# The Impact of Medical Health Records on the Healthcare System: A Case Study of Kaiser Permanente, Washington DC

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## Overview

In the recent past there has been exponential technological innovations tearing through every functional unit of the society. The health care industry is increasing facing complexity in operation, increased public demand, complexity of diseases, sophisticated diagnostic methods and need for confidentiality among patients, hospitals have been forced to adapt information systems that will premise all these needs under one roof. Luckily these multifaceted needs can be solved by enhanced computing power, increased data storage and sophisticated programs. Technology has enabled organizations all over the world to enjoy infinite data storage and vast computing power. Medical practitioners, computer scientist and academicians have aided the health industry by leveraging on this breakthrough to develop health record systems. Researchers and academicians alike concur that health care technology is the fastest growing sector in the entire world. Although the concept is nascent and gradually evolving to cater for the diverse and emerging issues in health care provision; the health care industry in the United States of America is still touted as the most inefficient information industry, with most of the medical record still in white and black (Rosenfeld, Bernasek and Mendelson, 2005). This is a major setback to both the industry and the patients, as this result into disjointed patients' medical history due to paper loss. It is estimated annual income attributable to the United States of America is in excess of $1.7 trillion, however, the reported cases of mortality is double the average of Organization for Economic Cooperation and Development which reports half of the United States of America annual revenue (Hillestad, Bigelow, Bower, Girosi, Meili, Scoville and Taylor, 2005).

Health information technology is the beacon tool of health information systems (Wulsin and Doughtery, 2008). These framework bring together all health industry stakeholders who include health insurance providers, government, patients, health care providers and quality

entities. Thus health information technology is a computerized platform that facilitates the storage, easy retrieval, timely sharing of health care data, information and knowledge among the health care stakeholders in a bid to enhance service delivery and effective communication (Electronic Health Records Overview, 2006). Consequently health information technology can be also be viewed as technological and informatics driven. Technological since it deals with the creation of systems to facilitate efficient flow of health information among stakeholders while informatics as it deals with processing of health information to make sound meaning to health information users. The ultimate stakeholder, who benefits from the implementation of HIT, as it is commonly referred, is the patient. Efficient flow and availability of health care information helps patients to make sound medical and economic decisions. This was underpinned by the signing of an executive order by President Bush in 2004 that formed the basis for expeditious adoption of health information technology to enhance transparency in the health care industry. In addition, various health studies postulate that adoption and implementation of health information technology will save the industry in excess of $81 billion annually, with unquantifiable benefits in form of provision of quality health care to patients, reduce premature mortality and eliminate other negative healthcare events (Shortliffe, 2005). However some players are adamant due to high infrastructural cost and subsequent loss of revenue due to shortened patient stay in hospitals.

**Health Information Technology and Medical Records**

Health information technology is applicable from the first stage of diagnosis, administration to the final stage of medicine dispensation (Hackbarth and Milgate, 2005). Application platforms in health information technology that constitute prescribing are electronic medical record or EMR, computerized physician order entry or CPOE, electronic medical

records. Electronic medication administration records or EMAR and bar-coding at medication administration or BarA constitute HIT that facilitates administration (Electronic Health Records Overview, 2006). Lastly application platforms for dispensing are automated dispensing machines or ADM, bar coding at medication dispensing or BarD and robot for medication dispensing or (ROBOT).

Electronic health record is a functional unit of health information technology and has positively impacted on the health care system. Electronic health record is an aggregation of personal health records and electronic medical record on patients' records (Innovation in Health Information Technology, 2005). Personal health record can be defined as a computerized system that updates and displays patient centric historical information by presenting an individual patient data from all sources of health care and at different time scale. Electronic medical record on the other hand presents real time historical information on a patient from a single source of health care provision (Schloeffel, Beale, Heard and Rowed, 2001). Thus electronic health record draws from personal health records and complementing it with other information from other health care providers like radiologists and physicians. Thus electronic health records are populated with immunization status, past laboratory tests, medical past, medication administered, personal biodata, radiology images, vital signs and billing information (Electronic Health Records Overview, 2006). In addition, electronic health records are interoperable hence remotely accessible from designated points. Contemporary health insurance plans are using personal health records to enhance customer satisfaction, reduce costs and improve health care quality (Innovation in Health Information Technology, 2005). Due to history tracking adoption of electronic health record system has inherent benefits such as reducing errors due to drug and tests while recurring signals facilitates track referrals and administration of preventive care.

