Physicians and Electronic Health Records

A Statewide Survey

Steven R. Simon, MD, MPH; Rainu Kaushal, MD, MPH; Paul D. Cleary, PhD; Chelsea A. Jenter, MPH; Lynn A. Volk, MHS; E. John Orav, PhD; Elisabeth Burdick, MS; Eric G. Poon, MD, MPH; David W. Bates, MSc, MD

Background: Electronic health records (EHRs) allow for a variety of functions, ranging from visit documentation to laboratory test ordering, but little is known about physicians’ actual use of these functions.

Methods: We surveyed a random sample of 1884 physicians in Massachusetts by mail and assessed availability and use of EHR functions, predictors of use, and the relationships between EHR use and physicians’ perceptions of medical practice.

Results: A total of 1345 physicians responded to the survey (71.4% response rate), and 387 (28.8%) reported that their practice had adopted EHRs. More than 80% of physicians with EHRs reported having the ability to view laboratory reports (84.8%) and document visits electronically (84.0%), but considerably fewer reported being able to order laboratory tests electronically (46.8%) or transmit prescriptions to a pharmacy electronically (44.7%).

Fewer than half of the physicians who had systems with clinical decision support, transmittal of electronic prescriptions, and radiology order entry actually used these functions most or all of the time. Compared with physicians who had not adopted EHRs, EHR users reported more positive views of the effects of computers on health care; there were no significant differences in these attitudes between high and low users of EHRs. Overall, about 1 in 4 physicians reported dissatisfaction with medical practice; there was no difference in this measure by EHR adoption or use.

Conclusions: There is considerable variability in the functions available in EHRs and in the extent to which physicians use them. Future work should emphasize factors that affect the use of available functions.

Arch Intern Med. 2007;167:507-512

The adoption of health information technology and electronic health records (EHRs) have emerged as key issues in health care and in public policy.1 Recent data2 suggest that fewer than one quarter of physicians in the United States use EHRs, and the rate is lower among physicians practicing solo or in small practices. A variety of efforts at the federal and state levels have begun to address the barriers to EHR adoption, but significant challenges still remain.3-7

Most studies have focused on EHR adoption. Relatively little attention has been paid to the capabilities of those systems and the degree to which physicians with EHRs actually use them. Electronic health records have great potential to improve quality and safety in health care,5,6,8 but these improvements will occur only if clinicians have access to key functions in EHR systems and use them regularly. While documenting the details of patient encounters and tracking medications and current problems in electronic lists are essential components of any EHR, models strongly suggest that the benefits of EHRs in terms of safety, quality, and costs will only be realized through the use of “higher-level” functions, such as electronic prescribing and laboratory order entry with advanced clinical decision support.2

We undertook a detailed study of how physicians use EHR systems by surveying a stratified random sample of physicians in Massachusetts in 2005. We sought to determine the degree to which physicians used the various functions available in their EHR systems and to identify factors that correlate with use. The survey also assessed physician views about how computers affect health care. We examined the relationship between EHR use and physicians’ reported levels of satisfaction with their practice and other indicators of professional fulfillment.

METHODS

The sampling methods, and the methods of survey development and administration, have been described elsewhere10 and are summarized briefly.
None of the Time | Some of the Time | Most or All of the Time
--- | --- | ---
Electronic Prescribing Transmittal | | 30%
Laboratory Order Entry | | 30%
Alerts, Warnings, and Reminders | | 30%
Radiology Order Entry | | 30%
Clinical Messaging | | 30%
Problem Lists | | 30%
Medication Lists | | 30%
Radiology Test Results | | 30%
Visit Notes | | 30%
Laboratory Test Results | | 30%

Exchange of electronic health record (EHR) functions among office practices with EHRs. The length of each bar indicates the proportion of physicians who have each function available within their EHR system. The component segments of each bar reflect the proportion of physicians using each function most or all of the time, some of the time, and none of the time. Electronic prescribing transmittal refers to the capability of transmitting prescriptions to a pharmacy electronically or via electronic faxing.

SAMPLE

We identified the population of all physicians practicing in Massachusetts in spring 2005. After excluding physicians who were residents in training, retired, or without direct patient care responsibilities, the total population of physicians was 20,227. These physicians practiced in 6,174 unique sites. We drew a stratified random sample of 1,921 practices and randomly selected 1 physician per practice. After excluding practices that had closed, the final sample size was 1,884 physicians.

