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Mobile access for patient centered care: The challenges of activating knowledge through health information technology

Sajda Qureshi
University of Nebraska at Omaha

Cherie Noteboom
Dakota State University

Alice Schumaker

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Mobile Access for Patient Centered Care: The Challenges of Activating Knowledge through Health Information Technology.

Sajda Qureshi, PhD
College of Information Science and Technology, University of Nebraska at Omaha, NE
squreshi@unomaha.edu

Cherie Noteboom, PhD
College of Business Information Systems, Dakota State University Madison, SD
Cherie.Noteboom@dsu.edu

Alice M Schumaker, PhD,
College of Public Health
Nebraska Medical Center Omaha, NE 68198-4355
amschumaker@unmc.edu

Abstract

With the growing use of mobile technology to access health information, patients are being empowered in their healthcare choices. While specific mobile applications are becoming available for patients to manage their own care, most treatment processes support healthcare professionals and offer little support for patient centered care. In order to address this problem, federal regulations require providers to become "meaningful users" of Health Information Technology (HIT) in an effort to encourage patient centered care through the assessment of health outcomes.

This paper contends that addressing meaningful use practices for patient centered care involves the activation of knowledge, which means bringing knowledge into action. A survey of 73 health care providers sought to discover how their knowledge activation affects patient centered care. The results suggest that current HIT usage by providers has limited knowledge activation. The contribution of this research is in that it identifies areas that would to bring about improvements in patient centered care and a model that shows how mobile access to patient records could potentially streamline the patient care process.

1. Introduction

An average of 16.9 million people used mobile phones to access health information per month in the US, which marks a 125 percent annual growth rate [15]. The increased popularity of smartphones has led more patients to proactively manage their care while on the go using specific mobile applications containing functionalities such as a Global Positioning System (GPS) tracker for Alzheimer's patients, not available on desktop computers [15]. Motivated by rising costs of healthcare, patients can achieve significant improvements in their health outcomes when they use mobile applications. There are currently over 3000 mobile applications available through Google Playstore and Apple Store to patients all over the world that support lifestyle changes such as fitness, a calorie counter and Body Mass Index calculators some of which

are used to control diabetes. Even the American Medical Association has released mobile applications, including patient focused My Medication, which enables medication updates, dosing and scheduling [15,21].

Despite the rise in mobile health applications, little research has been done to connect the growing mobile application use by patients to the established healthcare processes in hospitals and clinics. Current research focuses on physicians and other providers assessing their use of Electronic Health Records (EHR) to support health outcomes for patients [9,16,25,41]. These studies have found that when providers use Electronic Health Records to manage and monitor patients, their health outcomes do improve as long as the use of technology is accompanied by management of care [9,25].

While the development of mobile applications for accessing personal health records has grown, research on their usage has been limited. Current research on the use of mobile applications focuses on the self-management of specific conditions by patients [21,23]. Such mobile applications focus on dietary assessment tools for weight loss and management of body mass index. Few, if any, connect the mobile application to the patient health record or the physicians' EHR. In a study by Quinn et al.[36], mobile phones were used in a tightly controlled sample of 250 patients across 36 physician practices, to monitor patient glucose levels. In the intervention groups, the mobile phones were used to communicate information to and receive feedback from the providers. They concluded that active-self management was central to achieving diabetes control.

In order to promote patient care through the use of technology, government legislation in the United States has mandated healthcare providers to become *meaningful users* of electronic health records technology. *Meaningful use* entails that it "should improve quality, safety, efficiency, and reduce health disparities; engage patients and family; and improve care coordination, and population and public health." [26, p.1].

There is a gap in the literature between the use of technology to manage care by physicians and other

providers and the participation of patients in the management of their own care through mobile applications. This gap is investigated in this paper by investigating healthcare delivery by providers as they attempt to provide more patient centered care. In addressing the gap in the literature and government legislation on meaningful use of electronic health records, we contend that patient centered care can be improved by enabling established healthcare processes to include patient use of mobile applications.

