

Variation in Use of Informatics Tools Among Providers in a Diabetes Clinic

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ABSTRACT

A goal of health information technology (HIT) is to help eliminate variation when it may compromise safety, efficiency, or quality of care. This study utilized direct observation and semi-structured interviews to examine variability in HIT use among four nurse practitioners and four physicians in an ambulatory diabetes clinic and to assess the impact of this variability on patient care. While use of informatics tools for information access and communication was similar among all users, variability existed in patterns of data entry into the EMR. The study provides direction for developing new functionality that may be needed in HIT and suggests changes to existing functionality. By designing tools that meet user needs and workflows, adoption of informatics applications may be enhanced and patient safety and user satisfaction improved.

INTRODUCTION

Although stories of successful and failed clinical informatics implementations abound^{1,2}, rigorous evaluation of the day-to-day aspects of health information technology (HIT) use are less common. Details about how individual clinicians actually use HIT have been shown to reveal elements about how well the tools meet user needs and fit into existing workflow³. Use behaviors can also suggest revisions to existing design and new features that would benefit the end users⁴.

A study was conducted to examine workflow and information flow in three ambulatory chronic disease clinics at Vanderbilt University Medical Center (VUMC), an academic medical center in Tennessee. The goals of the study were to characterize existing clinic processes, informatics tools, and users' information needs in order to improve the usability of HIT. The pilot phase of the project was conducted in a multiple sclerosis clinic and demonstrated the value of this approach in understanding actual use of HIT⁵. This paper extends that initial work by comparing variability in HIT use among four nurse practitioners and four physicians providing care to diabetic patients in the same clinic. The observed variability reveals some of the strengths and weaknesses of existing informatics tools and also suggests approaches to improve usability and efficiency.

METHODS

The study was conducted in the Vanderbilt Eskind Diabetes Clinic, an ambulatory specialty clinic at VUMC. The clinic provides chronic disease management to approximately 6000 patients. Both adult and pediatric patients are seen in the clinic, although this study focused exclusively on adult patients. The frequency of routine visits and the types of providers seen by a patient vary dependent on disease stability and patient needs. Nurse practitioners provide care in collaboration with physicians, whereby patients alternate routine quarterly visits between the two providers. Physicians are typically assigned to use two specific exam rooms during their clinic hours, while most nurse practitioner patient encounters occur in their offices. Providers in the clinic have been using StarPanel™, Vanderbilt's electronic medical record (EMR), for approximately 3 years.

Direct observation and semi-structured interviews were used to understand the clinic's workflow and information flow. The value of these qualitative methods has been demonstrated in multiple informatics-related studies^{6,7}. Observations were conducted in offices, work areas, hallways, and exam rooms. Verbal assent was obtained from staff and providers prior to observation. Patients also gave verbal assent prior to observation of patient-provider interactions. All providers and adult patients in the clinic were eligible for the study.

The four nurse practitioners included in the study were observed for a total of 18 hours, which included 18 patient-provider interactions. The four physicians were also observed for a total of 18 hours, which included 25 patient-provider interactions. Each observation period focused on a single provider. Provider schedule and the number of patients who came to their scheduled appointments dictated the hours and number of interactions available to observe. All eight providers had equal access to VUMC HIT features and training except for dictation software, which was available only to the physicians. Sixteen additional hours of observation were conducted in the clinic, focused on intake, nursing, and dietitian activities. Additional details about individual provider observations and patient-provider interactions are shown in Figure 1.

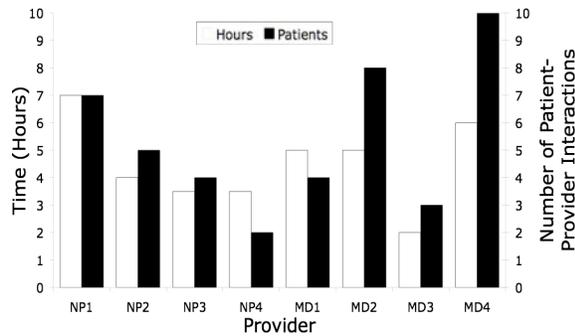


Figure 1. Hours of observation and patient-provider interactions

Detailed notes regarding interactions between people, processes, and technology were recorded during observation. These notes were then organized in a fully-indexed electronic notebook. An inductive analysis process was followed to extract key themes and concepts from the data⁸. Observations of individual providers were summarized and then analyzed to find patterns and themes shared across cases. These key themes and concepts guided further observations. Models of workflow, information flow, and temporal flow were developed and revised using the observational data. The iterative observation and modeling process incorporated elements of systems engineering⁹ and Soft Systems Methodology¹⁰. Observations continued until all significant interactions surrounding patient care in the clinic were explored.

Interviews were conducted with members of the health care team in the diabetes clinic, including nurse practitioners (2), a physician, a nurse educator and a dietitian. The goal of these semi-structured interviews was to augment and validate the observational data. Interviews focused on the models of workflow developed for the clinic, but ranged widely based on participant responses. Interviews were audiotaped and then transcribed. The interview data were used to refine the models.

RESULTS

Clinic systems overview

One computer was available in each exam room, typically located on a small desk along one side of the room. The layout allowed the provider to work on the computer while facing the patient and the provider was also able to rotate the screen to allow patients to view information. The physical layout of two of the exam rooms created difficulties in using the computer while interacting with the patient, as the computer was located in an alcove. The offices in the clinic also typically had one computer per office. Additional computers, accessible to all staff, were

located in groups by the two nursing stations and in a separate common work area.

Multiple paper artifacts were used in the clinic, including laboratory test order forms and billing forms. Nursing staff also maintained a binder that detailed intake procedures and documentation preferences for each provider. Some providers requested that nursing staff print out portions of previous notes and laboratory results from the EMR prior to patient visits. Data downloaded from patient glucose meters were also printed out for providers. All of the providers in the study also asked some patients to fax or mail in handwritten glucose logs.

Informatics tool use

Informatics tools were used in the clinic for three main purposes: information access, information input, and communication. