Real and Imagined Barriers to an Electronic Medical Record

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ABSTRACT

We developed an electronic medical record for ambulatory patients as part of the integrated clinical information system at Beth Israel Hospital. During the four years since it was installed, clinicians have entered 76,060 patient problems, 137,713 medications, and 33,938 notes. Residents, who had to type notes in themselves, entered 49.5% of their notes into OMR. Several factors that we had predicted would be barriers to an electronic medical record, such as clinician reluctance to type or perform data entry, have not proved to be significant problems. Other anticipated barriers, such as difficulties with dual charting on paper during transition to an electronic medical record, have been realized. The major unexpected barrier that has been encountered is increased clinician concern about the privacy and security of full text notes relative to other data elements in the clinical information system. We have attempted to modify the electronic medical record so as to overcome some of these barriers.

INTRODUCTION

Electronic medical records in the ambulatory setting have the potential to improve clinician access to information [1-4], improve the quality of patient care by providing computer-generated reminders[5-7], and to facilitate outcome-based research [8]. Despite this, few ambulatory medical practices make extensive use of electronic medical records, suggesting that there may be significant barriers to their implementation or adoption.

An ambulatory care electronic medical record system was first developed at Massachusetts General Hospital two decades ago [1], and such systems have now been installed in many locations. Most ambulatory medical record systems rely heavily on the use of data forms which are filled out by clinicians and then subsequently transcribed into the electronic record.

We chose to attempt to develop an electronic medical record for the care of outpatients which relied mainly on direct clinician entry of information into the computer. We felt that this would decrease errors and delays associated with transcription, and allow clinicians to interact with computer-based reminder systems at the point of care while the patient was present.

In developing such a system we considered some of the issues that we felt were likely barriers to the implementation and acceptance of an electronic medical record. In this paper, we describe the system in its current form, and the barriers we encountered. Some of the barriers we had predicted proved illusory, while others that we had not anticipated proved more substantial.

SYSTEM DESCRIPTION

The Beth Israel Hospital clinical computing system, developed and maintained by the Center for Clinical Computing, is a heavily used, integrated hospital information system [9-11]. There are more than 1400 terminals located throughout the hospital and ambulatory care facilities. Each week, clinicians use these terminals more than 50,000 times and send more than 20,000 pieces of electronic mail.

Clinicians can obtain results from clinical laboratories, read diagnostic reports from the clinical departments, view lists of medications used during hospitalizations, perform bibliographic retrieval, and obtain help in making clinical decisions from any of the 1400 terminals. They can also retrieve administrative information such as beeper and phone numbers, physicians' clinical schedules, and cross-coverage information.

The Outpatient Medical Record (OMR) is fully integrated with the Beth Israel Hospital clinical computing system [12]. Terminals in the hospital have complete access to information entered into OMR, and terminals in clinicians' offices have complete access to the hospital information system. There is only one registry of patients, so no duplication of patient identifiers or demographic information is necessary.

The OMR system was initially developed for the primary care internal medicine practice, Healthcare Associates, at Beth Israel Hospital. Healthcare Associates is an academic practice which

0195-4210/92/$5.00

employs a cooperative model with faculty internists, medical residents, nurse practitioners, psychiatrists, social workers, and community resource specialists practicing using a team approach to care.

In 1989, one-fifth of the Healthcare Associates practice moved to a location outside the hospital. It was not possible to transport the hospital's paper medical records to this new location. This posed a problem for communication between the outside portion of the practice and the rest of the hospital.

In response to this problem, we installed terminals connected to the main hospital computer system in every office and examination room in the outside location and developed programs to allow clinicians to enter, edit, and display problem lists, medication lists, and health-promotion and disease-prevention screening sheets. As discussed below, full text notes were added to the system.

OMR was designed with the intent that clinicians would directly enter information into the computer. We chose this strategy both to reduce the risk of transcription errors, and to encourage clinicians to interact with the system during the routine care of patients which would then allow the system to provide clinicians with prompts, reminders, and suggestions for care.

OMR was first used at the outside practice in February 1989, and in July 1990 became available throughout Healthcare Associates. It is currently being expanded to included multiple hospital-based ambulatory primary care and subspecialty practices at Beth Israel.

