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More Screen Time, Less Face time – Implications for EHR Design

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Abstract

Rationale, aims and objectives—Understanding the impact of health information technology on doctor-patient interaction is vital to designing better electronic health records (EHRs). This article quantitatively examines and compares clinically experienced physicians' interactions with patients using paper or electronic health records in ambulatory primary care settings.

Methods—Clinical encounters using paper or electronic health records were recorded with high-resolution video cameras to capture physicians' interactions with the health records and patients. All videos were coded using quantified video coding methodology to understand how physicians interacted with EHRs and patients through measuring eye gaze durations. Statistical analysis was conducted to compare the results of the paper and electronic health record visits.

Results—Eight experienced family medicine physicians and eighty patients participated in the study. A total of 80 visits, 40 with paper and 40 with EHRs were recorded. The proportion of time physicians spent gazing at medical records during EHR visits was significantly more than in paper chart visits (35.2% VS 22.1%, P=0.001). A significantly smaller proportion of physician time was spent gazing at the patient when using an EHR compared to when using a paper chart (52.6% VS 45.6%, P= 0.041). Shared gaze by both physician and patient at the records was not significantly different between the two settings.

Conclusions—For this group of family medicine physicians, more time was spent looking at the EHR screen than paper records and a little less time looking at the patient. These findings may negatively affect the patient perception of the visit with the physician and have implications for the design of future EHRs.

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Competing Interests
None of the authors have any conflicts of interest that could bias this work.

Keywords

EHRs; physician-patient interaction; physician-EHR interaction; primary care; EHR training; paper charts

INTRODUCTION

Health Information Technology (HIT) has become more important and widely used in health care due to advances in the last decade. Health care practices in the past were based on paper record keeping; however, in the early 21st century there has been a rapid influx of HIT into health care to facilitate billing, scheduling, record keeping, and analysis of data (1). With government funding and incentives, electronic health records (EHRs) have been rapidly adopted in the United States increasing in doctor's offices from 9% in 2008 to over 50% in May 2013(2). Similarly EHRs are now used in more than 80% of hospitals compared to 17 percent in 2008 (2).

Some of the reasons given for this rapid adoption of EHRs are potential benefits including more efficient, more effective, safer patient care (3) and more patient centered care (4, 5). However, using an EHR brings a third party into the examination room (6–8) and changes the interactions between doctor and patient. Several studies have reported potential negative impacts of computers on doctor –patient interaction during the visit (9, 10), such as minimizing physicians' focus and attention on patient communication because of computer related additional cognitive workload (11, 12). For example, physicians' computer use, which might be influenced by the type and content of the patient visit (13), may affect physicians' nonverbal and verbal communication behaviors (4, 14) and take the physician's attention away from the patients in the form of gaze and body positioning (15, 16).

Moreover, it has been reported that various computer use styles during patient visits were developed by physicians based on experience and observation rather than formal training (17–20). One recent study identified three different interactions styles that primary care physicians may use with an EHR in the exam room: 1) technology centered, 2) mixers (who mix technology-centered and human-centered behaviors), and 3) human centered. Technology centered doctors were reported as younger doctors that typed more and had less eye contact with patients. Human4 centered physicians were reported as more clinically experienced, older doctors, with less screen time, more face time with patient, and they tended to use papers or dictation for documentation during the visit with less typing (19).

A National Research Council (NRC) report concluded that many current EHR technologies are poorly designed and do not compliment care providers' cognitive capabilities and needs (21). The NRC report also states that current EHRs are not designed with human-computer interaction and human factors and ergonomics design principles, which contributes to their inefficient use (21). These factors contribute to the poor providers' satisfaction reported for commercial EHRs (22). In particular, older and more clinically experienced physicians are less likely to be satisfied with their current EHRs than younger physicians (23). Therefore, current design of EHRs might be another factor that shapes physicians' interaction styles

with EHRs. To our knowledge, there are no studies in the literature evaluating more clinically experienced physicians' interactions with current EHRs.

The purpose of this study was to examine and compare clinically experienced primary care physicians' use of paper medical records and an EHR using validated coding methods (24). This research has the potential to inform EHR designs which might accommodate physicians with lower computer skills and comfort and may facilitate better physician-patient communication.

