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The Path to Health Information Technology Adoption: How Far Have We Reached?

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HPM 699 Capstone

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Abstract

Health Information Technology (HIT) is an overarching framework that describes the management of health information across various computerized systems and the secure exchange between consumers, providers, government, and insurers. It has been viewed as a promising tool for improving the overall quality, safety and efficiency of the health delivery system (Chaudhry et al., 2006). This capstone examines the problem of urban rural divide in the process of Health IT adoption especially with regard to Electronic Health Records (EHRs). This paper also tracks the progress made during years 2009 to 2013 to the process of Electronic Health Record adoption in the United States.

This capstone contains a thorough literature review that assesses the background of the problem and various federal initiatives set up to increase adoption rates. Unique methods of obtaining the latest secondary data were used by this author, such as following numerous Health IT portals on social media like Twitter. In addition, secondary databases like NAMCS (National Ambulatory Medical Care Survey) were used to observe statistics related to office based physicians' adoption of Electronic Health Records. Articles published prior to 1999 were not considered in the literature review. Important comparisons related to barriers in adoption have been addressed with the help of attributes of Everett Rogers' theory of innovation adoption. Interesting case studies and environmental scans have been used to illustrate the concentrated efforts being performed in the direction of improving health information exchange and thereby reducing barriers to adoption. The results seem to indicate that the national overall adoption rates have increased significantly though an urban rural divide still persists. General EHR adoption in 2009 was 48.3% of office-based physicians. Latest figures as of 2012 put it at 71.8%. More than 130,000 primary care providers and 10,000 specialists have adopted Electronic Health Records as of 2012, due to concerted efforts of Regional Extension Centers and other federal initiatives. Further, a need has been observed, to make the curriculum of Health IT training programs more practical-oriented. The recommendations from this capstone may inform policy makers with better future decisions. This capstone would prove useful in generating an up-to-date knowledge base about the topic of Health IT adoption in the years from 2009-2013 and also generate increased awareness among EHR consultants to address the needs of community based physicians.

Introduction

Health Information Technology (HIT) is "the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision making"**(**ONCHIT, 2005). HIT, such as EHRs and electronic medical records, has the potential to improve the quality and safety of care received by patients (Amarasingham Ruban, et al., 2009; Blumenthal David, et al., 2006; Chaudhary, Basit et al., 2006). However, the adoption of EHRs, particularly those that meet the criteria of a fully functional system, has been slow among office-based physicians and also small rural hospitals (Hsiao, Chun-Ju, et al., 2009). Physicians in small practices provide care for the majority of Americans, and any national goal to improve EHR adoption rates should address the needs of these providers. Still, less than 2% of physicians in solo or two-physician (small) practices reported a fully functional EHR (availability of all 17 functionalities) and 5% reported a basic EHR system (<7% overall) compared with 13% of physicians from 11+ group (largest group) practices with a fully functional system and 26% with a basic system, 39% overall, in the year 2008 (Rao, Sowmya R., 2011**).** To encourage adoption, the Health Information Technology for Economic and Clinical Health (HITECH) Act was passed in 2009, authorizing up to $27 billion in total funding to support widespread adoption of EHRs by physicians and hospitals through incentive payments from Medicare and Medicaid programs (Blumenthal David et al., 2010)**.** The year 2011 was the first of the five-year incentive payment period. It is still too early to know the entire impact of the incentive payments on the diffusion of EHRs among physicians; however the results from this year and the trends in events starting from 2004 to 2009 might help policy makers make smarter future decisions. This capstone could provide an up-to-date knowledge about the topic of Health IT adoption over the years and also

generate increased awareness about the impact of various programs initiated by federal agencies, in the process of EHR adoption, on a nationwide basis. The nature of this capstone is a policy analysis resulting in possible implications for all concerned players in the healthcare marketplace.

Problem Statement

Rural/smaller practices have been lagging behind in the adoption of EHR/EMR technology.

Background (Literature Review)

Why Health IT is important

In the last decade, several reports attracted national attention to the quality of healthcare failures in the U.S. A report issued by the Institute of Medicine (IOM), titled "*To Err is Human*" (1999), focused on patient safety, proved to be an important trigger. It estimated that between 44,000 and 98,000 deaths from medical errors occurred annually in hospitals (Institute of Medicine, 2001, p. 1). Over half of these errors were deemed to be preventable and the report suggested that this would result not only in lives saved, but in an estimated financial saving of $17-$29 billion per year (Institute of Medicine, 2001, p. 1). Concluding that the know-how already exists to prevent many of these mistakes, the report set a minimum goal of 50 percent reduction in errors over five years, which at that point of time, was the year 2004. IOM released another report called, "*Crossing the Quality Chasm*", which emphatically stated that "between the care we have, and the care we should have, lies not just a gap but a chasm," and cited Health IT as a key tool toward bridging the span (Institute of Medicine, 2001, p. 1). RAND Corporation released a study in which researchers reviewed over 5,000 medical records, and concluded that patients received recommended care only 54.9% of the time. A root cause analysis was

performed, which revealed that many quality failures could easily be traced back to the inherent limitations of human information processing (Bates et al., 2003). Medical care had increasingly become extremely complex and it was completely unrealistic to expect even a remarkable team of doctors and support staff to be able to continuously provide high-quality care and also perform other allied duties (Adler-Milstein & Julia, 2010). Since anything related to healthcare is bound to have some political connotations, this author thought that the political decisions be discussed.

Early efforts to encourage HIT adoption

A host of federal actions created a climate that was conducive to EHR development and evaluation. In 2004, President Bush made an appeal for all Americans to have EHRs by 2014 and created the Office of the National Coordinator for Health Information Technology (ONCHIT) in the Office of Secretary of Health and Human Services (HHS). Soon, thereafter, the Secretary of HHS announced the establishment of the American Health Information Community (AHIC), a federally chartered commission for the purpose of providing input and recommendations to HHS on how to advance EHRs (Lobach, 2007; ONCHIT, 2005). To encourage adoption, the Health Information Technology for Economic and Clinical Health (HITECH) Act was passed in 2009, authorizing up to $27 billion in total funding to support widespread adoption of EHRs by physicians and hospitals through incentive payments from Medicare and Medicaid programs (Blumenthal, 2010).

Lack of HIT penetration in rural areas

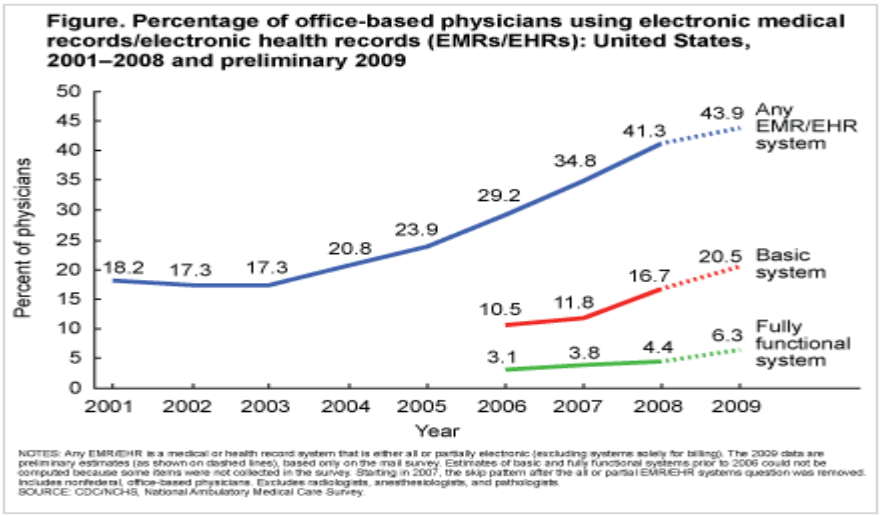
The 2005 American Hospital Association survey reported overall 2,009 (41%) of the 4,936 community hospitals are rural hospitals. Over half of these rural hospitals (1,279) had less than 25 beds and were designated as Critical Access Hospitals (CAH) that billed for services to

Medicare beneficiaries on a cost basis. Although 20%-25% of America's population resided in rural areas, there was a significant shortage of health care providers practicing close to rural residences, and major disparities existed between rural and urban settings including economic, cultural, social and educational differences (Bahensky, 2008).

Eric Poon conducted a study in 2006 which was instrumental in determining that adoption of EHR was slower than expected and that financial incentives were needed to boost its adoption. Poon et al. concluded that, despite the announcement in 2004 and the setting up of the Office of National Coordinator (ONCHIT), most nursing homes and rehabilitation hospitals still lagged behind significantly in EHR adoption. Also, small physician practices were highly risk-averse and perhaps fearful about the possibility of implementation failures and therefore less likely to deploy HIT (Ash J.S, 2004**).** Chart 1 depicts the trajectory of EMR/EHR uptake in physician practices in the time period of 2001 to 2009.

Chart 1

Percentage of office based physicians using EMRs/EHRs from 2001 to 2009.



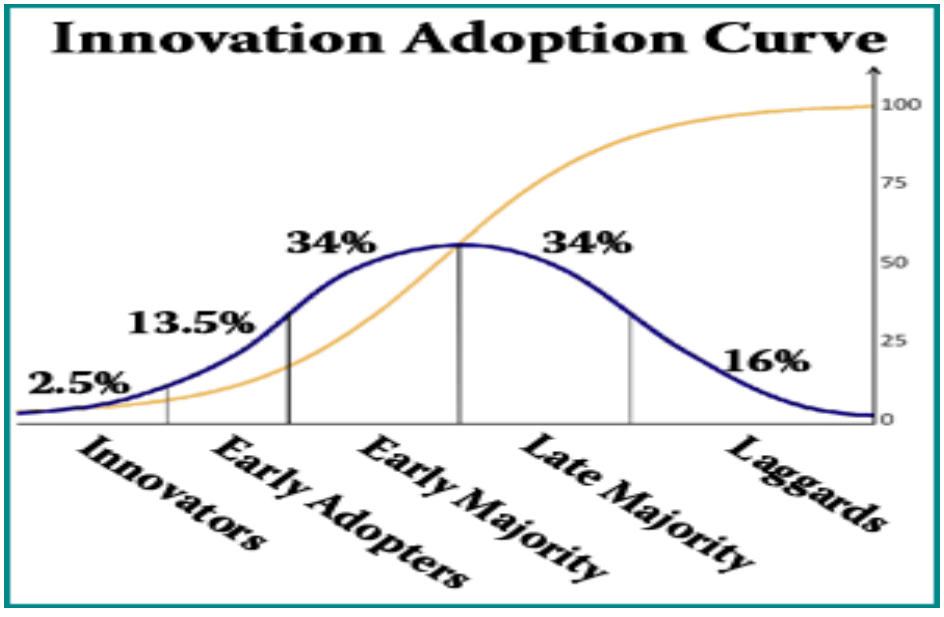
Note-The above graph is mainly for representational purposes indicating the trajectory of the curve from 2001 onwards. It has been adapted from (HIStalk Practice, 2010, p.3).

