The Evolution of the EHR in Medical Practice

Historical Paper

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Introduction

The introduction of the Electronic Healthcare Record (EHR) has transformed healthcare across the medical society. Healthcare information technology platforms have changed how healthcare services are offered, thereby creating a diverse set of technological healthcare delivery models. EHRs have created a streamlined process for providing healthcare services while improving the quality of care, enhancing the ability to receive instant access to patient health-related information, and knowledge access at the point of care (Busis, 2010). Additional benefits of EHRs include patient safety, improved decision-making, medical error reduction, and an enhancement of continuity of care. The shift in adoption of EHRs has been driven by a changing landscape in healthcare technology spearheaded by governmental mandates. Some of the driving factors include Physician Quality Reporting Initiatives (PQRI), Federal Health Information Technology (HIT) Standards and Meaningful Use incentives/penalties, 5010 Data Transmission Standards, and the International Classification of Disease (ICD)-10. All these new initiatives have predisposed goals of improving quality healthcare services within medical practice environments.

The EHR widespread availability of systems across the healthcare landscape, along with the value-based reimbursement programs have transformed healthcare. Value-based reimbursement models and the leveraging of the EHR through Meaningful Use maximization has reformed healthcare with the goal of providing better care for individuals and populations. EHR utilization drives improved diagnostics and patient outcomes through a comprehensive view of patient's current state of health. Through these advancements, EHRs provide overall risk management through multiple modalities. This shift of technology in relationship to meeting quality measures and the adherence to value-based reimbursement has created and interdisciplinary relationship between the EHR and the provider. The EHR has evolved significantly over the last fifty years, with much of evolvement ensuing from the passage of

government legislation promoting the utilization of technology to serve patient needs and interconnect the utilization with reimbursement models.

This paper has three main objectives pertaining to the evolution of the EHR in the medical practice setting, with all three objectives aimed at providing a glimpse of the evolution of the EHR from 1960 to the present. The first objective will be to provide an overview of healthcare information technology advancements, beginning in the 1960s. A review of the state of adoption over the last fifty years will outline the major focal points of each decade and advances made in healthcare information technology, which were pivotal in its advancement. Each decade provides a unique contribution to healthcare technology, with the World Wide Web opening the doors for opportunity and advancement.

The second objective will be to provide an overview of the impact of the American Recovery and Reinvestment Act (ARRA) on EHRs, and the provisions set forth by government regulation. This Act was signed into law in 2009 and prompted governmental incentives through a $19-billion-dollar program promoting the adoption of HIT with a major focus on EHRs (Blumenthal, 2009). ARRA touched almost every aspect of the U.S. economy, with a major focus on healthcare research and preventative healthcare services (Blumenthal, 2009). An analysis will be conducted on the impact of ARRA, with a focus on governmental programs, such as Meaningful Use and quality measure reporting.

The third objective of this paper is to evaluate the adoption rate effect of ARRA on EHRs in the medical practice setting, along with the current drivers and barriers to EHR adoption. Each decade has demonstrated its own obstacles in the advancement of healthcare information technology. The contents of this historical paper will consist of a literature search on the evolution and adoption of the EHR and the effects of governmental legislation on the EHR. Overall, the objective of the information is to provide a review of the transformation of the EHR in the medical practice setting.

Historical Overview (1960-2004)

There were a few key movements in the 1960s, which set a precedent of where healthcare technology was moving, along with the emergence of the EHR. The first onset of the EHR began with multiple efforts, such as data entry from punch cards being moved to keyboards, and the transition of data display from printed results to video (Tripathi, 2012). This early onset of evolution was driven by academic medical centers, government, and the industry (Atherton, 2011). Initial EHR systems in the mid-1960s were referred to as clinical information systems. A company by the name of the Lockheed Corporation initially developed a clinical informatics platform for a company named Technicon, and, over time, was passed on to TDS Healthcare (Atherton, 2011). This system was then transitioned to Eclipsys for the El Camino Hospital, which is now part of Allscripts, featuring a multiple and simultaneous function of Computerized Physician Order Entry (CPOE) (Tripathi, 2012).

Medical care during this era presented with several complexities, as providers were being left without access to medical records. The onset of Computer Stored Ambulatory Record (COSTAR) at Massachusetts General Hospital came in developmental collaboration with Harvard in 1968 (Atherton, 2011). The system provided separate clinical and accounting platforms with flexible vocabulary databases allowing for increased efficiency (Atherton, 2011). Another spearheading move was the introduction of the recording of patient information, directed by Dr. Lawrence L. Weed. This movement prompted the development of the Problem-Oriented Medical Record (POMR) concept driven by the University of Vermont, resulting in the first clinical information system, known as the Problem-Oriented Medical Information System (PROMIS) (Wright, Sitting, Ash, & Weed, 2014). This system had an innovative documentation system designed to allow the verification of diagnostic and treatment decisions. The 1960s began the initial movement of healthcare information technology, with several key movements identified by history.