METHODS

Study Settings and Data Collection

We conducted our study in University of Wisconsin-Madison family medicine clinics. All examination rooms had the same layout with the doctor sitting at a desk facing the wall and monitor screen and patient sitting in a chair next to the desk with their back against the wall, facing the doctor. Data for this study included 80 video recorded primary care visits. The visit types were a combination of acute and follow-up care. Forty of the visits were recorded at one practice that used paper records, and the other 40 visits were recorded at two practices that used the same electronic health record system. Data in the paper record practice were randomly derived from a larger project data set which was collected over a period between 2004 and 2006 (24). Data in the EHR settings were also derived from another project data set which was collected in 2011 (19). A convenience sampling approach was conducted to recruit physicians and patients in both settings. We selected data from physicians with at least 10 years of practice experience to avoid any variation or bias due to lack of experience with doctor-patient communication and to ensure that all physicians had experience using both paper and electronic health records. Informed consent was obtained from both patient and physician participants. Both studies were approved by the University of Wisconsin Health Sciences Institutional Review Board.

For EHR settings, we placed 3 video cameras as unobtrusively as possible in each examination room. These recorded the face of the physician as they looked at the health record, the patient while sitting in a chair, and both physician and patient for overall interaction. Then we synched all three streams into one video stream for the purpose of analysis. Cameras were turned on remotely so researchers were not present during any of the physician/patient interaction in the exam room. For paper-based setting, one high quality video camera was used to record overall interactions in the exam room.

Data Analysis

We used an empirical approach to analyze physicians' interactions with medical records and patients. Video recordings were coded using coding methodology from a previous study to understand physician-patient-health record interaction during the visit (24). Eye gaze, a form of nonverbal communication, was considered an indicator of information retrieval and recording as well as communication between patient and physician (16, 25); therefore eye gaze was assessed to indicate the interaction between physician and patient as well as between physician and health record (26).

Video coding is the process of reducing large amounts of complex data into quantifiable units of analysis (27). The coding activities in this study were: a) coding scheme was developed, b) coders were trained, c) each video was coded temporally, from the beginning to the end of the visit, d) reliability analyses were conducted, and e) statistical analyses of coded data were completed. A coding scheme was created for the variables of interest (Table 1). Each video was coded temporally for the entire visit length based on the coding scheme. Start and stop times for each code were annotated using Noldus Observer XT version 10.1. Each code included three parts: a subject, behavior, and object (Table 1). For instance, when the patient looks at the physician, it is coded as "patient gaze at physician" until the patient looks somewhere else. The software calculated the start and stop times, duration, and simultaneous occurrence of two or more codes after the completion of coding all videos. Coders were trained to execute the coding procedures, and reliability checks were conducted at weekly intervals. Inter-rater reliability scores (Cohen's kappa) for codes ranged from 0.62 to 0.88. The Cohen's Kappa range is considered "standard" at higher than 0.60 and "excellent" at higher than 0.75 (28).

The amount of physician and patient gaze at each other and the computer and/or the paper chart was estimated for each visit. The estimations are based on the proportion of time of these values in relation to the visit length. For example: in a single visit, we used "physician gaze at the computer occurred during 56% of the visit length," rather than, "physician gaze at the computer occurred for 330 seconds." Statistical analysis used a t-test with a 0.05 significance level to compare the time proportions between the EHR and paper record visits. Data had a normal distribution. The behaviors compared in this study are "physician gaze at patient," "physician gaze at computer monitor," "physician gaze at paper chart," "shared gaze at chart," and "shared gaze at computer monitor." Shared gaze means physician and patient both look at the same object at the same time. This usually happens when the physician shares the medical records (either paper or electronic) with the patient.

RESULTS

Eight physicians and eighty patients participated in the study. Four physicians were recorded in a paper record practice and four physicians were recorded in EHR settings. There were six male and two female physicians. All physicians had been practicing family medicine for more than 10 years at the time of the observation. Physicians in EHR settings had used EHRs in their practice between 4 and 7 years (mean 5.25 years).

Patient demographics are illustrated in table 2 for each site. Patients at the paper record practice were slightly younger (Mean= 39.5 years) than at EHR practices (Mean= 43.4 years), however there was significant differences in patient gender (P=0.006) with 65% female at the paper practice and 35% female at the EHR practices.

The average visit length for the study was 11.2 minutes (SD=8.1 minutes). Visit length is defined as the total time the physician spent with the patient in the room, except the exam period. The various visit lengths may influence the amount of gaze behaviors, so all gaze values were estimated as a proportion percentage of the visit length to allow for more meaningful comparison between the two samples.

