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ABSTRACT

Nationwide Health Information Network (NHIN) use in healthcare facilities was examined for utilization and efficacy, although the advantages are abundant, healthcare facilities have been reluctant to adopt it due to associated costs. The purpose of this study was to analyze the feasibility of a U.S NHIN by exploring and determining the benefits of and assessing the barriers to its implementation. The results of this study suggest that implementation and utilization of NHIN by healthcare industry stakeholders leads to an increased quality of patient care, increased patient-provider communication, and cost savings opportunities. Increased quality of care is achieved by reducing adverse drug events and medical errors. Cost savings opportunities are generated by a reduction in spending and prices that is attributable to electronic health record systems' increased efficiency and effectiveness.

Key Words: Nationwide Health Information Network, benefits, barriers to implementation

INTRODUCTION

Technology has skyrocketed and grown over the last decade, with an increase of its use also comes the potential of fraud and abuse of technology. In addition, laws such as the Health Insurance Portability and Accountability Act (HIPAA) were passed in 1996 to protect confidentiality information of individuals' private files in healthcare (Office of Mental Health, 2012). HIPAA works closely with the Nationwide Health Information Network (NHIN) and protects confidential information being transmitted over the internet (ONCHIT, n.d.a). In addition, surprisingly the United States (U.S.) is not the first to develop NHIN. France is one of the many that are the forerunners in developing a national HIE (Grady, 2012). France implemented the Dossier Medical Personnel for use in 2011 and many challenges arose, but according to this author, the U.S. could learn from the mistakes to help develop the full widespread use of NHIN (Grady, 2012).

NHIN was developed under the Office of the National Coordinator for Health Information Technology and was adopted in 2004 (ONCHIT, n.d.b). Files are secured electronically and safely instead of the old fashioned way of paper information. This process has allowed information to be readily available and transmitted to the right people which, in turn, increases process flow and leading to overall better quality of care for the patient when records are immediately available (ONCHIT, 2013).

NHIN has been used by various organizations which makes it feasible to exchange pertinent information between these organizations including: organizations that use Electronic Health Records (EHR), personal health records, health information exchanges, and government departments like public health departments and so forth use the NHIN (USDHHS, 2010). In spite of the benefits that NHIN has provided, many healthcare providers have remained reluctant about committing to implementation and maintenance of such a technology given the high costs and effort associated with establishing NHIN standards (Dixon, Zafar, & Overhage, 2010).

Multiple features come together to build NHIN. These features include NHIN Exchange, Direct Project and also Connect (Dimick, 2010). NHIN Exchange is the first initial startup of the NHIN and implemented the policies, standards, and specification that interlinked federal agencies like Centers for Disease Control and Prevention (CDC), Centers for Medicare and Medicaid Services (CMS), Department of Defense (DoD) and many more (Bouhaddou et al, 2012). As of 2012, NHIN Exchange had 30,000 clinical users, 65 million people involved, 1 million records have been shared, with an estimated 3,000 providers (Sullivan, 2012). NHIN Direct Project was created so that health

organizations and government agencies like DOD,CDC, and CMS can send authenticated and encrypted health information to known trusted individuals (ONCHIT, 2014). As of 2010, more than 200 participants and over 50 different organizations contributed with Direct Project (ONCHIT, 2014). NHIN Connect uses the Social Security Department to securely connect hospitals and government organizations with the Data Use and Reciprocal Support Agreement also connect has allowed health information to be exchanged in a healthcare organizati on which from there can connect to a Regional Health Information Network (RHIO) (Enrado, 2011). RHIO is a type of health exchange organization which includes stakeholders within a certain area and governs Health Information Exchange (HIE) for the purpose of improving quality care (USDHHS, 2012). With components like Exchange, Direct Project, and Connect the NHIN is able to form a stronger interoperability relationship between patients and providers at a private but quality standard (USDHHS, 2012).

Healthcare providers, health plans, and organizations that exchange information within a state have been referred to as RHIO (Vest & Gamm, 2010). RHIO interlinks with HIE which has greater synchronization of care and has allowed patient and physician portals, patients health personal records, health insurance, and information exchange to interlinks with HIE (Vest & Gamm, 2010). The HIT for Economic and Clinical Health's main goal was to have more EHR and hospitals by 2019 connecting physicians, hospitals, and patients through the internet. The investment of $19.2 billion in 2009 has been to encourage hospitals to use HIT. This allotment has allowed the creation of infrastructure towards HIT (ALN Medical Management, 2010).