However, health care industry in the United States of America is faced with bottlenecks in adoption and implementation of these health record systems. Notable challenges are huge infrastructural and operational costs of electronic health record systems, perceived loss in productivity during EMR conversion, anticipated low return on investments by health care providers, low software capabilities, litigation concerns, confidentiality issues, regulatory compliance challenges, legal interoperability and lastly technical issues.

**Historical Background of Electronic Health Records**

According to National Electronic Health Record Overview (2006) medical record can first be traced back to 5$^{th}$ BC during Hippocrates period. Hippocrates developed medical records to capture development and progression of diseases and to capture the cause of ailment. Though this are the tenets of contemporary health records additional information or functionalities which are not paper supported have been added these include interactive alerts and medical flow charts to physicians. Electronic medical records can be traced from 1960s. Electronic Health Record Overview (2006) asserts that in 1965 hospitals and clinical projects were in the initial stages of setting up electronic storage and retrieval procedures of medical documents. However academic medical center played a pivotal role in development of present day electronic medical records. This can be attributed to the fact that academic medical center are sophisticated entities, with hospitals, diagnostics, medical laboratories, research and commercial operations, they need systems that are able to capture information and data as it moves down the multiple healthcare systems. Thus development of electronic health records helped academic medical center collect data only once and then gives the multiple systems the relevant data as per the need of the system. In a hypothetical academic medical center, a nurse needs to report adverse effects on a patient, the physician need to monitor the effectiveness of

administered treatment, a researcher on the other hand need to analyze efficacy of treatment while the hospital administrator need to prepare billing information on the patient. Electronic health record will integrate this information into a single patient's record while also distribute the patient data to multiple systems as per their functionality. While the pioneer electronic medical records paved the way for present day electronic medical records, they had major setbacks which some have not yet been addressed, among the drawbacks were technical coding issues, non standardization in system interface and terminologies.

According to Atherton (2011) there are two time periods that are attributable to the development of electronic health records. The pioneering period was marked between 1960s and 1970s when academic medical centers developed the first electronic health record system. These pioneer systems were referred as clinical information systems. Atherton (2011) in analyzing the development course of electronic health record continues to say that Lockheed invention in around 1965 was a breakthrough in health systems as it not only in its processor speed but also allowed multiuser access to the system. Due to the enhanced performance of the system, these early invention has since been used by Technicon, TDS healthcare and presently Eclipsys. In tandem, health institutions, education institutions collaborated with system developers to develop their customized systems. Notably, development of Health Evaluation through Logical Processing or HELP system, which was among the earliest clinical decision support systems was developed by University of Utah in partnership with 3M. In 1968, Massachusetts General Hospital in alliance with Harvard developed Computer Stored Ambulatory Record or COSTAR. COSTAR, as the system was known, had unique features that distinguished it from other early innovations. It was designed to allow modular view of information; users of the system were only privy with the functional information that related to their department such that clinical

information was separated from accounting information hence improving the system's efficiency. Another distinguishable feature was it had standardized medical terminologies; different diseases have different terminologies and terms across different institutions, COSTAR's database was able to identify a disease that had multiple terms from different medical institutions this helped users pinpoint a disease in the system that had been referred in multiple terminologies across the multiple health care providers. The federal government adopted electronic health records in 1970s; this was through the Department of Veteran Affairs' who adopted and implemented Decentralized Hospital Computer Program or DHCP. Veteran Affairs has also used other systems such as Computerized Patient Record System or CPRS. Novels feature of Veteran Affair's electronic health record systems is its access to federal information.