Physician gaze at patient was significantly more in the paper record setting (52.6%, SD= 12.3%) compared to the EHR setting (45.6%, SD=17.9%) (P= 0.04). Patient gaze at physician was significantly longer in EHR settings (52.2%, SD=18.7%) than paper record settings (39.1%, SD= 13.2 %) (P= 0.05). However, we did not see a significant difference for mutual gaze between EHR (33.9%, SD=17.4%) and paper settings (28.5%, SD=13.9%) (P=0.136) (Table 3).

All physicians using the EHR also used paper worksheets or printed portions of the charts for reference and hand writing notes. The EHR physicians gazed at the computer monitor for 21.5% (SD=12.2%) of the visit length and gazed at the printed portions of the chart for 13.7% (SD=9.1%) of the visit length. The total EHR physicians' gaze time at medical records (including both computer and paper copy of records) was 35.2% (SD=15.7%) of the visit and is significantly more than in paper chart visits (gaze at chart = 22.1%, SD=8.9%) (P=0.001). The physicians spent 14.7% (SD=7.8%) of the visit sharing the paper chart with the patient (shared gazing at the chart) in paper record settings. In EHR settings, shared gazing at the record occurred for a total of 11.4% (SD=9.3%) of the visit with shared gazing at the computer monitor (10.3%, SD=9.1%)) and paper copies or worksheets (1.1%, SD=1.2%). Shared gaze at the health record was not significantly different in the two settings (P=0.214). Physicians in paper settings wrote on paper to take notes for 7.8% (SD=6.3%) of the visit length. Physicians in EHR settings wrote on paper to take notes for 9.9% (SD= 10.6%) of the visit. Physicians also typed during 2.9% (SD=2.4%) of the visit length in EHR visits.

DISCUSSION

This study evaluated clinically experienced physicians' interactions with patients and paper or electronic health records in primary care settings. The proportion of time physicians spent gazing at medical records during EHR visits (gaze at computer monitor and gaze at printed copy of portion of the EHR or worksheet) was significantly more than in paper chart visits (35.2% VS 22.1%, P=0.001). This may occur for several reasons including: 1) There is more information available in the EHR to view and process; 2) It is more difficult to find or understand key clinical information (display format); 3) More tasks are completed using the EHR such as documenting the visit, prescribing, ordering tests, or completing billing information; 4) There are other clinical resources accessible from the computer such as other health organizations' EHRs and internet decision support.

Not surprisingly, a significantly smaller proportion of physician time was spent gazing at the patient when using an EHR compared to when using a paper chart (45.6% VS 52.6%, P= 0.041). This is consistent with findings reported by Margalit et al that computer use can lead to decreases in dialogue and in the amount of eye contact between physicians and patients (15). Unexpectedly, patient gaze at physicians was significantly more in the EHR setting compared to the paper chart setting (52.2 % VS 39.1%, P= 0.005). Previous studies reported a decrease in the amount of eye contact in EHR settings compared to paper records (9, 15). However, no studies report that patients gazed at doctors more in EHR settings compared to paper settings. It is notable that the physician gaze at the patient in paper setting (52.6%) is almost the same as the patient gaze at the physician in EHR setting (52.2%) and similarly,

the patient gaze at the physician in paper setting (39.1%) is similar to the physician gaze at the patient in EHR setting (45.6%). This may be coincidental or something about the paper and electronic records creates a mismatch of gaze between the patient and physician that may be detrimental to patient satisfaction (29).

The physicians in EHR settings spent less time typing than writing on paper (2.9% VS 9.9%) which raises the possibility that the physician may not be looking at the patient because they are looking at the paper they are writing on. It also raises the question of exactly what is different between the use of paper and electronic records that forces the physicians to write more on paper during EHR visits. A previous study suggested that writing on a paper chart causes less interruption in communication with patients than typing during the visit (15). While another study reported that physicians' typing skills and ability to navigate the computer were important factors for effective EHR use during patient visits and these skills also reduce physicians' need to focus attention on the computer and positively influence physicians' communication with patients (18). This deserves more study to understand the EHR design implications.