The question investigated is: *how can mobile access to patient records be used to improve healthcare outcomes?* This question is investigated through a survey of 73 providers in a Mid-Western hospital who are required to become meaningful users of electronic health records. Qualitative data were collected and analyzed to arrive at labels and categories of patient care. The categories were explained through excerpts from transcript data to arrive at a model of Mobile Access to Patient Records. The contribution of this research is in the identification of areas that would bring about improvements in patient centered care and how mobile access to patient records could potentially streamline the patient care process.

2. Theoretical Background

While the technology has the potential to increase the quality of healthcare and reduce its costs, it appears a key challenge relating to the content of the Electronic Health Record is the exchange of data, data analysis, and sharing diagnosis and treatment information from the physicians to the people who need it. The multi-disciplinary nature of the healthcare providers and the large amount and multifaceted information they require contributes to the challenge. One of the main challenges to meaningful use is the multiplicity of actors and stakeholders involved in healthcare delivery processes. Given the multi-disciplinary nature of the healthcare providers, it appears that the physician is at the center of care provision and also the bottleneck according to Clifton [11].

From a public health perspective, patient centered care requires ''a partnership among practitioners, patients, and their families (when appropriate) to ensure that decisions respect patient's wants, needs, and preferences and that patients have the education and support they need to make decisions and participate in their own care'' [39]. Robinson et al. offers an economic view of the patient as the informed consumer who makes decisions based on cost and quality of care. They also identify care from a patient's perspective to include "respect, courtesy, competence, efficiency, patient involvement in decisions, time for care, availability/accessibility, information, exploring patient's needs, and communication" [39, p. 602]. It appears that in order to address these views,

meaningful use of patient health records (PHR) will need to be customized for patient-centered care.

Healthcare provision in the United States is currently undergoing a transformation that promises to address the high cost and decreasing quality of care. At the center of this transformation is the Electronic Health Records (EHR) technology, mandated by the Health Information Technology for Economic and Clinical Health Act (HITECH). This act authorizes incentive payments through Medicare and Medicaid to clinicians and hospitals when they use EHRs privately and securely to achieve specified improvements in care delivery. The road to patient-centered care is paved through HITEC as supported through incentives for proper usage by hospitals and clinicians. In addition, major incentives are available through the American Recovery and Reinvestment Act, passed in February 2009, which included a very large stimulus payment for eligible providers, hospitals and physicians for the adoption of EHRs. However, if providers do not become meaningful users of EHRs by 2015, penalties will be triggered through reduced Medicare payments.

The transformation of health care through the use of Health Information Technology continued with the passing of the Patient Protection and Affordable Care Act of 2010, which mandated the integration of physician quality reporting and Electronic Health Record reporting. This Act required the creation of measures and reporting of the "*meaningful use* of the electronic health record" and "quality of care furnished to an individual." In doing so, the law links the adoption of the electronic health record with quality of care to the patient through objectives that measure the adoption of technology by eligible providers. Core objectives of the act include identifying basic functions that enable EHRs to support improved health care, progress toward supporting advanced processes such as providing patients with increased online access to their records and measuring improved outcomes [7].

2.1 Healthcare Management & Meaningful Use

In order to achieve meaningful use of technology in patient centered care, patients need to take on a greater role in management of their care. This is possible through information made available from Electronic Health Records through HIT products such as home health devices and patient portals that enable better disease management through tracking of comprehensive health indicators. This has the overall potential to lower the cost of care [10]. Meaningful use processes include the tasks essential to creating any medical record, including the entry of basic data: patients' vital signs and demographics, active medications and allergies, up-to-date problem lists of current and active diagnoses, and smoking status [7]. According to the Office of the

National Coordinator for Health Information Technology (2014), there are three stages of meaningful use practices for Electronic Health Records.