SURVEY

We developed an 8-page survey that included questions about the availability of different EHR functions and the degree to which the physician used each of those functions. We asked, "Does your main practice have components of any electronic health record (EHR), that is, an integrated clinical information system that tracks patient health data, and may include such functions as visit notes, prescriptions, lab orders, etc.?” Physicians who responded affirmatively were considered to have adopted an EHR, and those respondents were then asked to identify the presence or absence of 10 functions in their EHR and to indicate the degree to which they used each function.

A series of questions assessed physicians' perceptions of how computers would affect 8 dimensions of clinical practice. The survey also asked about characteristics such as primary care vs specialty, number of visits per week, number of physicians, and number of other clinicians and staff functioning in the office. It also asked about Internet connectivity and current use of health information technology. In addition, the survey asked about financial incentives for use of health information technology. Some of these questions were based on published surveys.

SURVEY ADMINISTRATION

We administered the survey between June 1 and November 30, 2005. The initial survey was sent via express mail with a $20 cash honorarium. Subsequently, second and third mailings were sent to nonrespondents, without remuneration, via first-class and express mail, respectively. Between these mailings, multiple telephone contacts were attempted. On telephone contact, physicians were reminded to complete the written questionnaire and were offered the opportunity to complete the survey by telephone; 1.3% of respondents completed the survey by telephone. A total of 94 physicians in the sample were deemed ineligible for the following reasons: 62 had retired or closed their practice, 30 had relocated to a different practice site, 1 was deceased, and 1 had an address that was a corporate office, not a clinical practice. The study protocol was approved by the Partners HealthCare Human Research Committee.

STATISTICAL ANALYSIS

We classified respondents according to whether they reported having an EHR or not. In subsequent analyses limited to physicians with an EHR, we determined the reported availability (yes or no) of each of 10 listed functions and then measured the reported use (most or all of the time, some of the time, or none of the time) for each function. We created a "use index," an indicator of the degree to which the respondents used the functions available in their EHR. For each available function, we assigned a score of 1 if the physician reported using the function most or all of the time, 0.5 if used some of the time, and 0 if used none of the time. The sum of these scores, divided by the number of available functions, constituted the use index. For example, if a physician reported having 8 of the 10 functions available and used 5 of them most or all of the time, 2 of them some of the time, and 1 of them not at all, then the use index would be as follows: 

\[
(5 \times 1) + (2 \times 0.5) + (1 \times 0)/8 = 0.75
\]

We stratified respondents into 3 categories: EHR nonadopters, “low” EHR users, and “high” EHR users. High EHR users were defined as having an EHR use index greater than 0.5, while low EHR users had EHR index scores of 0.5 or less. The data were analyzed using SAS statistical software, version 9.1 (SAS Institute Inc, Cary, NC).

RESULTS

A total of 1,345 completed surveys were returned, resulting in a response rate of 71.4%. Respondents and nonrespondents were similar with respect to specialty, practice size, hospital-based practice, and nonurban practice location.

CHARACTERISTICS OF EHR USE

Among physicians who reported having an EHR, there was considerable variation in the EHR functions available and in the reported use of each function (Figure). The most commonly reported functions were the ability to view laboratory test results (84.8%) and to document visit notes electronically (84.0%). In contrast, the least available functions were electronic prescribing with electronic transmittal of prescriptions to pharmacies (44.7%) and laboratory order entry (46.8%).

For each of the 10 functions assessed, fewer than three fourths of physicians reported using the function most or all of the time if it was available in their system (Figure). The largest observed gap between availability and use existed for clinical decision support (alerts, warnings, and reminders). While 53.0% of physicians reported having this function, only 31.2% of them reported using it most or all of the time. In contrast, the smallest observed gap...
was for viewing radiology test results, where 73.6% of physicians who had this function available reported using it most or all of the time.