The 1970s presented the deployment of health evaluation through logical processing systems by the University of Utah, 3M, and the Latter-Day Saints Hospital (Tripathi, 2012). Along with logical processing, the Regenstief Institute in Indianapolis created the Regentstief Medical Record System in 1972, which assisted with the automation and integration of electronic data from their informational platform to laboratories and pharmacies (Tripathi, 2012). In 1976, Carnegie Mellon University directed a group of funded projects aimed at exploring the ideas of the Newell Report under the Defense Advanced Research Project Agency (DARPA), which was sponsored by the Speech Understanding Research Project (SUR) (Huang, Bader, & Reddy, 2014). This project led to the development of several speech recognition systems, such as Hearsay, Dragon, Sphinx I./II, and Harpy (Huang et al., 2014). The evolution of voice recognition had limitations, such as speech recognition on highly constrained tasks, compared to the current models of voice recognition, which have the capabilities to have unlimited vocabularies. The federal government also began its more engaged utilization of EHRs in the 1970s with the Department of Veteran Affairs division. They deployed the Decentralized Hospital Computer Program (DHCP), also known as the Veterans Information Systems and Technology Architecture (VistA). The system has since transitioned to a Computerized Patient Record System (CPRS), which has been recognized to reduce medical errors and improve overall healthcare integration (Atherton, 2011).

During the 1980s, electronic medical records systems were being developed and refined with uncertainty surrounding them and their utilization. There was more focus on computer adoption; however, the investments were fiscal, administrative, and ancillary-driven, with a primary billing objective and no clinical focus (Berner, Detmer, & Simbor, 2005). During this era, there was a physician-led resistance, along with an autonomous framework, as the government was primarily the leading effort in reimbursement (Berner et al., 2005). These factors led to a limited adoption or application of EMRs in medical practice and hospital settings. During this era, the emergence of personal computers and other technological software and

hardware, networking was expanding, and computers had evolved from minicomputers to microcomputers with Microsoft Windows being introduced in 1983 (Berner et al., 2005).

The development of the HL7, an international, nonprofit, standards-developing organization (SDO), was enacted in the 1980s (Atherton, 2011). This is one of the most widely recognized electronic standards designed to assist with creating platforms by which communication can flow seamlessly (Atherton, 2011). The Certification Commission for Healthcare Information (CCHIT) has now been certifying vendors as HL7 compliant since 2006 (Atherton, 2011). Clinical decision support systems, such as QMR, DXPLAIN, and ILIAD, were all developed in the 1980s and illustrated an ability to reduce medical errors and improve medical knowledge access (Berner et al., 2005). The initial thought was these systems would be the pivotal features that would drive an increase in healthcare information technology adoption; however, the introduction of the diagnosis-related groups (DRGs) legislation, along with managed care introduction, reduced the transition to clinical decision support systems (Berner et al., 2005).

A report released in 1991 by the Institute of Medicine (IOM) at a conference at the National Institute of Health (NIH) led to the foundation building of the concepts we have today for EHRs. The report *The Computer based Patient Record: An essential technology for healthcare* set up the following three aspects: uses and users, technology, and policy and implementation (Berner et al., 2005). The IOM report set the standards to create a new medical record name, referred to as the computer-based patient record (CPR). This technological movement prompted other countries to heavily invest in EHR adoption, with New Zealand, Australia, Canada, and Europe adopting national strategies for EHR adoption into their healthcare systems ((Berner et al., 2005). The Veterans Administration and the Department of Defense made advancing efforts to implement a national strategy, along with Kaiser Health System in the private sector ((Berner et al., 2005). Major concerns in EHR system adoption were confidentiality, security, and administrative costs. During the 1990s, there was an EHR adoption

rate of under 18% within the medical practice settings across the U.S. (Ford, Menachemi, & Phililps, 2006). The preliminary stages referred to EHRs as CPRs, computerized medical records, electronic charts, and longitudinal patient records (Murphy, Waters, Hanken, & Pfeiffer, 1999).