The second period of electronic health record innovation occurred in 1980. As earlier inventions of electronic health record became realizable, leaders in the health care industry formed alliances that would spur the standardization and use of electronic health information. Collen (1995) notes that Institute of medicine in their report that analyzed the weaknesses of health record system proposed seven recommendations that would streamline patient health recording. Among the recommendations were the conversion of all paper based patient record into electronic format, partnership among stakeholders and increased funding in research to spur development of electronic health records. However, in their report they highlighted cost, security breach and non standardization as the key challenges to adoption and implementation of electronic health records. According to Collen (1995), health players in the private industry on working on the Institute of Medicine recommendations formed the Computer-Based Patient Record Institute. Later on the institute contributed in facilitating in the development of electronic

medical record. As the implementation of electronic health records gained widespread lateral and ventral acceptance, there arose need to adopt standardization to enhance communication across the electronic health record system. Atherton (2011) notes that the Institute of Medicine has set Health Level Seven (HL7), which is electronic standards for health record systems. Electronic Health Records Overview (2006) notes that there are three major organizations that deal with standardization of electronic health records. They are Health Level Seven (HL7), Technical Committee Europeen de Normalization-Technical Committee (CEN TC) 215 and lastly the American Society for Testing and Materials (ASTM) E31. However, (CENTC) 215 develops electronic health standards in 19 European countries while ASTM mainly specializes with commercial laboratory dealers based in the United States of America. Artherton continues to elucidate that HL7, which is an electronic standard organization formed by the IOM, and other standard setting organizations have been pivotal in the industry's growth.

Standards are pillars in safeguarding the integrity and proper functioning of the systems. Different standards are set and enforced by different standard developing organizations. Atherton (2011) notes that Certification Commission for Healthcare Information or CCHIT is mandated to ensure dealers comply with HL7 standards. According Dunlop (2007) sensitive standards such as privacy and confidentiality are set and enforced by the government. This can be done through privacy legislations and Acts or in collaboration with accreditation institutions. Mandl, Szolovits and Kohane (2001) says that the Personal Information Protection and Electronic Documents Act (PIPEDA) that was enacted in Canada in 2000 later on in 2002 encompassed the health care industry, setting rules and procedures on disclosure, collection and the use of private information, where the details may be in digital or non-digital format. The other standards that are functional within the system are vocabulary standards; these standards are instrumental in the

capture of symptoms, diagnostic details and medication. These standards support decision making tools and facilitate research in the health institution. According to Amatayakul (2004), SNOMED standard is concerned with recording symptoms, ICD-9CM standard captures diagnosis, medical standards are AHFS and ATC, LOINC captures laboratory information while CPT standards help administrators in billing.

**Electronic health Records Legislations and Regulatory Regimes**

Politicians and health practitioners have been advocates for the adoption of electronic health records to foster efficiency in the health care industry. The federal government, on the other hand, has been equivocal on the need for the health care industry to convert from paper work to electronic record keeping. Congress has passed laws that facilitate and govern harmonious operation of the system. Consequently all stakeholders appreciate that patients' information is vital and there is need for efficient storage and retrieve systems. However, for the systems to optimally improve health care quality, legislations and regulations framework are needed to govern confidentiality of information and safeguard the integrity of the systems. According to Dick, Steen and Detmer (2003) the Health Insurance Portability and Accountability Act (HIPPA) which was passed in 1996 enhanced confidentiality of electrical medical records as it set out stringent rules on access, authentication and sharing of electronic medical information. In addition, according to Dick, Steen and Detmer (2003) the Act revolutionized financial transactions in the health care industry by instituting stringent rules on electronic financial transactions in the health care industry, resulting to increased financial transactions. In 2003, enactment of Medicare Modernization Act ushered in an era of electronic prescribing (Innovation in Health Information Technology, 2005). The Act spurred the use of medical prescribing by offering financial enticement to practitioners and outlining rules and procedures to