The main purpose of this study was to analyze the feasibility of a U.S NHIN by exploring and determining the benefits of and assessing the barriers to its implementation.

METHODOLOGY

The primary hypothesis of this study was: hospitals that commit to implementing and actively managing NHIN standards, services, and policies will experience increased quality of care, better communication, and lower costs. The research methodology applied in examining the implementation of NHIN in the U.S. followed the basic guidelines of a systematic literature review partnered with a semi-structured interview of JM, the Chief Information Officer at Carroll Hospital Center, a private, nonprofit, 193-bed hospital located in Westminster, MD (see Appendix A). This interview was tape-recorded, and only appropriate answers were used to support findings from the literature search to offer an example in practice and a more complete outline of this technology and its utilization in the hospital setting.

The research approach and conceptual framework found in this study followed those implemented by Yao, Chu, & Li (2010). The current study's use of this conceptual framework is appropriate because its original application was to explore how an adopting an emerging technology could enrich the healthcare delivery system. The circular process is similar to any project development method; it defines a problem and determines a need before preparing and implementing a solution. In this study, the solution is the utilization of NHIN in a variety of health care settings. After the adoption of NHIN standards, services, and policies, the benefits and barriers are assessed which permits the process to restart to address barriers and evaluate benefits (see Figure 1).

Figure 1: Conceptual Framework
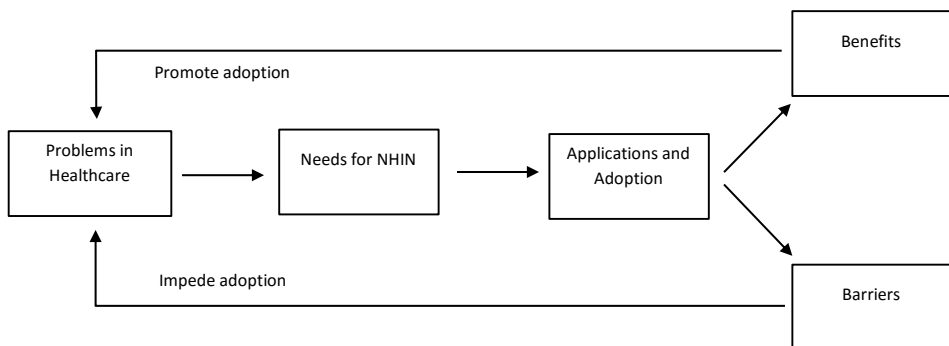
The literature review was separated into three stages: (1) Literature Recognition and Compilation; (2) Literature Analysis and Evaluation; and (3) Literature Categorization.

Stage 1: Literature Recognition and Compilation

The search of literature was conducted using the search engines and academic databases accessible through Marshall University Libraries. Databases that were used to explore literature included Academic Search Premier, LexisNexis, ProQuest, PubMed, SpringerLink and Google Scholar. In the search, the keywords 'Nationwide Health Information Network' or 'NHIN' were combined with the terms 'cost' or 'quality of care' or 'benefits' or 'privacy' or 'barriers' as inclusion criteria. Journal articles and other scholarly press written in English and from sources within the U.S. regarding NHIN adoption were pinpointed. Given the shortage of scientifically peer-reviewed publications concerning the subject matter of the current study, articles from well-respected newspapers and magazines were referenced to supplement the academic literature.

Stage 2: Literature Analysis and Evaluation

Literature was chosen for review on the basis of benefits and barriers to the utilization of NHIN by healthcare providers. The search queries were narrowed to include articles published between 2003 and 2014 to keep it a current review. Only primary and secondary data from literature written in the U.S. were included in this review. The primary step in establishing the relevancy of literature to the current study was to review the abstract of each respective article. If the material offered accurate information concerning the utilization of NHIN by healthcare providers with an emphasis on benefits and barriers, the articles were determined to have satisfied the inclusion criteria. The literature search was performed by TG, CG, and JV and validated by AC who acted as a second reader and also verified that references met inclusion criteria. From a total of 62 initial results, 44 sources were considered suitable for use in the current study.

