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Measurement of the Utilization of an Installed Electronic Health Record

Prashila Dullabh, Adil Moiduddin, Elizabeth Babalola

Department of Health Care Research, NORC at the University of Chicago, USA

Abstract:

For the past decade, adoption of electronic health records (EHRs) has been proposed as one of the most viable approaches to improving the United States health care system [1]. *Although there is evidence that EHR adoption is slowly progressing, current methods of assessing adoption have yielded significant variance in estimates of EHR utilization. We conducted an environmental scan consisting of a review of the literature as well as a series of discussions with health center and health center network representatives and experts in the field to understand the current state of EHR adoption and use in the United States and assess the feasibility of developing a systematic approach to tracking EHR usage.*

Keywords:

Computerized medical records systems, Utilization, Policy making, Automated reporting, United States health care reform

Introduction

In the face of rising costs and concerns about quality in the United States health care sector, an emphasis has been placed on the critical role that health information technology (IT) will play. Electronic Health Records (EHRs) have great potential to improve patient outcomes, increase patient safety, and bring about overall improvements in the quality of care delivered. EHRs also have the potential to be a critical enabler of a high-performing healthcare system having demonstrated improvements in the quality, increased adherence to guideline-based care, enhanced surveillance and monitoring and decreased medication errors [2]. As a result, the President, Congress and others have placed a great deal of attention on promoting widespread adoption of EHR technology. The 2009 American Recovery and Reinvestment Act (ARRA) authorized approximately $36 billion towards health IT, with a significant amount to promote the '*meaningful use' and adoption of certified EHRs* [3].

Despite the profusion of initiatives aimed towards accelerating the adoption of EHRs and the rising impetus for practices to adopt EHR systems, the health care sector is far behind other industries with respect to IT adoption [4]. At the same time, EHR adoption in the United States lags significantly behind that of many other Western countries [5]. Estimates of ambulatory EHR use in Austria, Belgium and Australia are 75%, 78% and 79-90% respectively while Denmark, England, Finland, the Netherlands and New Zealand have reported rates above 90% [5]. A report released by Harris Interactive showed that the United States was far behind all but a few European countries in terms of EHR adoption [6].

A great deal is also unknown about the use of specific features of EHRs in the United States, and there is no standard set of methods that reproducibly measures their utilization. Issues that contribute to making the question of quantifying adoption challenging include the lack of a clear definition of an EHR, a lack of standards to measure usage and inconsistencies in how EHR functions are described across the myriad of vendor products that are available today.

This study addressed the following questions:

- What are the major methods that have been used to assess EHR adoption and utilization?
- What are the core functions of EHRs?
- What is the nature of EHR use in ambulatory care settings? Which functions are most commonly utilized?
- What are the challenges and barriers associated with adopting and using EHRs?

Methods

Key research activities involved a literature review, review of EHR surveys and a series of key informant discussions. The initial literature review was used to identify EHR surveys and a framework for categorizing EHR functions. To contextualize what we learned from the literature review on EHR adoption and use we conducted a series of discussions with informants in the field.

We conducted a review of published and unpublished literature to identify previous studies of EHR adoption. We systematically searched electronic databases including PubMed, Academic Search Premier, MedLine and CINAHL and conducted targeted Internet searches using the Google and Google Scholar search engines in order to identify government reports, unpublished articles and other relevant resources.

Results of the literature review were also used to identify surveys for analysis of survey instruments. In identifying which surveys to include in our analysis, we used several criteria. First, we focused our search on surveys of ambulatory settings published within the last six years. Second, we sought to identify surveys utilizing nationally representative samples. Finally, surveys of EHR use in health centers were specifically included. To the extent that any additional surveys were deemed to be of use in our study, we also included them in our analysis. We conducted an examination of the common EHR features examined in the surveys to inform development of a comprehensive list of key clinical and administrative features within an EHR system within an EHR system. In developing this list, we also reviewed the initial Institute of Medicine (IOM) core functionalities of an EHR system [7] and expanded on this by examining the HL7 functional model and the Certification Commission for Health Information Technology (CCHIT) criteria for ambulatory EHRs.