be used in electronic prescribing. The use of medical prescribing has resulted to lower medication faults and increased efficiency in medical care. In 2009, under the American Recovery and Reconstruction Act, $19 billion were directed towards health care information technology. The Health information Technology for Economic and Clinical Health Act which was under the premise of the American Recovery and Reconstruction Act established standards, implementation plan and certification procedures guiding electronic health technology (Atherton, 2011). In addition, the act was instrumental in setting up medicare and medicaid programs that have promoted efficient and effective use of the technology.

**Components and System Architecture of Electronic Health Record System**

Electronic Health Record Overview (2006) and Amatayakul (2004) concur that the principle operational purpose of electronic health record is to capture data from various ancillary sources and integrate the data into a centralized location. Electronic Health Records Overview (2006) states that academic medical centers integrate technical system components of their electronic health record with the other functional units depending on their data structures and systems. The report continues to state that ancillary services not integrated with the electronic health record are accessed via a custom interface or through a portal. Key components of an electronic health record are administrative system components, laboratory system component, radiology system component, pharmacy system components, computerized physician order entry and clinical documentation.

Since electronic health record majorly contains registration, admission and discharge information. Administrative system component of the electronic health records facilitates identification and assessment of patients. This involves recording of the patient's bio-data information such as name, demographics, employer information, next of kin, patient ailment

complaint and patient health nature. To uniquely identify a patient, electronic health records have unique primary identifiers in the form of alphanumeric or numeric keys. They identifiers are known as master patient index or medical record number. Master patient index helps in identifying clinical observations, procedures, evaluations, diagnosis and complaints to a specific patient. In addition, the unique identifier key helps in aggregating a patient information for research and other clinical analysis.

According to Electronic Health Record Overview (2006), laboratory systems are standalone systems interfaced with electronic health records. For example, Cerner reports that more than half of the laboratory information systems they have installed were not integrated with electronic health records, given the intermittent integration of laboratory data with the electronic health records. However, some electronic health record systems have links within their interface to connect to laboratory information system. Laboratory information systems that are integrated with electronic health records facilitate integration orders, laboratory results, billing, schedules and other administrative information.

Just like laboratory systems, not all radiology systems are integrated with electronic health records systems, though analyst believe radiology systems are widely used in academic medical centers. Radiology information systems facilitate integration of radiology information and radiology images (Electronic Health Record Overview , 2006). Radiology information includes patient identity, orders and interpretation of the results. One notable system complement of radiology systems is picture archiving communications systems or PACS that direct digital radiography research. Another automated system widely used by academic medical centers but not necessarily integrated with the electronic health records is pharmacy systems. According to

Electronic Health Records Overview (2006) pharmacy robots and payer formularies are not integrated with electronic health records.

Computerized physician order entry system is another key component of electronic health records (Electronic Health Record Overview , 2006). The system performs simple tasks such as ordering of laboratory, radiology and pharmacy services to complex services such as alerting, reporting of results to supporting decision making. However data from Klas enterprises reveals that partly four percent of the hospitals in the United States of America use computerized physician order entry systems (Electronic Health Records Overview, 2006). Ondo and Hess (2005) report that teaching hospitals record widespread use of computerized physician order entry system than other healthcare providers due to high number of physicians they have employed. According to Electronic Health Record Overview (2006) the slow uptake of computer physician order entry system is attributed to cynicism among clinicians who feel the system does not add value in their decision support. Despite the skepticism by the clinicians, Handler, Feied, Coonan, Vozenilek, Gillam, Peacock, Sinert and Smith (2004) in their assessment of computer physician and order entry system and clinical support systems state that the use of the systems may have reduced medication errors but not eliminated them. They continue to say that the system may even introduce new set of errors. Additional advantages documented by Handler, Feied, Coonan, Vozenilek, Gillam, Peacock, Sinert and Smith (2004) and Bates, Leape, Cullen, Laird, Petersen, Teich, Burdick, Hickley, Kleefield, Shea, Vander Vliet and Serger (1998) is that dosage calculators are more accurate and reliable in complex calculations than hand computations. According to electronic health records overview (2006), medical apparatus can deliver real time patient condition by integrating medical apparatus with clinical information systems. Haugh (2006) illustrates that Cedars-Sinai Medical Center based in Los Angeles,