Stage 3: Literature Categorization

Those articles that were found to be relevant were then categorized using the adopted conceptual framework. The findings of the literature review are shown in the following sections of the results using the classifications of benefits and advantages of, as well as barriers to, NHIN adoption by healthcare providers.

RESULTS

Benefits and Advantages of NHIN

Increased Quality of Care

In 2013, 210,000 Americans died from preventable hospital errors, making it the third-leading cause of death in the U.S. (James, 2013). The most common and deadly medical errors are mistakes that take place with prescribing medication (Carter, 2012). The ability to electronically write and transmit prescription in the ambulatory setting is now mainstream and becoming the standard of care (Hillblom, Schueth, Robertson, Topor, & Low, 2014). In 2006, e-prescribing, the ability to electronically send an accurate, error-free and understandable prescription directly to a pharmacy from the point of care, was made available through HIE (CMS, 2014). Adverse Drug Events (ADE) affect nearly five percent of hospitalized patients, making them one of the most common types of medical errors (Boxer, 2013). HIE has greatly reduced the frequency of ADEs from known allergic reactions, by finding prior allergies that the patient may not have remembered, and improving the accuracy of the allergy list (Kaelber & Bates, 2007).

In 2014, a study on the enhanced checklists and electronic dashboards of an EMR system decreasing medical errors was published. Central line-associated blood stream infections among children rates dropped from 2.6 per 1,000 line days to 0.7 per 1,000 line days with the use of the EMR system (Pageler et al., 2014). With an implemented NHIN, physicians can easily access patient medical records to check any current medications patients are on, probe for any allergies and/or adverse drug interactions as well as review past visits to provider and examine medical test results (Crane & Crane, 2008). The fast and ubiquitous access to patient records and other medical information provided by the NHIN could reduce the number of medical errors due to inadequate information regarding a patient's history, prescribed medication, and current condition (Felder, Alwan, & Zhang, 2008).

Increased Communication

Patients play such a large role in determining both the need for care and the outcomes of care. There is a growing mindfulness that patients should be more participatory in successfully managing their own health and healthcare (Greene & Hibbard, 2012). According to Houston, Sands, Jenckes and Ford (2004), 82% of patients who used electronic based communication through NHIN stated that the experience as satisfying. More than 40% of these patients even answered they would be willing to pay a fee-per-email. The study also revealed that 95% of patients said email was more efficient than a telephone call and 40% stated it was a less intimidating forum to ask questions (Houston et al., 2004). NHIN has allowed the physician and patient to have more time to talk amongst another since the physician no longer has to contact various personnel to receive lab or test results and have more face-to-face time with patients (O'Malley, Cohen, & Grossman, 2010). The HIE, which is conducted through NHIN, has allowed patients and physicians to share information on an electronic chart such as test results. Patients who view their medical information regularly are more collaborative not only improving the patient-physician communication but relationship as well (White & Danis, 2013). Patients who are more engaged in their health have been more active participants in the therapeutic alliance collaboratively who manage their health with clinicians to improve factors such as pain reduction, functional outcomes, and medication adherence (Tang, Ash, Bates, Overhage, & Sands, 2006).

Cost Savings

Implementation of a NHIN using various EHR systems in primary care can result in a positive financial return on investment (ROI) to the healthcare organization. (Wang et al., 2003). In 2003, Wang et al. estimated cost savings of $86,400 per provider over a period of 5 years by using an EHR. Physicians who use commercially available EHR systems have been saving of $5.14 per patient per month (Information Management Journal, 2013).

Alder-Milstein et al. (2013) described a University of Michigan study that analyzed the impact of EHRs in community-based settings, including private practices and hospitals. Throughout the study researchers collected data from insurance agencies from the years 2005-2009 revealing that outpatient spending did not rise as fast in communities that had adopted an EHR system. Also, the findings of this study resulted in a three percent savings that could substantially increase if focus was pinpointed within the healthcare organization (Alder-Milstein et al., 2013). In 2008, Bar-Dayan et al. showed a 4.1% price decline, in overall expense, among specialty physicians who used an EHR system. The system made referral transfers more efficient, delivering needed information easier between primary care physicians and specialty physicians. EHR, used within the NHIN, can facilitate effective utilization of healthcare providers and decrease costs (Bar-Dayan et al., 2013).

