medication ordering and administration because of similar sounding names, similar dosages, and similar labeling. E-prescribing can be performed on a desk computer, a laptop, or a handheld device, which will record physicians' prescription orders and thereby eliminate the need for an individual to read a handwritten prescription. CPOE also has a decision support system that includes possible drug interactions and dosage information that help physicians make the best decisions possible for patients.

Section 132 of the Medicare Improvements for Patients and Providers Act of 2008 (MIPPA) authorized incentives to encourage physicians to e-prescribe. In January 2009, Medicare and some private healthcare plans began paying a bonus to physicians who e-prescribe to their Medicare patients. Since 2012, Medicare has also penalized physicians who do not e-prescribe by reducing their reimbursement rates by 1%, 1.5% for 2013, and 2% for 2014 and all subsequent years (CMS, 2016b). IT companies are providing free software to physicians to encourage them to electronically prescribe. This system can be used alone but it is best used with the EHR system because it integrates the information from the patient's EHR into its decision making.

Pharmacy Benefit Managers

Technology-based tools provide exceptional value to the prescription benefits of a health insurance program. E-prescribing will become more commonplace with the mandates of Medicare. In order to manage this technology effectively and efficiently, a **pharmacy benefit manager** (PBM) uses technology-based tools to assess and evaluate the management of the prescription component so it can be customized to address the needs of the organization. PBMs are companies that administer drug benefits for employers and health insurance carriers. They contract with managed care organizations, self-insured employers, Medicaid and Medicare managed care plans, federal health insurance programs, and local-government organizations. They provide an opportunity for employers to offer reduced prices for their employees. In 2016, approximately 266 million patients with drug coverage received benefits through a PBM. There are 30 PBM companies, with three major PBM companies covering 78% of the market. The PBM integrates medical and pharmacy data of the population to determine which interventions are the most cost effective and clinically appropriate. They operate within healthcare systems such as Kaiser or retail operations such as CVS (Balto, 2015).

Drug–Drug Interactions

Drug–drug interactions (DDIs) are used by software programs to alert pharmacists and clinicians about potential drug interactions. These alerts can be notifying the provider that two drugs may interact or there may be management strategies provided

regarding the DDIs. DDI software programs can be very beneficial to providers but must be updated continually to ensure there is current information provided regarding drug interactions (Murphy et al., 2009).

Telehealth

Telehealth is the broad term that encompasses the use of IT to deliver education, research, and clinical care. An important activity of telehealth is the use of email between providers and their patients. **E-health** refers to the use of the Internet by both consumers and healthcare professionals to access education, research, and products and services. There are several websites such as WebMD and Healthline that provide consumers with general healthcare information. Sometimes telemedicine is best understood in terms of the services provided and the mechanisms used to provide those services.

Telemedicine refers to the use of IT to enable healthcare providers to communicate with rural healthcare providers regarding patient care or to communicate directly with patients regarding treatment. The ultimate goal of telemedicine is to improve the patient's health status. The basic form of telemedicine is a telephone consultation. There are growing IT applications for telemedicine, including smart phones, video conferencing, and email (American Telemedicine Association, 2016). Telemedicine is most frequently used in pathology and radiology because images can be transmitted to a distant location where a specialist will read the results. Telemedicine is becoming more common because it increases healthcare access in remote locations such as rural areas. It is also a cost-effective mode of treatment. Telemedicine includes:

1. Synchronous electronic consulting between primary care providers and specialists;
2. Remote patient monitoring, which includes sending patient data to a remote location electronically;
3. Provision of electronic health consumer information; and
4. Provision of medical education to healthcare professionals.

The information can be sent electronically via networks and websites (American Telemedicine Association, 2016).

Avera Ecare

Beginning in 1993, Avera offered eConsult services to rural, frontier, and critical-access hospitals that were part of the Avera Health system. Avera eConsult completes more than 900 virtual visits each month with patients in 100-plus clinics and hospitals. Since eConsult services launched in 1993, they have provided support to approximately 35 medical specialties. Ten years later, eCARE expanded to provide eICU care, the first 24-hour, on-demand service that allows staff at partner facilities to connect virtually via a video and audio call for immediate assistance from board-certified providers. In addition, Avera eCARE delivers 24/7 access to medical specialists for underserved populations and communities.

Since Avera ePharmacy services began in 2008, they have provided remote pharmacy coverage for just over 700,000 patients, including 170,000 in 2015. For the 60-plus facilities currently in their network, they reviewed 630,000 medication orders in 2015 for any adverse drug events.

In 2009, Avera eCare established eEmergency, which provides rural providers with immediate electronic access to emergency-certified physicians and nurses to help them with diagnosis of patients with critical conditions. It is an example of tele-emergency services. Rural clinicians and administrators agreed that eEmergency services have demonstrated significant impact on the quality of clinical services provided in rural areas.