documentation of medication management and dosage verification are generated by the integration of the interface of intravenous medication apparatus and clinical information systems. In his description Haugh says that Shabot M.D monitors his patients' EKG from his office using a viewing system that uses web based technology. The web based system generates live waveforms from monitored bedsides and intensive care unit and relays the information to Shabot M.D's office. Lastly, Electronic Health Records Overview (2006) proposes that for clinical documentation system to spur clinical benefits clinician note, nurses notes, flow sheets, peri-operative notes, discharge summaries among other clinical information should be automated.

Clinical documentation systems play a pivotal role in electronic health recording by availing clinical reports and notes and patient assessments in digital format. Electronic Health Records Overview (2006) postulate that by successful adoption and implementation of clinical documentation systems medical facilities will be able to save upto 24 percent of nurses' time. The report adds that for the clinical benefits to be realized, comprehensive implementation of clinical documentation system will require reorganization of workflow and uniform implementation of the system by all the healthcare facilities. Additionally medical apparatus can produce real time information on patients health status.

According to Amatayakul (2004), computer-based patient record institute or CPRI propose that a standard electronic health record should at minimum be able to record data, incorporate data from the various points of care and offer possible solutions to support decision making. Electronic health records continues to assert that since the technical system captures, integrate data and support decision making, it should comprise of information systems that are capable of working independently at point of care, interrelate with the other systems to integrate the data and lastly comprise of decision support systems. The technical system of electronic

health record can be said to comprise of three technical components (Amatayakul, 2004). Source systems are instrumental in recording of data that pertain to the health record from various sources. The systems are notably used in clinical, administrative and financial department. The second component comprises of databases, rules engine, knowledge sources and data warehouses. The component centrally hosts data from various sources, delivers programming functions and logics that are essential in decision support, acts as a knowledge bank for information obtained from external sources and lastly acts as a storage for analyzed data from which useful information and effective decisions can be derived. Lastly, the third electronic health component is human-computer interface, these technical component facilitate interaction between the user of the system and the functional components of the system. Therefore, human computer-interface supports remote and consumer users of the system to capture data and retrieve information that supports decision making from the personal computers, notebook computers or personal digital assistant. The America Health Information Management Association (2003) in there support for the use of electronic health record envisages that the use of electronic health record systems will facilitate concurrent use of health information in healthcare delivery, finance, outcome measurement, research, clinical trials and disease prevention and surveillance at all levels of healthcare. They continue to state that the healthcare levels will be at individual, community, national and international all with diverse use with the health information. According to Shortliffe (2005) successful implementation and use of the technical systems that comprise electronic health record will reduce healthcare cost, enhance health care quality through improved data support from all departments concerned with healthcare delivery.

In addition, electronic health record system can be said to comprise of simple to intricate functional systems (Amatayakul, 2004). Document scanning system also known as imaging systems are used to capture and convert images in the paper format to digital format for storage and easier retrieval from a computer system. With the advent of technology, modern imaging systems index data or merge scanned forms with computer generated forms this helps in the retrieval of specific data. However, according to Shortliffe and Perreault (2001) milestone revolution of imaging systems has been the integration of the system with work flow technology. This helps concurrent use of the health record by multiple users, in different location and for various purposes. For example, a clinician can view documents on patient care and at the same time finance department can be using the patient's document to prepare claims attachment.

