21st Century Technology Used in Hospitals:
An Assessment of Electronic Health Records

by

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An Applied Research Project
(Political Science 5397)
Submitted to the Department of Political Science
Texas State University-San Marcos
In Partial Fulfillment for the Requirements
for the Degree of
Masters of Public Administration

Fall 2010

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Abstract

Purpose: The purpose of this research is three-fold. The first purpose is to establish a practical ideal model of Electronic Health Records (E.H.Rs) used in hospitals by reviewing relevant scholarly literature. The second purpose is to assess the extent Central Texas Medical Center (C.T.M.C) in San Marcos, Texas adheres to the elements of the ideal model. The final purpose is to provide recommendations for improving the current E.H.R system used at C.T.M.C. A thorough review of the literature identified eight key components of Electronic Health Records based on the Institute of Medicine Report, *Key Capabilities of an Electronic Health Record,* 2003. The components include: Health Information and Data, Results Management, Order Entry/Management, Decision Support, Electronic Communication and Connectivity, Patient Support, Administrative Processes, and Reporting and Population Health Management.

Methodology: The components of an Electronic Health Record identified in the literature led to the development of the conceptual framework. The conceptual framework was the assessment tool used to gauge the Electronic Health Record (E.H.R) system used at Central Texas Medical Center (C.T.M.C). The methodology used to collect data and make assessments was structured interviews and direct observation.

Findings: Structured interviews and direct observation revealed the E.H.R system used at C.T.M.C met all or the majority of components for ***Health Information and Data***, ***Results Management, Order/Entry Management, and Patient Support.*** Components that were missing included reminders for preventive services for patients, epidemiologic data and automated real time surveillance in ***Decision Support***, patient to provider communication and medical record integration across settings in ***Electronic Communication and Connectivity,*** clinical trial, drug recall and chronic disease management in eligibility determination in ***Administrative Processes***, and public health reporting and disease registries in ***Reporting and Population Management.***

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About the Author

Crystal M. Munoz is originally from Crystal City, Texas. She received a Masters Degree of Public Administration/ Allied Health Services in December 2010 and a Bachelor of Science Degree in Health Information Management in May 2008 from Texas State University-San Marcos. Crystal is currently employed at Central Texas Medical Center as an auditor in the Performance Improvement Department. Her duties include performing medical record reviews to abstract Core Measures/National Hospital Quality (CM/NHQ) data elements, Emergency Department audits and other audits as needed. Any questions or comments about this paper can be directed to Crystal's personal email at crystalmunoz914@gmail.com.

Chapter One: Introduction

*"Information is the lifeblood of modern medicine. Health information technology (HIT) is destined to be its circulatory system. Without that system, neither individual physicians nor health care institutions can perform at their best or deliver the highest quality care, any more than an Olympian could excel with a failing heart."- **Dr. David Blumenthal, National Coordinator for Health Information Technology***

The United States trails behind most European countries in the use of Electronic Health Records (E.H.Rs). Even though health care in the United States is known for the use of advanced technology in treating patients, doctors and hospitals have been slow to replace paper records with electronic records. Outside the Veteran's Affairs (VA) system, it has been estimated as of 2006, fewer than 10% of American hospitals have adopted E.H.Rs. (Furrow et al 2008, 37) According to the research, advantages of going paperless in health care include: improvement of quality of care, reduction of medical errors and costs, improved record keeping and mobility, and better management of chronic conditions (Chaudhry et al., 2006). The American Recovery and Reinvestment Act of 2009 (ARRA)[1] is investing in Electronic Health Records, most notably through Medicare. The Health Information Technology for Economic and Clinical Health Act (HITECH)[2] which is part of the 2009 economic stimulus package is aimed at encouraging hospitals to adopt E.H.Rs. The Institute of Medicine (I.O.M) has identified core functionalities for an E.H.R falling into eight categories which are: Health Information and Data, Results

[1] For more information about the American Recovery and Reinvestment Act of 2009 (ARRA) refer to http://recovery.gov

[2] For more information about the Health Information Technology for Economic and Clinical Health Act (HITECH) refer to http://www.hhs.gov/ocr/privacy/.

Management, Order Entry/Management, Decision Support, Electronic Communication and Connectivity, Patient Support, Administrative Processes, and Reporting and Population Management (Institute of Medicine-*Key Capabilities Report of an Electronic Health Record Report* 2003). This applied research project will describe the core functionalities identified by the Institute of Medicine (I.O.M) to develop an ideal Electronic Health Record (E.H.R) system used for hospitals.

Research Purpose

The purpose of this research is three-fold. The first purpose is to establish a practical ideal model of Electronic Health Records (E.H.Rs) used in hospitals by reviewing relevant scholarly literature. The second purpose is to assess the extent Central Texas Medical Center (C.T.M.C) in San Marcos, Texas adheres to the elements of the ideal model[3]. The final purpose is to provide recommendations for improving the current E.H.R system used at C.T.M.C. A thorough review of the literature identified eight key components of Electronic Health Records based on the Institute of Medicine Report, *Key Capabilities of an Electronic Health Record,* 2003. The components include: Health Information and Data, Results Management, Order Entry/Management, Decision Support, Electronic Communication and Connectivity, Patient Support, Administrative Processes, and Reporting and Population Health Management

Chapter Summaries

This applied research project contains five chapters.

Chapter Two: The purpose of this chapter is to examine the literature pertaining to Electronic

[3] For examples of Practical Ideal Model Applied Research Projects consult with: Casas (2006), Gilliam (2010) Harkins (2010), McLemore (2008), and Trial (2009)

Health Records. Historical background and early concepts of E.H.Rs is discussed; documents found in a medical record are described; the purpose of the medical record is explained; reasons for implementation are mentioned; and key capabilities of an E.H.R is also described in detail. The model described in this chapter is used to assess the current E.H.R system used at Central Texas Medical Center, San Marcos, Texas.

Chapter Three: This chapter explains the selected research method along the operationalization, methods of data collection and sampling, strengths and weaknesses of the selected research method. This chapter also provides discussion of Human Subjects Protection.

Chapter Four: This chapter analyzes and examines the results of this study. The findings are used to assess the Electronic Health Record (E.H.R) system used at Central Texas Medical Center (C.T.M.C) using the ideal components developed from I.O.M report discussed earlier. The results of the structured interview are presented in this chapter.

Chapter Five: This chapter presents the overall results of the study and summarizes which elements of the ideal Electronic Health Record (E.H.R) system were found at C.T.M.C. Recommendations also made for improving the current system at C.T.M.C.

Chapter Two: Literature Review

*"Electronic Medical Records will cut waste, eliminate red tape, and reduce the need to repeat expensive medical tests." "It just won't save billions of dollars and thousands of jobs -- it will save lives by reducing the deadly but preventable medical errors that pervade our health care system," -**President Barack Obama***

Introduction

The hospital medical record has undergone great changes over the last several decades. The implementation of Electronic Health Records (E.H.Rs) has become a powerful force in changing the traditional hospital environment. Unfortunately, paper is still the standard for medical record keeping in some facilities, and these documents increase the opportunities for error. Paper records are subject to errors from illegible writing and confusion arising from miscommunication among health care professionals on differences in what is being said and what is actually written on the piece of paper. This confusion can lead to duplicate lab tests, delays in treatment, delays in billing, and adverse drug interactions. Research has shown that the implementation of Electronic Health Records (E.H.Rs) records will reduce cost, reduce errors, and improve the overall quality of health care (Chaudhry et al 2006). Rising costs in health care and the current health care reform law (American Recovery and Reinvestment Act) has made E.H.Rs significant (Orszag and Emanuel, 2010). This paper will describe the ideal E.H.R system based on scholarly research; assess the current E.H.R system currently used at Central Texas Medical Center (C.T.M.C) in San Marcos and will offer several recommendations for improving the medical record keeping system used at C.T.M.C.

Historical Background: Early Concepts of Electronic Health Records (E.H.Rs)

Computers were sparsely used in hospitals before the 1960s. Those used were primarily in departments such as admissions or patient accounting departments. The concept of an electronic health record was first described in 1966 at the University of Wisconsin. Examples of early computer-based patient records (C.P.R) systems included: Computer Stored Ambulatory Record System, (COSTAR)[4] which was developed in 1968 by the Harvard Community Health Plan and pioneered by Octo Barnett; Computerized Medical Records by the Kaiser Permanente which was pioneered by Morris Collen in 1969; The Medical Record (TMR)[5], by Duke University Medical Center which was pioneered by William Stead; and Computer-aided diagnosis pioneered by Howard Bleich at Medical Center of Vermont in 1970 (Reel and Mandell from Lehmann et al. 2006,11).

In the late 1970s, the entry of billing was a primary motivation for Electronic Medical Record creation. Also important were audit parameters that would achieve payment guidelines (Grams 2009, 409). Examples include: PROMIS[6]-Problem Oriented Medical Record and Computer-based medical interviews were pioneered by Warner Slack in 1971 at Medical Center of Vermont, STOR-Summary Time Oriented Record in 1978 at University of California, San Francisco Medical Center and Automated adverse drug reactions systems in 1978 at Stanford University Medical Center pioneered by Stanley Cohen (Reel and Mandell from Lehmann et al,

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4 It provides its members comprehensive care including medical, surgical, nursing, laboratory, radiology, and emergency care. COSTAR was able to store, retrieve, and print patient information in an electronic format. (Reel and Mandell,2006,9) From Aspects of Electronic Health Record Systems, 2nd Edition, 2006, Lehmann, et al

5 Designed to permit healthcare personnel obtain data about a patient and enter the data directly into a database during the encounter. (Reel and Mandell 2006,12) From Aspects of Electronic Health Record Systems, 2nd Edition, 2006, Lehmann, et al

6 A unique system structured around the patient's problems. PROMIS guided the medical care provider using structured vocabulary, content and organization for the patient record. (Reel and Mandell 2006,12) From Aspects of Electronic Health Record Systems, 2nd Edition, 2006, Lehmann, et al

2006, 11).