Avera eCare recently established eCorrectionalHealth which provides medical consults to South Dakota prisons. In 2015, they completed 500 video consults and 150 service-related calls and eLongTermCare, which serves 30 long-term care facilities. In all of these instances, this type of electronic medical serve does provide cost savings to medical facilities because it requires no onsite visits (Avera eCare, 2016).

Million Hearts

Million Hearts is a national initiative to prevent one million heart attacks by 2017. The focus is to educate providers and patients on the "ABCS" through the use of HIT:

Aspirin therapy as needed
Blood Pressure Control
Cholesterol Management
Smoking Cessation.

Million Heart EHR optimization guides assist providers with optimizing their EHR systems with the ABCS. They help providers with improving their EHR data to maximize the Million Harts clinical data measures. The government is requesting EHR vendors to work to develop guides for their systems to customize it for Million Hearts ABCS data (Million Hearts, 2016).

Chief Information Officer

As more healthcare services are delivered electronically, many healthcare organizations have designated a chief information officer (CIO) to manage the organization's information systems. Some organizations may also refer to this position as a **chief technology officer (CTO)** or they may have both. Normally, the CIO is a vice president of the organization and the CTO reports to that position. The CIO also integrates HIT into the organization's strategic plan. The CIO must have knowledge of current information technologies as they apply to the healthcare industry and how new technology can apply to the organization. The CIO is also responsible for motivating employees whenever there is any technological change (Oz, 2006). C. Martin Harris, the CIO of the Cleveland Clinic, feels that the challenge of the CIO (who, he believes, is a change agent) is to move from the implementing of the EHR to continuing to provide quality care to the patient by developing an integrated system model regardless of the organization's size or location. As more health care is being delivered by technology, it will be the responsibility of the CIO to develop a model that is patient oriented rather than operations oriented (Harris, 2008).

Council for Affordable Quality Health Care

The Council for Affordable Quality Health Care (CAQH), a nonprofit organization, consists of alliances of health plans and trade associations that discuss efficiency initiatives to streamline healthcare administration by working with healthcare plans, providers, the government, and consumers. One initiative is creation of a **Committee on Operating Rules for Information Exchange (CORE)**, which borrows from the banking industry's standards for one of the largest electronic payment systems in the world. Based on stakeholder input, CORE has set up standards and operating rules for streamlining processes between providers and healthcare plans. This system allows for real-time access to patient information pre- and post-care. Established by the DHHS, the Health Information Technology Standards Panel (HITSP) utilized the CORE platform in its first set of data standards. HITSP is working toward the national integration of both public and private healthcare data standards for sharing among all organizations. As part of the required data standards mandated by the Affordable Care Act, CORE is being used for data exchange of EHRs to ensure compliance with the Health Insurance Portability and Accountability Act (HIPAA) and other standards. To date, 200 CORE certifications have been obtained (CAQH, 2016).

Other Applications

Enterprise Data Warehouse

Enterprise data warehouses (EDWs) are developed to provide information that helps organizations in strategic decision making. Data warehousing requires an integration of many computer systems across an organization. Business EDWs collect numeric data to assess trends. Retail, banking, and manufacturing use EDWs because these industries usually have repetitive actions that can be easily categorized. For example, banks have savings accounts, CDs, Roth IRAs, money markets, and so on. It is very easy to analyze that type of data. Healthcare transactions can occur in the hospital, in community health centers, and in physicians' offices, and each transaction is unique. Other patient healthcare data may not be numeric (Inmon, 2007). There is written information, such as a physician's prognosis, that needs to be integrated into a system. Therefore, a healthcare EDW must be developed that acknowledges these differences. One of the first healthcare systems to utilize an EDW was the Veterans Health Administration (VHA) (VHA, 2016).

The Centers for Medicaid and Medicare Services Enterprise Data Warehouse

In 2006, the CMS, as a pilot study, developed the largest EDW in history to gather hospital, prescription, and physician data to analyze the claims data for Medicare and Medicaid, based on the belief that integration of the data would enable the CMS to analyze the number of claims submitted by providers. Use of the EDW also assisted in identifying any potential fraud and abuse. The CMS determined the EDW was successful but was concerned that it was a claims-oriented warehouse. Therefore, part of the CMS's EDW strategy is the Integrated Data Repository (IDR), which integrates data from CMS and its partners in a consistent, secure, multi-view environment that includes providers, patients, claims, drug information, and other data as needed (CMS, 2016a).