Prior to 1996, there were no generally accepted security or general requirements protecting healthcare information, until the introduction of The Health Insurance Portability and Accountability Act (HIPAA) of 1996. The lack of a national effort prompted the National Committee on Vital and Health Statistics (NCVHS) to oversee the provisions of the HIPAA of 1996, and assist with advising the Secretary of Health and Human Services (HHS) in areas of confidentially, security, standards for computer-based patient records, and identifiers (Berner et al., 2005). Throughout this advisement, the HHS published what is commonly known as the HIPAA Privacy and Security Rule (HHS, 2013). These rules establish the national standards for the protection of healthcare information as technical safeguards in the management of healthcare information in an era in which technology was evolving, and the industry was beginning to transition away from paper processes (HHS, 2013).

A National Health Information Infrastructure (NHII) was formed to advocate for an infrastructure capable of assuring a scalable, interoperable system of networks and clinical support (Berner et al., 2005). The first NHII conference in 2003 illustrated the need for the government to become part of the solution and provide financial incentives for EHR adoption (Berner et al., 2005). The IOM chose the name *electronic health record* in 2003 as 'health' is defined as a 'state of well-being' and the overall goal of a computerized medical record was to improve the delivery of safe quality care, and improving patients' overall health (Murphy et al., 1999). The major change from 1989 to 2000 was the emergence of the World Wide Web and the diversity of impacts it made on healthcare applications. A British computer scientist by the name of Tim Berners Lee launched what came to be known as the World Wide Web in March 12, 1989

(Kujur and Chhetri, 2015). It has since changed the role of EHRs with the emergence of networking capabilities and healthcare access via online channels through broad utilization.

A major change in healthcare in the 2000s was prompted by President George W. Bush with the establishment of the Office of the National Coordinator (ONC) for Health Information Technology in 2004 under the U.S. Department of HHS. The initiative behind this directive was to develop a nationwide strategic plan on the implementation of public and private healthcare information technology platforms designed to improve quality, medical error reduction, and reduction in healthcare costs (Murphy et al., 1999). This executive order was directed at implementing EHRs nationwide over a ten-year span (Ford, Menachemi, & Philips, 2006). Some of the challenges exhibited during this time were the lack of interoperable EHR systems and institutional and financial support in the creation of the necessary workforce to meet national goals (Berner et al., 2005). Other debatable assumptions were buyers' lack of interest, the fear of sharing information, payer resistance, and market share control, all factors associated with the possibility of a lack of movement until the introduction of the ARRA of 2009.

American Recovery and Reinvestment Act

The Health Information Technology for Economic and Clinical Health (HITECH) provisions of the ARRA of 2009 assisted in setting forth the path to healthcare transformation (Gold, McLaughlin, Devers, Berenson, & Bovbjerg, 2012). Through the HITECH provisions, Congress was able to set the path for the expansion of EHRs and the exchange of healthcare information (Gold et al., 2012). The passage of ARRA assisted with the initiative of creating a system of efficiency with improved quality outcomes and population health management. This EHR movement was stimulated by providing federal funding for eligible providers who adopted a certified EHR system and demonstrated the system was meeting Meaningful Use measures. Specific criteria were published by the U.S. Department of HHS for EHRs to meet regulatory requirements and be considered certified technologies. The Certification Commission for Health

Information Technology (CCHIT) has been certifying EHRs since 2006, resulting in an increase of EHR availability (Kokkonen et al., 2013).

The federal government provided $19 billion dollars in incentives for the adoption of an EHR (Kokkonen et al., 2013). Meaningful Use incentives prompted healthcare providers to engage in the review and adoption of an EHR in an effort to receive the federally-funded reimbursements provided by Medicare and Medicaid. This healthcare shift created an assortment of EHR vendors throughout the U.S., resulting in multiple vetting processes of implementing an EHR suitable to the clinical practice setting. As of 2011, the federal government had approved more than 1,300 certified products from more than 600 vendors per federal government-established certification standards (Gold et al., 2012).

EHRs were slow to be adopted, as researchers estimated only 11.9% of hospitals and 6.9% of office-based physician practices offered fully functional informational platforms meeting stage 1 Meaningful Use requirements in 2009 (Gold et al., 2012). It is estimated that the creation of the HITECH provisions will increase adoption of EHRs by 70% in hospitals and 90% in physician-based practices by 2019, according to the Congressional Research Services (Gold et al., 2012). The top five barriers associated with the transition to an EHR are information technology support, capital resources, physician support, productivity loss, and utilization of legacy data (Gans, Kralewski, Hammons, & Dowd, 2005).