BARRIERS TO NHIN ADOPTION

By interviewing 18 executives at 10 different healthcare organizations, Dobalian et al. (2012) found that concerns have been raised about the additional financial resources required for NHIN during a time when cost-cutting is a main focus of the healthcare industry. Areas of apprehension included setup costs of new infrastructure needed, alteration costs of existing technology to be eligible for participation, training costs to educate workforce on using the new technology, and hiring costs to handle the increased workload necessary for operation (Dobalian et al., 2012). The interviews also found that healthcare executives were worried about patient privacy and the misuse of data. These concerns were attributable to: (1) the confidentiality of patient information, especially in vulnerable populations, such as those with HIV, psychological disorders, or celebrity status; (2) HIPAA compliance and burdening legal departments with an even larger workload; (3) unauthorized use of patient data for public health; and (4) increased risk of data breach. It was determined that apprehensions existed among the interviewed healthcare executives concerning the interoperability of NHIN; inhibited data translation due to organizations' varying definitions and infrastructure requirements for data transmission and retrieval to outside parties were the main issues voiced (Dobalian et al., 2012).

Uncertain Costs Associated with Implementation

Kaushal et al. (2005) estimated that achieving NHIN required an initial capital investment of $156 billion over the course of 5 years, equal to 2% of total healthcare spending over that same time span. Two-thirds of this initial investment was for establishing functionalities such as EHRs, CPOE, and electronic prescriptions, among others. The remaining one-third of the initial investment was needed for establishing interoperability. In addition to this preliminary investment, $48 billion in cost was anticipated annually for continual operation (Kaushal et al., 2005). A 2007 study presented by Pan, Cusack, Hook, and Middleton estimated the cost of the initial deployment of HIE across NHIN to be $97 million. An additional $41 million in cost was estimated for annual maintenance-related costs (Pan et al., 2007).

In a 2009 survey of 131 RHIOs conducted by Alder-Milstein, Bates, & Jha, it was reported that an average of 25 months was required for operational RHIOs to reach a level where operating costs were covered by revenues generated from entities participating in data exchange. Only 41% of operational RHIOs reported the ability to cover operating costs with revenue generated from entities participating in data exchange. Of the operational RHIO respondents that were unable to operate at a level where costs were covered by revenues at the time of the survey, only 28% reported that they eventually expected to reach that level (Alder-Milstein et al., 2009). The main barrier to the development of RHIOs among survey respondents was a lack of funding; over 80% of planning RHIOs and nearly 60% of operational RHIOs indicated this as an important barrier. Of the 131 survey respondents, 34 RHIOs reported pursuing clinical data exchange in the past but were no longer pursuing it as of June 2008, equaling a RHIO failure rate of 20% (Alder-Milstein et al., 2009).

Patient Privacy and the Misuse of Data

HIPAA, the legal epicenter of the public and professional attention in the health care industry, prohibits health care entities and their employees from disclosing any health-related information about a patient without authorization from the patient or their medical power of attorney; additional data security systems are needed to protect this sensitive patient information while stiff legal and financial ramifications, along with a sullied public image, await violators of HIPAA (Hollar, 2009). Another legal aspect of the electronic exchange of Protected Health Information (PHI) within the U.S. is the Family Educational Rights and Privacy Act (FERPA), which states that a child's parent or legal guardian must authorize the release of the child's school records to any agency or individual that requests them, if the child is under 18 years of age. The child's school records oftentimes contain PHI pertaining to cognitive development and immunization records (Hollar, 2009). FERPA overrides HIPAA and requires EHR networks like RHIOs and NHIN to obtain the consent of parents and guardians of children under the age of 18, compounding the already-troubling issue of obtaining the consent of all individuals age 18 and older for exchanging PHI electronically (Hollar, 2009).

Rosenbaum, Borzi, Repasch, Burke, and Benevelli (2005) provided insight into rights and legal issues surrounding the electronic exchange of PHI, including the ownership of health information, disclosure of PHI, access to PHI by governmental agencies, and basic research access to patient records. An agreement was reached that HIPAA was designed to prevent patient confidentiality and discrimination abuse, though certain conflicts exist with HIPAA overruling states' efforts to safeguard PHI (Rosenbaum et al., 2005). The ownership of a patient EHRs has remained a major unresolved issue among patients, hospitals, insurance companies, and other shareholders in the U.S. health care industry (Rosenbaum et al., 2005).