To further inform the study, we conducted a series of discussions with three major ambulatory EHR vendors, two key informants that have expertise in the area of health IT adoption in ambulatory care, and five health centers representing a small subsample of early EHR adopters and their protégés. In engaging with discussants, we sought to identify the common features and functions available in the EHR system, assess use of specific system functions, and EHR capabilities for capturing usage data. In addition, we also made an effort to understand vendors' technical architecture and capacity for reporting on system utilization and quality measures.

Results

Published estimates of EHR adoption are of varying quality. In a report comparing existing surveys assessing EHR adoption up till the year 2008, it was found that very few were adequate to accurately capture the state of EHR use in the United States [7]. In addition, while there are many studies which measure the rate of adoption of EHRs, there is significantly less information to be found regarding actual physician use of EHR features. The Robert Wood Johnson Foundation report titled *Health IT in the United States: The Information Base for Progress* defined adoption as "a process that, for measurement purposes, captures the acquisition, installation and use of EHRs" [8]. It was recommended that, in order to achieve accurate results, EHR adoption surveys should assess these three domains. However, many surveys of EHR adoption merely assess system availability (acquisition and installation) rather than the degree of system utilization (use).

Surveys Selected for Review

Our literature search identified three recurring national representative surveys that assessed EHR adoption. The National Ambulatory Medical Care Survey (NAMCS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS) both included the same sections measuring EHR use in practices. The Center for Studying Health System Change Community Tracking Study Physician Survey included a section assessing the use of IT in physician practices.

Four other key national studies emerged. The National Survey of EHR Adoption was developed by the DesRoches et al. study team and represents one of the most comprehensive studies on EHR adoption to date. Also included was the Commonwealth Fund National Survey of Physicians and Quality of Care, a 2003 survey which explored physicians' use of IT tools. The Medical Group Management Association (MGMA) conducted a 2005 survey to assess the adoption of health IT in their medical practices.The2007 Office Systems Survey which was administered by the Centers for Medicare & Medicaid Services (CMS) as part of their Doctors Office Quality Information Technology (DOQ-IT) initiative was also included in our analysis.

Two surveys of health center adoption of health IT emerged. A 2005 survey administered by the Community Clinics Initiative to assess information management in health centers was identified. Finally, the 2006 National Association of Community Health Centers (NACHC) survey of Health Center Use of Electronic Health Information was the first national measure developed to specifically access health center adoption of health IT.

A total of nine surveys were included in our final analysis. Six of these studies were large-scale national studies that measured EHR adoption, two were surveys developed to assess health IT use in health centers, and one was a statewide survey assessing EHR functionality and the level of physician use of the specific functions.

Categorization of EHR Functions.

Based on information gathered from review of the IOM core functionalities, the HL7 EHR functional model and the CCHIT criteria for ambulatory EHRs forty EHR features were identified and organized into the following eight function-based categories: "Organize Patient Data", "Compile Lists", "Receive and Display Information", "Order Entry (CPOE)", "Decision Support", "Communication and Connectivity", "Administrative and Billing Support" and "Other".

EHR Use

Health center network representatives and ambulatory care practices reported that in general the more basic, or first tier, EHR features such as those of patient demographics, recording patient vitals, documentation of notes, entering medication and allergy information, problem lists, referrals, billing (particularly in smaller practices), medical summary and entering insurance information features were the most frequently used. These were common functionalities that were cited as having been implemented in almost all practices.

Meanwhile, features such as drug formularies and eligibility checking received lower levels of use or were not used at all. In the case of drug formularies, some practices reported that it was difficult to have a comprehensive formulary as all insurance plans may not have chosen to participate. Health plans also tended to change their formularies and formularies in the EHR may not necessarily have been updated in a timely way. This resulted in providers not being very keen to use the drug formulary function. Eligibility checking functions were report-

edly very hard to integrate into the EHR. Instead, practices sometimes chose to make use of the eligibility checking through their existing practice management systems.