Meaningful Use

The Meaningful Use program was established by the Centers for Medicare and Medicaid Services (CMS) in 2011 through the HITECH provisions. This program consists of three stages, which encouraged eligible professionals, eligible hospitals, and critical access hospitals to adopt and demonstrate certified EHR technology (CEHRT) (CMS, 2017). Affordability, product availability, practice integration, and provider attitudes are all drivers associated with the adoption of an EHR in a medical practice (Gold, 2012). The HITECH provisions were designed to address the first three, with provider attitude being the transformational driver of successful

EHR acceptance. The mission of HITECH was to create an environment allowing the interoperability of health information, with a focus of achievement through healthcare advancement in process and outcomes resulting in incentive payments to participants meeting the Meaningful Use requirements.

Under the provisions of the HITECH, the Secretary of Health was tasked with developing Meaningful Use objectives, with the Centers for Medicare and Medicare Services taking the lead role. The Department of Health and Human Services (DHHS) utilized an open process to develop the requirements in 2010 for the years 2011 and 2012. Administration of the Medicare incentive program was managed by the Centers for Medicare and Medicaid services, while the Medicaid incentive program was managed by the states. Eligible professionals meeting the requirements for both programs were required to register under one of the incentive programs for participation, as they were not allowed to participate in both the Medicare and Medicaid incentive programs (CMS, 2012). During the years 2011 and 2012, physicians were eligible to receive up to $18,000 in Medicare payments and up to $44,000 over five years for eligible professionals, while Medicaid's incentive program provided up to $63,750 per provider (Kokkonen et al., 2013). Eligible providers choosing not to participate were faced with upcoming penalties in physician services if practices were unable to demonstrate Meaningful Use of certified EHRs. The penalties were scheduled to begin in 2015 at 1%, increasing to 2% in 2016, and 3% in 2017 (Kokkonen et al., 2013). These programs expire at different times, with Medicare providing eligibility through 2014, and Medicaid providing eligibility through 2021 (CMS, 2016).

Stage one of Meaningful Use set the foundation for implementing the required framework for the capture and sharing of patient data through electronic measures. The Meaningful Use mandate was established to improve quality, efficiency, safety, and reduce health disparities (CMS, 2017). These provisions required the ability to provide electronic copies of health information, improve care coordination, engage individuals in their healthcare, and provide population health management (CMS, 2017). The criteria for Meaningful Use consisted of a core

of fifteen measures, along with a menu set of ten, allowing providers to select five to meet the requirements. Core objective data capture entailed basic data such as: patient demographics, vital signs, active medication and allergies, current and active diagnoses, problem lists, and smoking status. Upon meeting the necessary requirements, eligible professionals were required to successfully attest the utilization of the certified EHR technology. As of May 2014, approximately 67% attested to meaningful use of a certified EHR through Medicare out of 392,800 eligible professionals (ONCHIT, 2017). As of 2016, 95% of eligible hospitals participating in the Medicare and Medicaid EHR incentive program have achieved meaningful use of certified health IT (ONCHIT, 2017). Overall, according to CMS data, 312,000 Medicare and Medicaid eligible professionals have received $19.9 billion in EHR incentive payments during Meaningful Use stage one (Landi, 2016). The number of providers failing to meet Meaningful Use in 2017, was 171,000, which all faced a 3% negative adjustment from Medicare (Gale, 2018).

Stage two of Meaningful Use expanded on the foundation of stage one, with a primary focus on enhanced clinical processes, more rigorous information exchange, patient engagement and a goal of supporting the National Quality Strategy. The goal of stage two Meaningful Use encouraged the utilization of CEHRT for continuous quality improvement at the point of service, along with an exchange of information (CMS, 2017). New core objectives and measures added for stage two of Meaningful Use allowed for the utilization of the electronic messaging process to communicate with patients regarding their health information. This stage of Meaningful Use also required systems to provide patients with the ability to view online, download, and transmit health information (CMS, 2012). Stage two of Meaningful Use was composed of seventeen measures for eligible providers to meet, with a menu set of six, and a requirement of three selective measures. Stage two of meaningful use has paid out 147,000 eligible professionals $3.4 billion in payments for meeting stage 2 meaningful use (Landi, 2016). As of 2015, only 12% of

physicians were able to successfully complete stage two of meaningful use, with 6% of providers able to share patient data (Reisman, 2017).