Barriers to Adoption

Rogers' theories of innovation diffusion

Rogers' diffusion of innovations theory may be the most appropriate to investigate the adoption of information technology in healthcare settings (Medlin, 2001; Parisot, 1995). According to Rogers, the initial process of adoption of a technology involves five steps: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation (Rogers 2003, p. 221). The rate of adoption was defined as "the relative speed with which an innovation is adopted by members of a social system" (Rogers 2003, p. 221). Rogers classifies the stages in the adoption curve as innovators, early adopters, early majority, late majority, and laggards. Since rural practices have been slow to adopt EHR technology, they may probably fall into the category of the laggards. Chart 2 depicts the stages in a typical adoption curve.

Chart 2 Innovation Adoption Curve



Note: Adapted from http://www.valuebasedmanagement.com

It is essential to note the barriers influencing the slow adoption in this particular scenario. Other factors influencing adoption of any innovation are noted as attributes of

innovations which included five characteristics of innovations: (1) relative advantage, (2) compatibility, (3) complexity (4) trial ability, and (5) observability. Rogers' states that "individuals'perceptions of these characteristics predict the rate of adoption of innovations" (Rogers, 2003, p. 219). "The degree to which an innovation is perceived as better than the idea it supersedes, by a certain group of users, measured in terms, like economic advantage, convenience, or satisfaction, is relative advantage (Rogers, 2003, p. 219)". Furthermore, Rogers' explains that if an innovation is "compatible" with an individual's needs, then uncertainty will decrease and the rate of adoption of the innovation will increase. The degree to which an innovation is perceived as difficult to comprehend and use is called as "complexity". "Trial ability" is described as "the degree to which an innovation may be experimented with on a limited basis" (Rogers, 2003, p. 16). The degree to which the results of an innovation are visible to others was called observability . A lack of compatibility in IT with individual needs was found to negatively affect the individual's IT use (McKenzie, 2001; Sherry, 1997). Hence, rural practices fall into the category of laggards due to issues related to trial ability, complexity, compatibility and observability to a certain extent. Based on the five attributes the barriers observed in the literature could be compiled as follows.

Table 1 Rogers' factors for Barriers to adoption vis-à-vis evidence based literature.

Attributes	Evidence from the literature
Relative advantage	Advantageous if going in for ACO, PCMH &MU, else may not be relevant to rural practices.
Compatibility	Physicians may not be familiar with new systems
Complexity	Difficulty in navigation of software for staff
Trialability	Rural physicians find it difficult to experiment with equipment due to paucity of resources.
Observability	Rural physicians may have issues for observing on site workings of equipment prior to decision making.

Note: Abbreviations: 1. ACO-Accountable Care Organization
2. PCMH-Patient Centered Medical Home
3. MU-Meaningful Use

In addition to the characteristics described above, Return on Investment (ROI) and Physician Patient Relationship are potential barriers which the various programs hope to address.

Return on Investment

A seminal study (Miller, Robert H., 2005) involving case studies of fourteen solo or small-group primary care practices using electronic health record (EHR) software from two vendors, revealed interesting results on the supposed financial impact of EHR which in turn paved the way for more research on productivity. “Initial EHR costs averaged $44,000 per full-time-equivalent (FTE) provider, and ongoing costs averaged $8,500 per provider per year. The average practice recovered its initial investment in 2.5 years and profited handsomely after that. However, some practices could not cover costs quickly, most providers spent more time at work initially, and some practices experienced substantial financial risks. These results led to the belief that policies should be designed to provide incentives and support services to help practices improve the quality of their care by using EHRs” (Miller et al., 2005).

Another published stakeholder analysis revealed the reactions of the different players in the market. It was evident that from the providers' perspective, the practices studied, achieved efficient quality improvement. They reduced inefficiencies in providing care and increased quality to some extent. From the same perspective, gains from higher coding levels rewarded providers' initial time costs and financial risk-taking for EHR implementation and corrected flaws in a reimbursement system that encouraged providers to code conservatively out of concern for "fraud and abuse" penalties. In contrast, from the payers' perspective, providers achieved inefficient Quality Improvement, as payers paid much more for very modest quality improvement gains (Miller et al., 2005). As of 2008, the evidence based barriers to implementing an EHR included lack of adequate funding and resources (75 percent). Some

other barriers were lack of knowledge of EHRs (35 percent), lack of support from medical staff (33 percent), lack of structured technology (28 percent), and lack of employee training (28 percent). Implementation and interpretation of the Health Insurance Portability and Accountability Act (HIPAA) and other privacy issues were also noted as barriers **(**Houser& Johnson , 2008). It would be interesting to correlate the barriers in the diffusion adoption theory and the ones observed in actual practices. The following paragraph describes the effect of EHR implementation on patient physician relationship. This is an important factor in the whole context of EHR adoption because it relates to physician compatibility with the new technology and patients' response to the new development in the office based practice.

Physician-Patient relationship

The three cross-sectional studies examined found either neutral (Rouf et al., Joos et al., 2006) or positive (Gadd , 2001) patient attitudes about physician EHR use during the outpatient visit, although these attitudes sometimes varied with the physician's level of experience. Gadd (2001) tried to determine whether EMR use had any negative impact on patient satisfaction by surveying 6 outpatient practices. Similarly Joos et al. (2006) used the physician's perception of patient satisfaction as their outcome. This study suggested that physicians perceive a decrease in patient satisfaction after EHR implementation (Joos et al., 2006). As physicians spent more time interacting with the computer for entering the data into Computerized Provider Order Entry (CPOE and EHR), some researchers expressed their concerns that providers may have less time to interact effectively with their patients (Rouf et al ., 2007). Specific fears in this regard included a loss of eye contact, less opportunity for psychosocial discussion, and decreased sensitivity to patient responses because of missed nonverbal communication cues (Irani et al., 2009).

An interesting ethnographic by study by Ventres and colleagues (2006) found that the introduction of EHRs into practice influences multiple cognitive and social dimensions of the clinical encounter. This study identified several factors that influence how EHRs are used and perceived in medical practice. These factors were categorized into four thematic domains: (1) spatial, relational, educational, and structural. An EMR system may empower physicians with the ability to complete information heavy tasks but can make it more difficult to focus attention on other aspects of patient communication (Patel et al., 2000). Several studies indicate disadvantages of EMR use such as altering the process of clinical reasoning, more workload on clinicians (Campbell et al., 2006), unfavorable changes in workflow analysis as well as new types of errors (Adler-Milstein, Julia, 2010). Kam (2012, July 30) noted that rapid electronic health record adoption could cause patient privacy issues since it is difficult to ascertain control over the modifying, accessing, and sharing of electronic data. A detailed literature review (Shachak, 2009) describes some positive impacts on patient provider communication. Physicians who used EMR, accomplished information related tasks such as checking and clarifying information, encouraging patients to ask questions and ensuring completeness at the end of visit, to a greater extent than physicians, who used paper records. Computer use was positively related to biomedical exchange, including questions about therapeutic regimen, patient education and counseling as well as patient disclosure of medical information to the physician (Shachak, 2009). Patients' satisfaction with physicians' familiarity with them, communication about medical issues and comprehensiveness of medical decisions increased after EMR implementation. The following section describes the various special initiatives undertaken by federal and state governments for speeding up adoption of HIT in rural areas.

Major Federal Efforts to encourage adoption of EHR

The Office of Rural Health Policy (ORHP) funded grantees through its Medicare Rural Hospital Flexibility (Flex) Critical Access Hospital (CAH) Health Information Technology (HIT) Network Implementation Program, which promotes the implementation of HIT in CAHs and their associated network of providers in States that are current Medicare Flex grantees. The grant program funded grantees to establish HIT systems, but allowed them to use these funds in a flexible way. Each grantee was at a different level of maturity when the program began, and the grant program allowed each to establish a new system or build upon an existing one. These grantees of the Flexibility Critical Access Hospital Health Information Technology Network Implementation Program reported having widely varied governance structures, within which real and perceived challenges existed. While many reported experience working with smaller CAHs in an existing collaborative, some found the addition of larger hospitals or health systems to their networks to be problematic (U.S. Department of Health and Human Services Health Resources and Services Administration, 2010). During the evaluation, grantees emphasized several grant administration challenges they had experienced, including, the limited timeframe given to complete the project, governance issues, unclear evaluation expectations, and issues concerning sustainability of the grant (U.S. Department of Health and Human Services Health Resources and Services Administration, 2010). An NHIN Work Group (Nationwide Health Information Network) was formed to offer recommendations regarding a policy and technical framework that allows the Internet to be used for the secure and standards-based exchange of health information, in a way that is open to all and fosters innovation (healthit.gov., 2010). The State-level Health Information Exchange Consensus Project is managed through a contract with American Health Information Management Association's Foundation of Research and Education. The project's

main objective is to provide a solid platform for ONCHIT to work with states to ensure all health information exchange activities throughout the Unites States align (healthit.gov, 2010). HHS and USDA signed a Memorandum of Understanding (MOU) linking rural hospitals and clinicians to existing capital loan programs that enable them to purchase software and hardware needed to implement health IT (healthit.gov, 2011).

ONC provided nearly $20 million in additional funding to 46 of the 62 Regional Extension Centers (RECs) to help critical access and rural hospitals convert from paper-based records to certified EHR systems. An additional $12 million supplemental funding was released in February 2011, for RECs to assist critical access and rural hospitals to adopt EHRs (Blumenthal, 2011). ONC's Health IT Workforce Development Program is also in place to train skilled professionals in the field of health IT to enable them to help providers adopt and meaningfully use EHRs. This includes training for health workers now employed in rural practices and facilities, with broad opportunities for distance learning (Blumenthal, 2011).

The Beacon Community Cooperative Agreement Program demonstrates how health IT investments and Meaningful Use of electronic health records (EHR) advance the vision of patient-centered care, while achieving the three-part aim of better health, better care at lower cost (healthit.gov, 2011). Strategic Healthcare IT Advanced Research Projects will be translated into patient-centered health IT products and services to create fundamental improvements along critical areas toward a high-performing, learning health care system (healthit.gov, 2011).