**PREDICTORS OF EHR ADOPTION AND USE**

Table 1 shows the characteristics of respondents, comparing physicians with high and low levels of EHR use and comparing all users with physicians who have not yet adopted EHRs. There were no apparent differences between high and low users of EHRs in terms of the measured demographic and practice characteristics. Compared with physicians who had not yet adopted EHRs, adopters had fewer years since medical school completion (mean, 20.6 vs 24.3 years) and had been in their current practice situation for fewer years (mean, 8.4 vs 12.0 years). Physicians in larger practices and physicians whose practice consisted of a specialty other than primary care were more likely to use an EHR. Compared with physicians who had not yet adopted an EHR, adopters were less likely to have ownership (full or part) in their practice, but were more likely to use the Internet at least daily.

There were no apparent differences between high and low users of EHRs in terms of the measured demographic and practice characteristics. Only when EHR use was analyzed as a continuous outcome did we find a significant correlation, where EHRs were used more often in larger practices (Spearman rank correlation coefficient, 0.2; P = .004).

**EFFECT OF COMPUTERS ON HEALTH CARE**

Physicians who had adopted an EHR consistently reported more positive views of the potential effect of computers on health care than physicians who did not yet have an EHR (Table 2). In contrast, there were virtually no differences in these attitudes between high and low users of EHRs (Table 2). The one exception was that high users of EHRs were significantly more likely to report that computers would have a positive effect on quality of health care than low users.
**Table 2. Perceived Effects of Computers on Health Care**

<table>
<thead>
<tr>
<th>Dimension of Health Care</th>
<th>EHR Adopters</th>
<th>EHR Nonadopters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>No Effect</td>
</tr>
<tr>
<td>Controlling costs of health care</td>
<td>67.0</td>
<td>27.3</td>
</tr>
<tr>
<td>Quality of health care</td>
<td>94.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Interactions with the health care team</td>
<td>88.6</td>
<td>9.4</td>
</tr>
<tr>
<td>Patient-physician communication</td>
<td>71.1</td>
<td>19.4</td>
</tr>
<tr>
<td>Clinicians’ access to up-to-date knowledge</td>
<td>29.9</td>
<td>30.3</td>
</tr>
<tr>
<td>Efficiency of providing care</td>
<td>86.5</td>
<td>4.4</td>
</tr>
<tr>
<td>Medication errors</td>
<td>90.1</td>
<td>8.2</td>
</tr>
</tbody>
</table>

**Table 3. Reported Concerns Related to the Practice of Medicine and Overall Satisfaction With Practice**

<table>
<thead>
<tr>
<th>Concern</th>
<th>All (N = 387)*</th>
<th>High Use (n = 303)*</th>
<th>Low Use (n = 84)*</th>
<th>P Value†</th>
<th>All (N = 794)*</th>
<th>P Value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isolation from colleagues§</td>
<td>14.7</td>
<td>13.2</td>
<td>20.2</td>
<td>.11</td>
<td>17.8</td>
<td>.19</td>
</tr>
<tr>
<td>Personal or professional stress§</td>
<td>42.6</td>
<td>43.9</td>
<td>38.1</td>
<td>.34</td>
<td>38.4</td>
<td>.16</td>
</tr>
<tr>
<td>Having to work long hours§</td>
<td>51.4</td>
<td>53.1</td>
<td>45.2</td>
<td>.20</td>
<td>48.0</td>
<td>.27</td>
</tr>
<tr>
<td>Feeling demoralized§</td>
<td>46.0</td>
<td>45.9</td>
<td>46.4</td>
<td>.93</td>
<td>53.2</td>
<td>.02</td>
</tr>
<tr>
<td>Dissatisfied with practice situation</td>
<td></td>
<td></td>
<td>25.6</td>
<td>26.2</td>
<td>23.8</td>
<td>.63</td>
</tr>
</tbody>
</table>

**Abbreviation:** See Table 1.

*Data are given as percentage of each group. Row percentages may not total 100 because of rounding.

†Among EHR adopters, comparison between proportion of high and low users who report positive. All comparisons used χ² tests.

‡Comparison between EHR adopters (combined high and low users) and nonadopters.