ANTICIPATED BARRIERS

Delayed Rewards

Slack has pointed out that clinician use of computers may be viewed in a Skinnerian model where if the clinician hits a computer key and something good happens (such as retrieving desired data), he or she is likely to try pressing more keys, while if nothing good happens, the behavior will quickly be extinguished [13]. Under this model, it is much simpler to induce clinicians to use a computer to retrieve necessary patient lab data than to use a computer to enter their own data for someone else's benefit.

Electronic medical records fall in a middle ground. Clinicians will be able to obtain rewards from a well-designed system, but these rewards tend to be delayed in time from the initial behavior. Entry of a medication list or problem list will likely prove beneficial not during the visit when the entry occurs but some time down the road when the patient either returns for a revisit or calls on the phone.

As we had anticipated, clinicians often showed an initial reluctance to enter data into OMR. Once they had been using it for a period of approximately six months or so, they generally began to experience overall time-savings and benefits from the system and to be enthusiastic about its impact on patient care [12]. A six month delay in benefits could be expected since most primary care patients are scheduled to be seen for routine care once or twice per year. When an electronic medical record is initially brought online, there will necessarily be a large backlog of information on patients that exists only in paper form. When OMR was made available throughout Healthcare Associates, we hired a research assistant to assist staff physicians in transcribing existing paper problem lists into the computer.

Healthcare Associates sees approximately 7000 different patients per year with approximately 30,000 patient visits per year. In the four years since the initial introduction of OMR to the outside practice, clinicians have entered 76,060 problems onto problem lists: 31,636 by staff physicians, 27,205 by residents and fellows, 4670 by nurse practitioners, and 12,549 by other clinical staff including social workers, resource specialists, and health assistants. Clinicians have entered 137,713 medications onto medication lists: 54,935 by staff physicians, 38,492 by residents and fellows, 36,856 by nurse practitioners, and 7430 by other clinical staff. They have also placed 112,632 screening entries on healthcare promotion and screening sheets: 39,141 by staff physicians, 24,601 by residents and fellows, 16,869 by nurse practitioners, and 31,751 by other clinical staff.

Clinician Typing

We assumed, based on previous designs of ambulatory medical records, that most clinicians would be unwilling to type progress notes into a computer terminal. As such, we did not initially create any facility for notes, with the plan that we would eventually incorporate dictated notes into the electronic medical record.

With the early use of the system in the outside location, several physicians began using the comments field in the electronic problem list to give long descriptions of problems and plans for care. When the system was expanded to the entire general medicine practice, we began to find problem lists maintained by residents that contained

comments that had all the usual information provided in a progress note. The primary care chief resident noted that in a few cases residents were only writing these comments and not placing any additional text in the paper chart. We discovered that clinicians who used the electronic problem list wrote 10.9 words per problem while clinicians who used the paper problem list wrote only 4.3 words per problem ($p<0.0001$) [12], suggesting that even clinicians who were keeping adequate paper progress notes found the electronic problem list more useful than the paper problem list.

In response to this, we rapidly developed an electronic notes feature for the OMR which was implemented for general use in November, 1990. As of June, 1993, clinicians have typed 18,524 progress and initial notes into the OMR and have dictated another 15,414 notes which are transcribed directly into OMR, and then edited and signed electronically. Residents are not allowed to dictate routine notes. A random review of visits to HCA in a recent two month period showed that interns and residents had typed 46 initial or progress notes in 93 patient visits (49.5%). While the practice now requires residents to keep problem lists and medications online, they are not required in any way to write electronic notes: this use of OMR is entirely voluntary. The same review showed that staff physicians, who may dictate notes or type them themselves, had 77 notes in OMR in 113 patient visits (68.1%) These two proportions are clearly different ($p=0.007$), and some of this difference is undoubtedly related to residents not being permitted to dictate. Still, a large percentage of residents are willing to type notes into OMR, and providing transcription services to staff physicians only raises the percentage of notes entered by 19% when compared with the percentage entered by residents. This suggests that clinician typing may not be as great a barrier as we had anticipated, and that there are other important barriers to the electronic capture of notes.