The third stage of Meaningful Use alignment is focused on improving health outcomes, decision support tool, patient access to self-management tools, and population health management with all providers being required to participate in stage three regardless of prior participation (CMS, 2017). A finalized set of eight objectives and measures were approved by CMS with a focus on improving quality programs, promote interoperability, and focus on the triple aim concept of cost, access and quality (Scheidlinger, 2016). The eight objectives include protect patient health information, E-scribing, clinical decision support, computerized provider order entry, patient electronic access to health information, coordination of care, health information exchange and public health reporting. The focus of stage three Meaningful Use is to create a single stage of requirements, with a goal of reducing the program's overall complexity and simplifying reporting measures. All providers will be required to report a full calendar year of EHR if they participate under the stage three requirements of Meaningful Use.

Quality Measures

Quality reporting has become a necessary component in the new healthcare delivery models in a medical practice, as pay-for-performance (P4P) models continue to shift the healthcare market. The P4P model is considered an umbrella term aimed at improving efficiency, quality, and overall healthcare (James, 2012). This model has assisted in the increase in EHR adoption as some of the major health insurance companies have directed their focus toward developing programs focused on quality and reducing cost. These programs have been rewarding hospital and providers for providing quality healthcare at a reduced cost by meeting predetermined quality measures (James, 2012). The focus of these programs has been to encourage providers to meet quality metrics with a goal of providing healthcare preventative services, resulting in a reduction of major medical claims. Overall, it is in the payers' interest to

pay for the P4P incentive payments, which has resulted in the promotion of EHR popularity across the country (James, 2012).

The transformation and adoption of EHRs have been driven by P4P models and quality reporting measures instilled by the Quality Payment Program. A variety of measures were deployed by CMS in an effort to gather data upon the successful implementation of an EHR. The Physician Quality Reporting System (PQRS), and the Medicare Access and CHIP Reauthorization Act (MACRA) of 2015 are two programs driven by CMS to improve quality reporting. The PQRS program was implemented by CMS in 2007 with a design to encourage individual eligible providers and group practices to assess and report the quality of care to Medicare through EHR capabilities. A focus of the program was to have an ongoing discussion of quality oriented questions between eligible providers and a patient in efforts of promoting overall healthcare awareness. This program entered its ninth year in 2015, with these years being an encouraging process for successful reporting. The continuous evolvement of the program was followed by mandatory participation in 2015 with all eligible providers subject to incentive payments, as well as penalties.

The PQRS program was initially funded by the Tax Relief and Health Care Act of 2006 (TRHCA), which provided a 1.5% incentive payment to eligible providers successfully submitting voluntary quality data (Marjoua & Bozic, 2012). A continuous effort to improve quality ensued the Medicare Improvement for Patients and Providers Act (MIPPA) of 2008 to provide a 2% incentive payment for successful participation in the 2009 and 2010 years (Marjoua & Bozic, 2012). Payment adjustments began in 2015 with a negative adjustment of 1.5 % to eligible providers and group practices who did not meet the quality reporting requirements for Medicare Part B Physician Fee Schedule for services rendered in 2013, and an ongoing adjustment of 2% through 2018 (CMS, 2013). A total of 63% of all eligible professionals avoided a 2% reduction in the 2017 Part B professional fee schedule, based on 2015 PQRS reporting, however there were 501,933 eligible professional who were subject to the negative

adjustment (CMS, 2017). The last year of the PQRS program was 2016 as it transitioned to the Merit-based Incentive Payment System (MIPS) under the Quality Payment Program (CMS, 2018). PQRS has distributed an estimated $261 million through the first six years of its existence (Zimlich, 2013).

The MACRA replaced the Sustainable Growth Rate (SGR) formula and prompted the path of two quality payment tracks through the Quality Payment Program. These tracks are the Alternative Payment Models (APMs) and the Merit-Based Incentive Payment System (MIPS) (CMS, 2017). The criteria for participation in the Quality Payment Program include being a member of the APMs, or billing more than $30,000 in Part B-allowed charges a year, and providing care for more than 100 Medicare patients in a given year (CMS, 2017). The APM is an approach aimed at providing additional incentive payments in an effort to provide high-quality care through a cost-efficient model. This model can apply to a population, a care episode, or a clinical condition (CMS, 2017). These models allow for a 5% incentive payment for taking on further risk by going through an APM. Value-based reimbursement is the new avenue spearheading the charge for better-quality care at a lower cost.

