



## Leveraging Electronic Health Records (EHR) for Enhanced Patient Care

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**ABSTRACT:** This study analyzes how electronic health records (EHR) can be utilized to enhance patient care. The objectives of the study are to; design predictive models to recognize patients are risk of developing some specific conditions; evaluate the effect of EHR systems on patient care outcomes; ascertain the impact of EHR systems on physicians' work; and develop a framework for incorporating EHR analysis into hospital systems, thus enabling real-time decision-making by healthcare specialists. This study adopts a qualitative research using semi-structured interviews, which was directed to physicians who had at least a year experience at Primary Health Care Centres (PHCs) to gather information about the current content and scope of Electronic Health Record Systems. Most of the respondents interviewed said that the health information system's adaptation and the availability of Electronic Health Records influenced encounters for patients positively in their PHCs. They talked about the many benefits of EHR in terms of effectiveness, which include the availability of patient information and accuracy of patient documentation; these are often hard to find in their paper documents. The interviewees also indicated that EHRs allow eprescribe of medication, which is a huge plus to the old system of prescribing and administering medicine to patients. The physicians stressed the need for private clinics and primary healthcare centres to share and link their systems to enhance the functionality of the EHR. The study recommends that; there is need for the PHC EHR system to integrate across other government and private institutions. There is also a need for increased capacity to support patients with physical activity and nutrition.

**KEYWORDS:** Electronic Health Records (EHR), convention paper recording, medication, patients' information, Primary Healthcare Centres (PHCs), record system.

### I. INTRODUCTION

Adopting Electronic Health Records (EHR) systems enable healthcare specialists to provide better healthcare through enhanced record keeping, patient care monitoring and decision making. At a system level, Electronic Health Records facilitate better outcome of healthcare, monitoring of quality and better identification of resource utilization at the patient level. Electronic Health Record systems are progressively seen as an essential tool in enhancing the overall quality, efficiency and safety of healthcare<sup>1,2</sup>.

During visits to you healthcare center, you may have noticed that many providers do not use paper records any more, they use electronic health records (EHRs) instead. Electronic Health Records are gradually replacing the conventional paper-based patient record system and changing many clinical tasks that were once done on paper to the electronic medium. These clinical tasks include ordering medications, documenting the visit, viewing test results, ordering diagnostic and laboratory tests, and tracking patients. The potential of Electronic Health Records is that they will pave way for a digital future that allows for new experiences that were not possible before, leading to improve efficiency, quality and safety<sup>3</sup>.

The healthcare sector of the United States have seen rapid adoption of Electronic Health Records over the years, more than 80% of hospital now use EHRs in 2015 compared to less than 10% in 2008<sup>4</sup> as indicated in figure 1. This growth has been fostered by the federal government's Health Information Technology for Economic and Clinical Health (HITECH) act initiated in 2009. More than \$40 billion have been invested in the quest to promote the acceptance of EHRs with a portion of this money being used to offer incentive payments for EHR use to providers of healthcare leading to an exceptional technological transition.