Additional second-tier functions included clinical decision support such as smart forms, alerts and reminders, drug interaction checking and clinical guidelines. Second tier functions were often not implemented when the systems were first installed and there also appeared to be variability in terms of the size of the practice; larger practices seemed to be more equipped to implement more advanced clinical decisions support features compared to smaller practices.

Electronic Exchange of Laboratory Information

The electronic exchange of lab results was one of the features of the EHR system that was most commonly used. In most instances, EHRs had established unidirectional interfaces with national labs or local labs and sites were receiving results electronically. Many sites reported that establishing interfaces with hospital labs was more difficult and oftentimes there was reluctance on the part of the hospital to establish a results interface with ambulatory care providers and health centers. In cases where results interfaces were established, providers routinely used the EHR to order labs that resulted in printed lab requisitions. A few sites reported supporting bi-directional lab interfaces, but this was not common. However, sites reported a growing trend to support bidirectional interfaces with labs and discussions with vendors also indicate that they are encouraging bidirectional lab interfaces at initial installation.

There was also a growing trend to use point of care (POC) devices in providers' offices for a variety of lab tests including HbA1c, simple blood chemistries, pregnancy tests, HIV testing and cholesterol testing. In cases where POC devices were being used, the extent to which they were integrated with the EHR varied. This resulted in health centers and practices supporting a variety of different workflows.

E-Prescribing

The practices reported that a majority of the e-Prescribing (eRx) done was only partly electronic. In cases where e-Prescribing was being used, the provider entered the prescription into the EHR using the eRx software. However, three different approaches were being employed to route the prescription to the pharmacy:

- *Fully electronic* – Prescriptions are sent electronically to pharmacies in a paperless process, through the SureScripts-RxHub network. In this case, the prescription is electronically routed to the pharmacy information system.
- *eFaxing* – Prescription information is electronically faxed to pharmacies. Using this process, a fax normally prints at the pharmacy and the pharmacist manually keys in the prescription into the pharmacy information system.
- *Prescription printing* – A hard copy script is printed and handed to the patient who fills the prescription at a pharmacy of choice. Among those practices capable of e-Prescribing, this approach is generally used only in instances where patients are not able to indicate which pharmacy they will print the script at or if the pharmacy does not support e-Prescribing.

In general, sites tended to use the eFaxing approach. Reasons cited for this included that, at the time of initial implementation, there were many barriers related to e-Prescribing and that there did not appear to be any financial benefits of the technology. Furthermore, while larger pharmacy chains are generally capable of receiving prescriptions electronically, many smaller pharmacies are not capable of this due to the high cost of implementation on the pharmacy end. A final barrier cited was the inability to use eRx for controlled substances due to current Drug Enforcement Agency (DEA) rules for eRx [9].

Clinical Decision Support

Practices and health center networks reported having EHR systems with Clinical Decision Support (CDS) modules. These modules were capable of numerous functions including providing drug interaction alerts, clinical practice guidelines for particular chronic diseases, and prompts and reminders for health maintenance. Sites also reported that EHR vendors are increasingly making available knowledge resources that allow for context sensitive help from within the patient record. While the availability of this function was not commonly reported, a few sites had implemented it and regarded it as a very useful tool for providers.

Many CDS functions were in the second-tier, i.e. most likely implemented only once the EHR system had been in use for a while. Providers also tended to use those functions only as it was relevant to their practice and specialty.