The early 1980s witnessed the development of personal computers (PC's)-desktop devices with computing power and storage capacity. The development of electronic data networks enabled PCs and larger systems to be linked together for the sharing of information on decentralized basis (Glandon et al 2008). In 1984, Johns Hopkins Hospital developed AUTRES which was designed as the first major computer-generated report to provide complete discharge information for a referring physician or other health care provider (Reel and Mandell from Lehmann et al. 2006, 13). The earlier versions of Johns Hopkins computerized record keeping evolved into the 1989 Electronic Patient Record (EPR), the system provided a patient-centered view of the patient's health care experience was layered on the AUTRES foundation (Reel and Mandell from Lehmann et al 2006, 16).

~~"~~HepaTopix and PsycTopix were developed at Yale University between 1989 and 1992 to extract key words from a patient‘s EHR and suggest topics of possible interest for an automated MEDLINE search based on MeSH terminology” (Albert 2007, 4). The 1990s brought the most noteworthy changes in the healthcare environment due to health care reform and managed care (Glandon et al 2008). These pioneering systems provided a basic model for current hospital-based and ambulatory E.H.R systems that has been emulated by current electronic health record systems today.

Electronic Health Record Definition

Throughout this chapter the terms electronic medical records (E.M.Rs) and electronic health records (E.H.Rs) interchangeably despite the minor definitional differences. The following are the definitions of the terms from the National Alliance for Health Information Technology: ~~"a~~n **electronic health record (E.H.R)** is an electronic record of health related

information on an individual that conforms to nationally recognized interoperability standards and that can be created, managed, and consulted by authorized clinicians and staff across *more than one health care organization" (*Amatayakul 2009, 10). –An **electronic medical record (E.M.R)** is an electronic record of health related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff *within one health care organization"* (Amatayakul 2009, 10). For the sake of not causing confusion, this paper will use the term electronic health record, (E.H.R).

The most widely accepted definition of an E.H.R used today is from the 2003 Institute of Medicine (I.O.M) Report titled *Key Capabilities of an Electronic Health Record System* which is:

- Longitudinal collection of electronic health information for and about persons, where health information is defined as information pertaining to the health of an individual or healthcare provided to an individual.
- Individual immediate electronic access to person-and population -level information by authorized, users.
- Provision of knowledge and decision support that enhance the quality, safety, and efficiency of patient care.
- Support of efficient processes for health care delivery (Miller 2005, xx).

Documents Found in a Medical Record

Most medical records are composed of the documents listed in the following table. The medical record may contain all or some of the documents, mostly depending on the facility and/or the individual patient's need (Lippincott Williams & Wilkins 2003, 4-5).

Table 2.1: Documents Found in Medical Records

Medical Record Document:	Description of Documentation:
Face Sheet or Admission Sheet	The first page of the medical record, this form includes information identifying the patient by name, birth date, social security number, address, and marital status. It also lists closest relative or guardian, food or drug allergies, admitting diagnosis, assigned diagnosis-related group, the attending physician, and insurance information.
Medical History and Physical Examination	Completed by the physician, this form contains the patient‘s initial medical examination and evaluation data.
Initial Nursing Assessment Form	This document contains nursing data, including the patient‘s health history, physical and psychosocial assessments, baseline functional status, demographics, and pertinent social environment information
Physician’s Order Sheet	This is the record of the physician‘s medical orders.
Problem or Nursing Diagnosis List	Known as a problem list or a nursing diagnosis list in health care facilities that follow the problem oriented medical record system; this record lists the patient‘s problems. Some health care facilities list nursing diagnosis on a separate form.
Nursing Care Plan	This is a statement of the nurse‘s patient care plan. Usually included with the basic medical record forms, it‘s sometimes kept in a separate folder at the nurses‘ station until the patient‘s discharge.

Table 2:1 Continued

Graphic Sheet	Known by various titles assigned by the health care facility, this form is a type of flow sheet that tracks the patient‘s temperature, pulse rate, respiratory rate, blood pressure and, possibly, daily weight. Additional graphic sheets may be designed for recording such information as skin care, blood glucose levels, urinalysis results, neurologic assessment data, and patient intake and output. These forms allow the nurse to show that a certain task or assessment was completed by simply dating, initialing, or checking off the appropriate column
Medication Administration Record	This document contains a record of each medication a patient receives, including the dosage, administration route, site, date, and time
Nurses‘ Progress Notes	This record details patient care information, nursing interventions, and the patient‘s responses
Physicians‘ Progress Notes	Like the nurses‘ progress notes, this record contains the physician‘s observations and notes on the patient‘s progress. It includes treatment data as well.
Diagnostic Findings	These forms contain diagnostic and laboratory data-for example, hematology, pathology and radiology test results
Health Care Team Records	This part of the medical record includes information from other professional personnel, such as physical therapists, respiratory therapists, and social workers
Consultation Sheets	These forms include evaluations made by physicians, clinical specialists, and others consulted for diagnostic and treatment recommendations.

Source: Lippincott Williams & Wilkins 2003, pages 4-5

The Purpose of the Medical Record

Medical records perform many useful functions. They serve as evidence of quality of care for accreditation[7], certification[8], and licensure[9]; they protect against liability; they are used for performance improvement[10] and peer review[11]; and also they are used for reimbursement requirements (Lippincott Williams & Wilkins 2003, 4-7). There are also other ancillary functions of a medical record such as use for biomedical research and for educational tools by medical schools, nursing schools, allied health training programs, etc. (Brown from Odom-Wesley et al. 2009, 46-51). They also serve as a communication tool for health care providers and clinicians and help coordinate care for patients.

Reasons for Electronic Health Record Implementation

The following provides a brief review of literature of why electronic health record implementation is so important. Generally, three broad reasons can be identified in the literature. They are: reduction of medical errors, better management of patient's chronic conditions, and improvement of reimbursement and cost savings.

Medical Errors

A 1999 study done by the Institute of Medicine (I.O.M) found that medical errors kill 44,000 people in U.S. Hospitals each year while another study put the estimate closer to 98,000

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7 Accreditation is the process of granting formal approval to a healthcare organization .The Joint Commission publishes operational standards developed by the accreditating organization. (Brown from Odom-Wesley, Brown, and Meyer, 2009,48)

8 Certification is the process of granting an organization the right to provide healthcare services to a specific group of individuals. (Brown from Odom-Wesley, Brown, and Meyer, 2009,48)

9 Licensure is the process of granting an organization the right to provide healthcare services. State governments establish licensure requirements, unlike accreditation, which is a voluntary process. Licensure is mandatory. (Brown from Odom-Wesley, Brown, and Meyer, 2009,48)

10 Refers to quality assurance efforts. Performance Improvement efforts emphasize the importance of identifying the shortcomings of processes and systems rather than individuals. (Brown from Odom-Wesley, Brown, and Meyer, 2009,44)

11 Peer review is the evaluation of review of the performance of colleagues by professionals with similar types of degrees of expertise. (Spath, 2005,137)

deaths per year (Kohn et al. 1999). According to a study of 37 million patient records that was released by Health Grades[12], the health care quality company, in the years 2000, 2001, and 2002, 195,000 people in the United States died due to potentially preventable, in-hospital medical errors. The Centers for Disease Control and Prevention (C.D.C) report that the incidence of medical errors is now ranked between the fifth and eighth leading cause of death in the United States. Having medical records computerized has been found to reduce medication errors by as much as 83 percent (Bates and Gawande, 2003). Also, a Harvard study found computerized provider order entry (CPOE), a technology in electronic health records, reduced adverse drug interactions by more than half (Bates et al. 1998, 1311-1316). Due to the alarming statistics of medical errors, patient safety is perhaps the biggest reason for adopting electronic health records.

Chronic Conditions

–A program of EMR-enhanced prevention and disease management should change the incidence of chronic conditions and their complications" (Hillested et al. 2005, 1112). Electronic medical records ameliorate the chronic conditions of patients by facilitating communication and coordination of care and treatment. It would also help in tracking the frequency of preventive services and provide reminders for physicians when patients need tests for their visits. More than half of people with chronic conditions have three or more different providers and report different information to those providers (Leathermann and McCarthy 2002). Disease management programs for chronic conditions often identify and target services for patients based on their level of risk (Hillested et al. 2005, 1110). Chronic conditions include hypertension, heart disease, diabetes, respiratory diseases such as chronic obstructive pulmonary disease (COPD), etc. Fifteen chronic conditions accounted for more than half of the growth in health care

[12] The complete study including the list of AHRQ patient safety indicators can be found at http://www.healthgrades.com

spending between 1987 and 2000. A study of the long term effects of prevention and management of chronic diseases estimates savings at $147 billion per year (Hillested et al. 2005, 1113). This would be a substantial amount of savings considering that ―studies have found that people with multiple chronic conditions are more likely to be hospitalized, see a variety of physicians, take several prescription drugs, and be visited at home by home health workers" (Burton et al. 2004, 458). Using health information technology such as electronic health records, would aid in chronic disease management by coordinating level of care and help reduce costs in managing them.

Reimbursement and Cost Savings

Documentation helps determine the amount of reimbursement a health care facility receives. The federal government uses a prospective payment system based on diagnosis-related groups (DRGs) to determine its reimbursement for hospital care, paying a fixed amount for a particular diagnosis (Lippincott Williams & Wilkins 2003, 5). Medical records have become important in the revenue cycle in that the accuracy and completeness affects reimbursement. ―The cornerstone of accurate coding is physician documentation." (Hazelwood and Venable from Eichenwald-Maki and LaTour 2006, 388). Coding refers to the process of assigning numeric representations to clinical documentation (Eichenwald-Maki and LaTour, 2006). Electronic Health Records help ensure that documentation is complete and accurate. Also, according to Amatayakul and Lazarus (2005), an E.H.R has significant productivity improvements that lead to direct cost savings such as reduced overtime, elimination of outsourcing expenses, and can help clinicians provide additional patient time. As far as cost savings, E.H.Rs would eliminate paper chart supplies, reduce clerical personnel, eliminate copy service, etc. (Amatayakul and Lazarus

2005, 84-94). Furthermore, EMRs would eliminate additional office staff need to process claims rejections by making payment transactions easier and faster (Grams 2009).