Radio Frequency Identification

Radio frequency identification (RFID) chips transmit data to receivers. Each of these chips is uniquely

identified by a signal indicating where it is located. RFID has been used in the business industry for inventory management by placing a chip on each of the pieces of inventory. Walmart was one of the first retailers to use RFID technology to manage its massive inventory. Recently, RFID technology is being used in many aspects of healthcare industry operations. RFID can be used for the following (GAO RFID, 2016):

- Tracking pharmaceuticals as they are shipped from the manufacturer to the customer;
- Tracking pharmaceutical inventory in a healthcare facility;
- Tracking wait time in emergency rooms;
- Tracking the use of what is being used in surgeries;
- Tracking costly medical equipment to ensure easy access;
- Identifying providers in hospitals to ensure efficiency in care;
- Identifying laboratory specimens to reduce medical errors;
- Tracking patients, including infants, while they are hospitalized;
- Tracking hazardous materials that pose a public health threat; and
- Tracking hand washing to ensure employee compliance.

The following are specific examples of how RFID technology is used in the healthcare industry:

- Wake Forest Baptist Medical Center (North Carolina) sewed RFID tags into the seams of x-ray protection vests in an effort to reduce the time it takes to locate the vests for governmental inspections.
- Texas Health Harris Methodist Hospital is using RFID tags deployed to patients and staff to trace people who come into contact with patients with a contagious, potentially dangerous infection such as tuberculosis.
- Sanraku Hospital, a 270-bed hospital in Tokyo, used a handheld reader with RFID tags in patient wristbands to match drugs with prescription information in electronic medical records (Balm, 2013).

Applied Health Information Technology

The PhreesiaPad

Chaim Indig and Evan Roberts spent one year examining the healthcare market. As young entrepreneurs, they believed that the healthcare industry was the best entry for them to start a business. They realized that patient check in at doctors' offices was a problem. Backed by venture capital firms and with advice from medical professionals, they developed PhreesiaPad, a wireless digital device with a touch-screen keyboard that allows patients to enter their demographic information and the reason they are visiting the doctor. This point-of-service technology eliminates the need for patients to replicate their information each time they visit the doctor. The software automatically verifies patients' insurance information. If they have a copay or balance, they can pay with a credit or debit card. When the patient is finished, a report is automatically generated for the doctor to review before seeing the patient. This increases office efficiency, shortens visit rates, and reduces error rates. This information can also be uploaded to an EHR (Phreesia, 2016).

According to a study conducted by the Medical Group Management Association (MGMA), approximately 30% of patients leave their clinician's office without making any payment, and it takes practices an average of 3.3 billing statements before a patient's outstanding balance is paid in full. Phreesia is a tool that can rectify these financial issues (Leatherbury, 2012).

PatientPoint (Formerly Healthy Advice Network)

PatientPoint provides education to patients electronically while they are in the waiting room or an exam room. Health education information is customized with brand advertising messages displayed on digital flat screens in physicians' waiting rooms. There are 25-minute loops of brand materials that focus on prevention and management of disease. PatientPoint has programs in over 31,000 locations. PatientPoint serves more than 70,000 healthcare providers and 750 hospitals nationwide, impacting 113 million patients and creating more than 586 million patient and caregiver exposures each year (PatientPoint, 2016).

MelaFind Optical Scanner

The **MelaFind optical scanner** is not for definitive diagnosis but rather to provide additional information a doctor can use in determining whether to order a biopsy. The goal is to reduce the number of patients left with unnecessary biopsy scars, with the added benefit of eliminating the cost of unnecessary procedures. The MelaFind technology (MELA Sciences, Irvington, NY) uses missile navigation technologies originally paid for by the U.S. Department of Defense to optically scan the surface of a suspicious lesion at 10 electromagnetic wavelengths (Gidalovtiz, 2014).

Electronic Aspirin

A technology under clinical investigation at Autonomic Technologies, Inc. (Redwood City, CA) is a patient-powered tool for blocking pain-causing signals at the first sign of a headache. The system involves the permanent implant of a small nerve-stimulating device in the upper gum on the side of the head normally affected by the headache. When a patient senses the onset of a headache, he or she places a handheld remote controller on the cheek nearest the implant. The resulting signals block the pain-causing neurotransmitters (Intellitechaz, 2015).

Robotic Checkups

Medical robots can make rounds, checking on patients in different rooms and managing their individual charts and vital signs without direct human intervention. The RP-VITA Remote Presence Robot produced jointly by iRobot Corp. and InTouch Health is the first such autonomous navigation remote-presence robot to receive FDA clearance for hospital use. The device is a mobile cart with a two-way video screen and medical monitoring equipment, programmed to maneuver through healthcare facilities. This is an innovative method of telemedicine (iRobot, 2016).

Sapien Heart Valve

The **Sapien heart valve** is a life-saving alternative to open-heart surgery for patients who need a new valve but for whom surgery is considered high risk. Manufactured by Edwards Life Sciences (Irvine, CA), the Sapien has been available in Europe but was approved for use by the FDA in 2011, and is finding its first use in U.S. heart centers—where it is limited only to the most at-risk patients. The Sapien valve is inserted by catheter from a small incision near the rib cage. The valve material is made of bovine tissue attached to a stainless-steel stent, which is expanded by inflating a small balloon in the valve space. A simpler procedure with much shorter hospitalizations could have a positive impact on healthcare costs (Edwards Lifesciences Corporation, 2016).