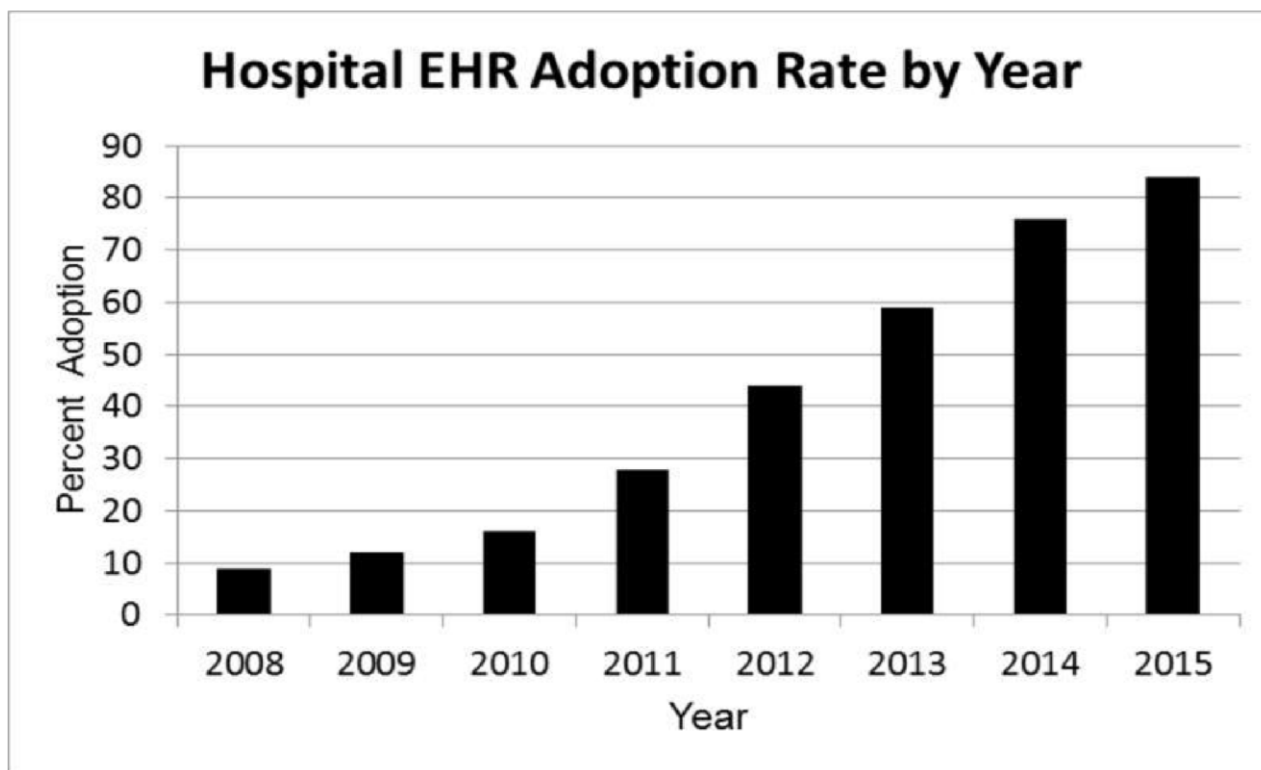


Figure 1: Electronic health record (EHR) adoption rate by year (from [dashboard.healthit.gov](http://dashboard.healthit.gov)).

The transition to Electronic Health Records has confirmed that the process is complex and expensive with some EHRs covering thousands of functions and taking ages to design, develop, and successfully be applied at the healthcare provider's location. A vast healthcare system adopting an Electronic Health Record System can spend hundreds of millions of dollars to buy, implement, maintain, and educate their staff on how to use these systems<sup>5</sup>.

If EHR is utilized properly, the resulting digitization of health data has the capacity for enhanced patient care and physician productivity by using the inherent abilities of software systems<sup>6</sup>. Data that was once restricted by the constraints of paper can now be freely accessed in near real-time by different providers across the nation. New abilities can be developed such as decision support that provides contextually relevant alerts based on a patient's past history and present condition, or that pinpoint vital information in the record to help the physicians' thinking and decision-making process<sup>7</sup>.

Although it has been discovered that EHRs have certain benefits<sup>6</sup>, the transition of this equipment has been challenging. Lessons gathered from other high-risk companies have shown that it is pertinent to recognize the whole socio-technical system<sup>8</sup> when incorporating technology with the aim of plummeting avoidable hospital admissions and improving patient care.

The effective utilization and management of Electronic Health Records (EHRs) have the probability to transform patient care in hospitals. This paper aims to utilize the wealth of data gathered within EHR systems to study patterns, gain insights, and predict future outcomes that can improve patient care drastically.

The primary objectives of this paper are as follows:

1. To design predictive models to recognize patients are risk of developing some specific conditions.
2. To evaluate the effect of EHR systems on patient care outcomes
3. To ascertain the impact of EHR systems on physicians' work
4. To develop a framework for incorporating EHR analysis into hospital systems, thus enabling real-time decision-making by healthcare specialists.