Several informants also reported that their health centers and ambulatory practices had implemented alerts and reminders in their EHR system in order to support preventive services and e-Prescribing. Although this feature has great potential to be an extremely valuable EHR tool for increasing patient safety, informants indicated that many physicians experienced problems using the drug interaction alerts component of the CDS. Some perceived these alerts to be intrusive or annoying. Others felt the information offered by the alerts was redundant and unhelpful. In both cases, the alerts often acted to interrupt and slow down physicians' workflow. As a result, some practices allowed physicians the flexibility of selectively turning off or adjust the threshold for these warnings. Sites reported that it appeared clinicians significantly took advantage of this option.

Use of Other EHR Functions

In terms of more advanced EHR functions, several discussants reported that they were beginning to use their EHR for referrals and for specialty reports such as radiology reports. Generally, mid and large sized practices were more likely to be expanding current EHR use in this direction. Very few health centers and ambulatory care practices reported being able to receive radiology images. In cases where this was supported, the EHR generally received a link to the image which was hosted by an external Picture Archiving and Communication (PACS) system. This was the preferred method as radiology images can be fairly significant in size and many small and mid-sized provider offices did not have sufficient bandwidth to

support the transport and storage of large radiologic images. In general, practices reported that receiving the radiology report was far more important to them than receiving the images. In cases where practices were not able to receive radiology or other reports electronically, most had at the very least implemented scanning technology that enabled them to scan the paper reports into the electronic health record.

Interoperability and Standards Support

The Health Level 7 (HL7) messaging standard is being used widely to support electronic exchange of information between provider practices and hospital, national and local labs. However, while most sites report using HL7 for messaging, many of them are yet to implement HL7 V2.51. Many of the health center networks that we spoke to used either commercially available or homegrown interface engines and reported that they spent significant amounts of time establishing interfaces with different labs and providers due to the significant variability in the implementation of the HL7 messaging standard.

With respect to data content standards, the National Council for Prescription Drug Programs (NCPPDP) Script is being used for eRx. Most practices also reported the use of the SureScripts-RxHub network to connect to retail pharmacies. Sites included in this study generally supported use of the Continuity of Care Document (CCD) while there were a few sites that indicated that they supported the Continuity of Care Record (CCR) for patient summary data. Although sites reported having the capability to exchange the CCD, they had limited experience in actually exchanging patient summaries as they reported that many sites that they routinely interact with were not able to receive the CCD.

For sites that supported electronic exchange of lab information, there was virtually no active use of the Logical Observation Identifiers Names and Codes (LOINC) for lab results. Sites reported that lab results from national, hospital or local labs were not LOINC encoded even though the EHRs are able to receive LOINC codes. Similarly, there appeared to be no use of SNOMED-CT.

Reporting on Quality Metrics

Unlike monitoring of usage, most of the sites we conducted discussions with were using EHRs to assist in reporting on different quality metrics. Many of the health center networks were reporting on the HRSA quality indicators [10], which include blood pressure control in hypertension, HbA1c in diabetics, pap smears and mammography for women, immunization for children less than 2 years, depressions screening and colorectal cancer screening. Sites did not directly use their EHR for quality reporting, but instead populated a registry or a vendor supplied reporting database with the subset of information that was needed for quality reporting. This approach was preferred over running reports against the EHR production database due to concerns of system speed and response times. Sites also reported that many EHR systems lacked out-of-the box reporting capability for quality metrics and they opted to use more sophisticated tools in the form of registries or custom databases with enhanced reporting tools.

Assessing EHR Usage

Efforts to monitor EHR use varied tremendously from site to site, dependent in part on the availability of IT resources, size of the organization, availability of canned reports within the EHR system and size of practice. In very few cases had sites implemented any robust capability to assess utilization of EHR functions. In general, smaller sites, or sites that relied largely on their vendor for IT support reported that they were not routinely collecting or reviewing usage data. In most cases, the vendor audit logs were a source of information to assess which providers had accessed different aspects of the EHR. This was largely done in the context of ensuring the security and privacy of patient records. Where sites were monitoring system usage at a granular level, they were either working with the vendor IT team to create the report or had independently undertaken the task of building customized reports (this was mostly done by networks). In almost all cases, significant customization was required in order to extract the kind of information sites were interested in from the EHR.