Stage I involves data capture and sharing which comprise the variables most clinics measure. This stage involves electronically capturing health information in a standardized format, using that information to track key clinical conditions, communicating that information for care coordination processes, initiating the reporting of clinical quality measures and public health information and using information to engage patients and their families in their care. Meaningful use stage I's objective is to ensure all providers eligible for reimbursement made use of Health Information Technology , primarily comprised of Electronic Health Records , Patient Health Records, and tele-health technologies which were all designed for the providers.

Stage II meaningful use practices involve Advance clinical processes to be implemented in 2014. This stage involves more rigorous health information exchange (HIE), increased requirements for e-prescribing and incorporating lab results, electronic transmission of patient care summaries across multiple settings, and more patient-controlled data. Objective 7: "Provide patients the ability to view online, download and transmit their health information within four business days of the information being available to the EP." [26, p.1]. Meaningful use stage II moved a step further to ensure that advanced clinical processes are integrated with patient health records and other processes that lead to direct improvements in the quality of care. At this stage, patients are to be given online access to their health records through the Patient Health Records (PHR) technology often known as a patient portal.

Stage III meaningful use practices involve the measurement of improved outcomes that are due to be implemented in 2016. This stage involves Improving quality, safety, and efficiency, leading to improved health outcomes, decision support for national high-priority conditions, patient access to self-management tools, access to comprehensive patient data through patient-centered Health Information Exchanges and improving population health [24].

The stage III objectives target the use of HIT for improved healthcare and identification of areas in a population that need healthcare interventions. The infrastructure upon which these tools are built necessitate hospitals and clinics to possess administrative and technical expertise to manage, maintain and upgrade these systems – which tend to become very large. Other than providing patients with some access to their health records, there is little support at present for patient centered care and outcomes.

Understanding the healthcare context is key to understanding the integration of Information Systems (IS) into the fabric of organizations. According to Fichman et al., at the most general level, 'a striking feature of healthcare industry is the level of diversity that characterizes patients (e.g. physical traits, and medical history), professional disciplines (e.g. doctors, nurses, administrators and insurers), treatment options, healthcare delivery processes and interests of various stakeholder groups [18, p. 419]. This diversity in healthcare means that the patients end up coordinating the different professionals, treatment options and stakeholder groups, but have little input into their healthcare delivery process.

2.2 Patient Centered Care

Patient-Centered care is seen to be a natural progression towards greater efficiency and effectiveness in healthcare provision. This form of care is one in which the patient actively participates in his or her care, delivery of care takes place from a patient's point of view, there is greater communication with the patient and therapy is tailored to the needs of the patient [32,40,41,42]. The implementation of Health Information Technology (HIT), in particular the Patient Health Record (PHR), may appear to enable greater patient centered care through better access to patient data, shorter recovery through targeted care, lower cost through fewer tests and increased meaningful use practices [7,10,42].

In order to enable patients to become more involved in their care, beyond coordinating the different components of their care, the healthcare delivery process needs to be more centered around the patient. Patient centered care implies a paradigm shift in the relationship between doctors and patients, but also requires the development of patient-oriented research [40].

The literature on patient centered care suggests that it requires that processes and treatment options be customized to patients' needs. But there is little agreement as to what those patient centered outcomes are and how they should be assessed. This is due to the complexity of the healthcare delivery which is in a tension between routine and variable processes. Healthcare information technologies support some of these processes but are often dispersed over multiple platforms that prevent information from being shared amongst the multiple stakeholders, including the patients, who stand to benefit the most from the sharing of their information among their care providers.

Patient centered care relies on physicians capturing the benefit from EHRs to collaborate with other medical practitioners ensuring that care is improved. In practice, this is a challenge when physicians resist technology, rely on other medical personnel to communicate with the patients and are accustomed to offering standardized therapies instead of those targeted to the patient's needs. The literature indicates physicians resist the technology due to productivity issues, workflow challenges, lack of

support and other issues related to the mismatch between the technology and healthcare delivery process [1,3,4,19,31,33].