## II. LITERATURE REVIEW

### *Challenges with the Transition to Electronic Health Records*

The shift to Electronic Health Records has necessitated safety considerations and increased physician stress and frustration<sup>9,10</sup>. The poor design of Electronic Health Records is fundamentally recognized as a major cause of these problems<sup>11, 12</sup>. Many Electronic Health Record systems are not fabricated with an appropriate understanding of the perceptual or cognitive needs of the physician<sup>13</sup>. As a result, the workflow within the EHR, the user interface, and incorporation of EHRs into medical routines has led to inefficiencies, overall dissatisfaction and safety hazards during use<sup>14, 15</sup>. In depth scrutiny of how physicians view and store information in memory, process and reason with clinical data, and make resolutions are often not part of the development, design and implementation process for Electronic Health Records<sup>15</sup>.

Numerous safety threats related to EHRs have been examined and error taxonomies are being established to understand these threats<sup>16, 17</sup>. Some of these errors may have catastrophic penalties for patients. For instance, one type of error that has been perceived is wrong patient selection, where a physician incorrectly chooses the wrong patient in the EHR and prescribes a medication, lab or imaging study, or even takes some other action that was not meant for the patient<sup>18</sup>. This can lead to patients receiving the wrong care (e.g. wrong test, procedure, or medication) which results in adverse concerns. There are different causes of wrong selection errors, including the interfaces that are not well designed and do not protect against clicking on the wrong patient and do not make the patient's name noticeable in the EHR.

### *Complexities of Developing Electronic Health Records*

Designing and fabricating EHR systems that support the needs of physicians and overcome the transition problems is no small achievement. There are complications unique to healthcare, which make developing and fabricating EHR systems a straining process that needs a deep and nuanced comprehension of the healthcare environment<sup>19</sup>. Firstly, healthcare is made up of different sub-specialties (e.g. cardiology, oncology, emergency medicine, etc), each has its own specific information workflows and needs. Secondly, there are different users of the Electronic Health Records (e.g. nurses, environmental services, billing staff, physicians, technicians, etc.) and each user may possess their unique goals and needs. With staff wants varying by specific role and sub-specialty, designing a unified EHR system is difficult; rather, the desires of each category of user and sub-specialty must be put into consideration and embraced by the system.

The arduous industry timelines under which design, fabrication, and implementation of EHR systems occur and the resource limitations during this process adds another layer of complexity<sup>12</sup>. Product managers, software developers, and other staff involved in the EHR development are often working under arduous design and development timelines in order to move the market of their product very fast.

### *Opportunities for Advancement of EHR Safety and Utility*

Many developers of EHR do not have staff with the experience needed to understand the perceptual, cognitive, and workflow needs of physicians, design and fabricate products that cater for these needs, and efficiently test products for effectiveness, efficiency and safety<sup>15</sup>. In the same vein, most developers lack the experience to comprehend where the EHR systems fall short in meeting the desires of users and enhancing to improve safety and utility. EHR providers and developers have constrained resources to tackle the technological issues they face. Some developers of EHR may not have access to respondents to test their products and may not have access to medical environments to study the physician user population.

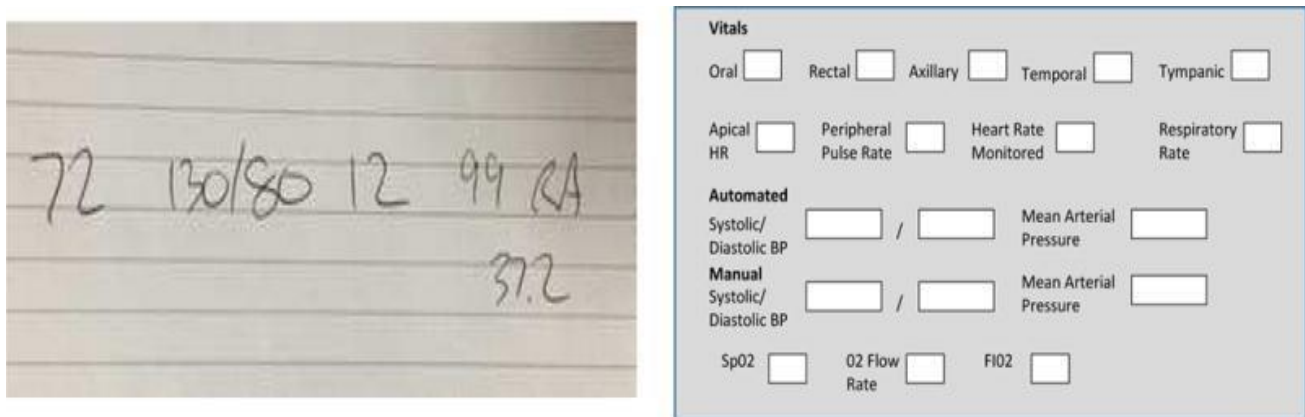
Below, I summarize three key areas which can be improved in Electronic Health records. The current state of EHRs can be advanced by developing new tools and techniques that meet the situational needs of EHR healthcare providers and developers. Although there are safety lessons that can be learned from defense and aviation, the EHR technology and healthcare domain pose new issues and provides the chance for developing innovative technologies that can better help users and EHR developers.