The Road Ahead

While some naysayers urged the government to adopt a wait and watch approach to make any further substantial investment in HIT unless there was significant evidence

regarding its benefits (Groopman, Hartzband, 2009), certain advocates felt that such investment was long overdue and that there was a critical role for government intervention (Blumenthal, 2009). This capstone looks into the data from 2009; after the HITECH Act was passed. There is a need to examine the impact of Health IT adoption acceleration measures.

Capstone Activities

Objectives

1. To develop a list of programs that address the various potential barriers to Electronic health record adoption based on evidence from literature and compares it to the theoretical barriers addressed. It is also essential to examine the ways in which various programs have possibly interacted in helping increase Electronic Health Record adoption.
2. To examine whether rural and small practices are catching up in the adoption curve with urban counter parts in order to bridge the disparity in adoption.
3. To explore, what initiatives the Beacon Community programs, State Health Information Exchange Cooperative Agreement Program , U.S. Department of Health and Human Services' (HHS), Rural Health Information Technology (Health IT) Task Force and Strategic Health IT Advanced Research Projects (SHARP) Program and Health Information Technology Extension Program are implementing, to increase adoption rates overall especially in rural areas.
4. An analysis on when these programs were implemented, what effects have been observed so far, and what the future may hold in terms of impact on adoption rates or simply mitigating any specific barriers.

Methods for data collection

The methods for data collection include doing a literature review using the broad databases such as PUBMED,MEDLINE, GOOGLE SCHOLAR. The period of consideration for this project is approximately 2000-2012. Other secondary data will be referenced through news - letters, press releases and documents through prominent HIT websites of organizations like HIMSS, ONC etc. Search results are limited to papers in English, published in the past 10 years. This timeframe has been chosen for two reasons. First, widespread implementation of EMRs started in the mid-1990s. There are limited number of studies on the use and impact of EMRs prior to that time. Second, the technology itself rapidly develops. Therefore, findings from old studies may not be relevant today. The cut-off of 10 years reflects a balance between the need to include as many papers as possible in this review and maintaining relevance for the present technology. After screening the various papers, web sites, press releases publications and abstracts, the following inclusion criteria have been selected for the final analysis: empirical investigations (quantitative or qualitative), direct assessment of the EMR impact on patient–doctor communication, rural urban divide in adoption of EHR technology and extent of dissemination of Health IT in rural areas. A unique method of using social networking media for tracking Health IT related updates and press releases via twitter will also be adopted for further analysis. This would include Healthcare IT focused twitter feeds of portals like EHR WATCH, NHIN WATCH etc. This author will also include findings from the NAMCS database.

Key words used in literature search include Health IT, EHR, EMR, ONCHIT, patient satisfaction, rural–urban HIT adoption, HIMSS, etc.

Capstone Activities

Table 2 presents a broad view of allocation of funding for some of the Health IT, Quality Improvement and Security Related Projects by Federal Government**.**

Table 2: Planned HITECH Obligations for Fiscal Years 2009-2014

Program Name	**Obligation Amount(Dollars in Millions)**
Beacon Community Program	265
Health IT Workforce Program	118
Health IT Regional Extension Centers Program	774
Transter to National Institutes for Standards and Technology	21
Other Omnibus Initiatives	204
Privacy and Security: Enforcement	17
Privacy and Security: Regulations, Guidelines and Studies	8
Transfer to CDC	31
State Health Information Exchange Program	564

Note: Adapted from http://dashboard.healthit.gov/onc/ last updated on 01/2013.

The following programs, which have been contributed to EHR adoption, have been described in this capstone.

1. Beacon Community Program
2. ONC's Standards & Interoperability Framework
3. ONC Certified Health IT Products List
4. CMS Medicare and Medicaid EHR Incentive Payment Programs
5. HRSA Office of Rural Health Policy (ORHP)
6. Flex CAH HIT Network Implementation Grant
7. USDA and HHS Agreement
8. State Health Information Exchange Cooperative Agreement Program
9. Regional Extension Centers

10. Strategic Health IT Advanced Research Projects
11. Community College Consortia to Educate Health IT professionals.

(1)Beacon Community Program

Program Description

Beacon Community Cooperative Agreement Program has indeed effectively demonstrated, how health IT investments and Meaningful Use of electronic health records (EHR) advance the vision of patient-centered care, while achieving the three-part aim of better health, better care at lower cost. Each year, beginning with 2009, the HHS Office of the National Coordinator for Health IT (ONC) is providing $250 million over three years to specific 17 selected communities throughout the United States that have already made inroads in the development of secure, private, and accurate systems of EHR adoption and health information exchange (healthit.gov, 2011).

Measures Implemented

Beacon Community has been leading a strong foundation and thus strengthening the health IT infrastructure and exchange capabilities within several communities both urban and rural, positioning each community to pursue a new level of sustainable quality and efficiency over the period from 2009 - 2013. This would effectively strengthen the process of health information exchange (healthit.gov, 2011).

Steps toward Accomplishment of Goal by Beacon Community Programs and Program Initiatives

1. Highlighted critical issues to state policy makers and aligned major initiatives at a Policy Roundtable in September 2011.

2. Prioritized the needs of safety net providers and procured funding of $100,000 to each FQHC in a Beacon catchment area in September 2011.
3. Conducted community level pilots to demonstrate initial improvement results using Medicare data.
4. Established a small work group consisting of 6 vendors to develop a standard clinical care document that can be automatically exported to a Health Information Exchange in 2012.
5. Roll out of program over 17 Beacon Communities.

Potential Barriers Addressed

Privacy issues like breaches of personal health information and use of this information for non-medical purposes like marketing and lack of finance. This also addresses the issue of patient privacy which was discussed briefly previously under "Physician Patient Relationship".

Theoretical Barriers Attempted to address based on Everett Rogers' Assumption.

Interoperability issues with relation to compatibility & complexity with exchange of sensitive information across portals.

Example of Bangor Beacon Community

Bangor Beacon Community received a three year federal grant for $12.75 million from the Office of the National Coordinator for Health Information Technology. Maine already has a Health Information Exchange, Health Info Net, which provides access to critical patient-care data such as prescriptions, problems, lab results, and allergies for 80 percent of the hospital stays in Maine. This has helped Bangor Beacon Community in improving patient safety, enhanced quality of clinical care, increased clinical and administrative efficiency. They accomplished this through extending access to health information data in a secure manner (healthit.gov, 2012).

Overall Impact of Beacon Community

In FY 2011, there were 5,678 health care providers participating in Beacon Communities interventions on a community specific level nationally. Fourteen of the seventeen Beacon Communities are already reporting improvements in at least two clinical care measures associated with the health IT interventions being implemented within their communities such as diabetes screening and colorectal cancer screening (healthit.gov, 2012).

(2)ONC's Standards & Interoperability Framework

Program Description

This framework was established to help EHRs realize their full potential and aid in the process of information sharing. Creating a structural framework, to generate uninterruptible seamless exchange of health information in a safe and secure manner, is the goal of ONCHIT's Standards & Interoperability (S&I) Framework. ONCHIT is working to build EHR interoperability, independent of the location of the system or the patient or provider. ONCHIT encourages the development of health IT standards across both urban and rural areas with a focus on rural areas.

Measures

Through the S&I Framework, ONC seeks opinion from the health IT community on what interoperability challenges should be prioritized and then provides a common platform for solving commonly occurring problems through discussions, thereby generating a database with respective solutions. Since its inception in early 2011, over 1300 people have registered on the S&I Framework "wiki".

Impact

Over 500 people have participated in more than 800 working sessions since 2011. Prior to the S&I Framework, standards development typically took anywhere from 18-36 months; this process has been significantly shortened to 9-18 months with the S&I Framework (healthit.gov, 2012).

Evidence Based Barriers Addressed

Evidence based barriers addressed are interoperability challenges and lack of communication among stake holders.

Theoretical Barriers Attempted to address based on Everett Rogers' Assumption

Complexity experienced in terms of interfacing between different platforms.

(3)ONC Certified Health IT Products List

Initiative

Through this program, ONCHIT has implemented a regulatory and technical framework that will protect and standardize health information exchange and promote the interoperability of EHRs.

Impact

This program led to the development of the Certified Health IT Products List (CHPL). As of June 2012, there were 2,268 certified EHR products from some 798 EHR vendors or developers. Of the 2,268 products listed in the CHPL, 1,501 were for unique products (healthit.gov, 2012, p.7).

(4)CMS Medicare and Medicaid EHR Incentive Payment Programs

Program Description

The Medicare and Medicaid EHR Incentive Programs provide incentive payments to eligible professionals, eligible hospitals and critical access hospitals (CAHs) for the purpose of meaningfully adopting and demonstrating use of certified EHR technology. "Eligible professionals can receive up to $44,000 through the Medicare EHR Incentive Program and up to $63,750 through the Medicaid EHR Incentive Program" **(**Healthit.gov, 2013**).**

Evidence Based Barriers Addressed

The evidence based barrier tackled in this case is lack of financial support.

Theoretical Barriers Attempted to address based on Everett Rogers' Assumption

Relative Advantage was addressed by making funding transparent and effective based on eligibility of professionals.

Impact

As of July 2012, program enrollment data indicates over 270,000 providers had begun participating in the EHR Incentive Programs, including over 267,000 eligible professionals and 3,884 eligible hospitals**.** Furthermore, more than $6.5 billion in financial incentives has been distributed to over 120,000 health care providers (ONCHIT, 2012, p. 5).

(5)HRSA Office of Rural Health Policy (ORHP)

Program Initiatives

5a.Rural Health IT Adoption Toolkit

The toolbox focuses specifically on rural health providers and contains a range of resources relevant to the various stages of considering, planning, executing, and evaluating the

implementation of health IT in rural settings. The most direct financial impact to rural providers will likely come from the newly authorized payments for eligible professionals and hospitals participating in Medicare and Medicaid as an incentive to becoming meaningful users of certified EHRs. Non-hospital-based providers and hospitals that implement EHR systems were eligible to receive payments for health IT adoption beginning in 2011. Rural health providers are eligible for a 10 percent increase in these payment amounts (HRSA, 2012).

(5b)Rural Health Information Technology Network Development Program

The purpose of the RHITND Program is to enhance health care delivery in rural America through supporting rural health networks in the adoption and meaningful use of electronic health records/electronic medical records (EHR/EMR). It is anticipated that this will be a one-time funding opportunity to assist networks in achieving EHR/EMR meaningful use requirements by 2014. Activities supported by RHITND grant funds include: workflow analysis, EHR/EMR strategic plan development, EHR/EMR training, purchase of HIT equipment, to identify and locate certified HIT equipment vendors and installation of broadband. This program is a three-year grant program with individual grant awards limited to a maximum of $300,000 per year (hrsa, 2012).