Order communication also known as results retrieval system is another functional system that facilitates transmission of orders and other diagnostic measures to auxiliary departments and transcription systems (Amatayakul, 2004). Therefore, results retrieval system facilitates the integration of source system for efficient operational purposes. The source documents of the system are paper based but are later dictated and transcribed or keyed into the system. The paper based record after use are scanned and combined with computer generated forms in a process known as computer output to laser disk or COLD. The COLD process utilizes centralized automated archive in the storage of paper based records. One functional advantage of order communication systems is remote access to results through automatic order transmission. The widespread use of the internet and the shortcoming of paper based system has necessitated the use of clinical messaging systems. Clinical messaging systems have the same functional role as order communication systems only that they are not paper based like result retrieval systems.

The system utilizes web technology such as web portal or intranet to deliver real time communication (Amatayakul, 2004).

According to Amatayakul (2004) patient care charting systems facilitate caregivers capture structure and structured data on vital signs, treatment administered among other care giving details. Earlier on the systems primarily were concerned with documentation of nursing details. Patient care charting system has a distinct architecture of structured and unstructured data entry method. Structured data involves the use of predefined answers found in tables, scales, checklist or drop down menu. The care giver or a nurse selects data from a drop down menu, checklist or a predefined scale using computer input devices such as keyboard, light pen or a touch screen. Structured data has an advantage of guaranteeing standardization. Cardiac monitors and laboratory apparatus commonly produce structured data. Unstructured data on the other hand refers to sequence of event information. Voice recognition and handwriting recognition interfaces facilitate caregivers to dictate and handwrite data into the system respectively. The patient care charting systems also facilitate transcribing and recording of data by the caregivers. Earlier on, patient charting system were slow and nurses found them hard to use. However, advances in technology has sophisticated patient charting system, as data entry today is done using wireless input devices, the use of smart text and natural language processing. Smart text is a data entry method that uses macros in word processors. This method involves keying a few letters which represent a specific term. Natural language processing is a new technology which converts narrative text to discrete format. However, one main disadvantage of unstructured data is inability to be analyzed or searched.

According to Koppel, R. Metlay, J. P. Cohen, A. Abaluk, B. Localio, R. Kimmel, S. E. & Strom, B. L.(2005). Computerized physician order entry systems emerged as a result of quality

drive by the Institute of Medicine or IOM. The system which is highly complicated facilitate physicians to enter orders into the system and in response receive appropriate directions on the order. This can be through relaying information on the required dose to be administered, contra-indications of the dose, alternative medication and whether the medication is comprehensive in the patient's insurance scheme. In contrast, physicians postulate that operations of the system is slow and of no value. However, various scholars concur that Institute of Medicine (2000) and Institute of Medicine (2001) computerized physician order entry systems will reduce medical errors and enhance medical care delivery and patients safety through the support of physicians' decision making process (Institute of Medicine, 2000; Institute of Medicine, 2001).

**Impact of Electronic Health Records in the Healthcare System**

As legislative and compliance requirement facing the health industry to automate mounts, it is vital to establish how automation has impacted on healthcare delivery. According to Walker (2005) one notable impact that automation of health records has heralded is long term storage of records. Researchers concur that storage of health records electronically will exceed the average live of paper based archival system. According to Innovations in Health Information Technology (2005) empirical studies have shown that health information technology has enhanced quality of healthcare by reducing medication errors and reducing administrative challenges that physicians encountered using paperwork. The report illustrates the positive impact that WellPoint physicians derived from using electronic prescribing. The results revealed that 75% of the physicians reported saving time on prescription routines since the introduction of electronic prescribing. Additionally, WellPoint estimates that by July 2005, over 90,000 prescriptions had been done using electronic prescribing program. Schloeffel, Beale, Heard, and Rowed (2001) and Gurley and Rose (2004) assert that the use of electronic health record will facilitate