The MIPS phased out PQRS in 2016, resulting in a different methodology of quality measure data capture. Through this payment model, there is quality reporting, improvement activities, and advance care information, which replaces Meaningful Use (CMS, 2016). Eligible providers under MIPS include physicians, physician assistants, nurse practitioners, clinical nurse specialists, and certified registered nurse anesthetists (CMS, 2016). Performance periods under the MIPS payment model begin in 2017 and end in 2018. The payment adjustments under the MIPS program begin in 2019 with a positive or negative adjustment of 4%, followed by a positive or negative adjustment of 5% in 2020. Payment adjustments in the year 2021 incur a positive or negative adjustment of 7% and finally, in 2022, the adjustment is positive or negative 9%. Submitting a partial attestation can have a neutral or positive adjustment on reimbursement; however, a full attestation provides more data, thereby promoting a higher possibility of receiving

the full positive adjustment (CMS, 2017). The quality reporting metrics available through an EHR have become a top priority, as reimbursement continues to be integrated with quality payments. These payment adjustments have changed the role of the EHR, resulting in the necessity for data capture on quality measure data for successful reporting.

Another spearheading movement within healthcare is the Patient Centered Medical Home (PCMH) model driven by physicians with the intent of providing comprehensive and continuous medical care with quality outcomes at a lower cost (Tayloe, 2016). The origin of the medical home came from the American Academy of Pediatrics in 1967, from Dr. Calvin C.J. Sia, a Hawaii-based physician. He created a plan for delivering continuous family-centered coordinated comprehensive care to infants and children (Tayloe, 2016). In 2002, the Future of Family Medicine project was created by seven US national family medicine organizations in efforts of revitalizing the medical home model. The American College of Physicians reviewed the concept, and in 2007, the American Academy of Osteopathic Association, American Academy of Pediatrics, American College of Physicians, and the American Academy of Family Physicians released principles for the patient-centered medical home model (Tayloe, 2016). The National Committee for Quality Assurance (NCQA) created the certification standards for PCMH. The principles for adoption of a patient-centered medical home include population health management, plan and managed care, self-care support through community resources, coordinated care, access to care, and performance measures (Smith, Graedon, Graedon, & Grohol, 2013).

The PCMH model goal is geared to provide care with a multidisciplinary team approach, with each member of the team practicing “at the top of their license”. Through this model of care, IT capabilities must be expanded and more accessible forms of communication must be established (Smith, et. al. 2013). Patient-centered medical home models are well supported by local, state, and public/private payers, as they offer additional payments to medical practices who provide this healthcare delivery model. Payment for a patient-centered medical home model must

be reviewed and certified by an outside agency, with payments varying by state and payer. Some of the national programs, which provide recognition and accreditation of PCMHs are the Medical Home On-Site Certification by the Accreditation Association for Ambulatory Health Care, the National Committee for Quality Assurance, and the Joint Commission. Payments to providers are not solely based on an office visit model, but on a system of monitoring of overall practicing population and agreed upon desired outcomes (Smith, 2013).

Population health management is a major component of the PCMH model and is driven by EHR technology. The management of population health was first discussed in 2003 by two individuals by the names of David Kindig and Gret Stoddart (Glaser, 2016). They defined population health as "the health outcome of a group of individuals, including the distribution of such outcomes within the group" (Glaser, 2016, para. 5). This definition today encompasses different meanings; however, the goal of population health management is to improve the overall quality of care at a lower cost to a defined group. EHRs have become an instrumental power in the shift to population health management. These systems are able to improve the foundation by improving transparency, value, and accountability (Glaser, 2016). EHRs play a pivotal focus role in population health management through data collection sources in real time for expedited care, and a reduction in test duplication. Through the PCMH model and properly managed population health management, EHRs can enable providers to provide better care.

Current EHR Adoption

The adoption of EHRs has been accelerated by the federal EHR incentive program, thereby creating an anomaly of benefits and challenges. EHRs are shifting focus and driving different solutions, therefore changing how organizational goals are set. Medical practices continue to evolve with the integrative and collaborative changes occurring in the healthcare service through the EHR. Vendors are feeling the pressure of the fast evolution of EHRs by their competitors and partners in providing the necessary solutions to an evolving model of healthcare delivery driven by governmental mandates and quality reporting. As of 2016, over 90% of all

Priority Primary Care Providers (PPCPs) are utilizing an EHR, with over 75% demonstrating meaningful use of certified EHR technology. Overall, a shift can be seen in the adoption of EHRs because of the governmental incentives to enhance the capture of patient information, and an avenue to provide the healthcare information back to the patient through different measures.