**Table 3. Perceived Effects of Computers on Health Care**

<table>
<thead>
<tr>
<th>Dimension of Health Care</th>
<th>EHR Adopters</th>
<th>EHR Nonadopters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Positive</td>
<td>No Effect</td>
</tr>
<tr>
<td>Controlling costs of health care</td>
<td>67.0</td>
<td>27.3</td>
</tr>
<tr>
<td>Quality of health care</td>
<td>94.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Interactions with the health care team</td>
<td>88.6</td>
<td>9.4</td>
</tr>
<tr>
<td>Patient-physician communication</td>
<td>71.1</td>
<td>19.4</td>
</tr>
<tr>
<td>Clinicians’ access to up-to-date knowledge</td>
<td>29.9</td>
<td>30.3</td>
</tr>
<tr>
<td>Efficiency of providing care</td>
<td>86.5</td>
<td>4.4</td>
</tr>
<tr>
<td>Medication errors</td>
<td>90.1</td>
<td>8.2</td>
</tr>
</tbody>
</table>

**Abbreviation:** See Table 1.

*Data are given as percentage of each group.

†Among EHR adopters, comparison between proportion of high and low users, using χ² tests.

‡Comparison between EHR adopters (all) and nonadopters, using χ² tests.

§Respondents identifying each potential issue as a major or minor concern.

||Respondents indicating they were dissatisfied or very dissatisfied with their practice situation.

**RELATIONSHIP BETWEEN EHR ADOPTION AND USE AND PHYSICIAN SATISFACTION**

**Table 3** shows the percentage of respondents who identified isolation from colleagues, personal or professional stress, having to work long hours, or feeling demoralized as minor or major concerns related to the practice of medicine and the percentage who were dissatisfied or very dissatisfied with their practice situation. Electronic health record nonadopters, high users, and low users reported similar levels of satisfaction with their current practice situation. There was no difference between nonadopters, high users, and low users in reported levels of isolation from colleagues, professional or personal stress, and having to work long hours (Table 3). However, physicians who had not adopted an EHR were more likely to report feeling demoralized about the state of medical practice in general compared with physicians who had already adopted one.

In this detailed survey of physicians’ adoption and use of EHRs, we found important variability in the functions available in physicians’ EHRs and in the extent to which physicians use each of the available functions. While most physicians with EHRs have and use functions such as electronic visit note documentation and medication lists, only about half or fewer have advanced functions, including clinical decision support, electronic prescribing with electronic transmittal to pharmacies, and electronic order entry for laboratory testing and diagnostic imaging. These findings highlight the importance of moving beyond “EHR adoption” as an important outcome and emphasize the need to assess and understand the functions available in EHR systems and the extent to which physicians are using them.

Despite finding variation in the availability and use of key EHR functions, this study did not identify any fac-
tors predicting EHR use that are easy to change. We found that physicians in larger practices were more likely to use available functions in their EHRs than physicians with EHRs at smaller practices. This observation suggests that larger physician organizations may have more extensive systems for supporting and training clinicians in using their EHR to maximize its potential benefits or that the volume of physicians in these organizations creates an environment and culture in which EHR use and clinical data exchange are necessary for successful practice. Larger practices may have EHRs that are more user friendly than smaller practices. Another possibility is that physicians in larger practices may have relatively more time available to learn how to fully use EHRs.

Physicians who have EHRs had consistently more positive attitudes than nonadopters about the influence of computers on health care. These perceptions differed most conspicuously in terms of physicians' views of the effects of computers on improving health care quality and on relationships between health care professionals and between physicians and their patients. Because our survey was cross-sectional, we were unable to determine whether the physicians with more favorable views toward computers led their practices to adopt EHRs or whether the use of EHRs resulted in the more positive views of computers on health care. More than 40% of responding physicians, regardless of whether they used EHRs, said that computers may have a negative effect on patient privacy. While it is extremely important to maintain the highest possible standards of security to ensure patient privacy and confidentiality, physicians may harbor more concerns in this area than the patients themselves.

Somewhat surprisingly, we found less difference in reported satisfaction with the practice situation among physicians who reported high EHR use, those who reported low use, and those who had not yet adopted EHRs at all. Given highly publicized episodes of physicians rejecting health information technology, our data provide reassurance that the use of EHRs does not result in lower levels of physicians' satisfaction with their practice and does not lead to increased concerns regarding work-related stress or longer hours. Perhaps most notable are the high levels of professional isolation, stress, and demoralization across all physicians in ambulatory practice independent of their use of EHRs. Further study is needed to determine whether and how information technology and other practice innovations can improve physicians' satisfaction with practice.