### *Modeling Clinician Needs and Work Procedures*

Monitoring and documenting the behaviors and work procedures of physicians in the live medical environment to gain understanding of how physicians carry out their activities is still not a prevalent exercise in the EHR industry. While there are specific developers that have utilized the appropriate expertise to conduct these monitoring sessions and come up with the appropriate knowledge to use their on their products, many vendors still have not utilized this vital practice<sup>15</sup>. Consequently, numerous products not only fail to support work procedures, but also do not compensate for distractions, interruptions, and other

environmental factors that have an effect on physicians. The arduous industry timelines for design and fabrication are often seen as a barrier to conducting well design monitoring sessions<sup>15</sup>.

As an instance of the disconnect between how physicians think about medical information and the EHR interface, figure 2, below, shows how a physician often records vital signs on paper (left) and in one version of an EHR (right). Paper permits the rapid collection of data in a usually standard format the physician is used to. The EHR shows the data in a different order and displays numerous options, some of which are not necessary, for heart rate, temperature, and blood pressure that raise the amount of time to collect vital signs.



**Figure 2: Heart rate, blood pressure, respiratory rate, oxygen saturation, and temperate (Celsius) as generally written by physicians (left) and as would need to be entered in one type of EHR**

Numerous EHR developers do not use standard techniques for modeling clinical procedures such as carrying out task analyses and conducting work domain<sup>20, 21</sup>, improving human performance models, designing and fabricating interfaces based on these models, and testing these interfaces with the right experiments and metrics. Consequently, Electronic Health Records are made with poor support from physicians. For instance, when physicians place specific medication orders through the Electronic Health Record, they may be required to know the vital signs of the patient; conversely, many EHRs do not show this information to the physician on the same screen as the medicine ordering process. Therefore, physicians have to either exit the medicine ordering process to check the vital signs which resulted in inefficiencies in the course of the ordering process, or the physician has to memorize the information which pointlessly increases memory load and is error prone.

There is a requirement for development of models of physician work to drive design and fabrication, and a need for the development of procedures and tools that can be used with ease by different EHR developers in a short-while. Scholars have made some tools to address this issue, however, these tools have not been widely used<sup>22</sup>. The application of Goals, Operators, Methods, and Selection Rules (GOMS) modeling to comprehend human data processing in the context of computer interface improvement and other interface modeling techniques could drastically reduce the cognitive burden delegated to physicians and enhance the safety of EHRs.

### III. METHODS

This study adopted a qualitative research using semi-structured interviews, which was directed to physicians who had at least a year experience at Primary Health Care Centres (PHCs) to gather information about the current content and scope of Electronic Health Record Systems. The respondents were chosen based on their experiences and place of practice utilizing a combination of purposive and convenient sampling<sup>23</sup>. A final sample of 22 physicians working in chronic disease clinics at PHCs were interviewed covering different locations and clinic sizes in New York, United States’ capital city. Recruitment stopped when data saturation of the themes was achieved, meaning that additional information was no longer recounted<sup>24</sup>. The researcher conducted all the interviews utilizing a semi-structure guide between May 2015 and August 2015.

The semi-structure interview manual was developed after reviewing the relevant scholarly literature on Electronic Health Records and healthcare systems in USA<sup>25, 26, 27, 28</sup>. The physicians’ interview manual included questions on their view on the present EHR system, the effect of EHR on the management of hospitals and views related to education in using the Electronic Health Records.