healthcare facilities to provide quality healthcare. Schloeffel, Beale, Heard, and Rowed (2001) state that quality healthcare can be guaranteed by relaying of reliable, relevant and timely patient's information to the medical team. The information relayed to each member of the medical team should not be discriminatory on the patient's level of care. MedQuery program which was launched by Aetna analyzes medical information such as laboratory data, pharmacy data and health care claims to investigate errors that may have arisen due medical errors (Innovation in Health Information Technology, 2005). Since its rollout, it is reported that MediQuery has proposed 70,000 ways to improve healthcare quality, increased return on investment, reduced the number of complaints due to ineffective treatment and lastly physicians have hailed it as reliable. According to (Innovation in Health Information Technology, 2005) MediQuery analyses and calibrate the severity of the situation, the system using a communication platform conveys the appropriate steps to be taken. Koeller (2002) state that implementation of electronic health records has greatly reduced paper work. This has in turn improved efficiency and lowered operational costs (Gurley and Rose, 2004 ). According to Hillestad, Bigelow, Bower, Girosi, Meili, Scoville and Taylor (2005) hypothesize that adoption of electronic medical records system could improve efficiency and account for $ 142 billion to $371 billion dollars in safety savings. These savings are derived from reduced patients' hospitalization time, reduced loss of time by nurses in administrative duties, prudent drug and radiology usage.

Wulsin and Daughtery (2008) state that implementation of electronic health records portends two potential benefits, with the inherent benefits being lowering of costs and enhanced medical care. Wulsin and Daughtery continue to state that health information technology and electronic health records investments will help healthcare industries contain the ballooning

annual healthcare expenditure which is expected to hit $3 trillion by 2012. Hillestad, Bigelow, Bower, Girosi, Meili, Scoville and Taylor (2005) in their estimation on cost saving by adoption of health in formation technology and electronic health records found that ideally if the entire health sector adopted the technology, there would be $40 billion in saving for a period of fifteen years. They hypothesized that three quarter of the saving would be realized through shortened hospital stay and increased healthcare teams productivity. However, researchers agree implementation of the technology comes at a cost. Federico, Meili and Scoville (2005) estimate that for hospitals to realize 90% health information and electronic health record nationwide adoption within 15 years, they will have to spend $17.2 billion and $98 billion for physicians and hospitals respectively. The study by the same researchers extrapolate that for a hospital to fully implement health information technology and electronic health records it will cost 1.8 percent to 3 percent of their annual expenditure. On a national scale this is equivalent to an annual spending of $6.5 billion or $ 97.4 billion over a 15 year period. Implementation costs in the ambulatory care were forecast to be a sixth of the annual expenditure or $ 22,000, but over 15 years ambulatory care implementation will cost $ 17.2 billion. Federico, Meili and Scoville (2005) in their cost saving analysis found that it was economically viable to adopt the health information technology and electronic health records as annual total cost is $7.6 billion against savings of $42 billion. Hillestad, Bigelow, Bower, Girosi, Meili, Scoville and Taylor (2005) compares health information technology and electronic health record investment synergy and productivity to increased productivity reported by retail and wholesales that invest in information technology. The researchers contine to estimate that cumulatively hospital systems and physicians will save $468 billion and $159 billion respectively by 2016. However some researchers disagree with these findings. Walker (2005) feel that it is premature to ascertain the true cost saving as the