Maintenance of Data

We were concerned that medication lists, if not carefully maintained, would rapidly become out-of-date. To examine this, we reviewed the medication lists of patients in the practice. Only 3% of medications had appeared on the medication sheet for more than one year without being rewritten, and 68% had been prescribed or rewritten within 6 months. This suggests that physicians maintain a relatively accurate and up-to-date medication sheet. It was noted that antibiotics prescribed for short course treatment of infections were often left on medication sheets after the antibiotic course should have been completed, and so an option was added to allow clinicians to automatically discontinue a medication after a specified number of days.

Dual Charting

While making the transition to an electronic medical record, there must be one complete chart for every patient where all notes are kept. We currently print every note written in OMR and have it placed in the paper chart. Although this means that the paper chart is kept complete, it does not allow a clinician viewing the electronic chart to discern what information is missing.

As the OMR has come to appear more complete for some patients, clinicians have become more willing to rely on the record in OMR when dealing with patient phone calls, without requesting the paper chart. An important handwritten note could, therefore, be overlooked. This has the potential to compromise care. We suspect that this may become even more of an issue at the point when very few notes are still being handwritten. While significant handwritten charting continues, clinicians will likely recognize that the paper chart may contain important information. As handwritten charting becomes rare, clinicians would be more likely to overlook an important handwritten note. One solution might be to make electronic charting mandatory at a time when there is a small but significant percentage of charting that is handwritten. Healthcare Associates is currently considering requiring electronic entry of all notes.

Obligate Paper Records

We anticipated that certain records would need to be maintained on paper. We currently have no capability to capture images, and scanning handwritten notes from other facilities in an attempt to translate them into ascii files is beyond the capability of current technologies.

We assumed that clinicians who routinely draw sketches would be very hesitant to use OMR. Recently, however, clinicians in the ophthalmology outpatient clinic have requested that they be one of the first subspecialty clinics to be added to OMR, and have told us that they believe the benefits of electronic charting will outweigh the loss of their ability to make sketches (which some of us had trouble reading anyway). We do not yet have enough experience with their use of OMR to be

able to tell whether they will indeed find this to be the case.

UNANTICIPATED BARRIERS

Data Security and Privacy

The Beth Israel Hospital clinical information system requires a key (a password) that uniquely identifies users who access data on the system. Every user lookup of patient information is tracked. The computer records the identity of the patient, the identity of the user, the information examined, the time of the lookup, and the location of the terminal from which the lookup was performed. Hospital employees can easily check to see if anyone has examined information in their computer record, and any physician may request a list of users who looked up information on a patient under his or her care.

We had felt that since there was already much highly confidential information on the computer system, such as HIV antibody test results and hospital discharge diagnoses, that there would be little additional security concerns in placing full text notes on the system.

This proved to be incorrect. A number of physicians and psychiatric social workers felt strongly that their notes required a greater degree of confidentiality than other types of data. Although we considered the possibility that this concern was being raised as a surrogate for clinician reluctance to perform data entry, this seems unlikely since several of the clinicians who raised the strongest concerns already routinely dictated notes which would have been transcribed for them into OMR with no additional effort.

In response to clinician concerns, we modified OMR so that all resident and staff physicians at Beth Israel Hospital, as well as all clinicians in Healthcare Associates, could access all information in OMR, but non-physician clinicians outside of Healthcare Associates were denied access to problem lists and notes. All clinicians at Beth Israel Hospital have access to medication lists.

This solution, too, has generated concerns. Physicians who maintain complete documentation in OMR feel that it jeopardizes patient care to restrict floor nurses, for instance, from reading their notes. We continue to look for a solution that allows clinicians who chart in OMR to feel that OMR provides their notes both adequate confidentiality and access.

We have recently implemented monitored notes. This feature allows any clinician who has written an electronic note to designate it as "monitored." Whenever anyone attempts to view a monitored note on the computer, they are warned that the note is monitored and asked to enter a reason for viewing the note. They are not restricted from viewing the note, but if they proceed, an electronic message is sent to the author of the note informing him or her of when the note was viewed, whom it was viewed by, and the reason given. Early reactions to this option have been favorable.