Previous studies have focused on the rate at which physicians in office practice have adopted EHRs. A recent report from the Centers for Disease Control and Prevention indicated that EHR adoption has increased rapidly during the past 2 to 3 years, with about 25% of physicians in the United States using such systems. However, that same report indicated that nearly 1 in 5 physicians reporting that they had a “full electronic medical record” also indicated that their system was unable to maintain clinical notes or access laboratory results via computer. Our study confirms that these and other essential functions may not be available (or that physicians may not realize that they are available) in existing EHRs. This study provides a more detailed view of the functions available to physicians with EHR systems and confirms that having functions available does not mean that physicians will use them.

Why do physicians not use the available functions to a greater degree than we observed? One explanation is that they view their medical record not as the exclusive “product” of EHRs and fail to recognize the potential value of other functions. Or, the demands and pressures of delivering office-based care may not afford them the time to learn how to use new functions. Future studies should examine further physicians' own reasons for not using functions that they know are available in their EHR systems.

The finding that the largest gap between availability and use was for decision support is of particular concern. It is known that physicians will often turn off or override decision support, such as allergy checking. However, such types of decision support are among the most critical to improving safety and quality. Clearly, overalerting can be a problem, but it is probably best not to allow the locus of control for decision support to lie solely with the individual physician. A major limitation of this study is that it was conducted in a single state, Massachusetts. If the findings regarding the gap between available functions and used functions hold true for the rest of the country, then this gap is an important issue for EHR implementation nationwide.

Another limitation is that our estimates of EHR function availability and use were based on the self-report of responding physicians. It is conceivable that physicians may have reported having and using more functions than they actually have or use. If this social desirability bias occurred, then our findings overestimate the actual use and availability of advanced EHR functions, further highlighting the observed gaps.

The findings of this study have important implications for efforts to make health information technology available in physicians' offices throughout the country. Establishing standards for EHR functionality, interoperability, and security, such as those of the Certification Commission for Healthcare Information Technology (available at http://www.cchit.org), will help to ensure that physicians' EHRs incorporate the components necessary to improve quality and safety in health care. However, Certification Commission for Healthcare Information Technology certification cannot ensure that the key functions are turned on or used.

This study also underscores the importance of ensuring that physicians take full advantage of the functions available in their EHR systems. There may be a role for professional organizations, such as the American College of Physicians, the American Academy of Family Practice, and the American Medical Association, to assist physicians in the implementation and optimal use of EHR systems. State medical societies, quality improvement organizations, and other entities also may be able to support these efforts. In addition, pay-for-performance initiatives should include not only adoption of EHRs but also the actual use of specific functions.

In conclusion, we found that a considerable fraction of physicians with EHRs do not have the necessary functions available to improve quality and safety in health care...
and that having functions available does not always translate to regular use of them in day-to-day practice. It is especially striking that relatively few physicians were using clinical decision support, one of the notable benefits of EHRs. Future studies should assess ways of helping physicians to optimize their use of these systems in ambulatory practice.

Accepted for Publication: November 23, 2006.

Correspondence: Steven R. Simon, MD, MPH, Department of Ambulatory Care and Prevention, Harvard Medical School and Harvard Pilgrim Health Care, 133 Brookline Ave, Sixth Floor, Boston, MA 02215 (steven_simon@hphc.org).

Author Contributions: Dr Simon had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Simon, Kaushal, Cleary, Volk, Poon, and Bates. Acquisition of data: Simon, Kaushal, Jenter, Volk, and Bates. Analysis and interpretation of data: Simon, Kaushal, Cleary, Jenter, Volk, Orav, Burdick, Poon, and Bates. Drafting of the manuscript: Simon. Critical revision of the manuscript for important intellectual content: Kaushal, Cleary, Jenter, Volk, Orav, and Burdick. Study supervision: Simon, Volk, and Bates.

Financial Disclosure: Dr Bates is a coinventor on patent 6029138 held by Brigham and Women’s Hospital on the use of decision support software for medical management, licensed to the Medicals Corporation. He holds a minority equity position in the privately held company Medicals, which develops Web-based decision support for radiology test ordering, and serves as a consultant to Medicals.

Funding/Support: This study was supported by grant 1UC1HS015397 from the Agency for Healthcare Research and Quality.

Role of the Sponsor: The funding body had no role in data extraction and analyses, in the writing of the manuscript, or in the decision to submit the manuscript for publication.

REFERENCES