According to Clifton [11], healthcare in America costs 2.5 trillion dollars a year and is expected to grow to 4.5 trillion in six years. The Institute of Medicine [27] reported that the U.S. healthcare system is "fundamentally broken" and called on the Federal Government to make a major investment in information technology in order to achieve the changes, such as the "commitment to technology to manage the knowledge bases and process of care" [27, p. 178]. According to the Agency for Healthcare Qua7lity and Research, automation is able to improve the quality and safety of care delivered by healthcare facilities by enabling collaboration among physicians, medical personnel and patients.

Kane and Labianca [28] add that "patient-level data are particularly valuable for the quality of care metrics, because individual patient characteristics play a significant role in determining care results (e.g., how faithfully the patient follows the doctor's recommendations). If patients fail to manage their chronic diseases adequately, escalating conditions can become extremely expensive to treat and can significantly compromise the patient's quality of life." [28,p. 510].

2.3 Knowledge Activation

In order for physicians and healthcare providers to provide care to patients, they need to bring their knowledge into action. According to Qureshi and Keen [37], knowledge activation is "the conversion of knowledge into action." Activating knowledge is about finding people with relevant knowledge and using it effectively through their willingness to provide, access, and share it as and when needed." [37,p.41]. There are three types of knowledge identified in a person: 1) accountable which is part of individuals' professional lives; 2) discretionary which is theirs to share voluntarily; 3) autonomous which forms from their private experience. These identities determine the willingness of people to communicate and share. Noteboom and Qureshi [34] found that successful adaptation of the EHR by physicians requires the capacity to enable physicians to activate all three levels of knowledge for use in their work processes. The physician's adaptation of the technology can enable better knowledge activation as they assess and verify the data, solve problems and find innovative solutions to the conditions for which there are few treatments. It is the ability to enable physicians to do more than just record data, but to enable them to share knowledge that is an integral part of themselves' and knowledge they are unaware of incorporating into their awareness.

Activating knowledge requires that there be demand for it. For instance, when a patient with symptoms that need to be treated visits the physician, this creates demand

for action. Demand for action triggers collaboration between people who then activate their knowledge to bring it into action. In order to provide meaningful patient centered care, physicians and other care providers need to collaborate. Collaboration is a purposeful joint action through the construction of relevant meanings that are shared among members. Collaboration is needed to: 1) determine what action is required and relevant; 2) identify knowledge to carry out a required action; 3) meet the demand for action [37]. There are many incentives to share accountable knowledge, which is part of responsibility and position. There is less incentive to share discretionary and autonomous knowledge, which is personal and in many instances can be tacit information the owner is unaware of possessing or the owner may carefully guard as a component of his or her identity.

In order to achieve patient centered care, healthcare management needs to develop meaningful use of HIT. In order for physicians and healthcare professionals to achieve meaningful use practices, they need to use HIT to activate their knowledge. In other words, meaningful use of HIT comes about when physicians are able to activate knowledge and bring it to bear on effective patient care. These concepts are summarized in the following figure 1:

Figure 1: Theoretical concepts

Concept	Definition
Patient Centered Care	Efficiency of care, patient satisfaction, and quality of care (Gabiriel and Normand 2012, Kane and Labianca 2011, Ginneken 2002, Greenhalgh et al. 2009, Robinson et al. 2008, Stewart et al. 2000).
Healthcare Management	Prevention, Diagnosis, treatments, and medication compliance. (Eichelberg et al 2005, Fichman et al. 2011, Fontaine et al 2010, Gabriel and Normand 2012, Ginneken 2002, Greenhalgh et al. 2009, Kohli, Kettinger 2004, Linsky and Simon 2012).
Meaningful Use Practices	Data capture and sharing, Advance clinical processes, Improved outcomes (Blumenthal and Tavenner 2010, DesRoches et al 2010, DesRoches et al 2013).
Knowledge Activation	Accountable, Discretionary and Autonomous (Qureshi and Keen 2005).