Evidence based barriers addressed

Evidence based barriers addressed include lack of trained staff, lack of finance, and lack of internet connectivity in rural areas.

Theoretical Barriers Attempted to address based on Everett Rogers' Assumption

Observability issue was addressed by training staff and making them visit nearby implemented systems. Trial ability was addressed by giving a certain leeway in experimenting and handling of functions in order to get used to them.

(5c)Rural Health Network Development Program

Program Description

The main purpose of this program is expanding access to, coordinating, and improving the quality of essential health care services, besides enhancing the delivery of health care, in rural areas. The primary motive of this program is to aid health networks in developing and maintaining sustainability of networks with efficient self-generating income streams (hrsa.gov, 2012). This program aims to integrate administrative, clinical, technological, and financial functions thereby creating a comprehensive model. This program is a three year grant program with individual grant awards limited to a maximum of $180,000 per year. The estimated project start date is 05/01/2011 to 04/30/2014 (hrsa.gov, 2012).

Impact

This program was instrumental in achieving economies of scale and cost efficiencies of certain administrative functions such as billing and collections, claims management, information management systems integration, shared staffing and purchasing. It has also contributed in increasing the financial viability of network members, sharing of staff and expertise across network members through enhancing retention efforts and new workforce recruitment.

Evidence Based Barriers Addressed

Evidence based barriers addressed include lack of finance based on investment in access to new technology and lack of trained staff.

Theoretical Barriers Attempted to address based on Everett Rogers' Assumption

They include compatibility with respect to claims management and workforce retention and observability based on job shadowing and shared staffing.

(6)Flex CAH HIT Network Implementation Grant

Program Initiatives

Flex CAH HIT Network Implementation Grant was instituted to ensure that clinical information of patients served by the CAH HIT network is accessible to providers across the continuum of care thereby ensuring that health information exchange is uninterrupted. This would enhance adoption of Health IT by addressing barriers in interoperability (Swamy, 2009).

Measures

1. Provide concentrated funding within smaller service areas to support the development of sustainable pilot projects.
2. Encouraging the development of rural-centric health networks.
3. Offering grants to States to implement a CAH program to support rural health care infrastructure. This would also help rural providers for implementation of a robust network with CAHs in the area.
4. Grant requirements and deadline: Identifying up to 3 CAHs and their associated network of providers that together provide a continuum of care for rural residents in their particular service area in a stipulated grant period of 18 months (Swamy, 2009).

Evidence Based Potential Barriers faced and relatively addressed

Evidence based barriers include limited HIT infrastructure, complex governance issues, lack of funding (to mitigate unexpected costs and budget overruns) and receptivity of staff to culture change and change management.

Theoretical Barriers Attempted to address based on Everett Rogers' Assumption

These include complexity with respect to HIT infrastructure and handling of software and hardware technicalities in implementation process.

Impact of the Initiative

This program has definitely increased availability and access to patient data, and improved provider collaboration and information sharing. Better adoption rates have been fueled by word of mouth related to positive outcomes and eased data sharing.

(7)USDA and HHS Agreement

Program Initiative

Rural Healthcare Initiative

The U.S. Department of Health and Human Services' (HHS) Rural Health IT Task Force, specifically the Office of the National Coordinator for Health Information Technology (ONCHIT) and the Health Resources and Services Administration, worked with the U.S. Department of Agriculture (USDA) to make sure that rural health care providers can avail of USDA's Rural Development grants and loans to finance. The primary aim of this initiative is to

effectively support the acquisition of health IT infrastructure such as new software and hardware **(**HRSA, 2012).

Measures Implemented

HHS and USDA signed a Memorandum of Understanding (MOU) in 2010-11 linking rural hospitals and clinicians to existing capital loan programs that enable them to purchase software and hardware needed to implement health IT. On August 16, 2011, the White House officially made public, the Obama Administration's commitment to executing this MOU (HRSA, 2012).

Evidence Based Barriers Addressed

This initiative addressed infrastructure issues, broadband connectivity, and access to health information.

Theoretical Barriers Attempted to address based on Everett Rogers' Assumption.

Theoretical barriers like compatibility and complexity with respect to health information exchange and interoperability are addressed by this program.

(8)State Health Information Exchange Cooperative Agreement Program

Initiatives and Measures

In 2009, the Office of the National Coordinator for Health Information Technology (ONC) created the State HIE Cooperative Agreement Program, announcing the availability of $564 million for states and territories to enable HIE (ONC, 2012**).** In 2010, Centers for Medicare & Medicaid Services (CMS) released its final rule on Stage 1 MU requirements which announced the availability of incentive payments for providers and hospitals for the meaningful

use of certified EHR technology (CMS, 2012). In 2010, ONC launched the Direct Project, providing a set of standards, policies, and services to transport health information point to point through a secure, fast, and inexpensive "push" model, thereby creating an additional method for HIE (The Direct Project, 2011). ONC also funded the Challenge Program in December 2010 to encourage development and innovation to address other persistent barriers in HIE, for example, transitions to long-term and post-acute care, and consumer-mediated exchange (ONCHIT, 2011).

Evidence Based Barriers Addressed

The evidence based barriers attempted to address included HIE Exchange, interoperability (in which they partially succeeded), and lack of funding.

Theoretical Barriers Attempted to address based on Everett Rogers' Assumption

Theoretical barriers addressed included complexity and compatibility in terms of different platforms encountered during HIT implementation

(9)Regional Extension Centers (ONCHIT Directed).

Program Description and Initiative

The Health Information Technology for Economic and Clinical Health Act (HITECH) authorized the Office of the National Coordinator for Health IT (ONCHIT) to implement the Health IT Regional Extension Center (REC) Cooperative Agreement Program to support extensive adoption of electronic health records. The REC Program provides information, guidance, and technical assistance to health care providers to support and accelerate their efforts to become meaningful users of electronic health records (EHR). The REC program is funded to provide technical assistance for EHR implementation to 100,000 primary care providers through 62 sites located nation-wide.

Measures

The Health IT Regional Extension Center (REC) Program has a performance-based reimbursement format which compensates REC grantees for assisting primary care providers through three milestones along the path to meaningfully using electronic health records (EHR). "The performance milestones that qualify an REC for grant payment are: (1) a health care provider enrolls to receive assistance from a REC; (2) the provider "goes live" with an electronic health record (EHR) that has e-prescribing and quality reporting functionalities enabled; and (3) the provider or REC attests that the provider has met the Medicare and Medicaid EHR Incentive Program criteria for meaningful use of an EHR" (dashboard.healthit.gov, 2012). ONC made more than $27million available to RECs to provide support to Critical Access Hospitals (CAHs) and small rural hospitals. Therefore, ONCHIT designated supplemental funding for RECs to prioritize small rural hospitals and Critical Access Hospitals (CAHs). RECs are eligible for supplemental funds based on achieving performance milestones for 87 percent of these hospitals which in absolute numbers is 1,501 of 1,726 hospitals (Heisey-Grove et al., 2012, p. 6).

Evidence Based Barriers Addressed

The core evidence based barriers addressed include lack of finance and technical assistance on and after implementation.

Theoretical Barriers Attempted to address based on Everett Rogers' Assumption

Technical Assistance implies that barriers like complexity and compatibility were addressed.

Impact

Nationwide, thirty-nine percent of office-based providers had implemented at least a "basic" electronic health record (EHR) system by 2011. On the other hand, general EHR adoption in 2009 was 48.3% of office-based physicians. Latest figures, as of 2012, put it at 71.8% (healthit.gov, 2012). A basic EHR includes specific functionalities in the following areas of health care and administrative data: patient demographics, patient problem lists, electronic lists of medication taken by patients, clinical notes, orders for prescriptions, laboratory results viewing, and imaging results viewing (healthit.gov, 2012). As of January 1, 2013, all 62 RECs are actively working with approximately 132,000 primary care providers and more than 11,000 specialists. From the pool of such providers, 70 percent of small office based providers in rural areas as well as 74 percent of critical access hospitals are working with RECs (Regional Extension Centers). As of 31st March 2013, 52 % of primary care providers were demonstrating Meaningful Use (dashboard.healthit.gov, 2013). It must be noted here that data for years 2012 and 2013 is not uniformly available on the ONCHIT dashboard. Table 3 illustrates the increasing percentages of hospital adoption of EHR on a national basis till 2011.

Table 3: **Hospital Adoption of EHRs as of 2011**

Time Period	Region	Hospitals Overall (%)	Rural Hospitals (%)	Small Hospitals (%)
2008	National	13	8	9
2009	National	16	10	10
2010	National	19	14	14
2011	National	35	27	27

Note: Adapted from U.S. Department of Health and Human Services, Office of the National Coordinator for Health IT. The measure presented above includes all non-federal general acute care hospitals responding to the American Hospital Association Annual Survey, IT Supplement, including critical access hospitals, and excluding federal hospitals and hospitals located outside of the 50 states and the District of Columbia.

Maine, Missouri, New Hampshire, and Vermont had 100% of critical access and other small rural hospitals in their states with an EHR in 2011. 43 of 46 states had RECs working with Critical Access Hospitals and other small rural hospitals (Heisey-Grove et al., 2012 , p. 6). An

important thing to note is that RECs covering North Carolina and South Carolina opted out of the supplemental grant program which was conducted by The Flex Monitoring Team, and the Small Hospital Improvement Program (Heisey-Grove et al., 2012 , p. 5).

(10)Strategic Health IT Advanced Research Project (SHARP)

Program Description

SHARP is a multi-dimensional research project, supported by the Office of the National Coordinator for Health Information Technology (ONCHIT). SHARP is involved in "advancing the requirements, foundations, design, development and deployment of security and privacy tools and methods. The project is organized around three major healthcare environments: Electronic Health Records (EHR) Health Information Exchange (HIE) &Telemedicine (TEL)" (sharps, 2012).

Initiative

A multidisciplinary team of computer security, medical, and social science experts is developing security and privacy policies and technology tools to support electronic use and exchange of health information. The projects address strategic cross-cutting themes that foster collaboration, consistency, and a multi-purpose technology convergence of EHR, HIE, and TEL (sharps.org, 2012).

Impact

This initiative has resulted into the maturation of security and privacy technologies and policies, removing key barriers that prevent the use of valuable health information. Also this has made possible the creation of an integrated security and privacy research community for HIT that will exist following the culmination of the SHARPS program (Sharps.org , 2012).