Key Capabilities of an Electronic Health Record (E.H.R.)

The Institute of Medicine Report (I.O.M), *Key Capabilities of an Electronic Health Record,* (2003) identifies eight key components of E.H.Rs. These components include:

- Health Information and Data
- Results Management
- Order Entry/Management
- Decision Support
- Electronic Communication and Connectivity
- Patient Support
- Administrative Processes
- Reporting and Population Health Management.

Health Information and Data

Health Information and Data includes key data using codes sets, narrative information, patient acuity information and capture of identifiers. **Key data** include problems lists, procedures, diagnosis, medication lists, allergies, demographics, diagnostic test results, radiology results, health maintenance, advance directives, dispositions, and level of service. Collected information includes clinical and patient **narrative information** in free text; template based and derived structure from unstructured text. **Patient acuity,** which determines the severity of illness and risk adjustment needed for patient care. Finally, the information of **capture of identifiers** is

also included which lists people and their roles, products/devices and places which include directions (Institute of Medicine-*Key Capabilities Report of an Electronic Health Record Report* 2003)

Narrative information in free text is, ―the entry of narrative data, primarily via keyboarding, although dictation, voice recognition, and handwriting recognition are possible." E.H.Rs uses the combination of structured data entry and free text. Structured data entries allow pull down menus (Amatayakul 2009, 396). Structured data, also referred to as descrete data, have been predefined in a table or checklist for recording a patient's problem from a drop down menu. A user would select data values using a mouse, arrows on the keyboard, touch screen, voice command, or other human computer interface. Also included is entry of numbers or numerical score such as those used in pain scales (Amatayakul 2009, 15-16). ―Structured data entry (SDE) applications can prompt for completeness, provide greater accuracy, and better ordering for searching and retrieval, and permit validity checks for data quality monitoring, research, and especially decision support" (Roukema et al. 2006, 15).

Template based entry is, ―something of a cross between free text and structured data entry." ―Macros that provide phrases or sentences to complete the variable portions of templates can further speed the use of automated templates" (Amatayakul 2009, 397). Natural language processing (NLP) is deriving structure from unstructured text. ―NLP is a technical process in which highly sophisticated computer programs ―read" strings of free text and separate words or phrases into little packets called parsing" (Amatayakul 2009, 398). Unstructured data refers to narrative data which is an area where caregivers can key in or dictate anything they want to record (Amatayakul 2009, 16). The feature of displaying all previous diagnostic tests, procedures, radiology results and so forth in an E.H.R can reduce the redundancy of tests being

ordered which will ultimately save time and money (Bates et al. 1999). Matters requiring prompt attention, such as abnormal test results, can be addressed on a timelier basis if the physician has access to information at the point of care (Bates et al. 2003). All these forms (free text entry, structured data entry, pick and pull down menus, template based entry, and NLP) of data entry allow for data retrieval and data capture at the point of care which is very important because it can allow for greater efficiency in a process.

Results Management

Results management includes results reporting, results notification, multiple views of data, and multimedia support. Results management of **results reporting** lists laboratory, microbiology, pathology, radiology reports and consults. Results management also includes **results notification, multiple views of data and multimedia support** which are images, waveforms, and scanned documents (Institute of Medicine-*Key Capabilities Report of an Electronic Health Record Report* 2003). ―Access to data is the most fundamental function clinicians want as they approach information system adoption." The data being viewed when needed is very significant. Many hospitals are attempting to make this the primary source of diagnostic studies and are encouraging clinicians to retrieve the results directly online (Amatayakul 2009, 399). The goals of results reviewing are to save clinician time, prioritize, and ensure critical information is not missed. ―Clinicians should be provided with a snapshot of patient results that provides at a glance views and clear visual cues that differentiate critical and abnormal results" (Carter 2008, 176).

Having access to these reports over a period of time helps providers make informed choices for diagnosis and treatment which increases quality of care. Electronic health records (E.H.Rs) formats for trending and comparing results over time are not accessible in paper based

systems (Homan from Johns 2007, 42). Electronic results would, ―reduce lag time which would allow for quicker recognition and treatment of medical problems, the automated display of previous test results makes it possible to reduce redundant and additional testing, and allow for better interpretation and for easier detection of abnormalities" (Gartee 2007,3). Results review functionality should include: 1) ability to trend and graph a series of results, 2) flagging results that require further action 3) ability to electronically acknowledge and sign results 4) reporting of results for copying and pasting to email and printing to paper and 5) customizing results to meet own personal workflow (Cater 2008,176-177).

Order Entry/Management

Order Entry /Management refers to **Computerized Provider Order Entry (C.P.O.E.)** It includes electronic prescribing, laboratory, microbiology, pathology, x-ray, ancillary, nursing, supplies, and consults (Institute of Medicine-*Key Capabilities Report of an Electronic Health Record Report* 2003). Computerized Provider Order Entry (C.P.O.E) is intended for use by physicians and other providers such as nurse practitioners, physician assistants, etc. ―It is the process by which providers enter orders directly, making them more accurate and legible, and receiving back any alerts or reminders that they would act on in real time and that would help reduce errors, particularly medication errors" (Amatayakul 2009,407). Studies have shown that C.P.O.E reminder systems improve immunization rates, preventive care, clinician adherence to practice guidelines and the thoroughness of patient histories. According to one source, ―C.P.O.E systems could likely prevent sixty-five percent of prescribing errors, largely by incorporating decision support features that educate doctors about medications" (Hoffman and Podgurski 2008 113-114). E.H.R system do this by integrating individual records with evidence based clinical decision support which helps provide best -practice guidelines (Hillested et al. 2005).

Furthermore, C.P.O.E could eliminate 200,000 adverse drug events and save about $1 billion per year if installed in all hospitals (Hillested et al. 2005, 1109). C.P.O.E may also save the physician time by not having to return phone calls about illegible refill orders or incomplete documentation (Amatayakul 2009). Paper-based patient data often results in health care professionals working from fragmented and incomplete medical histories (Miller 2005, 29). A significant amount of time is spent by health care professionals on trying to decipher illegible orders. C.P.O.E helps provide efficient care by reducing the time elapsed from physician order to patient care. It ultimately eliminates paper trail. In summary, C.P.O.E 1) allows providers to enter orders directly into the computer rather than on paper, 2) reduces the amount of time between the physician orders to patient care, 3) allows the majority of the patient record to be available anytime and anywhere and 4) reduces adverse drug interactions.

According to Carter (2008), even though C.P.O.E can be one of the greatest attributes of an E.H.R., it has failed to live up to expectations because of clinicians‘ unwillingness to embrace it. The main reason for resistance is the negative impact that CPOE has on physician time. For example, it takes order entry longer to order an individual test electronically compared to ordering it on paper (Carter 2008, 177). But, Carter (2008) mentions, the current E.H.R systems currently available today have worked hard to streamline order entry which makes order entries faster. Another barrier for C.P.O.E has been the high cost. Only 5 percent of hospitals use this technology (Jha et al. 2006). Almost everything in a hospital begins with a physician order. Therefore, changing the way physicians order will result in significant changes in the maintenance of medical records. In the end, the implementation of C.P.O.E in an E.H.R is really about how well a health care facility handles change and on their willingness to embrace it.

Decision Support

Decision support includes access to knowledge sources, drug alerts, other rule based alerts, reminders for preventive services, clinical guidelines and pathways, chronic disease management, clinician work list, incorporation of patient and/or family preferences, diagnostic decision support, use of epidemiologic data, and automated real time surveillance. Decision support such as **access to knowledge sources** which is domain knowledge and patient education. Also included in decision support are **drug alerts** such as drug dose defaults, drug dose checking, allergy checking, drug interaction checking, drug-lab checking, drug-condition checking and drug-diet checking. Decision support also includes other **rule based alerts** such significant lab trends or lab test because of a drug, **reminders** for preventive services, **clinical guidelines and pathways**[13] such as passive, context sensitive, and integrated. Also included in decision support is **chronic disease management, clinical work list** which incorporates patient and/or family preferences, diagnostic decision support, the **use of epidemiologic data,** and **automated real-time surveillance** which can detect adverse events[14] and near misses, detect disease outbreaks, and detect bioterrorism (Institute of Medicine-*Key Capabilities Report of an Electronic Health Record Report* 2003).

Clinical decision support provides access to knowledge sources such as medical literature, research studies, and drug knowledge bases. Decision support refers to the ability of E.H.R systems to store or quickly locate materials relevant to the findings of the current case (Gartee 2007, 443). Decision support provides help with prescribing drugs, access to evidence based guidelines or literature, and protocols that speed up the documentation process (Gartee

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13 Clinical guidelines can be defined as ~~a~~ means of ensuring that practice is evidence based. Guidelines play an integral role in delivering quality care in an efficient, consistent, and cost-effective manner." (Budnick from Miller,2005,67)

14 Adverse event is a patient staff, or visitor injury resulting in disability, misdiagnosis, or serious illness or death in which the adequacy of medical care is reasonably in question or patient, visitor, or staff dissatisfaction is of such multitude that it could raise the potential for a claim or jeopardize the public image of the organization. (Spath,2005,184)

2007, 7-8). Health care facilities can imbed links in their forms that when selected would provide needed and helpful information. The structured data entry tools in decision support also ensure complete and accurate recording information (Amatayakul and Lazarus, 2005, 6). ―Decision support is not about ‗artificial intelligence' replacing a physician with a computer", but about providing assistance/support when it is needed (Gartee, 2007, 7). ―Many clinicians are offended by the term ‗artificial intelligence' and believe the emphasis needs to be on using clinical expertise and scientific evidence to support clinical decision making with the aid of an E.H.R" (Amatayakul 2009, 410). Clinical guidelines are means of ensuring that clinical practices are evidence based. Clinicians understand the goals of protocols and how they impact the delivery of care. They do not devalue the clinicians' knowledge but rather give them more time care for patients (Budnik from Miller 2005, 67-68). Decision support is extremely important because, ―physicians in today's world are involved in a rapidly changing landscape of new knowledge and breakthroughs in medical research" (Grams 2009, 410). In other words, medicine is dynamic and always changing. Technology continues to advance at a rapid rate at which physicians need to keep up with.