All physicians interviewed were willing to engage and respond to the interview questions. We made sure that there was no bias in this study as there was not prior correlation between the interviewees and interviewer. The interviews were voice recorded, translated and coded into key themes. A thematic analysis outline was used for the data analysis which consisted of six steps: becoming acquainted with the data, searching for themes, revising themes, defining themes and writing the research report<sup>29</sup>. The use of thematic analysis aided in summarizing key characteristics of information and highlight similarities and differences in data-sets. NVivo software was utilized in organizing and coding the data<sup>30</sup>.

## IV. RESULTS

Findings are categorized according to four themes that were derived from the interviews: these themes include effect on patient care, effect on physician's work and effect of EHR systems beyond the Primary Health Care Systems.

### 1. Effect on Patient Care

Most of the respondents interviewed said that the health information system's adaptation and the availability of Electronic Health Records influenced encounters for patients positively in their PHCs. The interviewees noted a number of key benefits of Electronic Health Records in their reactions about catering for patients' ailments, which can be broadly categorized as useability and efficiency. The respondents explained the ways in which the Electronic Health Records made patient care more effective. For instance, one physician stated, *'Electronic health records make our work faster, as we get the patient's records and results whenever the patients come along – this saves time and effort'* (Phys 21, 11 years).

The main theme consequent from the interviewees' observation was the advantages of EHR on the workflow of care. They talked about the many benefits of EHR in terms of effectiveness, which include the availability of patient information and accuracy of patient documentation; these are often hard to find in their paper documents. They also noted the benefits of having EHR information because it could assist them to screen patients with ailments, for the early detection of comorbidities. As a physician noted *"An advantage of the electronic health records is the availability of the patients' information that helps doctors to diagnose, treat and follow up more quickly"* (Phys 5, 8 years). In terms of useability, an interviewee noted that the *"... system is without hitches and easy to use"* (Phys 12, 4 years). Conversely, the interviewee persisted, the system does not have a patients' portal and does not allow patients to access the full data about their health.

### 2. Effect on Physician's Work

As part of the Electronic Health Records, patients are needed to book an appointment to visit a PHC via an electronic service that is part of the EHR package<sup>31</sup>. Booking can be done through the application, by calling the call centre or by going to the patient's PHC. The interviewees indicated that these booking services aided them in organizing their work – they knew their schedule for the day, so that they could prepare, reduce wait times and easily plan for follow-up with the patients. EHR as follow: *'... electronic health is a breakthrough in the history of healthcare in America. It raises the quality of health services, improves the management of chronic diseases, and reduces file errors'* (Phys 1, 12 years).

The interviewees also indicated that EHRs allow e-prescribe of medication, which is a huge plus to the old system of prescribing and administering medicine to patients. The e-prescription app, was fabricated to help the dispensing of medicine to patients by giving them room to receive the prescription digitally on their phones with a link to a closeby pharmacy, where they could purchase their prescription<sup>32</sup>. The app ensures that medicines are readily available for patients; however, some of the interviewees said that they had gotten complaints from some of their disadvantaged patients, about facing challenges while getting their medications. The physicians also noted that the app is not built into the Electronic Health Record system and operates independently: *'the current applications are separated and tiring to use, but their services are different. I hope the developers will co-join the application into one platform'* (Phys 7, 5 years).

### 3. Linking of Electronic Health Record Systems

The physicians stressed the need for private clinics and primary healthcare centres to share and link their systems to enhance the functionality of the EHR. The current EHR is only linked to primary healthcare centres and does not connect to other quasigovernmental health organization and private clinics in USA. Interviewees noted issues when patients previously attended quasi-governmental health organizations or private physicians and they had follow up at other primary healthcare facilities. One interviewee indicated this decentralised circumstance as follows: *'the problems are the lack of data and not having the clinical records and results from private sectors and other facilities outside the Ministry of Health'* (Phys 18, 3 years). The physician agreed



that incorporating patient records with other healthcare centers would help the exchange of health information between healthcare professional and patients.