Effective patient-centered care is about the identification of the best intervention for every individual patient using personalized medicine and tailored therapeutics [40]. However, current medical work practices revolve around the providers, standardized practices and treatment options [1,2,12,13,28]. Kane and Labianca [28] offer a multi-level view of IS avoidance in healthcare groups and suggest that a key to enabling better use of the technology

among and between healthcare providers and patients is by enabling people central to the healthcare group to overcome the detrimental effects of IS avoidance on quality and efficiency. The avoidance of information systems by healthcare providers, patients and physicians is beyond simple non-use and has to do with a number of factors at the individual, group and organizational levels [12,13,28]. These factors affect IS avoidance at the patient level, doctor level and group level. This paper focusses on IS avoidance at the physician level, as they control the information available to patients, their therapies and which additional healthcare professionals get involved in the patient's healthcare outcome.

3. Methodology

In order to investigate the use of HIT by physicians for providing patient-centered care, a survey was carried out and analyzed using the concepts described above. The participants in the study were identified as health care professionals or physicians, pharmacists, and residents, representing various different specialties in a Midwest medical center setting. The hospital is a 272 bed tertiary facility and a member of a large U.S. Catholic healthcare system. Participants in the study included the following: Pharmacists Hospitalists, Family Practice Residents, Pharmacy Residents, Family practice clinics (Family Medicine physicians), Pathologists, Wound Care, Internal Medicine, Cardiology, and Emergency Medicine.

The data collection process consisted of an email invitation sent directly to the participant's email account. A Survey Monkey link was presented in the email invitation to enable the participant to access the survey instrument. The hospital directors and/or clinic managers were informed of the survey and requested to encourage participation and were advised of all survey activity. Prior to administering the survey, an Institutional Review Board examined the questions and the survey administration protocol. All institutional procedures were followed for data collection. Out of the 96 physician invitations sent, 73 respondents voluntarily participated in the survey. There were 29 female respondents and 44 male respondents. Observations from 5 medical students were excluded due to "student" status and lack of experience in the field. In the final 68 respondent dataset, there were 24 female and 44 male respondents. The average age of a respondent was 43.597 (round to one decimal) years with a median of 41 and a mode of 42. Of the 68 respondents, 60 noted they had previous experience outside their facility with EHR or computerized entry systems, with an average of 5.6 years in healthcare experience of the 58 who responded with their time spent in healthcare.

The survey data were tabulated according to the concepts identified in the literature. The remaining open ended responses were analyzed through grounded theory methodology. Open coding was used to analyze the data and develop concepts as they relate to physician interaction with EHRs. The qualitative method and open coding analysis enables discovery of the relationships in the real world situation.

Open coding was used to identify "labels of meaning" and placed next to the relevant occurrence. Occurrences were events, happenings, actions, feelings, perspectives, actions and interactions. Categorization of the coding was done in two phases. First, the data obtained from the interviews were labeled and then, second, they were sorted into broad categories. This process was carried out by two coders. This process of theoretical sensitivity allows the researchers to have insight into and to give meaning to the events and happenings in data. "Insights do not just occur haphazardly; rather, they happen to prepared minds during interplay with the data [43, p. 47]." The theoretical concepts from Figure 1 were used to guide the categorization of labels in the analysis.

4. Results and Analysis

The results of open coding led to a series of labels that provide meaning to the occurrence of that label in the transcripts. A total of 165 labels were uncovered. These labels were then categorized through theoretical sensitivity established by the theoretical concepts in Figure 1. The result of this analysis is depicted in Table 1 entitled "Categories of patient care" below.

Table 1: Categories of patient care

Category	Labels	F(x)	/%age
Knowledge Activation	Efficient and correct orders, Patient data from multiple locations, drug interactions integrated, rapid response to execute orders, consistent and widely available data to providers and caregivers	45	27%
Knowledge Activation Difficulties	Over documentation, mistakes difficult to rectify electronically, massive time commitment, too much to enter physician notes and orders, pharmacy cannot access or dose, finding information difficult, incomplete orders.	48	29%
Physician Productivity	HIT Takes Away Human Interaction, more time consuming, takes longer to chart patients, takes away from patient care.	43	26%
Patient care	Increase in medical errors, need for training, security privacy concerns, charting everywhere HIPPA Concern, inaccuracies, copy paste results in misinformation	29	18%
	Total	**165**	**100 %**