Electronic Communication and Connectivity

Electronic Communication and Connectivity includes connectivity of **provider to provider, team coordination, patient to provider, medical devices and integrated medical record within and across settings** (Institute of Medicine-*Key Capabilities Report of an Electronic Health Record Report* 2003). Electronic communication among clinicians enhances safety and quality of care by allowing patients who have different providers coordinate their care plans. E-mail and Web messaging have been shown to be effective in facilitating communication both among providers and with patients (Gartee 2007, 3-5). ―Secure Web messaging, the

structured, encrypted communication via web browsers is an alternative to e-mail. User ID and password authentication for patients, providers, and staff protects privacy, controls access, and prevent spam" (Lidermann et al. from Miller, 2005, 88). Remote access along with e-mail, fax, and internet capability will increase utility of an E.H.R system. It can help conduct in depth analysis of data. Data repositories and warehouses have links to E.H.R systems and help to support patient care and data analysis (Carter 2008 365).

According to Liedermann, Sands, and Handley, seventy-four percent of Americans used the Internet to research medical information for self-help health care services. (Lidermann et al. from Miller, 2005, 85) E.H.R functions relevant to electronic patient-provider communication include: —trigger or respond to electronic communication between providers and patients with pertinent actions in the care process, identify and make available educational or support resources, enable the accessibility of reliable information about wellness, disease management, treatments, etc., provide patient with self-management for a condition, capture patient-originated data, and patient access management" (Liedermann et al. from Miller, 2005, 86). A number of studies have shown that patient-provider e-communication has a positive effect on patient satisfaction. Online patient appointment scheduling has had reductions in no-show rates. Uploading of data by chronic disease patients to PHRs (Patient Health Records), has shown that smoking cessation has doubled, weight loss by obese patients more than doubled, and so forth (Liedermann et al. from Miller, 2005, 88)

Patient Support

Patient support includes patient education, family and informal caregiver education, and data entered by patient, and family and/or informal caregiver. Patient support such as **patient education** includes access to patient education materials, custom, patient education, and

tracking. Patient support in the form of **data entered by patient, family, and/or informal caregiver** includes home monitoring and questionnaires (Institute of Medicine-*Key Capabilities Report of an Electronic Health Record Report* 2003). Physicians and other health care professionals are obligated to inform patients about their health status, tests and procedures, methods for primary prevention of disease and medical therapy. "Effective, high quality of care and patient encouragement is often dependent on the patient being well informed about their health status, medical conditions, and medications." E.H.Rs can automatically generate handouts, letters reports, reminders and sources of important information which can improve quality and patient satisfaction (Carter, 2008 151-152).

Provider education, provider feedback, provider reminders, patient education, patient reminders, and patient financial incentives are associated with improvements in provider adherence to guidelines and improving chronic illnesses (Weingarten et al. 2002, 928). Computer based patient education is found successful in primary care (Balas et al. 1996). Several studies also indicated that home monitoring is improved by adding patient support (Finklestein et al. 2000). There is also evidence that computerized approaches to patient education leads to improvements in patient knowledge and leads to better health outcomes (Carter 2008, 187-188).

Administrative Processes

Administrative processes include scheduling management and eligibility determination. Administrative processes such as **scheduling management** are appointments, admissions, surgery/procedure schedule. **Eligibility determination** includes insurance eligibility, clinical trial recruitment, drug recall, and chronic disease management (Institute of Medicine-*Key Capabilities Report of an Electronic Health Record Report* 2003). According to the Certification

Commission for Healthcare Technology (CCHIT)[15] eligibility verification and determination coverage, ―shall provide the ability to display medical eligibility obtained from a patient's insurance carrier, populated either through data entry in the system itself or through an external application interoperating with the system" (Eichenwald-Maki and Petterson 2008, 73). Scheduling management can be primary scheduling such as the need to schedule patients for new or follow-up visits or secondary scheduling which is scheduling needs for patients who will have tests or procedures in other settings or patients being referred to a colleague (Carter 2008, 146). According to Carter (2008) it can be difficult to effectively manage the availability of clinicians because of the lack of access to the office schedules of other colleagues or other departments. An effective and efficient E.H.R system can help improve the scheduling process by better managing visits or procedures. Scheduling patients is done in conjunction with gathering patient demographic and financial information and accessing the MPI[16] (Master Patient Index). Also, for scheduling software to operate efficiently, some key information must be stored in it for use each time a scheduling activity is initiated (Eichenwald-Maki and Petterson 2008, 73). According to the Certification Commission for Healthcare Information Technology, a scheduling system shall, ―provide the ability to display a schedule of patient appointments, populated either through data entry in the system itself or through an external application interoperating with the system" (Eichenwald-Maki and Petterson 2008, 75).

Eligibility determination includes communication and content standards that are important in the billing and claims management area. ―Electronic authorization and prior approvals can eliminate delays and confusion; immediate validation of insurance eligibility

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[15] An independent ,nonprofit organization formed to establish functional, interoperability and security critieria and to certify E.H.R products as meeting those criteria (Eichenwald-Maki and Petterson,2008,6).

16 MPI is a database of patients within a facility or associated group of facilities. Whether in paper or electronic format, it tracks patient activity across customer-care settings. The MPI identifies all patients who have been treated in a facility and lists the health records or identification numbers associated with the names. (Odom-Wesley, Brown, and Meyer, 2009,78)

results in more timely payments and less paperwork" (Gartee 2007, 4). Some scheduling systems prompt staff to initiate a benefits eligibility inquiry (Amatayakul 2009, 425). Most of the billing process occurs after the patient visit, when diagnostic and procedural codes and service charges are added to the claim. Interoperability CCHIT criteria includes: "Query and receive electronic medical insurance eligibility information, send a query to coordinate patient identification, receive patient registration data from a practice management system, and receive electronic authorization for referral from payer" (Eichenwald-Maki and Petterson 2008, 73).

Reporting and Population Health Management

Reporting and population management includes patient safety and quality reporting, public health reporting coordination, reporting done patient to provider, medical devices, and integrated medical record information within and across settings. Reporting and population health management in **patient safety and quality reporting** includes clinical dashboards, and external accountability reporting, **public health reporting** such as reportable diseases and immunization, **deidentifying** data and **disease registries** (Institute of Medicine-*Key Capabilities Report of an Electronic Health Record Report* 2003). Population based care come from the need to aggregate patient data. "In order for a system to provide useful data analysis and reporting capabilities, it must be designed with certain features." Those features include a database that stores discrete, coded data items (Carter 2008, 366). Public and private sector reporting requirements are at the state, federal, and local levels for patient safety and quality, as well as for public health. Having computerized data in an E.H.R eliminates the labor intensive time it takes to abstract data from paper records. There would be fewer errors in reporting of quality indicators[17] for internal quality improvement and public health surveillance. Also, timely

17 An example of quality indicators are Core Measures which are measures used to assess the quality management efforts of health care organizations. For accreditation purposes, core measures are grouped into measure sets,

reporting of adverse reactions and disease outbreaks would also be improved. (Gartee 2007, 4)

Disease registries help identify geographic areas where diseases are found, effective treatments, life spans of those with the disease, conditions under which the disease occurs and so forth. Registries can include Cancer and Tumor registries. Contagious diseases such as tuberculosis and sexually transmitted diseases are required to be reported to certain federal and state agencies (Eichenwald-Maki and Petterson 2008, 175). New initiatives to address public health such as Homeland Security are included in disease management. ―International travel has brought new conditions of never experienced illnesses and introduced biologicals into countries‘ water supply and food sources that are not native and spread disease" (Amatayakul and Cohen 2004, 156). E.H.R software built in with features that recognize such data is extremely vital for public health.

Health Insurance Portability Accountability Act (HIPAA)

The Health Insurance Portability Accountability Act (HIPAA), a federal statute that was enacted in 1996 and amended in 2003, establishes a consistent set of privacy, and security rules that are designed to protect the privacy of patients, while at the same time simplifying the sharing of health information for legitimate purposes (Odom-Wesley et al. 2009). The patient medical record includes some of the most ―sensitive, private and intimate information about an individual's life" (Carter 2008, 295). Health information can be protected through a security program in an E.H.R that provides administrative[18], technical[19], and physical[20] controls.

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which may include clinical performance, client perception of care, health status, and administrative or financial measures (Odom-Wesley et al. 2009,475)

[18] Administrative safeguards involve assigning responsibility for security management, establishing security training, and developing policies and procedures to guide the security-related behavior of the organization‘s human resources (Maki and Petterson,2008,38).

[19] Technical safeguards are the automated processes th at limit who is able to access the E.H.R system and what they are able to do within the system. Encryption of data when it is stored and/or transmitted is also an aspect of

Administrative controls include security review and audit trails. Technical controls include fixed passwords, dynamic passwords, encryption, detection and intrusion systems, and so forth. Physical controls include the use of locks, badges, and alarms to control access. HIPAA provides provisions that are the basis for national privacy and security standards (Carter 2008, 313). The infrastructure of E.H.Rs should include capabilities that support HIPAA compliance. Documentation needs to include a process for authenticating the individual. The use of unique identifiers and passwords is inherent in the infrastructure (Amatayakul and Lazarus 2005).