Numerous studies have been undertaken on the positive and negative benefits of the EHR, with return on investment being the top issue. Factors to consider over the longevity use of an EHR include whether or not a return on investment will be realized, owing to limited volumes or system maintenance (Gans et al., 2005). The ongoing costs associated with the adoption of an EHR include the replacement of hardware infrastructure, software licensing, system maintenance, and training for the end users. The Congressional Budget Office has estimated the initial cost of an EHR can range from $25,000 to $45,000, while annual operating and maintenance costs range from $3,000 to $9,000 (Murphy, 2012). According to a study by Fleming, Culler, McCorkle, Becker, & Ballard (2011), the average cost for physician implementation is approximately $32,000. The cost benefit can be spread across multiple providers in a clinic, thereby decreasing the expense; however, in a single-provider medical practice, a provider would have to incur the full allocated expense.

The financial benefits of converting to an EHR include access to stimulus dollars for successful attestations. Through this transition, opportunities are created to enhance revenue streams by improving documentation, resulting in a higher level of evaluation and management coding (Busis, 2010). The utilization of an EHR allows for repetitive tasks to be more streamlined and error-free, thereby improving the quality of care. Some of the ongoing developments of EHRs include the capabilities of providing drug interaction alerts and evidence-based medicine guidelines, and e-prescribing capabilities that allow providers to make the prescription process much more efficient and safe (Busis, 2010). The utilization of e-Prescribing via EHR has seen an increase from 7% in 2008 to 66% in 2013 (ONCHIT, 2014). One of the major EHR functionalities has been the need for capture of specific quality data, which enhances

the P4P functions, thereby creating opportunities for generating additional revenue into the medical practice. Further benefits of utilizing an EHR include a reduction of record storage, paper, and office supplies, staff reduction, and reduction of transcription or elimination of the service. As EHR technology continues to evolve, patient file sharing has become a top priority through the new governmental mandates with a focus on continuity and transition of care, for the improvement of overall quality.

The latest statistics published by the Office of the National Coordinator for Health Information Technology in 2016 illustrate a strong movement of EHR adoption in both hospital and medical practice settings. Since 2008, medical practice adoption has doubled from 42% to 87% for any EHR, with adoption of a basic EHR experiencing a growth from 17% to 54% (ONCHIT, 2016). EHRs have become more evolved and robust with the different stages of Meaningful Use incentive criteria guidelines. EHR initiatives have proven to be successful, as the implementation rate of EMRs grew to 86.9% through 2015 (CMS, 2017). National trending statistics illustrate that 77.9% of the providers who have adopted an EHR have implemented a system certified to meet all the Meaningful Use guideline requirements. A certified EHR system is defined as meeting the requirements adopted by the US Department of Health and Human Services. Cardiologists have the highest percentage of EHR system adoption, at 95.6%, with neurology at 94.5%. The lowest percentage of EHR system adoption is psychiatry at 61.3%, followed by dermatology at 70.2% Table 1 below illustrates the adoption rate of EHRs across office-based physician practices through 2015 in primary care and multi-specialty medical practices, and further details the percentage of providers who have a basic and certified EHR system in their practice setting.

Table 1. Percentage of office-based physicians using any EHR/EMR, physicians that have a basic system, and physicians that have a certified system by specialty: United States, 2015

Specialty	Any EHR or EMR system Percent	Basic system Percent	Certified system Percent
All physicians	86.9	53.9	77.9
Primary care	89.6	57.9	80.9
Non-primary care	84.4	50.1	75.1
Surgical	84.5	48.5	77.0
Medical	84.4	51.1	74.0
All physicians	86.9	53.9	77.9
General/family practice	92.7†	66.1†	84.0†
Internal medicine	88.2	53.9	81.4
Pediatrics	87.4	51.0	76.3
General surgery	93.8†	52.3	77.6
OB/GYN	89.2	63.8	80.6
Orthopedic surgery	93.2†	64.6	86.6†
Cardiovascular disease	95.6†	64.4	83.2
Dermatology	70.2	21.3§	62.3
Urology	94.0	60.4	92.6†
Psychiatry	61.3§	15.5§	40.8§
Neurology	94.5†	75.7†	89.9†
Ophthalmology	72.7	22.8§	70.0
Otolaryngology	89.4	68.0	82.7
Other	86.4	53.4	78.6

Note: Reprinted from NCHS, National Electronic Health Records Survey. Table of Electronic Health Record Adoption and Use among Office-based Physicians in the U.S. by Specialty by N. Yang and E. Hing. 2015, NCHS, National Electronic Health Records Survey, 2015. Reprinted with permission.