4.1 Activation of Knowledge

Results of the open coding indicate that activation of knowledge did take place using the electronic health record for the purposes of providing basic care. When a patient comes in with symptoms, *demand for action* is triggered requiring healthcare providers (with differing professional roles, training, and experience), to work together to diagnose and treat the patient. We found 45 instances which accounted for 27% of the labels sorted into this category. Instances of these labels were comments relating to how physicians used the electronic health records to bring their knowledge to bear on addressing the patients care. Examples of such comments are:

"Having physician notes and labs readily available, to see if patient is improving or not improving."
"[The technology enables] seeing their home medications."
"Rapid response to order entry from floors."
"Immediate access to a patient's record by multiple members of the healthcare team."

An important component in activating knowledge for patient care is *collaboration*. Collaboration among multiple providers, care givers and professionals is needed when carrying out care. The results suggest that the HIT did enable collaboration as illustrated in the following:

"if pharmacy has a question regarding an order it is helpful that the nurse or physician can be looking at the same data where ever they might be - this can help speed up the process of clarifying questions related to medical orders."
"I like having instant access to any part of the health record. Looking up labs, H&P's,multiple users can be looking at chart at same time."
"Communicating between different providers is made easy."
"More than one personnel can look at a patient info at the same time."

Once demand for action has triggered collaboration among the healthcare providers, they still need to bring their knowledge into action in order to treat the patient. Our results suggest that the technology codifies the basic data through which Accountable knowledge is activated by the providers. Comments relating to the activation of Accountable knowledge are provided in the comments below:

"Easy access to flow sheet type reports related to chronic 02 (i.e. diabetics summary sheet listed last."
"It is easier to pull up patient info such as previous tests and consults quickly."
"Historical data and availability in reference to other departments."

"Access to demographics."
"Rapid availability of old records. lab data, xray, etc. For us, access to patient histories."
"The ability to look up information regarding a patient's medical history at any point."

These comments pertain to Accountable knowledge codified in charts, medical histories and demographics. We did not find any indication of discretional knowledge pertaining to how a diagnosis was arrived at, treatments or processes pertaining to patient care. Discretionary knowledge is often experiential and related not just to the experience of a physician but is also developed through the management of care by the care providers and the patients. For example, a provider with experience with a certain symptom will arrive at a correct diagnosis without the need for multiple tests as opposed to a less experienced provider. There was also no indication that autonomous knowledge, that of a personal nature, was shared or used in the treatment. For example, a patient may pursue other treatments or lifestyle changes that preclude them from taking certain medications. Prescribing these may cause more side-effects that could potentially worsen the patient's condition.

4.2 Difficulties in Activation of Knowledge

Our coding found 48 instances or 29% of the total occurrences of difficulties with activating knowledge using the HIT. These related mostly with the ways in which the technology was used and the restrictions it imposed on the providers. Some examples of comments that relate to difficulties in activating knowledge are as follows:

"Allows all users to quickly enter pre-specified/template notes, which in turn results in in very little pertinent history and data in progress notes leading to little detail for visits."
"Easier to make mistakes.
"When electronic medical record systems are down, patient care comes to a halt."
"Templates causing inaccurate notes, slowing ability to see patients and interfering with doctor patient
"Design based primarily on IT concerns, rather than clinical workflow."
"Massive time commitment required to maintain EHR to be congruent with current practice and guidelines; on part of clinicians and IT staff."

These comments suggest that the technology may also have taken away from the ability of physicians to bring their knowledge into action when treating patients.

4.3 Physician Productivity

The difficulty in activating knowledge using the HIT also affected the physician's productivity in a negative manner. Our coding analysis found 43 instances of physician productivity negatively affected by the

technology which accounts for 26% of the total number of labels. Comments made by physicians sorted under this category are as follows:

"Too much time spent not on direct patient care."

"Dictating physician plan of treatment and work-up of patients with pre-set algorithms. This decreases efficiency and interferes with timely patient care."