Evidence based barriers addressed

Evidence based barriers addressed include security and privacy barriers briefly discussed under "Physician-Patient Relationship".

Theoretical barriers of Everett Rogers' addressed

Theoretical Barriers include complexity in terms of deployment and design of privacy tools.

(11) Community College Consortia to Educate Health IT professionals.

Description and Initiative

In 2009 the Congress passed the Health Information Technology for Economic and Clinical Health (HITECH) Act to speed up the growth of secure electronic health records that impart the clinically correct information to both doctors and patients. This process will obviously require a large workforce to train and educate health care providers as they transition to electronic health records (EHRs) from the paper based ones. To pay attention to this need, the Office of the National Coordinator for Health Information Technology (ONC) created the Community College Consortia to Educate Health IT Professionals in Health Care Program, which is in fact a cog in the wheel of ONC's Health IT Workforce Development Program (healthit.gov, 2012).

Measures

It is essential that the training imparted, must reach the intended students, especially in underserved areas. Hence, the Community College Consortia Program offers multiple modes of learning, like courses taking place in class, through on-line avenues, and using mixed methods. In addition, the additional option is that Consortia members can partner directly with providers and vendors to implement tailored training to meet specific business needs (healthit.gov, 2012).

Evidence Based Barriers Addressed

The primary evidence based barrier tackled is lack of trained staff.

Theoretical Barriers Attempted to address based on Everett Rogers' Assumption

Three theoretical barriers attempted to address were trial ability, observability, and compatibility with major emphasis on training of medical personnel and job shadowing. However not many students have got exposure to actual environments through this program.

Impact

The Community College Consortia Program with an allowance of $70 million in a span of two-years has been enlisted to train 10,500 professionals per year in health IT competencies at community colleges all across the US. Since the Program's initiation in September 2010, interest and completion of these training programs has exceeded expectations, and as of July 2012, more than 14,000 professionals had completed training (dashboard.healthit.gov, 2012). However, if compared with the national level and urban enrollment, the rural enrollment slightly appears to lag behind. Rural small city enrollment as in March 2013 was 6.40% compared to 87.08% in urban metropolitan areas (Swain, 2012). The Table 4 describes program enrollments by area type for the Health IT training program. It is evident that enrollment of people in the Health IT

training programs is taking place at an excellent rate. However, the numbers clearly indicate a slight skew in favor of urban cities as against rural areas.

Table 4: **Urban Rural Backgrounds of Enrollees-National as on 3/27/2013**.

Area Type	Program Enrollments	% enrollment	% distribution from census
Rural-Small Cities/Micropolitan Areas	1926	6.40	9
Urban-Large Cities/Metropolitan Areas	26218	87.08	85
Rural-Other/Not Core Based Statistical Area	1544	5.13	5
Unknown	419	1.39	1
Total	30107	100	100

Note: this chart uses data from healthIT.gov containing zip codes provided by students during the program enrollment. Figures in this chart/table include only those students that completed Health IT workforce training. The student zip codes are assigned the attributes of 'Rural,' 'City' or 'Metro' (Metropolitan) according to Core Based Statistical Areas (CBSA) defined by the U.S. Census Bureau.

Evidence of concerted efforts in rural States

Case studies and environmental scans in the field of health information exchange have been described by this author since they contribute in determining the experience of the states in enhancing health information exchange and thereby enhancing electronic health record adoption by working in tandem with RECs and allied federal initiatives. These different studies such as case studies and environmental scans, have been selected for inclusion in this capstone because they illustrate precisely how some of the above described programs have helped in influencing EHR adoption in rural areas and how different theoretical and evidence based barriers were overcome. The selection of these studies was done with a basic focus on reduction in barriers to HIT adoption and health information exchange.

Case study synthesis

The primary objective of this case study synthesis was to assess the experience of states in establishing technical services to enable health information exchange, and implementing

privacy and security frameworks and identifying barriers during implementation in the course of gradual EHR adoption. Dullabh et al (2013) narrates the synthesis of how different types of partnerships were used to overcome barriers in EHR adoption. It must be noted here that the goal of this synthesis was not to directly gauge impact of health information exchange facilitation on EHR adoption. However, facilitation of EHR adoption is definitely related with ease of transfer of health information (interoperability on different platforms). Hence, this author has included this case study synthesis as part of the overall discussion on electronic health record adoption.

Table 5: State Planning, Leadership, and Funding Characteristics (Adapted from Dullabh et al., 2013, p. 9).

Classification	Maine	Nebraska	Texas	Washington	Wisconsin
Funding Amount($)	6,599,401	6,837,180	28,810,208	11,300,000	9,441,000
Recipient of State Funds	State of Maine/ Maine CDC , OSCHIT	State of Nebraska, The N I T Commission's e-Health Council	Texas Health and Human Services Commission (HHSC)	Healthcare Authority (HCA)	State of Wisconsin
State Designated Entity (Lead Organization	Health Info Net	Nebraska Health Information Initiative	Texas Health Service Authority	One Health Port	Wisconsin Statewide Health Information Network
Strategic Approach	Public Utility	Orchestrator, Public Utility	Capacity Builder, Orchestrator	Orchestrator, Public Utility	Elevator, Orchestrator
Strategic/ Operational Plan Approved	8/16/2010	11/15/2010	11/3/2010	12/10/2010	12/21/2010

Strategic approach described here refers to the ONC strategic model classification scheme, which is comprised of four models: the elevator, capacity-builder, orchestrator, and public utility models. The elevator model indicates a rapid facilitation of directed exchange

capabilities to support Stage 1 meaningful use. The capacity-builder model illustrates the boosting of sub-state exchanges via financial and technical support. The orchestrator model is a state-level network to connect existing sub-state exchanges. States using the public utility model are connecting directly to end-users and to sub-state exchanges which are already in existence **(**Dullabh et al., 2013, p. 9).

This case study synthesis describes how four of these five states have adopted a "Direct Method" for mitigating evidence-based barriers of lack of communication & interoperability. "Direct is a method of secure exchange between two known parties who connect to one another point-to-point, rather than through a hub that serves multiple parties. Once a direct connection has been established, "two providers can send and receive information, such as laboratory orders and results, referrals, and discharge summaries" (Dullabh et al., 2013, p. 13). Another point brought forward in this case study synthesis is that a mixed model of health information exchanges and RECs works together in reducing barriers to Health IT adoption.

Current status

Of the five states included in the case studies, Maine and Nebraska are pursuing an opt-out model with an opt-in (see glossary for definition) for sensitive health information. On the other hand, Texas and Washington do not have a state level consent policy while Wisconsin may seek legislation that achieves congruence on state law with HIPAA. Consent does not present an issue in Washington because the state does not store data. Texas confronted consent issues even in the absence of state-level data storage (Dullabh et al., 2013**)**. This indicates that these states have been trying hard to mitigate theoretical barriers like complexity and compatibility and evidence based barriers like privacy.

Environmental Scans

Environmental Scans provide insight and information about market forces such as Health IT, which have a high probability of affecting the health care field. This environmental scan is designed to help policy makers and health system leaders better understand the critical issues and emerging trends that organizations might face in the foreseeable future (hhnmag.com, 2012).

Key Findings of Environmental Scan in North Dakota

In the year 2008, the top five significant drivers of EHR adoption were found to be improving quality of healthcare, improving patient safety, inefficiencies experienced by providers, administrator advocate for EHR, and the monetary incentive of grant funding. In 2012, they remained more or less similar with the addition of availability of loan funding. With respect to barriers, unfortunately, most of the earlier aspects such as lack of financial funding, initial capital investment, and technical hardware and software issues continue to exist even after significant efforts by federal government through agencies like HRSA. However, these deficiencies, though prevalent, have reduced considerably from 2008. In addition a couple of new legitimate concerns seem to have cropped up such as sustainability of this business model in the future and changes in workflow patterns (Dickson et al., 2012, p.22). The North Dakota environmental scan also sheds some light on the issue of internet connectivity and high speed broadband access in rural and urban areas. In 2008, over 90% of the respondents (rural and urban), expressed that high-speed/broadband access was already in place and this remained the same. What has changed is the amount of wireless internet in place in the rural facilities; 83% of

the hospital respondents in 2012 indicated wireless internet was already in place in their facility compared to 65% of the respondents in 2008 (Dickson et al., 2012,p. 26).

Another relevant aspect brought out in the environmental scan is about the Health IT workforce. In 2008, one of the top three barriers that had the most impact on implementation of an EHR was the lack of well-trained health IT staff. Responses in 2012 indicated a slight increase in the percent of facilities with a dedicated IT person. The number of facilities with no FTE designated for overseeing IT decreased by nearly half from 13 in 2008 to 7. Fewer facilities (48%) in 2012 than 2008 planned to increase their IT staff and (26%) indicated they currently have adequate staff (Dickson et al., 2012, p. 31). This observation from the North Dakota based environmental scan is consistent with the national trend of gradual increase in number of enrollees of Health IT Community College Consortia on a regional and national level as indicated in the data from ONCHIT dashboard in Table 3.

Key Findings of Montana Environmental Scan

Purpose

To better inform the state's activities related to HIT and HIE, the administration of the Centers for Medicare and Medicaid Services (CMS) Electronic Health Record (EHR) incentive programs, and the activities of the State's Regional Extension Center (Health Share, 2011, p. 16).

Findings

The Health Information Exchange of Montana has succeeded in implementing a model of electronic health information exchange between participating healthcare providers. It is also addressing the lack of affordable, reliable bandwidth through development of a secure fiber - optic network in the region with financial assistance from the Federal Communications

Commission and the University of Montana for future expansion of network services. Health Share Montana, which is a consortium of providers, planned and implemented a statewide HIE infrastructure. HIE capabilities were developed according to requirements that allowed its eventual inclusion as a Nationwide Health Information Exchange (NHIE) (Health Share, 2011). However the state of Montana yielded some interesting results indicating that even in 2011, their biggest challenges were training their employees and having the IT infrastructure to support EHR (Health Share, 2011, p.16).

How have the programs interacted with each other to enhance adoption?

Data as of July 2012 suggests that 100,000 health care providers are using electronic health records that meet federal standards and have benefitted from the Medicare and Medicaid Electronic Health Record (EHR) Incentive Programs, the Centers for Medicare & Medicaid Services (CMS) and the Office of the National Coordinator for Health Information Technology (ONC) initiatives like RECs and Beacon Community Programs. An important component for the success of the CMS EHR Financial Incentive Programs is the establishment of the EHR Certification Program. This program involved significant interactions with State Health Information Co-operative Exchange Program and the Regional Extension Centers (RECs) for doing the requisite 'needs assessments'. Through this program, ONC has implemented a regulatory and technical framework that will protect and standardize health information exchange and promote the interoperability of EHRs. This program led to the development of the Certified Health IT Products List (CHPL) (healthit.gov, 2012).

