Evaluation of Community Care Network (CCN) System in a Rural Health Care Setting

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ABSTRACT

Concurrent Engineering Research Center (CERC), under the sponsorship of NLM (National Library of Medicine) is in the process of developing a computerized patient record system for a clinical environment distributed in rural West Virginia. This realization of the CCN (Community Care Network), besides providing computer-based patient records accessible from a chain of clinics and one hospital, supports collaborative health care processes like referral and consulting. To evaluate the effectiveness of the system, a study was designed and is in the process of being executed. Three surveys were designed to provide subjective measures, and four experiments for collecting objective data. Data collection is taking place in several phases: baseline data are collected before the system is deployed; the process is repeated with minimal changes three, then six months later or as often as new versions of the system are installed. Results are then to be compared, using whenever possible matching techniques (i.e. the preliminary data collected on a provider will be matched with the data collected later on the same provider). Surveys are conducted through questionnaires distributed to providers and nurses and person-to-person interviews of the patients. The time spent on patient-chart related activities is measured by work-sampling, aided by a computer application running on a laptop PC. Information about missing patient record parts is collected by the providers, the frequency by which new features of the computerized system are used will be logged by the system itself and clinical outcome measures will be studied from the results of the clinics' own patient chart audits. Preliminary results of the surveys and plans for the immediate and distant future are discussed at the end of the paper.

INTRODUCTION

Concurrent Engineering Research Center [1] with the partnership of Valley Health Systems Inc. (VHS) is conducting a field trial of the computer-based clinical environment connecting two of the 15 clinics of VHS and the radiology department of a tertiary care hospital located in southern West Virginia. Initially the system will support only the prenatal care providers but it will be eventually expanded to additional clinics and for other types of care. In this paper, we will describe our effort in evaluating as well as measuring the effectiveness of the system.

When studying the effectiveness of any system, the first thing to do is to define exactly what do we mean by "effectiveness". Since a pure cost-effectiveness study is made all but impossible by the nature of the medical environment, this study is designed to measure the reduction in time and provider effort spent on patient-chart related activities and to evaluate providers', nurses' and patients' satisfaction with the new system as compared to the paper-based records. Effectiveness in our study means reduction in time and effort on one hand and higher levels of satisfaction with the system and confidence in the quality of the care on the other.

In evaluating a new system, control group studies are the most reliable. This means comparing data for a group of users to similar data for a group of nonusers or "controls". However, this design in our rural health-care environment poses several problems: though there are several clinics, and initially our system is deployed in only two of them, the differences between clinics are too large to use the providers in the rest of the clinics as controls. So we use a version of this -- the so-called before-after study, when each individual is its own control, because we compare data collected before and after the system is installed, matching whenever possible for the same subject. In fact, we

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collect data several times after the deployment of the system, so that the effects of the adjusting period can be determined and discarded.

To avoid an overly complicated design without discarding differences among the different types of healthcare providers, we classified them in two different categories: Medical Care Providers (MCPs) - physicians, physicians' assistants, nurse practitioners, nurse-midwives -, and Nursing Care Providers(NCPs).

BREAKDOWN OF THE STUDY

In the next few paragraphs we list the experiments forming our study and their goals. A more detailed description of the individual experiments can be found in the next section.

1. Survey of MCPs and NCPs [2]

Goal: to determine general satisfaction level as well as problems with the paper based and, later, the computer based patient record systems, to assess providers' readiness to use the new technology.

2. Patient Survey [3]

Goal: to pinpoint problems with the patient record system from the patient's point of view and identify any fears that the patients might have regarding computer-based records.

3. Time-Motion and Work-Sampling Study [4]

Goal: to measure the proportion of providers' time spent on activities related to the patient record (reviewing chart and documenting visit) with the paper based and then with the computer based system.

4. Missing Information Data Collection [5]

Goal: to determine the frequency of information missing from the patient record and the time needed to recover that information. By missing information we mean results of tests that were ordered but have not been entered in the chart or parts of the patient record that were misplaced or not sent with the patient.

5. Compliance with Guidelines for Clinical Outcome Measures.

Goal: to see how much, if any, difference the computerized patient record system made relative to patient well-being as measured by compliance with guidelines for clinical outcomes

6. Use of New Features Provided by the Computerized Patient Record System

Goal: to measure the frequency with which the feature is used.

METHODS AND MATERIALS

Survey of MCPs and NCPs

The survey of providers at VHS is conducted in several phases. A first set of questionnaires (preliminary survey) was distributed before the computer based system was installed, and will be followed by at least two other sets, three and six months after the deployment of the patient record system. In addition, questionnaires will be prepared and distributed after any major change in the computerized patient record system. The preliminary survey pinpointed problems and assessed the general satisfaction level with the paper based patient records. It also helped determine providers' readiness to accept a new, computer based patient record system. The surveys performed after the system is installed will deal with the same range of properties of the patient records, with some questions dropped and others rephrased so that they relate to the new system. The secondary goal of these questionnaires will be to assess the general satisfaction level with the computer-based records and highlight possible problems in the area of usability of the system. Repeating the surveys could make it possible to track the learning process of providers and test for the effectiveness of the different components of the system that are installed separately.