Acuson P10

Siemens has introduced a pocket-sized ultrasound, **Acuson P10**, which can be used for traditional applications of diagnostic and screening tests. It is designed for quick and easy use in emergency medicine, cardiology, ICU, and OB/GYN situations. In each of these situations, the device provides a quick view of anatomy and tissue. It can be used in outpatient areas, intensive care units, and rescue helicopters to provide instant information to make a diagnosis. The results can be viewed on the screen but can also be uploaded to a computer. This technology eliminates the need for the provider to send the patient to an imaging center (MNT, 2016a).

Piccolo Xpress Chemistry Analyzer

The size of a shoebox, Piccolo xpress is a compact, portable chemistry analyzer that delivers blood test results quickly. The provider places blood and the like on a small disc and slides the disc into the Piccolo xpress. The provider requests tests to be performed using the device's touch-screen display. The device can print a hard-copy report in approximately 12 minutes, or the information can be transferred to an EHR. This technology expedites the provider's ability to diagnose a patient (Piccolo xpress, 2016).

The Importance of Health Information Technology

In a recent study focused on the implementation and management of IT in the hospital setting, Szydlowski and Smith (2009) interviewed six hospital CIOs (or their equivalents) and nurse managers to assess why they used HIT. The CIOs indicated they used HIT to streamline administrative processes in the organization. They all recognized the substantial cost to invest in HIT but understood that the investment was long term and that it would ultimately be very cost efficient. The nurse managers focused on the ability to reduce medical errors as a result of HIT. They also indicated that having electronic patient data ultimately contributed to more efficient and effective clinical decision making. The barriers to successful implementation identified by both the CIOs and the nurse managers were inadequate training on HIT and the amount of time needed to become familiar with HIT. The concerns the CIOs indicate are also applicable to other healthcare settings such as physician offices and outpatient facilities.

From a consumer perspective, health information technology can mean safer care. Electronic health records can provide a more complete picture of a person's health status. E-prescribing may reduce medical errors because pharmacists will not have to interpret poor physician writing. Sharing medical information with other providers electronically may reduce the number of tests a consumer could receive. In case of a disaster in which paper records could be destroyed, having an electronic copy of consumer medical records could save a life (Why is health information, 2016).

Technology can produce innovative ways to improve patient care, and for all of the providers that is the main goal.

Conclusion

The healthcare industry has lagged behind other industries utilizing IT as a form of communicating important data. Despite that fact, there have been specific applications developed for HIT such as e-prescribing, telemedicine, ehealth, and specific applied technologies such as the PatientPoint, MelaFind optical scanner, the Phreesia Pad, Sapien heart valve, robotic checkups, Electronic Aspirin, Accuson P10, and the Piccolo xpress, which were discussed in this chapter. Healthcare organizations have recognized the importance of IT and have hired CIOs and CTOs to manage their data. However, healthcare consumers need to embrace an electronic patient record, which is the basis for the Microsoft Health Vault. This will enable patients to be treated effectively and efficiently nationally. The patient health record can be integrated into the electronic health records that are being utilized nationwide. Having the ability to access a patient's health information could assist in reducing medical errors. As a consumer, utilizing a tool like HealthVault could provide an opportunity to consolidate all medical information electronically so, if there are any medical problems, the information will be readily available. The major IT issue in healthcare is the need to establish the interoperability of EHR systems nationwide. This communication between systems will enable patients to be treated more quickly because there will be immediate access to their most current medical information. Although the federal government has indicated this communication between systems is necessary to ensure the full success of electronic health records system, progress continues to be slow.

Wrap-Up

Vocabulary

Acuson P10
Artificial intelligence
Avera eCare
Chief information officer (CIO)
Chief technology officer (CTO)
Committee on Operating Rules for Information Exchange (CORE)
Computerized physician order entry
Drug-drug interactions
E-health
Electronic aspirin
Electronic clinical decision support systems
Electronic health record (EHR)
Electronic medical record (EMR/EHR)
Electronic patient record
Enterprise data warehouse
E-prescribing
Expert system
Health information systems (HIS)
Health information technology (HIT)
HealthVault
Healthy Advice Network
Imaging informatics
Informatics
Information technology (IT)
Meaningful use
Medical informatics
Melafind optical scanner
Million Hearts
National Alliance for Health Information Technology (NAHIT)
PatientPoint
Pharmacy benefit manager
Piccolo xpress Chemistry Analyzer
Radio frequency identification
Robotic checkups
Sapien heart valve
Telehealth
Telemedicine

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