From 2008- 2012, over 133,000 primary care providers and 10,000 specialists were partnering with RECs to overcome common EHR adoption barriers. RECs have worked to

ensure that these clinicians meet meaningful use and receive incentive payments through the Medicare and Medicaid EHR Incentive Programs. As per data available in July 2012, approximately over 12,000 providers working with RECs had already received their incentive payments. RECs are proven to be practice transformation agents supporting federally qualified health centers (FQHCs) as they strengthen the health IT infrastructure and improve the quality of care. They coordinate with community college consortia and other health IT teaching institutions to provide education, training, and practice coaching especially, to rural clinicians. With such a multi-pronged approach, many theoretical and evidence based barriers are addressed, such as trialability, observability, complexity, and lack of trained staff.

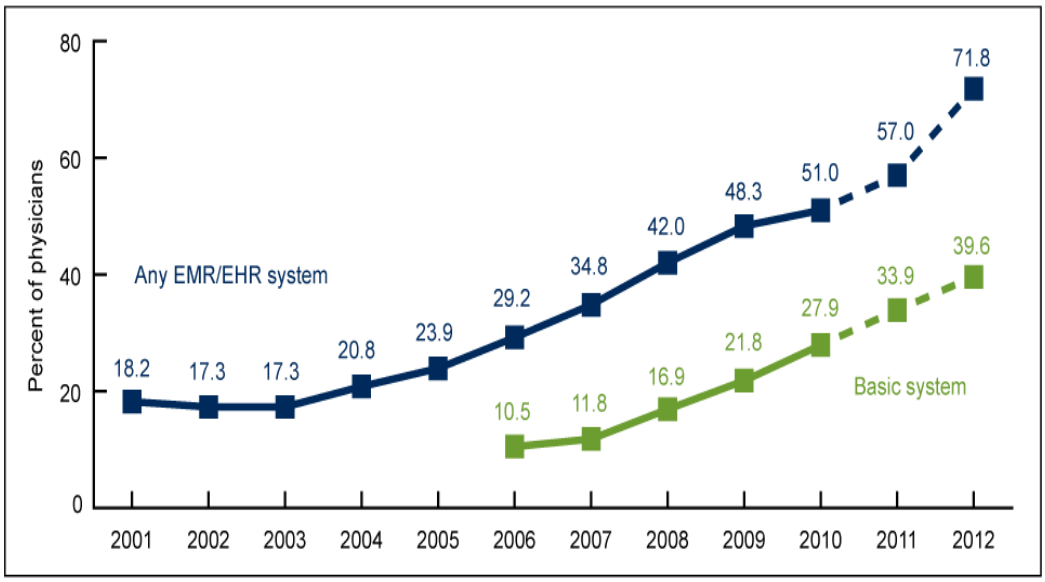
Alongside the progress that RECs have had with assisting providers to "go-live" with an EHR, the Health IT Research Center (HITRC) and National Learning Consortium (NLC) projects are leveraging the technical assistance materials created by RECs so that they can have the broadest audience and impact as possible. The HITRC and NLC are particularly valuable for assisting providers in rural and remote areas (pcmhri.org, 2011). HITRC Portal serves as a connector for Beacon communities across the country to meet online and through conference calls to connect with program staff and experts; facilitate program and cross-program communications; and to share knowledge, experiences, and lessons learned through a forum aptly called Communities of Practice (CoP) (pcmhri.org, 2011). An excellent example of this model of communication is the way the members of the Rhode Island Beacon Community got together to remove communication barriers in the process of health information exchange and Electronic Health Record adoption. These Communities of Practice work to promote interactions with clinical Beacon teams, with RECs, State HIEs, and other ONC resources, and also volunteer in testing and documenting new technologies (pcmhri.org, 2011). ONC also

works with RECs and Medicaid programs to insure that a digital divide does not occur in underserved areas. The environmental scan of Montana demonstrates how RECs, State Health Information Exchange and Federal Commission on Communication work in tandem to reduce barriers to adoption of EHRs.

Discussion

Chart3. Percentage of office based physicians with EMR/EHR systems (Adapted from NAMCS 2001-2012)

Figure 1. Percentage of office-based physicians with EMR/EHR systems: United States, 2001–2010 and preliminary 2011–2012



NOTES: EMR/EHR is electronic medical record/electronic health record. "Any EMR/EHR system" is a medical or health record system that is all or partially electronic (excluding systems solely for billing). Data for 2001–2007 are from in-person National Ambulatory Medical Care Survey (NAMCS) interviews. Data for 2008–2010 are from combined files (in-person NAMCS and mail survey). Data for 2011–2012 are preliminary estimates (dashed lines) based on the mail survey only. Estimates of basic systems prior to 2006 could not be computed because some items were not collected in the survey. Data include nonfederal office-based physicians and exclude radiologists, anesthesiologists, and pathologists.
SOURCE: CDC/NCHS, National Ambulatory Medical Care Survey, 2001–2012.

Since the passage of the HITECH Act in 2009, overall adoption of EHR technology has increased significantly specifically among physicians with the idea of achieving the three tier aims of quality, safety and efficiency in patient care. After 3 years, in 2012, 71.8% office based physicians had adopted any EHR system and 40% had adopted basic EHR systems with certain advanced capabilities (Hsiao & Hing, 2012). The research at ONCHIT indicates that provider

adoption of basic EHRs is generally perceived to be an early indicator to the meaningful use of EHRs. Significant increases in adoption have been observed in all types of practice settings such as primary care providers, small office based practices, rural practices and on a national landscape. Rural practices have seen an encouraging increase in adoption rates of 38% in 2011, up from nearly nothing in 2008. However there still seems to be a long way to go to achieve a greater adoption percentage (healthit.gov, 2012). The DHHS recently announced that more than 110,000 eligible professionals and over 2,400 eligible hospitals have received funds from CMS for EHR use. This clearly indicates that the goal of getting 100,000 PCPs live on EHR has been exceeded. On a region-wide basis certain RECs were found to have a lesser impact in regions like Alaska, parts in rural California, central Florida, Greater Cincinnati etc (dashboard.healthit.gov, 2012). Thus if viewed on a national scale, out of the 133,000 primary care providers and 10,000 specialists working with RECs, 70 percent are small practice providers in rural areas and 74 percent are critical access hospitals. RECs have therefore helped more than 12,000 REC-aided providers to receive incentive payments. An important point to note here is that these 70% small practice providers were the ones who were contacted by the Regional Extension Centers (RECs) for electronic health record adoption purposes. However, this figure does not reveal the % EHR adoption. It is an indication of the outreach efforts of the Regional Extension Centers (RECs). On a nationwide basis, 52 % of primary care providers have demonstrated Stage 1 Meaningful Use as of March 2013 (dashboard.healthit.gov, 2013). It is important to note here that data in Table 6 is until the year 2011 and not updated for the current period of 2013.

Table 6: **Office Based Provider Adoption of Basic EHRs (%) as of 2011.**

Time Period	Region	Providers Overall	Primary Care Providers	Providers in Small Practices	Providers in Rural Practices
2008	National	17	20	13	0
2009	National	21	20	15	14
2010	National	25	30	21	30
2011	National	39	39	29	38

Note: Adapted from U.S. Department of Health and Human Services, Office of the National Coordinator for Health IT data from http://dashboard.healthit.gov/HITAdoption/?view=0

Non- Federal acute care hospitals

ONCHIT reports that approximately 44.4% of non-federal acute care hospitals had adopted at least a basic electronic health record system by 2012. This definitely shows an upward trend from 28% in 2011 and 9% in 2008. According to a second ONC report, adoption rates for each of the 14 Stage 1 core objectives for meaningful EHR use ranged from 72% to 94%. The data for the year 2012 indicates that South Dakota (71%), Rhode Island (69%), and Colorado (68%) had the highest percentage of non-federal acute care hospitals with adoption of at least a Basic EHR system. Consequently, New Hampshire (21%), New Mexico (26%), and Kansas (26%) had the lowest percent of hospitals with adoption of at least a Basic EHR system. Surprisingly Maine also lagged behind in adoption of a basic EHR system in non-federal acute care hospitals till 2011, despite doing well in the overall adoption scenario of adopting certified EHRs (Charles, Patel, Furukawa, 2012, p. 2). However, Maine is catching up at a higher rate even in this field as per trends in 2012 (Mosquera, 2012, December 12). Non Federal acute care hospital adoption of a Basic EHR system was significantly higher than the national average in twelve states such as Colorado, Illinois, Indiana, Maryland, Massachusetts, Michigan, Minnesota, Ohio, Rhode Island, South Dakota, Virginia, and Wisconsin . Hospital adoption of at

least a Basic EHR system was significantly lower than the national average in eleven states such as Alabama, Kansas, Kentucky, Maine, Montana, New Hampshire, New Mexico, Oklahoma, South Carolina, Tennessee, and Texas (Charles, Patel & Furukawa, 2012, p. 3). Maine was reportedly at 27.5% in 2011 and increased to 42% as reported by Mosquera (2012). ONC reported that 42% of all eligible providers in Maine had met Meaningful Use stage one rules which is the highest percentage of all 50 states. It has also been touted as the fastest acceleration in the nation in terms of electronic health record adoption. This is also testimony to the fact of the great collaborative work put in by the Bangor Beacon Community, Healthinfonet and Regional Extension Centers. The EHR adoption rates are increasing at rapid rates on a yearly basis. Thus, out of the 11 states supposed to have lower adoption rates for Basic EHRs in 2011, Maine and Kentucky have shown remarkable progress in the year 2012-2013 (Mosquera ,2012, December 12). Thompson Reuters (2012) reported that although Beacon Community programs are centered on addressing issues related to improvement of data and clinical care measures like cancer and diabetes screenings, the sheer absence of an integrated health IT environment caused problems for patients, providers and payers alike. Inaccessible patient information more often than not contributed in a large manner to the annual waste in healthcare spending. Beacon Communities have demonstrated that in addition to accomplishing their goals of clinical innovations and quality improvement, they can prove to be a catalyst for increase in EHR adoption. This has been achieved through increased health information exchange capacity and interoperability.