In all these surveys, providers are not identified by name (in compliance with Institutional Review Board (IRB) requirements), but with code-labels that are used for the whole duration of the study.

As nursing and medical care providers' responsibilities are different, two sets of questionnaires are used for each phase of the study. All the providers at VHS have been included in the preliminary survey, but only those working in the clinics with computerized records will participate in the next phases.

Dimensions included in the survey are:

- Level of general satisfaction with current patient record system

- Degree of providers' effort (usability)
- Level of organization of the patient record system
- Opportunities for prevention provided by the current record system.
- Support for recording data related to clinical outcomes
- Completeness of records
- Confidence in accuracy of information
- Confidence in security
- Frequency of unnecessary tests caused by failings in the record system
- Availability of information after hours or from other clinics
- Support for referral/consulting
- Providers' familiarity with computers

In most of the questions the subjects are asked to rank on a three- or five-point Likert scale their satisfaction with the patient record system's performance on a particular task from highly dissatisfied to highly satisfied. There are also some multiple-choice questions.

Patient Survey

Unlike the providers' survey, where questionnaires are distributed and filled out by the subjects, the patient survey is conducted by "trained observers" in the form of person-to-person interviews in the waiting rooms. This is to accommodate patients of all ages as well as patients with disabilities which would make reading, comprehending and filling out a questionnaire difficult.

Every effort is made to interview a random sample of patients frequenting the two clinics targeted for initial deployment of the computerized record system. Participation is, of course, voluntary. Patients are not identified in any way except for the clinic in which the interview took place. Some demographic data is also obtained in the course of the interview, to explain any correlation between patients' satisfaction and factors like age, gender and education level. The survey is repeated three, then six months after the system is installed and three months after significant changes are made to the system. Results are then compared and interpreted.

The interviewer uses a standard questionnaire in conducting the survey. The questions target areas like waiting time and the burden placed on patients in moving pieces of medical record and in obtaining information related to the medical history of the patient, as well as apprehensions that the patients might have of computerized records.

Time-Motion Study and Work Sampling

There are two kinds of methods to measure providers' time spent on different activities: patient-based and non-patient-based. In the first, the time spent on different activities for each patient is recorded separately, and at the end an average time is computed by adding them up and dividing by the number of patients. The non-patient-based methods record the time spent on the activities regardless of which patient it was performed on. In this study we considered two different experiments: the time-motion study and work sampling. While work sampling clearly belongs to the second group, time-motion has variants for both of them. At first, our study focused on the patient-based methods.

The time-motion study is a method used primarily to measure effectiveness in industrial settings. The purpose of the study is to measure and record the time a subject spends on different tasks during a given time interval and compute the average time spent on each of them. It requires a one-to-one observer-subject ratio which may be expensive, but, if sufficient data is collected, the results are very reliable. In our effectiveness study time-motion serves to measure the time spent by providers on activities related to the patient record (reviewing and updating the chart) as opposed to time spent caring for the patient.

During the pilot-study several problems were discovered with the patient-based approach. Since physicians often delegate to the attending nurses responsibilities related to the patient record, the observer has to follow two persons' activities instead of one. The two subjects may be working on different tasks related to the same patient, or to different patients, at the same time. Activities may be interrupted and then resumed again. All this makes the recording of data by hand impossible. So a computer application with an easy-to-use interface was designed using Visual Basic to help the observer. The recording is done by a laptop computer with a light-pen.

However, further problems surfaced when the data gathering began. The main problems arose from two facts: that chart-related activities were going on in the examination room, where the observer couldn't follow, and that some of these activities were so fractioned that measuring was made impossible. For instance, it became obvious that reviewing the chart took sometimes half a minute or less, or wasn't done before entering the examination room. Updating the patient chart was done by some providers at the end of the day or even after several days. It became obvious that collecting data with a patient-based method can't be applied to this environment.

Because of this, methods for gathering data without following the patients have to be used. This can be done by a time-motion study that follows only the activities of one provider, or with another evaluation technique called work sampling. Work sampling has successfully been used in medical environments, and, though the resulting data is not as detailed as for time-motion, it is considerably less expensive, for one observer studies all the subjects at the same time. Again, the possible activities of the subjects are categorized in just a few classes: reviewing the patient record, caring for patient, updating the patient record, other activities. A computer application was developed for a laptop computer with a light-pen, so that the observer could record an observation with just a couple of touches on the screen.

Every ten or fifteen minutes the observer records the activities of all the MCPs on duty in a clinic. Since the clinics targeted are rather compact in size and there are just a few subjects, a "round" will take less then a minute. Statistical formulas give the number of observations necessary to provide data with a given significance level for the inference. In the case of the two clinics targeted in our study at least three weeks of observation are necessary.