For practices that were currently measuring EHR usage, there was a significant variability in the granularity of data collected. All sites were able to track usage both at the practice and at the physician level and assess the use of specific functions. Usage data was easier to access around basic features such as the use of templates, completing insurance information, signing of forms and keeping track of the functions within the EHR system which had been disabled. However, monitoring clinician use of more advanced features such as CDS was particularly challenging.

Discussion

This study provided valuable information regarding the nature of EHR use and implementation in health centers and practices. There existed variability in the EHR functions that are used based on practice size, practice specialty and length of time for which the EHR has been implemented.

Commonly used EHR functions. Review of current EHR use in ambulatory care settings suggests that in all practices (small, mid and large) there are certain basic clinical and administrative functions that are commonly used. The clinical functions used include encounter notes, medication lists, allergy lists, problems lists, and order entry functions focused around lab order entry and results delivery. The use of eRX appears to be increasing dramatically but current use is still limited.

Current use of Standards. Despite the availability of industry accepted standards and CCHIT requirements that certified EHRs support certain standards, current use in ambulatory care settings appears to be limited. While most sites report using HL7 for messaging many of them are not yet on HL7 V2.51. With respect to data content standards, NCPDP Script is being used for eRx. Some sites report that they generate a CCR or a CCD but have had limited experience in its use as organizations that they interact with often are not able to accept summary documents in this format. There is virtually no active use of LOINC for lab results even though lab results are one of the most commonly used functions within the EHR.

Use of EHRs for Quality Improvement. Practices of all sizes also report that they support clinical decision support functions related to eRx largely in the form of drug interaction and drug-allergy checking. More comprehensive clinical decision support functions tend to be more common in larger practices and may include the use of smart forms, preventive care reminders, clinical guidelines and knowledge resources. While sites report using EHR data for quality reporting, in most cases a third party registry product or alternate database is used to generate these reports. Ambulatory EHRs have limited out-of-the box capability for quality reporting and oftentimes, due to concerns regarding system speed and response times, quality reporting is not done off the production database.

Sites using clinical decision support for eRx report that this has improved medication management and compliance with formulary. Additionally large practices that utilize smart forms and other forms of decision support report higher compliance with evidence-based practices and improved outcomes. An objective assessment of impact of EHR use on quality improvement cannot be made given the rudimentary nature of how EHR utilization is being tracked. Additionally while sites are reporting on quality outcomes the lack of standardization of measures and how these should be collected and reported also presents a challenge

Challenges and Barriers in utilization of EHRs. Our findings suggest that barriers to EHR use are multi-factorial. In many cases cultural resistance of providers and other clinical staff result in limited use of available functionality. In other cases the implementation of new systems have not accounted for good integration with clinical workflows and consequently providers use workarounds or may stop using certain functions entirely. Particularly in the context of CDS sites reported numerous challenges to ongoing use of this feature. In some cases the immaturity of the vendor product and usability issues were cited as reasons for non-use. In some cases regulatory challenges presented a burden for example, sites reported that due to DEA rules they were not permitted the use of eRx for controlled substances. Many of our informants reported that they encountered numerous challenges in exchanging information electronically with labs or other provider sites. Limited interoperability resulted both from lack of use of standards and tremendous variability in how certain standards were being implemented.

Conclusions

Understanding EHR utilization and ongoing challenges and barriers to use will have important implications across the medical and health IT industries. Study findings indicate that there is a common set of EHR functions that all practices are likely to have purchased and that sites would be capable of implementing. Most EHR vendors have capability to track usage of these common functions even though they may not all support the same robust reporting capabilities. By providing tools to health centers and networks to monitor EHR utilization these organizations would be better equipped to promote meaningful use and adoption proactively.

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Address for correspondence

Prashila Dullabh MD, National Opinion Research Center, 4350 East-West Highway, Bethesda, MD 20814, United States