## V. DISCUSSION

This study examined the views of physicians on the current scope and content of EHR systems. Physicians in this study indicated benefits of utilizing EHR, which are supported with existing literature. They highlight the multiple benefits of using Electronic Health Records in terms of effectiveness, which includes the availability of patient information and the accuracy of patient records. These importances have also been noted in other studies<sup>33, 34, 35</sup>. While physicians recognize these importances, shortcoming identified involved the lack of patient portal to give patients access to information about their health and there is a need for the primary healthcare center EHR system to integrate across other government and private facilities.

### 1. Patient Portal

Gaining access to personal health information is seen as one of the most vital tools for revolutionizing a health information system<sup>36</sup>. This study discovered that physicians reported an advantage of the introduction of an Electronic Health Record into Primary Healthcare Centres. However, the effect of using the EHR in patient care within PHCs is still possibly not achieving its full reach. The present EHR does not give patients full access to their health records, current research on patient portals has shown that they can improve patients' ability to self-manage their ailments by increasing their involvement in their health, and their obedience to screening recommendations; on the long-run this has enhanced patient-centred care delivery and the eminence of care<sup>37, 38</sup>. Other scholars have discovered that when patients can access and view a patient portal, their satisfaction with care will improve, allowing for good management of their conditions as well as enhancing their engagement in their own medical choices<sup>39, 40, 41</sup>. To increase the effect of care on patients, the Electronic Health Records should promote a more patient-centric system, patients should be involved in decision-making processes concerning their care and they should be encouraged to modify unhealthy behaviors by observing displays, introducing critical data and setting health goals. This helps patients to effectively engage in their own healthcare and enhances the efficiency of communication among physicians.

### 2. System Improvement

The healthcare system places a lot of emphasis on technology to enhance healthcare delivery. The drug prescribing program is seen as a positive step, providing faster access for most patients to their medication. Enhancing medication policies and patients obedience reduces the economic and health burdens caused by ailments<sup>42</sup>. However, the application may be less attractive to older patients living within walking distance to their Primary Healthcare Centers, as they may prefer to have their medication gotten from the same PHC rather than being referred to a different pharmacy. Solutions to this may include policies that make sure prescribed medications are available at the PHCs and mail delivery/home delivery. Reducing barriers to obtaining drugs improves adherence to medication<sup>43</sup>, therefore, medication services are required to be responsive to the desires of elderly and disadvantaged people. The Electronic Health Record system has been implemented at PHCs in order to enhance the efficiency and quality of the healthcare they dispense. The present study has discovered that physicians must use three different softwares to complete patient care actions, which gives them more workload. A vital enhancement to the EHR functions is incorporating the three platforms to simplify physician requirements in dispensing healthcare services. This is a critical barrier to accessing the full benefits of the EHR system, as reducing administrative task time and complications can increase physicians' clinical time, quality of care and work satisfaction<sup>44</sup>.

### 3. Integration of Patient Records

The developers of the software should consider completing linkages between PHCs, private clinics and other governmental health agencies EHR systems. Disengaged EHR systems between sectors clearly have implications for efficiency of healthcare delivery. A singular system, or at least systems that can communicate within themselves, should be implemented in all clinics, hospitals and specialized centres within the nation to make sure one unified electronic patient record is being handled. Incorporating patient records could drastically reduce unnecessary duplication of care and services, and may have positive impact on the nation's healthcare budget, for instance by preventing the unnecessary repetition of radiology and pathology tests<sup>45</sup>. It can reduce wastage of drugs and enhance coordination, and thereby the quality of patient cares by helping physicians access patient data where patients use different healthcare institutions. An organized exchange of medical data amongst healthcare providers enhances care coordination and improves safety of care; it also supports better disease management<sup>46</sup>.



## VI. CONCLUSION

Electronic health record systems have many positive advantages when applied in healthcare. The effect of USA's EHR use on patient care at Primary Healthcare Centers is not being fully realized, despite the positive insolences of the interviewees in the current study. The requirement for the EHR system to give patients access to their healthcare records was seen as a function which would increase its capacity to support disease management. Similarly, there is requirement for the PHC EHR system to integrate across other government and private institutions. There is also a need for increased capacity to support patients with physical activity and nutrition. Altogether, efficiency of physician time would be increased by an incorporation of the EHR system with systems for patient booking, prescription and referral. This study suggests future researches should monitor the effect of EHR utilization on physician satisfaction, healthcare management, and workload efficiency.

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