Regional Extension Centers have certainly contributed in a significant way towards increasing EHR adoption, especially in rural areas. Healthcare providers barring a few, are adopting EHR and taking advantage of CMS programs at a faster rate than anticipated and some

early adoption challenges are beginning to dissipate. The REC success rate is testimony to the fact that it is working on some level. However, there continues to be challenges in health information exchange especially when there is more than one entity in a region. Similarly, except for states like Maine, Missouri, New Hampshire, and Vermont, implementation challenges remain for small and rural hospitals in other parts of the country. However, one cannot discount the progress made; hence small and rural hospitals should not be penalized. The focus should be aimed at a thoughtful adoption with minimal penalties at Stage 2 and Stage 3. Table 7 shows the particular RECs that are slightly falling behind in their goal of getting primary care providers to adopt Electronic Health Records.

Table 7: **Regional Extension Center Co-operative Agreement Program**
Enrollment of PCPs by State or County. List of Centers falling behind the standard enrollment %.

Area	PCP providers live on EHR(goal in %)	PCPs showing Meaningful Use (in %)
Alaska eHealth Network	60%	14%
California Health Information Partnership Services Organization North	65%	9%
California Health Information Partnership Services Organization South	61%	12%
Center for the Advancement of Health IT (FL)	63%	11%
Central Florida HIT Initiative	67%	14%
Georgia HITREC	64%	12%
Gulf Coast Regional Extension Center (GCREC) (TX)	44%	7%
Louisiana Health Care Quality Forum	52%	14%
Michigan Center for Effective IT Adoption (M-CEITA)	67%	18%
North Carolina REC	67%	12%
North Texas REC	63%	20%

Note: Extracted from Key Performance Indicators on http://dashboard.healthit.gov/rec/ . The distinction “primary care provider” includes: physicians (Internal Medicine, Family Practice, OB/GYN, Pediatrics) and other healthcare professionals (PA, NP, Nurse Midwife) with prescribing privileges in the following settings, which are prioritized by the program: small group practices (10 or less providers); ambulatory clinics connected with a public or critical access hospital and community health centers and rural health clinics.

Table 7 shows the regional extension centers are falling slightly behind of the primary care provider enrollment, which sheds some light on rural areas of big states like Texas, North Carolina, Louisiana, and Alaska.

ONCHIT funded the Community College Consortia for educating Health IT professionals. This has worked in a substantial way to tackle the shortage of Health IT workforce which was a significant barrier in 2008-2009. However, it is still early to decide on whether this skilled workforce is able to find suitable jobs to fill the demand. The reason for this mixed result, according to this author, is that though the ONC training programs are useful, the training is not necessarily aligned with what hospital CIOs (Chief Information Officers) believe, they want in health IT employees. The big vendors and health IT systems are interested in hiring tenured health IT professionals, rather than those with just nine months -worth of classroom or online experience. Another aspect, which could be the focus of this initiative, is that this training could be more connected to jobs which would in turn be connected to office based practices in rural areas.

Conclusion

While it is evident that many challenges are not exclusive to small, rural hospitals adopting health IT, these hospitals acutely experience adoption challenges and must actively work within their own limited environment to overcome them. Another consideration is that immediate negative outcomes of a dynamic and volatile Health IT field would be felt severely in rural areas. This can be compounded if rural hospitals and providers fail to meet Meaningful Use criteria. It would not be fair to conduct a critique on which programs are giving the best results for enhancing Electronic Health Record adoption since the programs have focused in many different directions, with the cumulative aim of enhancing adoption and mitigating

barriers. The key to success in achieving parity in urban rural adoption rates is sustainability in the efforts.

Recommendations from this author

1. Expand the Beacon effort through additional local funding and participation, and conduct research on eliminating interoperability issues.
2. Make the curriculum of the Community College Consortia Health IT education practical-oriented with on -site training in crystal report generation and SQL querying. This author has the experience of taking a six month certificate course which is more focused on the theoretical aspects of electronic health records than the practical ones.
3. Promote rural areas as attractive investment destinations for EHR vendors and their employees.
4. Monitor, measure, and report on progress of the HIT industry sector on at least an annual basis on ONCHIT. It would not be wise to base future policy decisions based on 2011-2012 data, as the area of Health IT adoption, is very dynamic.

Limitations of the study

This capstone is dependent on data from government sources like ONCHIT which have not yet updated data in certain cases beyond 2011. Hence it is difficult to come to conclusions on a quantitative basis for questions related to EHR hospital adoption in 2013.

Definitions

1. *Non-federal acute care hospital*: This category includes facilities like acute care general medical and surgical, children's general, and cancer hospitals owned by private/not-for-profit,

investor-owned/for-profit, or State/local government and located within the 50 states and District of Columbia (Charles, Patel & Furukawa, 2012).

2. *Office-based physician*: This category includes non-federally employed physicians providing direct patient care in Office-based practices in the 50 states and the District of Columbia, excluding radiologists, anesthesiologists and pathologists (King, Patel &Furukawa, 2012).

3. *Possession of Certified EHR*: A certified EHR is EHR technology that has been certified as meeting federal requirements for some or all of the hospital objectives of Meaningful Use. Possession of certified EHR technology is considered to be either the physical possession of the medium on which a certified Complete EHR, or certified EHR Module resides, or a legally enforceable right by an eligible health care provider to access and use, at its discretion, the capabilities of a certified Complete EHR or certified EHR Module (Charles, Patel,& Furukawa, , 2012).

4. *Opt-in*: Opt-in category involves affirmative authorization from the consumer, often through signing a standardized consent form, before a consumer's health information may be exchanged through the network (Dss.mo.gov, 2012).

5. *Opt-out*: This includes a situation which requires that the consumer is given notice through mailings, brochures, posted notices or other means - and allows a consumer's health information to be exchanged through the network unless and until the consumer formally requests that it not be (Dss.mo.gov, 2012).

References

Adler-Milstein, J., & Bates, D. W. (2010). Paperless healthcare: Progress and challenges of an IT-enabled healthcare system. *Business Horizons, 53*(2), 119-130. doi: 10.1016/j.bushor.2009.10.004.

Amarasingham, R., Plantinga, L., Diener-West, M., Gaskin , D.J., Powe ,N.R.(2009). Clinical Information Technologies and Inpatient Outcomes: A Multiple Hospital Study. *Archives of Internal Medicine*. 169 (no. 2):108–14.

Ash, J.S., Berg, M., Coiera, E. (2004). Some unintended consequences of information technology in health care: the nature of patient care information system-related errors. *Journal of the American Medical Informatics Association*, 11 (2), 104–112. Retrieved on October 30, 2012 from http://www.ncbi.nlm.nih.gov/pubmed/14633936.

Blumenthal, D., DesRoches C, Donelan, K., Ferris, T.G., Jha A.K, Kaushal R., Sowmya, R., Rosenbaum, S., S, Alexandra. (2006). *Health Information Technology in the United States: The Information Base for Progress.* Princeton, NJ: Robert Wood Johnson Foundation. Retrieved on October 18, 2012 from http://science.icmcc.org/2010/08/26/health-information-technology-in-the-united-states-the-information-base-for-progress/.

Blumenthal, D., & Tavenner, M. (2010). The 'Meaningful Use' Regulation for Electronic Health Records. *New England Journal of Medicine*.; 363 (no. 6):501–4. Retrieved on October 2, 2012 from http://www.nejm.org/doi/full/10.1056/NEJMp1006114.

Bahensky, J. A., Jaana, M., & Ward, M. M. (2008). Health care information technology in rural America: Electronic medical record adoption status in meeting the national agenda. *The Journal of Rural Health, 24*(2), 101-105. doi: 10.1111/j.1748-0361.2008.00145.x.

Blumenthal, D. (2011, February 8). Rural Health IT Is a Priority for HHS. Retrieved on November 29, 2012 from http://www.healthit.gov/buzz-blog/local-implementation-support/rural-health-it-is-a-priority-for-hhs/.

Charles, D., King, J., Furukawa, M.F, Patel, V. (2013, March). Hospital Adoption of Electronic Health Record Technology to Meet Meaningful Use Objectives: 2008-2012.(2013,March). *ONC Data Brief*, no. 10. Washington, DC: Office of the National Coordinator for Health Information Technology.

Chaudhry, B., Wu, S., Wang .J., Manglione, M., Mojica, W., Roth , E., Morton, S.C., Shekelle ,P.G. (2006). Systematic Review: Impact of Health Information Technology on Quality, Efficiency, and Costs of Medical Care. *Annals of Internal Medicine*. 144(no. 10):E12–E22.

cms.gov. (2012). *CMS Finalizes Definition of Meaningful Use of Certified Electronic Health Records (EHR) Technology*. Retrieved on March 20, 2012 from http://www.cms.gov/apps/media/press/factsheet.

cms.gov. (2013). *EHR Incentive Programs.* Retrieved on April 2, 2013 from http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/index.html?redirect=/ehrincentiveprograms.

directproject.org . (2011, October 11). *The Direct Project Overview*. Retrieved on February 23, 2012 from http://wiki.directproject.org/ONC+Website.

dashboard.healthit.gov. (2012). *Nationwide Key Performance Indicators*. Retrieved on February 3, 2013 from http://dashboard.healthit.gov/HITAdoption/?view=0.

dss.mo.gov. (2012). *Opt-in Versus Opt-out: Consent Models for Health Information Exchange through Missouri's Statewide Health Information Exchange Network.* Retrieved from http://www.dss.mo.gov/hie/leadership/pdf2010/optin_vs_optout_overview.pdf on April 16, 2013.

Dickson, L., Nissen, K., Wolf, S., Peterson, C., Willis, N.(2012,July). *Environmental Scan of Health Information Technology (HIT) Adoption amongst North Dakota Health Care Entities*. Center for Rural Health. Retrieved from ruralhealth.und.edu/pdf/hit_**environmental_scan**_2012.pdf.

Dullabh, P., Hovey,L.,Ubri, P.(2013). *Evaluation of the State Health Information Exchange Cooperative Agreement Program*. The Office of the National Coordinator for Health Information Technology, US DHHS: Washington DC. Retrieved on April 7, 2013 from www.healthit.gov/sites/.../casestudysynthesisdocument_2-8-13.pdf.

Gadd, C.S., Penrod, L.E.(2001). Assessing physician attitudes regarding use of an outpatient EMR: a longitudinal, multi-practice study. *Proc AMIA* .194–8. Retrieved on November 2, 2012 from http://www.ncbi.nlm.nih.gov.ursus-proxy-1.ursus.maine.edu/pmc/articles/PMC2243374/.

Groopman, J., & Hartzband, P. (2009, March 12). *Obama's $80 billion exaggeration*. The Wall Street Journal, p. A15.