Interoperability

While the importance of NHIN is widely recognized in the U.S., the storage of patient data has remained divided on which of the following two data storage architectures should be utilized: (1) the distributed or institution-centric model, where patient data is stored where it is created and inputted; or (2) the centralized or patient-centric model, where patient data is stored in one central location for a given patient (Lapsia, Lamb, & Yasnoff, 2012). In simulation studies aimed to analyze data availability, data integrity, and data retrieval failure rates for each of the architectures listed above, the distributed model fared poorly in data availability, integrity, and retrieval failure rates when compared with the centralized model of patient data storage architecture (Lapsia et al., 2012). The choice of patient data storage architecture impacted the efficiency, usability, and effectiveness of NHIN at the point of care,

given that both architectures studied are popular models utilized within the U.S. healthcare industry (Lapsia et al., 2012).

According to JM, the interviewed hospital information technology executive, NHIN implementation has faced challenges in maintaining interoperability. A characteristic of the U.S. healthcare industry is the non-standard language used in health information technology. The lack of a structured nomenclature for data in healthcare has inhibited the ability of organizations to effectively and efficiently exchange information across a nationwide network. Inconsistencies also exist among documentation included in a patient's EHR, where physicians provide a telling and lengthy narrative about the care provided to the patient and other healthcare personnel use shorthand notes in order to work as efficiently as possible. The inconsistencies in documentation techniques make it difficult on developers of architecture for NHIN because it is difficult to recognize text to include in a universal, recognizable language used in the exchange of a patient's PHI (James, 2005).

DISCUSSION

The purpose of this study was to examine and analyze the feasibility of a U.S. NHIN by exploring and determining the benefits of and assessing the barriers to its implementation. The results of the literature review have suggested that NHIN has had a positive effect on the U.S. health systems. The possibilities of advanced HIT are consistently growing, thus enhancing quality of care with factors such as interoperability and compatibilities between systems, therefore making it much easier to transmit imperative information through state and federal systems. The literature review supports the feasibility of the U.S. NHIN as well as significant savings for hospitals and providers. NHIN assures progress in accessing patient information and being able to transmit necessary information into the hands that need it. In fact, with the capabilities and progressiveness that NHIN has shown; NHIN allows patients to be able to go to different providers and have their medical information follow them without paper medical records which is pertinent to not alone patient but their providers.

From the literature review conducted the implementation of a NHIN would increase the quality of care by providers. NHIN permits HIE, which includes E-prescribing. E-prescribing has the ability to electronically send prescriptions rather than physicians having to hand write them. Medical errors will significantly reduce with the use of this system. The legibility of hand written prescriptions have been obstacles in the clinical field and often result in prescribing incorrect dosage and or drugs to patients. This hindrance is eliminated when prescriptions are electronically typed in and transferred. E-prescribing detects errors and contain alerts to make sure the right drug and dosages have been distributed which in return increases the quality of care. Along with E-prescribing HIE contains EHRs that contain patients medical history. Having access to a patients' medical history is very influential in the quality care that is given by the provider. Patients have easily forgotten received treatments and conditions they have previously had. The history that is offered by HIE help physicians in making decisions for the patients' treatment because they do not have to rely on their patients' memory.

Increased communication was also identified as a benefit from the literature review. The patient-physician relationship is important and communication is key. Communication is enhanced by NHIN with the HIE's e-mail messaging system between patient and providers. The results stated that 40% of patients stated that e-mail communication was a less intimidating way to communicate. If patients are comfortable with their physician communication is more likely to occur, and in a result physicians are more likely to treat, and appropriately. Along with the e-mail system, HIE offers access to test results for patients. Patients who have had access to test results are more concerned with their health. The access to such information gives initiative for patients to ask their physicians about their results and any other health concerns that may stem.