The American Recovery and Reinvestment Act mandate that starting in 2015, physicians and hospitals that do not use certified products such as Electronic Health Records in a ―meaningful way" to be penalized. The stimulus act also incorporates rules changes for privacy which allows patients to request an "audit trail" showing all electronic disclosures of their health information and mandates that they be notified about any unauthorized disclosure or use. ―The American Recovery and Reinvestment Act extends protections to personally controlled electronic health data (such as those stored by Google Health, Microsoft Health Vault, and other online data repositories), as well as to companies that do work on behalf of health care providers, health plans, and health care clearinghouses (the entities covered under the Health Insurance Portability Accountability Act)"(Steinbrook 2009, 1059). ―The act also includes limits on the sale of an individual patient's health information or its unauthorized use in marketing or fund-raising, increases penalties for violations, and strengthens enforcement and oversight" (Steinbrook 2009, 1059).

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technical control (Eichenwald-Maki and Petterson,2008,38)

[20] Physical safeguards are mechanisms put into place that protects the equipment and data associated with the E.H.R system (Eichenwald- Maki and Petterson,2008,38).

American Recovery and Reinvestment Act (ARRA) and Health Information Technology for Economic and Clinical Health (HITECH) Act

The Presidential debates in 2008 had both candidates John McCain and Barack Obama mentioning the use of Electronic Health Records to reduce costs and errors in health care. On February 17, 2009, President Barack Obama signed into law a $787 billion economic stimulus package. President Barack Obama, included $19 million in incentives for the adoption of electronic medical records and Congress health care reforms include an investment of $50 billion to promote health information technology as part of the American Recovery and Reinvestment Act. (D'Avolio 2009 1109) ―Medicare physicians adopting and making _*meaningful use*‘ of EMRs in 2011 and 2012 will be eligible for an initial payment of up to $18, 000, with reduced subsequent payment amounts in 2013 and 2014. Those physicians who do not adopt EMRs by 2015 will face a reduction of 1% in their Medicare fee schedule, increasing to a 2% reduction in 2016 and a 3% reduction in 2017 and beyond”(D‘Avolio 2009, 1109). Congress and the Obama administration structured the Health Information Technology for Economic and Clinical Health Act (HITECH) so as to reward the meaningful use of qualified, certified EHRs which focus on the effective use of EHRs with certain capabilities, the HITECH Act makes clear that the adoption of records is not a sufficient purpose: it is the use of E.H.Rs to achieve health and efficiency goals that matters (Blumenthal 2009).

Outlined criteria for 2011 ―Meaningful use”[21] include:

- Capturing data in coded format;
- Documenting progress note for each encounter (outpatient only);
- Using CPOE for all order types (using e-prescribing and drug and allergy checks;

[21] To read more about ―Meaningful Use” guidelines, please refer to: Blumenthal, D. (2009). Launching HITECH. *New England Journal of Medicine.* Perspective. Also refer to: http://healthcarereform.nejm.org/?p=2669, and healthcareitnews.com/news/officials-outline-criteria-meaningful-use.

- Managing populations (generating list of patients by specific conditions and sending patient reminders):
- Engaging patients and their families in their health (providing access to personal health information, educational resources and encounters of clinical summaries);
- Improving care coordination (exchanging clinical info among providers and performing medication reconciliation);
- Improving Population and Public Health (submitting electronic data to immunization registries, electronic labs to public health agencies, and electronic syndrome surveillance data to public health agencies); and
- Complying with HIPAA Rules and state law, and with fair data sharing practices set forth in the National Privacy and Security Framework (Blumenthal, 2009).

Summary of Conceptual Framework

The following table lists the components of each of the categories and shows their linkage to the literature.

Table 2.1: Summary of Conceptual Framework Linked to the Literature:

Practical Ideal Type Category	Scholarly Support
Health Information and Data: • Should include key data using code sets • Should include narrative information • Should include patient acuity information • Should include capture of identifiers	• Institute of Medicine, Key Capabilities of an Electronic Health Record System Letter Report (2003) • Health Level Seven (2003) • Amatayakul (2009) • Roukema, et al (2006) • Bates, et al (1999) • Bates, et al (2003)
Results Management: • Should include results reporting • Should include results notification • Should include multiple views of data • Should include multimedia support	• Institute of Medicine, Key Capabilities of an Electronic Health Record System Letter Report (2003) • Health Level Seven (2003) • Amatayakul (2009) • Carter (2008) • Gartee (2007) • Johns (2007)
Order Entry/Management: • Should include computerized provider order entry (C.P.O.E)	• Institute of Medicine, Key Capabilities of an Electronic Health Record System Letter Report (2003), • Health Level Seven (2003) • Amatayakul (2009), • Hoffman and Podgurski, 2008, • Hillested et al, (2005) • Carter(2008) • Jha et al. (2006) • Miller (2005)

Table 2.1: Continued

Decision Support: • Should include access to knowledge sources • Should include drug alerts • Should include other rule based alerts • Should include reminders for preventive services • Should include clinical guidelines and pathways • Should include chronic disease management • Should include clinician work list • Should include incorporation of patient and/or family preferences • Should include diagnostic decision support • Should include use of epidemiologic data • Should include automated real-time surveillance	• Institute of Medicine, Key Capabilities of an Electronic Health Record System Letter Report (2003) • Health Level Seven (2003) • Amatayakul (2009) • Amatayakul and Lazarus (2005) • Carter (2008) • Gartee (2007) • Miller (2005) • Grams (2009)
Electronic Communication and Connectivity: • Should include provider-provider • Should include team coordination • Should include patient-provider • Should include medical devices • Should include integrated medical record within and across settings	• Institute of Medicine, Key Capabilities of an Electronic Health Record System Letter Report (2003) • Health Level Seven (2003) • Gartee (2007) • Carter (2008) • Miller (2005)
Patient Support: • Should include patient education • Should include family and informal caregiver education • Should include data entered by patient, family and/or informal care-giver	• Institute of Medicine, Key Capabilities of an Electronic Health Record System Letter Report (2003) • Health Level Seven (2003) • Carter (2008) • Weingarten et al, (2002) • Finklestein (2000)

Table 2.1:Continued

Administrative Processes: • Should include scheduling management • Should include eligibility determination	• Institute of Medicine, Key Capabilities of an Electronic Health Record System Letter Report (2003) • Health Level Seven (2003) • Eichenwald-Maki and Petterson, 2008 • Carter (2008) • Amatayakul (2009)
Reporting and Population Management: • Should include patient safety and quality reporting • Should include public health reporting • Should include deidentifying data • Should include disease registries	• Institute of Medicine, Key Capabilities of an Electronic Health Record System Letter Report (2003) • Health Level Seven (2003) • Carter (2008) • Gartee (2007) • Eichenwald-Maki and Petterson (2008) • Amatayakul and Cohen (2004)

Chapter Three: Methodology

Statement of Purpose

The purpose of this chapter is to describe the research methods used to assess the extent in which Central Texas Medical Center (CTMC) in San Marcos, Texas adheres to the elements of the ideal model for an Electronic Health Record (E.H.R) system used in hospitals. Structured interviews and direct observation will help assess the ideal model of an Electronic Health Record (E.H.R) system. Interviews were conducted with the Informatics/Education Manager and the Manager of Performance Improvement Department. Through operationalization of the conceptual framework, this chapter establishes a link between each of the practical ideal components and their respective research method(s).

Operationalization

―Conceptual frameworks act like maps that give coherence to expertise, and they are a critical missing link in successful student empirical research" (Shields and Tajalli 2006, 313). ―A practical Ideal Type/gauging is used to answer, ―How close is the process/policy to an ideal standard?" Also asked is, ―how can x be improved?" (Shields and Tajalli 2006, 318) A Practical Ideal type of Electronic Health Records (E.H.Rs) was constructed through a thorough review of the literature in order to develop an ideal model. An operationalization table is a useful way to achieve a detailed breakdown of the ideal components. It connects the conceptual framework to the identified research methods (Shields and Tajalli 2006). The table below summarizes the methodology utilized in this research and how it connects to the conceptual framework.

Table 3.1: Operationalization Table of an Ideal Model of an Electronic Health Record

Practical Ideal Type Category	Research Method	Questions	Sources
Health Information and Data: • Should include key data using code sets • Should include narrative information • Should include patient acuity information • Should include Capture of identifiers	Structured Interview	Does the E.H.R include: Q1) Key data such as problem lists, procedures, diagnosis, medication lists, allergies, demographics, diagnostic test results, radiology results, health maintenance, advance directives, dispositions, and level of service? Q2) Clinical and patient narrative information in free text; template based and derived structure from unstructured text? Q3) Patient acuity, which determines the severity of illness and risk adjustment needed for patient care? Q4) Capture of identifiers which list people and their roles, products/devices and places which include directions?	Education/ Informatics Manager, RN Performance Improvement Manager, CPHQ

Table 3.1: Continued

Results Management: • Should include results reporting • Should include results notification • Should include multiple views of data • Should include multimedia support	Structured Interview	Does the E.H.R include: Q1) Results reporting which lists laboratory, microbiology, pathology, and radiology reports and consults? Q2) Results notification, multiple views of data and presentation? Q3) Multimedia support of images, waveforms, and scanned documents?	Education/ Informatics Manager, RN Performance Improvement Manager, CPHQ
Order Entry/Management: • Should include Computerized provider order entry (C.P.O.E)	Structured Interview	Does the E.H.R include: Q1) **Computerized Provider Order Entry (CPOE)** for electronic prescribing, laboratory, microbiology, pathology, x-ray, ancillary, nursing, supplies, and consults?	Education/ Informatics Manager, RN Performance Improvement Manager, CPHQ

Table 3.1: Continued

Decision Support: • Should include access to knowledge sources • Should include drug alerts • Should include other rule based alerts • Should include reminders for preventive services • Should include clinical guidelines and pathways • Should include chronic disease management • Should include clinician work list • Should include incorporation of patient and/or family preferences • Should include diagnostic decision support • Should include use of epidemiologic data • Should include automated real-time surveillance	Structured Interview	Does the E.H.R include: Q1) Decision support which includes **access to knowledge sources** (domain knowledge and patient education)? Q2**) Drug alerts** such as drug dose defaults, drug dose checking, allergy checking, drug interaction checking, drug-lab checking, drug-condition checking and drug-diet checking? Q3) **Rule based alerts** such significant lab trends or lab test because of a drug? Q4) **Reminders** for preventive services? Q5) **Clinical guidelines and pathways** such as passive, context sensitive, and integrated? Q6) **Chronic disease management?** Q7) **Clinical work list?** Q8) Patient and/or family preferences? Q9) Diagnostic decision support? Q10) **Use of epidemiologic data, and automated real-time surveillance** which can detect adverse events and near misses, detect disease outbreaks, and detect bioterrorism?	Education/ Informatics Manager, RN Performance Improvement Manager, CPHQ