"Time spent by providers attending the computer but not patients."

"Takes time away from hands on care."

"Design based primarily on IT concerns, rather than clinical workflow. "

"Downtime procedures and negative impact of downtime on the EHR."

"Massive time commitment required to maintain EHR to be congruent with current practice and guidelines; on part of clinicians and IT staff."

"The time it takes physician notes to be entered into the system."

"Physican has 'pharmacy to dose varamycin'. The Rph looks at patient notes for a 'history', sometimes, nothing is there! We need to see the whole picture if we are supposed to be able to dose patient."

These comments suggest that the HIT does not match the physician's work process. If the providers are unable to use the technology to support their work processes, the impact on patient care could be affected negatively.

4.4 Patient Care

The effect on patient care was found to be influenced by patient safety, training of providers to use the technology, HIPPA and privacy concerns. These labels accounted for 29 instances or 18% of the total. Examples of comments sorted into this category are:

"I have seen increase in medication errors with the system. It is harder to find information. Scanned results are difficult to find. Summary of problems is a mess with many incidental visits. OTC meds are mixed in with prescription meds, and often discontinued short term medications."

"Less security and more access to government and insurance companies to information that is none of their business."

While treatments tend to be standardized and based on data from test results, patients with the same symptoms and conditions have very different personal characteristics, combinations of conditions, which require different types and combinations of medications. This means that patient centered care would have to customize medical procedures and treatments to the needs of the patient. The following comments suggest that there may be a role for the electronic health record in enabling more patient centered care.

"Patient safety is enhanced. Records are readily available (even for past admissions going back years)."

"Immediate access to records."

"Overall organization and ability to locate information quickly."

"Approximately 20% of drug orders require manipulation, time changes, allergy inquiry, order change, comments don't match the order, duplication removal, therapeutic inquiry by the pharmacist, and many other issues before the order is completed."

The challenges of designing technology to suit the work practices of the physicians while enabling patient centered care would require infrastructure and processes that enable more mobile access to healthcare delivery.

## 5. Mobile Patient Record System

The analysis above has shown that access to patient records is limited due to the difficulties in activating physicians' knowledge through the electronic health record which then limits their productivity and affects the quality of patient care – often in a negative way. In addition to the long wait times experienced by many patients, the technology has meant that the physicians, who are at the center of the healthcare process, spend more time in front of the computer than examining the patient.

As described by Pardue et al. [35], the treatment process rarely takes into account input from the patient. Other than the recording of symptoms, test results and physicians examination, patients are left in the dark as to the nature of their treatments and the nature of any progress they may have. After the physicians examine patients, they order tests and offer treatments to address the condition. In its current form, the health record contains information entered by the physicians and their representatives. A selected portion of that information is made available in the form of a PHR to the patient. The current process does not allow inputs from the patients, nor does it enable patient centered therapies to be designed as there is no feedback loop through which patients may enter information to the PHR or offer feedback to the physicians as to the progress of their care. In this system, the physicians monitor a condition based on the results of tests and standardized therapy outcomes.

It is thus not surprising that government- mandated online access to patient records has been rudimentary at best. In particular, objective #6 of the Stage II Meaningful Use Practices state: "Provide patients the ability to view online, download, and transmit information about a hospital admission." (Centers for Medicare and Medicaid Services, p1. 2014). Despite this mandate, only basic lab results are usually shared with patients making it difficult for them to access any other test results or specialist reports that they may have paid for.