From the literature review, study has shown that there is significant savings in costs associated with the implementation of NHIN. The feasibility of NHIN has a noteworthy amount of cost savings of $86,400 in ROI over 5 years with the implementation of EHR within NHIN. The rate of outpatient spending has also decelerated with a 3% savings. This study suggests that NHIN is vital to hospital savings relative to costs.

The number of patient to physician ratio continues to escalate, physicians that have patients information already can open the door for other ways of communication amongst patients and physicians. NHIN can allow greater communication possibilities for advancement within HIT. For example, telehealth allows patients to see physicians online 24 hours of the day from their computer (i.e.. American Well). With NHIN's capabilities, it could be possible in the near future to allow those physicians to have access to the patients records. In return, quality of care more is

more efficient and effective. In addition, physicians can actually see what problems the patient has had in the past. This would allow physicians chances of diagnosing the problem correctly at a much faster rate than if a physician didn't know anything about a patient while decreasing costs on both ends.

As it was learned one size does not fit all especially when it comes to interoperability. In the early stages of NHIN, variances in states that have larger HIE's have taken on new characteristics. This has helped lead the way for solid groundwork with identity proofing/ authentication, addressing and secure routing for the states that are lower in the chain that may not be able to acquire for themselves without getting in the way of other HIE projects involving DoD, CDC, CMS, and others (McCloskey, 2010).

NHIN provides an abundance of advantages, the concept of everyone adapting is more challenging. In addition, some physicians do not like participating in Meaningful Use because it requires change and it is very costly and hard to meet (Kibbe, 2010). Meaningful Use is an incentive for physicians to show that physicians are using EHR efficiently and effectively. In fact NHIN Direct is easy to subscribe to and transmit important data. With NHIN, Meaningful Use criteria has allowed or is allowing data exchange to support care coordination, patient interaction/engagement, and submission of quality data to meet and lower costs (Kibbe, 2010).

This research study could be limited by the search strategy undertaken, the quantity of databases searched, and publication bias, which may have constrained the articles that were used in this study. Researcher bias may also have been an issue given that articles were searched for and evaluated by the researchers to establish their relevancy to this study. Published research on NHIN implementation is limited given that it is still in the developmental and trial stages across the U.S.

NHIN can grow substantially to be the cornerstone of HIE across the U.S. for all participants within the healthcare industry. It can produce cost savings opportunities, increase the quality of care that is being delivered to patients, and increase communication among patients, providers, and other industry stakeholders. Given that NHIN is still an emerging HIE technology that has gained momentum and support in the 2000s, further research is needed to assess the impact that NHIN will have on the healthcare industry, with a focus on providers and patients. A comparison of the effectiveness and efficiency of NHIN methods and frameworks provided by governmental organizations in the U.S. would progress the implementation and utilization of this new HIE technology by providing a standard for all to follow.

CONCLUSION

The findings of this study have suggested that the utilization of NHIN has the capability to generate opportunities for cost savings after investment for implementation, increase in quality of patient care, and increase in patient-provider communication. Nevertheless, barriers to NHIN implementation and utilization still remain throughout the healthcare industry, the main one being concerns about interoperability.

REFERENCES

Alder-Milstein, J., Bates, D., & Jha, A. (2009). U.S. Regional Health Information Organizations: Progress and challenges. *Health Affairs, 28*(2), 483-492.

Adler-Milstein, J., Salzberg, C., Franz, C., Orav, E. J., Newhouse, J. P., & Bates, D. W. (2013). Effect of electronic health records on health care costs: longitudinal comparative evidence from community practices. *Annals of Internal Medicine, 159*(2), 97-104.

ALN Medical Management (2010). Understanding the HITECH Act- Q&A's. Retrieved September 12, 2014, from http://www.alnmm.com/article/hitech-act-faq

Bar-Dayan, Y., Saed, H., Boaz, M., Misch, Y., Shahar, T., Husiascky, I., et al. (2013). Using electronic health records to save money. *Journal of the American Medical Informatics Association, 20*(e1), e17-20.

Boxer, B. (2014, May 10). Medical Errors. In *U.S. Senator Barbara Boxer, California*. Retrieved September 9, 2014, from http://www.boxer.senate.gov/en/press/related/MedicalErrorsReport.pdf

Bouhaddou,O., Bennett, J., Cromwell, T., Nixon, G., Teal, T., Davis, M., et al. (2012). The Department of Veterans Affairs, Department of Defense, and Kaiser Permanente Nationwide Health Information Network Exchange in San Diego: Patient selection, consent, and identity matching. In *AMIA Annual Symposium Proceedings, 2011*, 135-143.