Table 3.1: Continued

Patient Support: • Should include patient education • Should include family and informal caregiver education • Should include data entered by patient, family and/or informal care-giver	Structured Interview	Does the E.H.R include: Q1**) Patient education** which can include access to patient education materials, custom patient education, and tracking? Q2) **Family and informal caregiver education?** Q3) **Data entered by patient, family, and/or informal caregiver** such as home monitoring and questionnaires?	Education/ Informatics Manager, RN Performance Improvement Manager, CPHQ
Administrative Processes: • Should include scheduling management • Should include eligibility determination	Structured Interview	Does the E.H.R include: Q1) **Scheduling management** such as appointments, admissions, surgery/procedure schedule? Q2) **Eligibility determination** such as insurance eligibility, clinical trial recruitment, drug recall, and chronic disease management?	Education/ Informatics Manager, RN Performance Improvement Manager, CPHQ

Table 3.1: Continued

Reporting and Population Management: • Should include patient safety and quality reporting • Should include public health reporting • Should include deidentifying data • Should include disease registries	Structured Interview	Does the E.H.R include: Q1) **Patient safety and quality reporting** such as clinical dashboards, and external accountability reporting? Q2) **Public health reporting** such as reportable diseases and immunization? Q3) **Deidentifying data**? Q4) **Disease registries**?	Education/ Informatics Manager, RN Performance Improvement Manager, CPHQ

Methods of Data Collection and Sampling

Structured interviews were conducted to assess the Electronic Health Record (E.H R) system at Central Texas Medical Center (C.T.M.C). Structured interviews allow for direct questioning of the E.H.R system used at C.T.M.C. The Performance Improvement manager and Education/Informatics manager have comprehensive knowledge of the hospital E.H.R system. The Performance Improvement manager is credentialed as a CPHQ (Certified Professional in Health Care Quality), is a Lean Six Sigma[22] (Black Belt), and is also the workflow[23] champion for the implementation of Computerized Provider Order Entry (C.P.O.E) which ―go live"[24] date was August 24, 2010. The other individual interviewed is a Registered Nurse (RN) who is in charge of the E.H.R system used at Central Texas Medical Center and manages training sessions for clinicians and staff using medical informatics at the hospital.

Strengths and Weaknesses of Structured Interviews

Structured interviews were the first techniques used for this research. The advantages for structured interviews in this research project are the fact that the interviewer had access to individuals who had expertise of Electronic Health Records and worked in the environment where the study is taking place. Yin (2009) explains that interviews are insightful because they provide perceived casual inferences. Also, ―well-informed interviewees can provide important insights into such affairs or events." (Yin 2009 108) Among the biggest weaknesses of the structured interview is reflexivity in the interviewee. At times the interviewee may give the

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[22] Six Sigma used in health care is an application of error prevention. Its goal is breakthrough knowledge leading to demonstrate process improvements. (Barry et al. 2002) Refer to:The Six Sigma for Healthcare, Improving Outcomes by Reducing Errors, (2002). Chicago: Health Administration Press for more information.

[23] Workflow refers to the sequence of steps and hand-offs taken within a process (Amatayakul 2009 172).

[24] ―Go live" is the act of turning over activities to the new system. (Amatayakul and Lazarus 2005 261).

interviewer what is wanted rather than what may be actually happening or be inaccurate due to poor recall (Yin 2009, 102). Another obstacle when conducting a structured interview is to avoid leading questions. The interviewer must carefully word questions so that the interviewer appears genuinely naïve about the topic, thus allowing the interviewee to provide a fresh commentary on the case at hand (Yin 2009, 107).

Strengths and Weaknesses of Direct Observation

The second research technique was direct observation. The major strength in direct observation is the fact that the researcher uses the E.H.R system at Central Texas Medical Center daily to audit and abstract medical record information for Core Measures/National Hospital Quality Measures (CM/NHQ). Another strength noted by Yin (2009 2) is that direct observations allow examination of real-life events and the ability to view them in a context-specific environment. Drawbacks of direct observation are that it can be time-consuming and for this particular study, the researcher is the only one making the observations.

Human Subjects Protection

This project involves interviewing employees of Central Texas Medical Center (C.T.M.C). Babbie (2007) states that the fundamental ethical rule of social research is that it must bring no harm to research subjects. Fortunately, there are no probable risks or discomforts to the subjects, as the subjects have voluntarily participated in the interview. At the outset of each interview subjects, participants were informed that they could stop the interview process at anytime. Furthermore, the interview did not pertain to sensitive, confidential, or personal information. Although the information obtained through the interview is not of a confidential nature, subjects will ***not*** be identified in this study by name, only by position and credentials. Any questions or concerns pertaining to the structured interviews should be directed to Crystal

M. Munoz. She can be contacted by email at crystalmunoz914@gmail.com. Additionally, this study received a formal exemption from the Texas State Institutional Review Board (IRB). The IRB exemption was submitted on June 24, 2010 and approved on June 29, 2010. Application number requested was EXP2010W7269.

Chapter Four: Results

Statement of Purpose

The purpose of this chapter is to discuss the data collected for this applied research project. Detailed results of the structured interviews are discussed and related to each practical ideal type category. The findings are used to assess the Electronic Health Record (E.H.R) used at Central Texas Medical Center (C.T.M.C) using practical ideal categories described earlier. The results of the interview are presented in this chapter.

Health Information and Data

Health Information and Data included in an Electronic Health Record (E.H.R) included key data such as problem lists, procedures, diagnosis, medication lists, allergies, demographics, diagnostic test results, radiology results, health maintenance, advanced directives, dispositions, and level of service. It also included clinical and patient narrative information in free text; template based and derived structure from unstructured text, patient acuity which determines the severity of illness and risk adjustment needed for patient care and capture of identifiers which lists people and their roles, products/devices and places which include directions. Most components were found in the system with the exception of advanced directives and patient acuity. Advanced directives are currently scanned to be included in the patient medical record but are not electronic. As for patient acuity, this component is only used in the Emergency Room (E.R) to help triage with their assessments. It is not currently available in any other departments. An important function of the E.H.R system at C.T.M.C is its capture of identifiers, which is called a P2 Sentinel Report. This function allows for monitoring of individuals viewing

patient medical records. It also tracks the duration of viewing which is especially helpful for HIPAA audits and audit trails.

Table 4:1 Results of Health Information and Data Category

Practical Ideal Type Category	Questions	Informatics/Education Manager and Performance Improvement Manager Responses
Health Information and Data: Should include key data using code sets Should include narrative information Should include patient acuity information Should include capture of identifiers	Does the E.H.R include: Q1) Key data such as problem lists, procedures, diagnosis, medication lists, allergies, demographics, diagnostic test results, radiology results, health maintenance, advance directives, dispositions, and level of service? Q2) Clinical and patient narrative information in free text; template based and derived structure from unstructured text? Q3) Patient acuity, which determines the severity of illness and risk adjustment needed for patient care Q4) Capture of identifiers which list people and their roles, products/devices and places which include directions?	**Problem lists-**Yes **Procedures-**Yes **Diagnosis**-Yes **Medication lists-**Yes **Allergies-**Yes **Demographics-**Yes **Diagnostic test results-**Yes **Radiology results-**Yes **Health maintenance-**Yes **advance directives-No, they are currently scanned into the E.H.R** **Dispositions-** Yes, it is under Case Management System **Level of service-**Yes **Clinical and patient narrative-** Yes **Information in free text-**Yes **Template based-**Yes **Derived structure from unstructured text-**Yes **Patient acuity-Found only in the Emergency Room (E.R) to help triage. It is *not* found in other departments.** **Capture of identifiers which lists people and their roles-** Yes, the P2 Sentinel report shows who has been in the record. It enables HIPAA audits, audit trails, and time spent looking at record **Products/devices-**Yes **Places which include directions-** Yes

Results Management

Results management is an Electronic Health Record (E.H.R) which included results reporting lists of laboratory, microbiology, pathology, and radiology reports and consults. Results management also included results notification of multiple views of data and presentation and multimedia support of images, waveforms and scanned documents. All elements in _results management' were found in the E.H.R system used at CTMC with the exception of waveforms which are soon to be implemented with Power Chart Maternity which would allow for fetal monitoring strips to be seen and accessed in the Electronic Health Record system.