Based on the analysis of this research, we offer the following model that would enable the Electronic Health Record and Patient Health Record, both of which depend on physician's orders, to become more patient centered through mobile access. The Mobile access would enable additional input from patients to be taken into account in developing, monitoring, and altering treatments. At the same time, the mobile technology enables active self-management of care by the patient. The model to enable this mobile access and active self-management is illustrated in the model in Figure 2:

Figure 2: Model of mobile patient record system
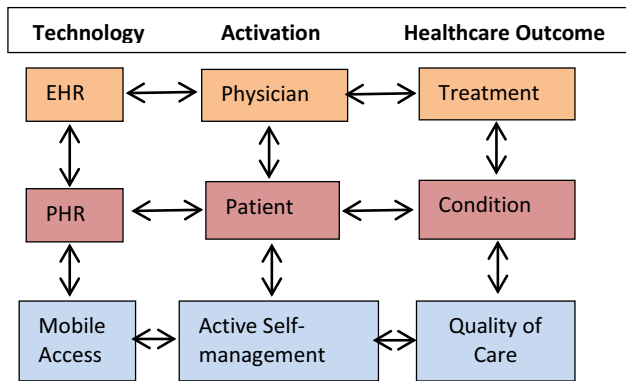
This would involve not only access to the electronic health record but also its use by patients in their daily lives as they go through their condition. This would also entail physicians taking inputs from patients as they monitor the condition.

Physicians and healthcare providers tend to have a mobile work process where they move between patients, clinics, hospitals and long-term care. Our analysis has shown that the current HIT does not support a mobile work environment. In addition, putting the patient back in patient care would entail not just sharing their data but also involving them in their care. Otherwise the patient may not survive the hospital visit as described in a case by Pardue et al. [35].

Patient centered care entails greater access by patients to their records. While this is still in its infancy, patients are beginning take advantage of the small amount of information made available to them online. In the course of a treatment, patients will also move between care facilities and providers. If they are to make use of their information, they will also need mobile access to their information

6. Recommendations for Action

Connecting mobile applications, such as those for diabetes control, and weight loss to a patient health record could enable basic patient data to be accessed and updated by the patient. The accuracy of the data would be monitored by the sensors on the mobile application. In theory, the quality of care would be affected in a positive manner as the condition could be treated more easily and without additional tests and treatments. A benefit would be a reduction in time spent entering data and orders on the electronic health record. As the patient would be allowed to enter information pertinent to their care, other health care professionals will be able to bring their knowledge to bear on the condition and arrive at therapies without depending on the physicians input. The combination to technology, multiple inputs to the HIT and collaboration between the healthcare professionals can potentially enable more efficient and effective provision of healthcare.

By connecting mobile applications and access to patient health records the challenges in the exchange of data, their analysis, and sharing, diagnosis and treatment information from the physicians to the patients and other care givers who need it would bring about patient centered care.

7. Conclusions, Limitations and Implications for Further Research

The meaningful use of Health Information Technology, in particular Electronic Health Records, for the improvement of healthcare delivery has been plagued with uncertainty and has brought about mixed results. This research has shown that the non-routine nature of healthcare processes and the variability of treatments and patient needs, has meant that the technology is often unable to adequately support the healthcare delivery processes. The analysis of this research has shown that activation of knowledge can be improved by integrating mobile access to patient records with the current electronic health records mandated by government legislation on meaningful use practices.

Lessons learned from this research are twofold. First, the HIT infrastructure encompassing the EHR and PHR need to be modified to include inputs from patients and communication with the other healthcare professionals involved in the therapy. At the moment only the physicians and their representatives communicate with patients. If the clinics are achieving high scores on the meaningful use practices identified by Blumenthal and Tavenner [7], DesRoches et al [12], DesRoches et al. [13], we posit that patient centered care will increase. Activation of knowledge is enabled when there is a request for information by the patient or healthcare professional and that information is not just communicated but also brought into action when carrying out care for the patient. This supports the patient's self-management of their care.

Limitations of this research are in that this is a single study in which the survey of providers who use technology can change given how successful the

implementation of government legislation. Further research involving the assessment of knowledge activation can throw light into the type of interactions that need mobile application support. If the providers score high on the knowledge activation scales in our instrument, then the increase in patient centered care will be even higher. If the use of health information technologies (EHR and PHR), are used to manage healthcare, with the patients in prevention, diagnosis, treatments and medication compliance, then patient centered care will be higher. This outcome will be higher if the providers score high on the knowledge activation scales in our instrument.

7. References

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