Carter, J. H. (2014, September). How EMR software can help prevent medical mistakes. In *American College of Physicians* . Retrieved September 9, 2014, from http://www.acpinternist.org/archives/2004/09/emr.htm

Centers for Medicare & Medicaid Services [CMS]. (2014). Health information exchange and patient safety. Retrieved October 27, 2014, from http://www.cms.gov/Medicare/E-Health/Eprescribing/index.html?redirect=/eprescribing

Crane, J., & Crane, F. (2008). The adoption of electronic medical record technology in order to prevent medical errors: A matter for American public policy. *Policy Studies, 29*(2), 137-143.

Dimick, C. (2010). NIHN Direct. ONC keeps it simple in effort to jumpstart data exchange. *Journal of the American Health Information Management Association, 81*(6), 30-34.

Dixon, B., Zafar, A., & Overhage, J. (2010). A framework for evaluating the costs, effort, and value of nationwide health information exchange. *Journal of the American Medical Informatics Association, 17*(3), 295-301.

Dobalian, A., Claver, M., Pevnick, J., Stutman, H., Tomines, A., & Fu Jr., P. (2012). Organizational challenges in developing one of the Nationwide Health Information Network trial implementation awardees. *Journal of Medical Systems, 36*(2), 933-940.

Enrado, P. (2011). NHIN evolution to NwHIN: From the ground up. *HIEWatch*. Retrieved September 12, 2014 from http://www.hiewatch.com/perspective/nhins-evolution-nwhin-ground

Felder, R., Alwan, M., & Zhang, M. (2008). *Systems engineering approach to medical automation*. Boston, MA: Artech House.

Grady, A. (2012). Electronic Health Records: How the United States Can Learn From The French Dossier Medical Personnel. *Wisconsin International Law Journal*, 30(2), 374-400.

Greene, J., & Hibbard, J. (2012). Why does patient activation matter? An examination of the relationships between patient activation and health-related outcomes. *Journal of General Internal Medicine, 27*(5), 520-526.

Hillblom, D., Schueth, A., Robertson, S., Topor, L., & Low, G. (2014). The impact of information technology on managed care pharmacy: today and tomorrow. *Journal of Managed Care Pharmacy, 20*(11), 1073-1079.

Hollar, D. (2009). Progress along developmental tracks for electronic health records implementation in the United States. *Health Research Policy and Systems, 7*(3), 1-12.

Houston, T. K., Sands, D. Z., Jenckes, M. W., & Ford, D. E. (2004). Experiences of patients who were early adopters of electronic communication with their physician: satisfaction, benefits, and concerns. *The American Journal of Managed Care, 10*(9), 601-608.

Information Management Journal. (2013). Study Shows EHRs Do Lower Costs. *47*(5), 10.

James, B. (2005). E-health: steps on the road to interoperability. *Health Affairs*, *24*, W5-26-W5-30.

James, J. (2013). A new, evidence-based estimate of patient harms associated with hospital care. *Journal of Patient Safety, 9*(3), 122-128.

Kaebler, D., & Bates, D. (2007). Health information exchange and patient safety. *Journal of Biomedical Informatics, 40*(2007), S40-S45.

Kaushal, R., Blumenthal, D., Poon, E. G., Jha, A. K., Franz, C., Middleton, B. et al. (2005). The Costs of a National Health Information Network. *Annals of Internal Medicine, 143*(3), 165-W-138.

Kibbe, David. C. (2010, May 5). NHIN Direct: Getting to Health Internet, Finally! Retrieved from http://thehealthcareblog.com/blog/2010/05/05/nhin-direct-getting-to-the-health-internet-finally/

Lapsia, V., Lamb, K., & Yasnoff, W. (2012). Where should electronic records for patients be stored? *International Journal of Medical Informatics, 81*(12), 821-827.