Table 4:2: Results of Results Management Category

Practical Ideal Type Category	Questions	Informatics/Education Manager and Performance Improvement Manager Responses
Results Management: Should include results reporting Should include results notification Should include multiple views of data Should include multimedia support	Does the E.H.R include: Q1) Results reporting which lists laboratory, microbiology, pathology, and radiology reports and consults? Q2) Results notification, multiple views of data and presentation? Q3) Multimedia support of images, waveforms, and scanned documents?	**Laboratory-**Yes **Microbiology-**Yes **Pathology-**Yes **Radiology reports-**Yes **Consults-**Yes **Results notification of multiple views of data and presentation-**Yes **Multimedia support of images-**Yes **Waveforms-No, waveforms are soon to be implemented with Power Chart Maternity (this would allow for fetal monitoring strips to be seen/accessed in the E.H.R)** **Scanned documents-**Yes

Order Entry/Management

Order Entry/Management is referred as Computerized Provider Order Entry (C.P.O.E) for electronic prescribing, laboratory, microbiology, pathology, x-ray, ancillary, nursing, supplies, and consults is found in the E.H.R system used at C.TM.C. The "go-live"[25] date for C.P.O.E at Central Texas Medical Center was Tuesday, August 24, 2010 at 7a.m. Before the implementation of C.P.O.E, there was limited ability in the Emergency Department for physicians to write non-medication orders in the E.H.R. C.T.M.C has joined less than 8% of hospitals in the United States using this very latest type of technology. Locally, C.T.M.C is the only hospital system in the region using a fully-integrated E.M.R and related technologies. (ctmc.org)

Table 4:3 Results of Order Entry/Management Category

Practical Ideal Type Category	Questions	Informatics/Education Manager and Performance Improvement Manager Responses
Order Entry/Management: Should include Computerized provider order entry (C.P.O.E)	Q1) Does the E.H.R include Computerized Provider Order Entry (CPOE) for electronic prescribing, laboratory, microbiology, pathology, x-ray, ancillary, nursing, supplies, and consults?	Computerized Provider Order Entry (CPOE) for: **Electronic prescribing-**Yes **Laboratory-**Yes **Microbiology-**Yes **Pathology-**Yes **X-ray-**Yes **Ancillary-**Yes **Nursing-**Yes **Supplies-**Yes **Consults-**Yes **"Go-Live" date for CPOE was August 24, 2010. Before the implementation there was limited ability in the Emergency Department for physicians to write non-medication orders in the E.H.R.**

[25] Go-live is the act of turning over activities to the new system (Amatayakul and Lazarus 2005, 261).

Decision Support

Decision support in an Electronic Health Record (E.H.R) includes access to knowledge sources (domain knowledge and patient education), drug alerts such as drug dose defaults, drug dose checking, allergy checking, drug interaction checking, drug-lab checking, drug-condition checking, and drug-diet checking. Also included are rule based alerts such as significant lab trends or lab test because of a drug, reminders for preventive services for patients, clinical guidelines and pathways such as passive, context sensitive, and integrated, chronic disease management, clinical work list, patient and/or family preferences, and the use of epidemiologic data, and automated real-time surveillance which can detect adverse events and nears misses, detect disease outbreaks, and detect bioterrorism. These tasks are accomplished by clinical alerts and reminders. ―Clinical decision support is a set of knowledge based tools that are fully integrated with both the clinician workflow components of an E.H.R and a repository of complete and accurate data" (Carter 2008, 182).

All the elements in decision support were included in the Electronic Health Record system used at C.T.M.C with the exception of the use of epidemiologic data and automated real-time surveillance which can detect adverse events and near misses, detect disease outbreaks, and detect bioterrorism, and reminders for preventive services for patients. Also excluded were chronic disease management and diagnostic decision support. Patient and family preferences are found in the Obstetrics assessments for patients. According to the Performance Improvement Manager and Informatics/ Education Manager who were interviewed, the system used at C.T.M.C is far from including the function epidemiologic data and automated real-time surveillance. Interestingly, the Performance Improvement Manager and Informatics/Education

Manager has stated access to knowledge sources (domain knowledge and patient education) has greatly improved the available evidence based literature with implementation of C.P.O.E

Table 4:4 Results of Decision Support Category

Practical Ideal Type Category	Questions	Informatics/Education Manager and Performance Improvement Manager Responses
Decision Support: Should include access to knowledge sources Should include drug alerts Should include other rule based alerts Should include reminders for preventive services Should include clinical guidelines and pathways Should include chronic disease management Should include clinician work list Should include incorporation of patient and/or family preferences Should include diagnostic decision support Should include use of epidemiologic data Should include automated real-time surveillance	Does the E.H.R include: Q1) Decision support which includes access to knowledge sources (domain knowledge and patient education)? Q2) Drug alerts such as drug dose defaults, drug dose checking, allergy checking, drug interaction checking, drug-lab checking, drug-condition checking and drug-diet checking? Q3) Rule based alerts such significant lab trends or lab test because of a drug? Q4) Reminders for preventive services? Q5) Clinical guidelines and pathways such as passive, context sensitive, and integrated? Q6) Chronic disease management? Q7) Clinical work list? Q8) Patient and/or family preferences? Q9) Diagnostic decision support? Q10) Use of epidemiologic data and automated real-time surveillance which can detect adverse events and near misses, detect disease outbreaks, and detect bioterrorism?	**Access to knowledge sources (domain knowledge and patient education)-**Yes, with the implementation of CPOE, evidence based literature has improved **Drug dose defaults-**Yes **Drug dose checking-**Yes **Allergy checking-**Yes **Drug interaction checking-**Yes **Drug-lab checking-**Yes **Drug-condition checking-**Yes **Drug-diet checking-**Yes **Significant lab trends-**Yes **Lab test because of a drug-**Yes **Reminders for preventive services-No** **Clinical guidelines and pathways such as passive-**Yes **Context sensitive-**Yes **Integrated-**Yes, these elements are found in Quality Consults**.** **Chronic disease management-No** Clinical Work list- Yes, called a Task List. **Patient and/or family preferences- Currently only found in Obstetrics (O.B) assessments of patients.** **Diagnostic decision support-No** **Use of epidemiologic data-No** **Automated real-time surveillance which can detect adverse events and near misses, detect disease outbreaks, and detect bioterrorism-No, this would be an ideal goal, but currently far from reaching this goal.**

Electronic Communication and Connectivity

Electronic Communication and Connectivity in an Electronic Health Record (E.H.R.) includes electronic communication and connectivity between provider to provider, team coordination, patient to provider, electronic communication and connectivity for medical devices and integrated medical record communication within and across settings. Electronic communication and connectivity between providers to provider (physician) is found in the system at C.T.M.C. Physicians are also able to query each other. Team coordination has improved with the implementation of C.P.O.E. Physicians are able to query pharmacists and members of the Health Information Management (H.I.M) department and vice versa. Physicians, pharmacists and the H.I.M department are currently the only members of the hospital care team that can participate in team coordination. Medical Devices communication and connectivity is included in the system used at C.T.M.C. An example are the Biomedical Device Interfaces (B.M.D.I) which is for the Intensive Care Unit (I.C.U) monitors, Emergency Room (E.R) monitors, Patient Acute Care Unit (PACU), Obstetrics (O.B.) and ACCUCHECK (blood glucose testing which is point of care testing). Patient to Provider communication and connectivity function, on the other hand, is not included in C.T.M.C system, although it would be an ideal feature according to the individuals interviewed. Also not included is a medical record system that is integrated across settings. All systems at C.T.M.C are currently able to communication with each other ***only within*** the hospital setting.

Table 4:5 Results of Electronic Communication and Connectivity

Practical Ideal Type Category	Questions	Informatics/Education Manager and Performance Improvement Manager Responses
Electronic Communication and Connectivity: Should include provider-provider Should include team coordination Should include patient-provider Should include medical Devices Should include integrated medical record within and across settings	Does the E.H.R include: Q1) Electronic Communication and Connectivity between provider-provider? Q2) Electronic Communication and Connectivity in Team coordination? Q3) Electronic Communication and Connectivity between Patients to Provider? Q4) Electronic Communication and Connectivity for Medical Devices? Q5) Electronic Communication and Connectivity in Integrated medical record within and across settings?	**Provider-Provider-**Yes, physicians can query each other. **Team coordination-** With the recent implementation of CPOE, physicians are able to query pharmacists and Health Information Management (H.I.M) department and vice versa. ** Physicians, pharmacists and H.I.M are the only members of hospital employees able to currently participate in team coordination. **Patient to Provider-No, this is an ideal goal for all E.H.Rs, but the system is not there yet.** **Medical Devices-** Yes, Biomedical Device Interfaces (B.M.D.I) which are for Intensive Care Unit (I.C.U) monitors, Emergency Room (E.R) monitors, Patient Acute Care Unit (PACU), Obstetrics (O.B.) and ACCUCHECK (blood glucose testing which is point of care testing). **Integrated medical record within and across settings-No, only within setting**

Patient Support

Patient support which included access to patient education materials, custom patient education, and tracking, family and informal caregiver education, data entered by patient, family, and/or informal caregiver, such as home monitoring and questionnaires, are all included functions in the E.H.R system used at C.T.M.C.

Table 4:6 Results of Patient Support Category

Practical Ideal Type Category	Questions	Informatics/Education Manager and Performance Improvement Manager Responses
Patient Support: • Should include patient education • Should include family and informal caregiver education • Should include data entered by patient, family and/or informal care-giver	Does the E.H.R include: Q1) Patient education which can include access to patient education materials, custom patient education, and tracking? Q2) Family and informal caregiver education? Q3) Data entered by patient, family, and/or informal caregiver such as home monitoring and questionnaires?	**Access to patient education materials-**Yes **Custom patient education, and tracking-**Yes **Family and informal caregiver education-**Yes, this is included in the Discharge instructions. **Data entered by patient, family, and/or informal caregiver such as home monitoring-**Yes **Questionnaires-**Yes

Administrative Processes

Administrative processes includes scheduling management such as appointments, admissions, surgery/procedure schedule and eligibility determination such as insurance eligibility, clinical trial recruitment, drug recall, and chronic disease management. Appointments, admissions, surgery/procedure schedules, which are included in scheduling management, were all found in the current system used at C.T.M.C. Eligibility determination

which includes insurance eligibility was found to be present in the E.H.R system, called Electronic Eligibility Management (E.E.M) but other functions such as clinical trial recruitment, drug recall and chronic disease management are not.