Printing

Hardware and software issues relating to printing have proven to be a continuing difficulty in the development of OMR. Laser printers are used to print copies of notes for the paper record and to print letters on stationary with letterhead. Sprocket fed printers are used to print prescriptions. Notes that are not printed at the time they are signed are printed at midnight in either the hospital medical records department or in the outside practice medical records room.

Finding space for printers has been difficult both in Healthcare Associates and as we have tried to expand OMR into new locations. Directing printer output to the correct printer for midnight printing relies on maintaining an up-to-date list of the locations where clinicians practice. The sprocket fed printers for prescriptions routinely jam and misprint. We plan to switch prescription printing to laser printers. Laser printers, though, have difficulty handling reduced-size paper, and so we plan to place three prescriptions on a sheet of microperforated paper. Unfortunately, since most prescriptions are printed singly, this will lead to significant waste.

Because notes are printed on the day they are written, paper is not used as efficiently as in a handwritten chart where a clinician may begin a new note on the same page as an existing note. This has resulted in both excess use of paper, and difficulties in the filing of notes and the storage of medical records. We are continuing to look for ways to print notes more efficiently while still assuring that the paper chart remains complete on a day-to-day basis.

CONCLUSIONS

Many of the barriers we had expected to encounter in implementing an electronic medical record with direct clinician entry of data proved more imaginary than real. Clinicians are willing to keep extensive online problem lists and medication

lists, and seem far more willing to type than had been predicted. Some of the willingness to use the system may relate to prior clinician familiarity with the heavily utilized Beth Israel Hospital clinical information system, however this suggests that clinicians who are experienced in retrieving data from a clinical information system may be willing to enter data as well. Clinicians may be more concerned about the security and privacy of full text notes than they are about other data elements in a hospital clinical information system. By distinguishing real from imagined barriers to an electronic medical record it should be possible to confront and overcome the most significant barriers, and to develop an electronic medical record that is widely accepted and used by clinicians.

References

1. Grossman JH. An ambulatory medical record system for patient care and health care management. Methods Inf Med Suppl 1972; 6:375-82.
2. McDonald CJ, Murray R, Jeris D, Bharagava B, Seeger J, Blevins L. A computer-based record and clinical monitoring system for ambulatory care. Am J Public Health 1977; 67:240-5.
3. McDonald CJ. Tierney WM, Computer-stored medical records. Their future role in medical practice. JAMA 1988; 259:3433-40.
4. McDonald CJ, Blevins L, Tierney WM, Martin DK. The Regenstrief medical records. MD Comput 1988; 5(5):34-47.
5. McDonald CJ. Protocol-based computerreminders, the quality of care and the non-perfectibility of man. N Engl J Med 1976; 295:1351-5.
6. McDonald CJ, Murray R, Jeris D, Bharagava B, Seeger J, Blevins L. A computer-based record and clinical monitoring system for ambulatory care. Am J Public Health 1977; 67:240-5.
7. McDonald CJ, Hui SL, Tierney WM. Effects of computer reminders for influenza vaccination on morbidity during influenza epidemics. MD Comput 1992; 09(5):304-12.
8. McDonald CJ, Tierney WM. Research uses of computer-stored practice records in general medicine. J Gen Intern Med 1986; 1(4 Suppl):S19-24.
9. Bleich HL, Beckley RF, Horowitz GL, et al. Clinical computing in a teaching hospital. N Engl J Med 1985; 312:756-64.
10. Safran C, Bleich HL, Slack WV. Role of computing in patient care in two hospitals. MD Comput 1989; 6(3):141-8.
11. Bleich HL, Safran C, Slack WV. Departmental and laboratory computing in two hospitals. MD Comput 1989; 6(3):149-55.
12. Safran C, Rury C, Rind DM, Taylor WC. A computer-based outpatient medical record for a teaching hospital. MD Comput 1991; 8(5):291-9.
13. Slack WV, Van Cura LJ, Greist JH. Computers and doctors: use and consequences. Comput Biomed Res 1970; 3:521-7.