The "subjects" are all the MCPs in the two clinics in the study, not just those providing prenatal care. As the observer only records how many of the subjects are engaged in a given activity at the time the observation is taken, it is impossible to get data about one particular provider. This is one of the drawbacks of the method. The other problem is the same one as mentioned before: activities going on in the examination room can not be observed. This means that some of the patient-chart related activities will be confounded with caring for the patient. There is no solution to this problem without having the providers time themselves, which would be burdensome and subjective. Still, since our goal is not to give absolute measurements but to compare observations taken before and after the study, the results will be valuable in determining whether the computerized system had any effect on the proportion of providers' time spent on record-related activities outside the examination room.

Gathering Missing Information Data

Often, information is missing from a patient record due to the shortcomings of the paper-based record system (pages get lost, lab results are not entered or are late, part or the whole of the patient record is at another clinic etc.). The MCPs in our study were asked to record such incidents in a three-weeks time period and to try to record the time spent on retrieving that information. The average number of missing information items per patient will be computed and compared to such measurements after the system is installed.

Compliance with Guidelines for Clinical Outcome Measures

Although the effects on patient well-being of the computerized patient record system may take a long time to show up, the system itself helps the recording and analysis of data used to measure compliance with clinical guidelines. This may mean better results in the quarterly and annual patient chart audits. No separate study will be done, the clinics' reports will be compared to those taken before the system was installed.

Tracking the Use of New Features

The system will log the frequency with which new features like packaging and sending referrals electronically or plotting lab results or looking at X-ray and ultrasound images are used.

PRELIMINARY RESULTS

So far, only the results of the first survey of providers are available. We analyzed the distributions of the answers for each question separately for MCPs and NCPs. Then we compared their answers to the questions which appeared on both questionnaires. Last, we tried to detect any difference in the answers due to the different clinics and we compared prenatal care providers' answers with the rest.

About a third of providers report spending more than 35% of their time on activities related to the patient chart. Only for 10% of MCPs and 12% of nurses is the time spent on patient chart below 20%. There are clinics where all the nurses spend more than 35% of their time on updating patient records.

Asked about how easy it is to use the current (paper-based) patient record system, 64% of MCPs and 42% of nurses say that they have difficulties with it. 35% of MCPs, but only 12.5% of nurses have major difficulties finding information in the paper-based records. About half of both groups report that sometimes they can't even access the patient chart because it is in another location and 53% of MCPs admit that unnecessary testing "happens sometimes" in their practice. Prenatal care providers admit to more unnecessary tests than their peers.

Generally, both MCPs and nurses are satisfied with the security of the patient records, but prenatal care providers as a group are more sceptical: only 33% are entirely satisfied.

Several questions dealt with referral and consulting situations. Only 57% of MCPs are satisfied with the reliability and completeness of the information sent with a patient referred to them and 37% say that it is unacceptably hard to retrieve information to send with a patient. If an easier information packaging method would be available, 70% of MCPs would send more information with a patient they refer to another provider. In an informal consulting situation, 80% would at least sometimes share more information when asking for advice, and fully 96% would like "sometimes" to see the actual data before giving advice.

When asked about their overall satisfaction with the current patient record system, MCPs' opinions are almost equally split between low, moderate and high satisfaction levels. Nurses are much more satisfied, while prenatal care providers in the two targeted clinics are less satisfied than their peers.

In conclusion, we can state that in a majority of the providers' opinion their is a need for improvement in the performance of the patient record system. Reducing the time spent on patient records, improving the organization level, providing access to the charts from other clinics and providing better information-packaging and -sharing facilities are all areas where a computerized system will be extremely helpful.

FUTURE WORK

During our work, one of the major obstacles was the lack of standards for this kind of evaluation study. As a first step toward the development of a common data base for similar studies we placed the explanation of our study and methodology with the questionnaires used for the surveys on a Web site accessible to anyone with a web-browser. The URL of the homepage is `http://www.cerc.wvu.edu/nlm/evaluation/evaluation.html`.

At this moment, the collection of baseline data is finished. The data is to be formatted and analyzed. The next step is to prepare, plan and conduct the second phase of the study, three months after the system is deployed. That is to be repeated again after another three month, because these months are essentially a learning period for the users. Then, these results will be compared to the baseline data, matching the subjects whenever possible. Whenever the software support for a new type of care is ready, some of the experiments will be repeated. Eventually, we plan to include in the study all types of healthcare providers.

In the long term, our study should show the effects of the computerized system on the health of the patients by analyzing compliance with the clinical guidelines for patient outcomes. Improvement in communication between the providers and between providers and their patients is another area to be targeted for evaluation in the long term as well as in the short term, because this information sharing is one of the keys for raising the quality of patient care and the quality of life for both patients and healthcare providers.

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