Table 4:7 Results of Administrative Processes Category

Practical Ideal Type Category	Questions	Informatics/Education Manager and Performance Improvement Manager Responses
Administrative Processes: • Should include scheduling management • Should include eligibility determination	Does the E.H.R include: Q1) Scheduling management such as appointments, admissions, surgery/procedure schedule? Q2) Eligibility determination such as insurance eligibility, clinical trial recruitment, drug recall, and chronic disease management?	**Appointments-Yes** **Admissions-**Yes **Surgery/procedure schedule-**Yes **Insurance eligibility-**Yes, system called Electronic Eligibility Management (E.E.M). **Clinical trial recruitment-No** **Drug recall-No** **Chronic disease management-No**

Reporting and Population Management

Reporting and Population Management includes patient safety and quality monitoring such as clinical dashboards and external accountability reporting. Also included in reporting and population management is public health reporting such as reportable diseases and immunization, deidentifying data, and disease registries. Patient safety and quality reporting and deidentifying data are both functions found in the current system used at C.T.M.C. Deidentifying data is used through Power Insight using Financial Identification Numbers (F.I.N), instead of using identifiable information/data such as patient names, social security numbers, date of birth, etc. Public health reporting is not currently found in the system. Not having this function available

requires the Infection Preventionist (Infection Control nurse) to manually abstract this information for reporting purposes. Disease registries are also not included in the system used at C.T.M.C. The Tumor Registry in the Health Information Management (H.I.M) department also currently abstracts data manually.

Table 5:7 Results of Reporting and Population Management Category

Practical Ideal Type Category	Questions	Informatics/Education Manager and Performance Improvement Manager Responses
Reporting and Population Management: • Should include patient safety and quality reporting • Should include public health reporting • Should include deidentifying data • Should include disease registries	Does the E.H.R include: Q1) Patient safety and quality reporting such as clinical dashboards, and external accountability reporting? Q2) Public health reporting such as reportable diseases and immunization? Q3) Deidentifying data? Q4) Disease registries?	**Clinical dashboards-Yes** **External accountability reporting-**Yes **Reportable diseases and immunization-No, but in the process of adding this in the near future. Infection Preventionist currently manually abstracts this information.** **Deidentifying data-**Yes, this is done through Power Insight, using Financial Identification Numbers (F.I.N) numbers, instead of using identifiable information such as patient names, social security numbers, date of birth, etc. **Disease registries- No, there is a Tumor registry in the Health Information Management (H.I.M) department. Abstraction of data is done manually.**

Chapter Five: Conclusion and Recommendations

Statement of Purpose

The purpose of this research is three-fold. The first purpose is to establish a practical ideal model of Electronic Health Records (E.H.Rs) used in hospitals by reviewing relevant scholarly literature. The second purpose is to assess the extent Central Texas Medical Center (CTMC) in San Marcos, Texas adheres to the elements of the ideal model. The final purpose is to provide recommendations for improving the current E.H.R system used at C.T.M.C. This chapter focuses on those recommendations.

Conclusion

For practical ideal-type research, the research purpose is to gauge ―what should be done" to improve an administrative process (Shields & Tajalli 2006 324). ―What should be done" refers to recommendations to improve the current Electronic Health Records (E.H.Rs) system used at Central Texas Medical Center (C.T.M.C) at San Marcos, Texas. The Practical Ideal Model for Electronic Health Records (E.H.Rs) based on the Institute of Medicine (I.O.M) report in 2003, include the following eight categories:

- Health Information and Data
- Results Management
- Order Entry/Management
- Decision Support
- Electronic Communication and Connectivity
- Patient Support
- Administrative Processes
- Reporting and Population Health Management

Health Information and Data

The majority of Health Information and Data components were found in the E.H.R system used at C.T.M.C. The two elements which were not completely included were advanced directives which are scanned to be included in the patient medical record and patient acuity which is only utilized in the Emergency Department to assist triage. With that being said, the E.H.R system used at C.T.M.C does meet the standards of having the essential components of Health Information and Data.

Results Management

The vast majority of Results Management components were found in the E.H.R system used at C.T.M.C. The only missing component was waveforms, which are soon to be implemented according to the individuals who were interviewed.

Order Entry/Management

Order Entry/Management which is Computerized Provider Order Entry (C.P.O.E) was implemented on Tuesday, August 24, 2010 at 7 a.m.

Decision Support

Decision support lacks three critical components which are reminders for preventive services, diagnostic decision support, chronic disease management epidemiologic data, and automated real time surveillance. Reminders for preventive services are essential because they can maximize the benefit of decision support mechanisms by automatically prompting the physician of important information needed for patient care. –Computer reminders and prompts improve patient practices in areas such as vaccinations, breast cancer screening, colorectal

screening, and cardiovascular risk reduction." (Gartee 2007, 3)

Electronic Communication and Connectivity

Electronic Communication and Connectivity in the E.H.R system used at C.T.M.C lacks two essential components, Patient to Provider communication and integrated medical record connectivity and communication across settings. Both individuals who were interviewed agreed that this would be an ideal goal, but the system is currently not there yet.

Patient Support

All the components of Patient Support were included in the E.H.R system used at C.T.M.C.

Administrative Processes

All components in scheduling management were found in the E.H.R system used at C.T.M.C. Eligibility determination did not include clinical trial recruitment, drug recall, and chronic disease management as components in the E.H.R system used at C.T.M.C. "E.H.R. data can be analyzed to identify patients potentially eligible for clinical trials, as well as candidates for chronic disease management programs and reporting tools in an E.H.R can support drug recalls" (Gartee 2007,4). Especially important is chronic disease management because diseases such as diabetes are expected increase in the coming years. According to the Centers for Disease Control and Prevention (CDC) 23.6 million people in the United States (7.8% of the total population) have diabetes, of these, 5.7 million have undiagnosed diabetes. Also, management of chronic diseases such as diabetes can be very costly. Total costs (direct and indirect) of diabetes is $174 billion, direct medical costs is $116 billion. Indirect costs that is related to

disability, work loss, premature death is $58 billion. People with diagnosed diabetes have medical expenditures that are about 2.3 times higher than medical expenditures for people without diabetes (Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion 2010).

Reporting and Population Management

Reporting and Population Management have two components missing which were public health reporting and disease registries. These two functions are currently manually abstracted. Gartee (2007,4) mentions having this data computerized can eliminate the ~~l~~abor intensive and time consuming abstraction of data from records and the errors that often occur in a manual process."

Recommendations

Recommendations for improving the E.H.R system at Central Texas Medical Center include the addition of the following components:

- Reminders for preventive services
- Epidemiologic data and real time surveillance
- Electronic Communication and Connectivity between Patient to Provider
- Integrated medical record communication and connectivity across settings
- Clinical trial recruitment
- Drug recall
- Chronic disease management
- Public health reporting
- Disease registries

Suggestions for future studies and limitations

Developing and ideal Electronic Health Record (E.H.R) is a work in progress as medicine and technology continue to be dynamic. The cutting edge medical technology of today will seem trivial in the future years to come. Other factors to take into consideration are the cost barriers for E.H.R implementation and the tailoring of an E.H.R system to meet the needs of a hospital or health care facility. Structured interviews and direct observation revealed the E.H.R system used at C.T.M.C met all or the majority of components for ***Health Information and Data***, ***Results Management, Order/Entry Management, and Patient Support.*** Functionalities that were missing included reminders for preventive services and epidemiologic data and automated real time surveillance in ***Decision Support***, patient to provider communication and medical record integration across settings in ***Electronic Communication and Connectivity,*** clinical trial, drug recall and chronic disease management in eligibility determination for ***Administrative Processes***, and public health reporting and disease registries for ***Reporting and Population Management.***

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Appendix

Health Information and Data

Does the E.H.R include key data such as problem lists, procedures, diagnosis, medication lists, allergies, demographics, diagnostic test results, radiology results, health maintenance, advance directives, dispositions, and level of service?

Does the E.H.R include clinical and patient narrative information in free text; template based and derived structure from unstructured text?

Does the E.H.R include patient acuity, which determines the severity of illness and risk adjustment needed for patient care?

Does the E.H.R include capture of identifiers which list people and their roles, products/devices and places which include directions?

Results Management

Does the E.H.R include results reporting which lists laboratory, microbiology, pathology, and radiology reports and consults?

Does the E.H.R include results notification, multiple views of data and presentation?

Does the E.H.R include multimedia support of images, waveforms, and scanned documents?

Order Entry/Management

Does the E.H.R include Computerized Provider Order Entry (CPOE) for electronic prescribing, laboratory, microbiology, pathology, x-ray, ancillary, nursing, supplies, and consults?

Decision Support

Does the E.H.R include decision support which includes access to knowledge sources (domain knowledge and patient education)?

Does the E.H.R include drug alerts such as drug dose defaults, drug dose checking, allergy checking, drug interaction checking, drug-lab checking, drug-condition checking and drug-diet checking?

Does the E.H.R include rule based alerts such significant lab trends or lab test because of a drug?

Does the E.H.R include reminders for preventive services?

Does the E.H.R include clinical guidelines and pathways such as passive, context sensitive, and integrated?

Does the E.H.R include chronic disease management?

Does the E.H.R include clinical work list?

Does the E.H.R include patient and/or family preferences?

Does the E.H.R include diagnostic decision support?

Does the E.H.R include use of epidemiologic data and automated real-time surveillance which can detect adverse events and near misses, detect disease outbreaks, and detect bioterrorism?

Electronic Communication and Connectivity

Does the E.H.R include electronic Communication and Connectivity between provider-provider?

Does the E.H.R include electronic Communication and Connectivity in Team coordination?

Does the E.H.R include electronic Communication and Connectivity between Patients to Provider?

Does the E.H.R include electronic Communication and Connectivity for Medical Devices?

Does the E.H.R include electronic Communication and Connectivity in Integrated medical record within and across settings?

Patient Support

Does the E.H.R include patient education which can include access to patient education materials, custom patient education, and tracking?

Does the E.H.R include family and informal caregiver education?

Does the E.H.R include data entered by patient, family, and/or informal caregiver such as home monitoring and questionnaires?

Administrative Processes

Does the E.H.R include scheduling management such as appointments, admissions, surgery/procedure schedule?

Does the E.H.R include eligibility determination such as insurance eligibility, clinical trial recruitment, drug recall, and chronic disease management?

Reporting and Population Management

Does the E.H.R include patient safety and quality reporting such as clinical dashboards, and external accountability reporting?

Does the E.H.R include public health reporting such as reportable diseases and immunization?

Does the E.H.R include deidentifying data?

Does the E.H.R include disease registries?