There is continuous debate as to whether there is a benefit to transitioning to an EHR. One of the pivotal things to monitor is how the medical practice market will endure the lack of

government incentives in the near future. The lack of incentives could pose a diversity of problems, as the cost of information technology services continues to increase and the lifespan of hardware is limited, thereby creating a continuous cycle of issues in the EHR market. Medical practice providers and administrators must take into account future expenses and how a medical practice will endure the shifts of technology and changes in governmental regulations. Some items of concern with EHR purchases include ongoing training, legal costs, software and hardware upgrades, software licensing, operability, user-friendliness, and vendor viability. The incentive payments have proven to be very helpful in moving the healthcare market; however, questions remain as to how EHR vendors will handle market share transition, governmental regulations, and the needs of the consumer (Kokkonen et al., 2013). There are both benefits and risks when deciding on an EHR; however, current data reflect a continuous positive movement of EHR transitions, driven by Meaningful Use and quality incentives (Kokkonen et al., 2013).

The shift of the healthcare information technology market has created an assortment of EHR vendors, which has forced vendors to capture market share in an attempt to sustain operations. Limited market share for vendors poses risks for medical practices, resulting in a future replacement of the current EHR, or risk to clinical practice management resulting from operational system maintenance (Busis, 2010). There are still many medical practices, small systems, and independent hospitals seeking to implement comprehensive EHRs, unified under one system. Large organizations are considering changing to new EHRs because of market changes or dissatisfaction with current EHRs. Quality reporting has shifted how an EHR is utilized; therefore, the ability to capture the required quality data for incentive payments and clinical practice management reports for improved operational performance are another area of concern for medical practices. The inabilities of EHR quality reporting can place a practice at risk of penalty adjustments, and closure. Medical practices have been challenged by the evolution of the EHR in the medical practice setting, and the long-term business use, along with short-term gains, with the potential for increased productivity and revenue growth.

Conclusion

In summary, a review of the pertinent literature indicates EHRs are continuously advancing and medical practices continue to strive to meet productivity with quality of care through the evolvement of value-based reimbursement. The payment model system under MACRA has impacted clinical practice management in a diversity of ways. Medical practices are more dependent on the overall functionality of data capture and reporting in efforts of avoiding reimbursement penalties and maximizing on incentives. Value-based reimbursement models continue to change the model of healthcare delivery in medical practices, with a more inclined focus on patient medical home models, population health management, and preventive medicine through the evolvement of the EHR. The EHR has evolved over the last fifty years, with much of the evolution occurring with the passage of ARRA in 2009. Through this system progression, practice administrators continue to be challenged with creating a bridge between meeting quality metrics, productivity, and technological advancements of EHRs. EHR investment is considered one of the most difficult processes to undertake, given the diversity of EHRs available on the market and all the complexities associated with meeting the Meaningful Use criteria and quality measure reporting (Keshavjee ,et al., 2006). The adoption rate of EHRs has increased since the inception of the ARRA, with small and independent practices illustrating a delayed transition in the early stages.

EHR technological advancement within medical practice settings, along with the HITECH provisions, has created interdependence on EHRs for everyday clinical and practice management. EHRs have now developed platforms for storage and management of charts, remote access to patient data, e-scribing, and patient education summaries. A current hurdle among the majority of EHRs has been the exchange of patient information, or interpretation of data across different systems. A future need for continued progress will be defining health IT policies outlining the sharing of patient data across different systems. Medical practices are now under

more pressure to work in tandem with EHR vendors to reach full EHR optimization. Some of the current barriers encountered by medical practices include long-term operational maintenance, workflow interruptions, software usability, and technical support (Fleming et al., 2011). Overall, these systems continue to evolve into much better transition systems of care, with more efficient care coordination, and quality reporting.

Legislation continues to change the landscape for healthcare environments across the nation. Limitation of resources through financial constraints, knowledge, and staffing can present challenges for small physician practices trying to implement or transition to an EHR. Medical practices that continue to be active role players within the healthcare spectrum will be more inclined to avoid reimbursement penalties, and maximize reimbursement opportunities. Technological advancement is a part of the systematic process of evolution, and practices must continue to evolve with the changes in efforts of providing value-based care. Reports indicate a growing number of medical practices continue to transition to an EHR. The adoption of an EHR, its sustainability over the long term, as well as technical support, will continue to be industry concerns (Gans et al., 2005). The continuous shift in healthcare delivery driven by technology has challenged medical practices to understand the transformation created by all the governmental requirements, and the importance of outlining a long-term strategic plan (Busis, 2010). Overall, a medical practice should be focused on the changes stemming from legislation, vendor market share, population health management, and an EHR with adaptability qualities. The key component to assuring continued success with the evolution of the EHR is to understand that the technology is an evolving process (Busis, 2010).

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