This study had several limitations. The sample size of physicians was small and restricted to experienced family medicine physicians, located in Wisconsin, using the same EHR software, in examination rooms with similar layouts, so our results may not be representative of all physicians. More research with other physician specialties, at various times in their career, in different locations, with different room layouts and different EHR software will be needed to confirm generalizability of our results. The paper record and EHR data was collected during different periods of time and unknown temporal factors could have influenced the outcomes. In addition the patients from the paper record practice were somewhat younger and more likely to be female (65% VS 35%) and it is unclear how much this would affect patient-physician interaction. All of the EHR physicians also used paper worksheets or printed portions of the charts for reference and hand writing notes, and it is also unclear how much this would affect patient-physician interaction. We have not yet analyzed verbal communication and this variable may correlate with gaze or typing time. We are not able to determine what tasks were being accomplished during screen, gaze and typing times to determine the associations between these variables. We only used one video camera for the paper records evaluation and data with multichannel stream is reported as being superior than single video stream (30, 31). However, we trained coders for each type of video to get the most accurate data, so we do not think that this difference in data collection technique had much impact on the result. Including different type of visits such as preventative care might yield different results for proportion of gaze. Finally, more study is needed to determine if differences between practices or between the doctors within the same practice influences the outcomes of interest.

The value of comparing use of paper versus electronic health records is rapidly diminishing with the increasing adoption of EHRs. However, our findings suggest a variety of future research questions to further evaluate how EHRs influence the physician-patient interaction such as: 1) How does different EHR software influence gaze, writing, and typing times? 2) What happens to these factors over time as physician computer skills and familiarity with the EHR improve? 3) How does use of paper worksheets or printed portions of the charts

influence gaze and other EHR behaviors? 4) How do the tasks being performed by the physician impact gaze, writing, and typing times? 5) How does the content of the verbal exchanges impact these times? 6) How do each of these affect patient perception of the interaction? 7) How does the age of the physician or patient influence the interaction? and 8) How does the gender of the patient influence the interaction? Each of these areas of inquiry may have implications for design of the EHR and may influence cognitive workload for the physician, efficiency of providing care, or patient satisfaction. In addition, it is also critical to identify best practices for how to integrate EHRs into patient centered communications, so it can be used in training residents and medical students (32, 33).

With widespread adoption of EHRs and the expectation that in the near future, most, if not all healthcare in the United States will be documented in a digital format (34), the debate about whether a paper record has desirable characteristics that facilitate physician-patient interactions is a moot point. The question becomes: How can EHRs best facilitate doctor patient interaction and avoid being detrimental? Some of the user skill issues that impact use of the EHR will either resolve as skills grow with continued use, can be mitigated with additional training, or can be solved with other technologies such as voice recognition, handwriting recognition, or touch screens (35). The next big challenge is how to change the design of current EHRs to enhance the physician and patient experience while improving the quality of care and decreasing costs.

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Table 1

Coding Scheme

Codes	Definition
Subjects	
Patient	The patient in the medical visit
Physician	The primary care clinician in the medical visit
Behaviours	
Gaze	Participant's head or body were in the direction of the target object
Writing	Physician writing
Typing	Physician typing on a keyboard or using mouse
Objects	
Computer monitor	The computer monitor viewed during the medical visit
Chart	The paper chart or worksheet the physician uses
Physician	The primary care clinician in the medical visit
Patient	The patient in the medical visit

Table 2

Patient demographics for each site

Sites	Age (mean)	Gender	Race
Paper	39.5 years (SD=16.8)	14 male, 26 female	40 white
EHR 1	47.3 years (SD=13.1)	14 male, 6 female	19 white, 1others
EHR 2	39.8 years (SD=13.2)	12 male, 8 female	17 white, 3 others

Table 3

Proportion of visit for gaze and other activities (Mean/SD)

	Paper record settings	EHR settings	P-value
Physician gaze at patient	52.6% (12.3 %)	45.6 % (17.9 %)	**0.041**
Patient gaze at physician	39.1% (13.2 %)	52.2 % (18.7 %)	**0.005**
Mutual gaze	28.5 % (13.9 %)	33.9 % (17.4%)	0.136
Physician gaze at paper chart and/ or worksheet	22.1 % (8.9 %)	13.7 % (9.1 %)	**0.002**
Physician gaze at monitor	-	21.5 % (12.2 %)	NA
Total physician gaze at record	22.1 % (8.9 %)	35.2 % (15.7 %)	**0.001**
Shared gaze at paper chart	14.7 % (7.8 %)	1.1 % (1.2 %)	NA
Shared gaze at monitor	-	10.3 % (9.1 %)	NA
Total shared gaze at records	14.7 % (7.8 %)	11.4% (9.3 %)	0.214
Typing	-	2.9 % (2.4 %)	NA
Writing	7.8 % (6.3 %)	9.9 % (10.6 %)	0.495