Heisey-Grove, D., Hufstader, M., Hollin, I., Samy, L., Shanks, K. (2012, November). Progress towards the meaningful use of electronic health records among critical access and small rural hospitals working with Regional Extension Centers. *ONC Data Brief*, no. 5. Washington, DC: Office of the National Coordinator for Health Information Technology.

Han, Y. Y., Carcillo, J. A., Venkataraman, S. T., Clark, R. S., Watson, R. S., Nguyen, T. C., Bayir, H. & Orr, R. A. (2005).Unexpected increased mortality after implementation of a commercially sold computerized physician order entry system. *Pediatrics*, 116 (6), 1506–

1512. Retrieved on November 8, 2012 from http://www.ncbi.nlm.nih.gov/pubmed/16322178.

healthit.gov. (2011). *Health IT Adoption Programs: Beacon Community Program*. Retrieved on January 16, 2013 from http://www.healthit.gov/policy-researchers-implementers/health-it-adoption-programs.

healthit.gov. (2012). *HITECH and Funding Opportunities*. Retrieved on March 10, 2013 from http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__hitech_and_funding_opportunities/1310.

Healthit.gov. (2012). *HITECH and Funding Opportunities*. Retrieved on March 10, 2013 from http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__hitech_and_funding_opportunities/1310.

healthit.gov. (2011, February). *Health Information Exchange Challenge Grant Program*. Retrieved on April 13, 2013 from http://healthit.hhs.gov/portal/server.pt?open=512&mode=2&objID=3378.

healthit.gov. (2010). *Ongoing Development Activities*. Retrieved December 2, 2012 from http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__ongoing_development_activities/1408.

healthit.gov. (2010). *State level Initiatives*. Retrieved December 2, 2012 from http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__ongoing_development_activities/1408.

healthit.Gov.(2011). *Rural Health Initiatives*. Retrieved December 2, 2012, from http://healthit.hhs.gov/portal/server.pt/community/healthit_hhs_gov__rural_health_it_initiatives/3769.

HRSA.gov. (2012). *Rural Health Network Development Program*. Retrieved from http://www.hrsa.gov/ruralhealth/about/community/networkprogram.html on April 2, 2013.

healthit.gov. (2012). *EHR Adoption and Utilization: 2012 Highlights and Accomplishments* Washington DC. Retrieved on March 30, 2013 from http://www.healthit.gov/policy-researchers-implementers/reports.

healthit.gov. (2012). *Health IT Standards Committee*. Retrieved on April 1, 2013 from http://www.healthit.gov/policy-researchers-implementers/health-it-standards-committee.

Health Share Montana. (2011, January). *MONTANA: Health Information Technology and Health Information Exchange Environmental Scan.* Retrieved on April 26, 2013 from http://healthinfo.montana.edu/MTHWAC/Environmental%20Scan%20Final.pdf.

hhnmag.com. (2012). *AHA Environmental Scan*. Retrieved on March 31, 2013 from http://www.hhnmag.com/hhnmag/jsp/articledisplay.jsp?dcrpath=HHNMAG/Article/data/09SEP2011/0911HHN_Feature_Gatefold&domain=HHNMAG.

Houser, S.H., & Johnson, L.A. (2008, May). Perceptions Regarding Electronic Health Record Implementation among Health Information Management Professionals in Alabama: A Statewide Survey and Analysis. *Perspectives in Health Information Management*, 5: 6.Retrieved on December 23, 2012 from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2394577/.

Hsiao, C.J., Hing, E.,Socey, T.C., Cai, B. (2010). Electronic Medical Record/Electronic Health Record Systems of Office-based Physicians: United States, 2009 and Preliminary 2010 State Estimates. *National Center for Health Statistics (NCHS) Health E-stat*. Retrieved on October 25, 2012 from http://www.cdc.gov/nchs/data/hestat/emr_ehr_09/emr_ehr_09.pdp.

Irani, J. S., Middleton, J. L., Marfatia, R., Omana, E. T., & D'Amico, F. (September-October 2009). The use of electronic health records in the exam room and patient satisfaction: A systematic review. The Journal of the American Board of Family Medicine, 22(5), 553-562. doi: 10.3122/jabfm.2009.05.080259.

Institute of Medicine. (2001). *Crossing the quality chasm: A new health system for the 21st century*. National Academy Press: Washington, DC .Retrieved on October 3, 2012 from http://www.iom.edu/Reports/2001/Crossing-the-Quality-Chasm-A-New-Health-System-for-the-21st-Century.aspx.

Joos, D., Chen, Q., Jirjis, J., Johnson, K.B. (2006). An electronic medical record in primary care: impact on satisfaction, work efficiency and clinic processes. *Proc AMIA Symp*.394–8. Retrieved on September 17, 2012 from http://www.ncbi.nlm.nih.gov.ursus-proxy-1.ursus.maine.edu/pmc/articles/PMC1839545/.

King, J., Patel, V., Furukawa, M.F. (2012, December). Physician Adoption of Electronic Health Record Technology to Meet Meaningful Use Objectives: 2009-2012. *ONC Data Brief, no. 7*.Washington, DC: Office of the National Coordinator for Health Information Technology.

Kam, R. (2012, July 30). *Rapid Adoption of EHRs Create Patient Privacy Issues*. Retrieved on April 25, 2013 from http://www.hitechanswers.net/rapid-adoption-of-ehrs-create-patient-privacy-issues/.

Lobach, D. F., & Detmer, D. E. (2007). Research challenges for electronic health records. *American Journal of Preventive Medicine, 32*(5, Supplement), S104-S111. doi: 10.1016/j.amepre.2007.01.018.

McGlynn, E.A., Asch, S.M., Adams, J., Keesey, J., DeCristofaro, A., Kerr, E. A.(2003). The quality of healthcare delivered to adults in the United States. *New England Journal of Medicine*, 348 (26), pp. 2635–2645.Retrieved on November 10, 2012 from http://www.nejm.org/doi/full/10.1056/NEJMsa022615.

Miller, T. (2012). *SE MINNESOTA BEACON PROGRAM: Building Technology Capacity to Improve Health*. Retrieved on February 20, 2013 from https://secure.ruralcenter.org/conference/sites/default/files/3B%20Southeast%20Minnesota% 20Beacon%20Program%20Community%20Perspectives.pdf.

Medlin, B.D. (2001). The factors that may influence a faculty member's decision to adopt electronic technologies in instruction (Doctoral dissertation, Virginia Polytechnic Institute and State University, 2001). *ProQuest DigitalDissertations*. (UMI No. AAT 3095210).

Miller, R.H., West, C., Brown, T.M., Sim, I., & Ganchoff, C. (2005). The value of electronic health records in solo or small group practices. *Health Affairs*, *24*(5), 1127-1137. doi: 10.1377/hlthaff.24.5.1127.

McKenzie, J. (2001). How teacher learn technology best. From Now On: *The Educational Technology Journal*, 10(6). Retrieved March 01, 2013 from http://www.fno.org/mar01/howlearn.html.

Mosquera, M. (2012, December 12). Maine tops states for provider rate of EHRs, meaningful use. Retrieved on April 6, 2013 from http://www.govhealthit.com/news/maine-tops-states-provider-rate-ehrs-meaningful-use.

Patel, V. L., Kushniruk, A., Yang, S., & Yale, J. F. (2000). Impact of a computer-based patient record system on data collection, knowledge organization, and reasoning. *Journal of the American Medical Informatics* Association, 7 (6), 569–585. Retrieved on November 2, 2012 from http://www.ncbi.nlm.nih.gov/pubmed/11062231.

pcmhri.org.(2011). *HITRC: A Beacon Community Resource*. Retrieved on April 3, 2013 from http://www.pcmhri.org/news/hitrc-beacon-community-resource.

Poon, E.G., Jha, A., K., Christino, M., Honour, M., Fernandopulle, R., Middleton, B., Kaushal, R. (2006). Assessing the level of healthcare information technology adoption in the United States: a snapshot. *BMC Medical Informatics & Decision Making*, *6*(1), 1-9.

Parisot, A.H. (1995). Technology and teaching: The adoption and diffusion of technological innovations by a community college faculty (Doctoral dissertation, Montana State University, 1995). *ProQuest DigitalDissertations.* (UMI No. AAT 9542260).

Rouf, E.,Whittle, J., Lu, N., Schwartz, M.D. (2007). Computers in the exam room: differences in physician-patient interaction may be due to physician experience. *J Gen Intern Med*. ***22***: *43*–8.

Rogers, E.M. (2003). *Diffusion of innovations* (5th ed). New York: Free Press.

Rao, S. R., DesRoches, C. M., Donelan, K., Campbell, E. G., Miralles, P. D., & Jha, A. K. (2011). Electronic health records in small physician practices: Availability, use, and perceived benefits. *Journal of the American Medical Informatics Association, 18*(3), 271-275. doi:10.1136/amiajnl-2010-000010.

Swamy, N. (2009). Evaluation of Flex CAH HIT Network Implementation. *NRHA CAH* Conference. Retrieved from www.ruralhealthweb.org/download.cfm?downloadfile.on April 2, 2013.

Swain, M., Vibbert, D., Furukawa M.F. (2012 May). ONC's Community College Program Trains Over 12,000 Health IT Professionals. *ONC Data Brief, no. 3*. Washington, DC: Office of the National Coordinator for Health Information Technology.

Sherry, L. (1997). The boulder valley internet project: Lessons learned. *THE (Technological Horizons in Education) Journal*, 25(2), 68-73.

Sharps.org. (2012). *Overview*.Retrieved on April 19, 2013 from http://sharps.org/.

Thompson Reuters. (2012). *Beacon Community and EHR Vendor Collaboration: A Catalyst for Interoperability and Exchange.* Retrieved on April 20, 2013 from www.healthit.gov/sites/default/files/ehr-vendor-**beacon-***topic.pdf.*

U.S. Department of Health and Human Services American Health Information Community Office of the National Coordinator for Health Information Technology. (2005). Retrieved on September 10, 2012 from www.hhs.gov/healthit/ahic.html.

U.S. Department of Health and Human Services Health Resources and Services Administration. (2010). *Evaluation of the Flexibility Critical Access Hospital Health Information Technology Network Implementation Program*: *Final Report*. Retrieved on December 25, 2012 from http://www.hrsa.gov/ruralhealth/pdf/cahhit_evaluation.pdf .

Ventres,W., Kooienga, S., Vuckovic, N., Marlin, R., Nygren, P. & Stewart, V. (2006) Physicians, patients, and the electronic health record: an ethnographic analysis. *Annals of Family Medicine*, 4 (2), 124–131.