systems are yet to be tested by complexities and implementation glitches. Goodman (2005) conjectures that there is no net cost saving as any potential saving is ploughed back to the system due to increased public demand. According to Hillestad, Bigelow, Bower, Girosi, Meili, Scoville and Taylor (2005) the use computerized physician order entry system has enhanced patient safety. This has been made possible through alerts and warning that CPOE relays when an order is keyed to the system. The researchers continue to state that CPOE could reduce 200000 in patient adverse drug events saving $1 billion annually and $3.5 billion for ambulatory patients. Hillestad, Bigelow, Bower, Girosi, Meili, Scoville and Taylor (2005) state that health information technology can help provide preventive services by identifying patients with specific needs. These preventive mechanisms can be for short term illnesses and long term chronic ailments. The electronic medical record system have alerts that instructs the physician of the checkup the patient should undergo and the treatment schedules. According to Schloeffel, Beale, Heard, and Rowed (2001) paper records contained fragmented clinical information this resulted to increased information management costs. Young (2000) on the other hand believes the greatest impact of electronic health records on healthcare system has been remote accessibility of medical information and continuous and instant update of patient status. According to Gurley and Rose (2004) electronic health record has positively impacted the healthcare industry by providing patients with accurate medical information and billing details. This view is supported by Innovation in Health Information Technology (2005) that states a Web based program sponsored by Aetna has helped price discovery among patients, by click of a button members logged on the system are able to view medical facilities in Cincinnati that are offering discounted medical charges. Additionally healthcare providers will benefit from prompt payment as claims are submitted electronically.

**Impediments to Implementation of Electronic Health Record Systems**

Though pundits believe that adoption and implementation of electronic health record will streamline and enhance quality of healthcare delivery, the healthcare fraternity is yet to fully implement the system (Shortliffe, 2005). The stakeholders in the healthcare industry are face with serious bottlenecks in the implementation of the systems. According to Wulsin and Daughtery (2008) one challenge facing the implementation process is the lack of incentives for medical facilities to implement the switch. Wulsin continues to state that while hospitals incur the cost of implementation and maintenance of the system, full benefits are only enjoyed by the government, employers, insurance and individuals. Hackbarth and Milgate (2005) explain that improved healthcare quality results to low business for hospitals and physicians and these only benefits the healthcare insurers. The two propose that there should be a system to compensate the health facilities for lost business. DesRoches, Campbell, Rao, Donelan, Ferris, Jha, Kaushal, Levy, Rosenbaum, Shields and Blumenthal (2008) in their survey state that 56% of physicians without electronic health record cited lack of financial incentives as the key factor for lack of implementation. Another major bottleneck is high initial cost. A fully functional system requires huge sums of infrastructural cost in terms of hardware and software platforms. According to DesRoches, Campbell, Rao, Donelan, Ferris, Jha, Kaushal, Levy, Rosenbaum, Shields and Blumenthal (2008) 66% of physicians were discouraged to implement electronic health record system due to high capital cost, while 50% were doubtful of the return on investment. According to Shortliffe and Perreault (2001) the use of electronic health record undermines physician reimbursement this discourages implementation. Wulsin and Daughtery (2008) believe privacy and security also inhibits implementation. Researchers believe that data and information on the network is susceptible to malicious hacking hence undermining confidentiality (Goodman,

Berner, Dente, Kaplan, Koppel, Rucker, Sands and Winkelstein, 2011). However, Wulsin and Daughtery (2008) and Dick, Steen and Detmer (2003) feel that the Health Insurance Portability and Accountability Act may foster cyber security in the electronic health systems.

**Emerging and Future Trends in Electronic Health Systems.**

As the healthcare system in the United States of America continue to embrace technology just like its peer country, Denmark, new trends are emerging in an effort to contain cost and improve service delivery. According to Electronic Health Records Overview (2006) trends in medical electronic system can be grouped into technical and business. Technically clinical ontology is still nascent and new innovations are either being incubated or emerging. According to Electronic Health Records Overview (2006) in the near future, semantic web will heavily use XML or extensible markup language and RDF or resource description framework. These developments will enhance database search by yielding appropriate search results. In the business context, the emerging trend among the electronic health solutions provider is consolidation (Electronic Health Record Overview, 2006). Big companies providing electronic healthcare solutions are acquiring small companies while some established companies like Accenture who are not big players in the clinical information systems space are strengthening their electronic health record technology.

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