McCloskey, P. (2010, March 11). States' roles will shift in new NHIN landscape. *Government HealthIT*. Retrieved October 20, 2014 from http://www.govhealthit.com/news/states-roles-will-shift-new-nhin-landscape

Office of Mental Health (2012). In *Health Insurance Portability and Accountability Act (HIPAA)*. Retrieved September 11, 2014, from http://www.omh.ny.gov/omhweb/hipaa/

Office of the National Coordinator for Health Information Technology [ONCHIT]. (n.d.a). *Nationwide Health Information Network Exchange?* Retrieved October 7, 2014, from http://www.healthit.gov/sites/default/files/pdf/fact-sheets/nationwide-health-information-network-exchange.pdf

Office of the National Coordinator for Health Information Technology [ONCHIT]. (n.d.b). *What is the NHIN?* Retrieved September 11, 2014, from http://www.healthit.gov/sites/default/files/what-Is-the-nhin--2.pdf

Office of the National Coordinator for Health Information Technology [ONCHIT]. (2013). *Nationwide Health Information Network (NwHIN)*. Retrieved September 11, 2014, from http://www.healthit.gov/policy-researchers-implementers/nationwide-health-information-network-nwhin

Office of the National Coordinator for Health Information Technology [ONCHIT]. (2014). *DIRECT Project*. Retrieved October 7, 2014, from http://www.healthit.gov/policy-researchers-implementers/direct-project

O'Malley, A. S., Cohen, G. R., & Grossman, J. M. (2010). Electronic medical records and communication with patients and other clinicians: are we talking less? *Issue Brief Center for Studying Health System Change*, 131, 1-4.

Pageler, N. M., Longhurst, C. A., Wood, M., Cornfield, D. N., Suermondt, J., Sharek, P. J., et al. (2014). Use of electronic medical record-enhanced checklist and electronic dashboard to decrease CLABSIs. *Pediatrics, 133*(3), e738-746.

Pan, E., Cusack, C. M., Hook, J. M., & Middleton, B. (2007). *Cost of interconnecting health information exchanges to form a national network.* Paper presented at the American Medical Informatics Association 2007 Symposium.

Rosenbaum, S., Borzi, P., Repasch, L., Burke, T., & Benevelli, J. (2005). Charting the legal environment of health information. In *Proceedings of Legal Environment for Emerging Information Systems and Implications for Access to Quality and Disparities Data.* Washington, D.C.: The George Washington University, School of Public Health and Health Services, Department of Health Policy.

Sullivan, T. (2012, March 15). ONC to stand up NwHIN Exchange in October. *Government HealthIT*. Retrieved September 12, 2014 from http://www.govhealthit.com/news/onc-stand-nwhin-exchange-october

Tang, P. C., Ash, J. S., Bates, D. W., Overhage, J. M., & Sands, D. Z. (2006). Personal health records: definitions, benefits, and strategies for overcoming barriers to adoption. *Journal of the American Medical Informatics Association, 13*(2), 121-126.

United States Department of Health and Human Services [USDHHS] (2010). *Nationwide Health Information Network (NHIN) Exchange: Architecture Overview, Draft v.0.9*. Retrieved September 11, 2014, from http://www.healthit.gov/sites/default/files/nhin-architecture-overview-draft-20100421-1.pdf

U.S Department of Health and Human Services [USDHHS].(2012). *What is a regional health information organization (RHIO)?* Retrieved October 7, 2014, from http://www.hrsa.gov/healthit/toolbox/RuralHealthITtoolbox/Collaboration/whatisrhio.html

Vest, J., & Gamm, L. (2010). Health information exchange: persistent 706 challenges and new strategies. *Journal of the American Medical Informatics Association, 17*(3), 288–294.

Wang, S. J., Middleton, B., Prosser, L. A., Bardon, C. G., Spurr, C. D., Carchidi, P. J., . . . Bates, D. W. (2003). A cost-benefit analysis of electronic medical records in primary care. *The American Journal of Medicine, 114*(5), 397-403.

White, A., & Danis, M. (2013). Enhancing patient-centered communication and collaboration by using the electronic health record in the examination room. *Journal of the American Medical Association, 309*(22), 2327-2328.

Yao, W., Chu, C. H., & Li, Z. (2010). The use of RFID in healthcare: Benefits and barriers. In *RFID-Technology and Applications (RFID-TA), 2010 IEEE International Conference,* 128-134.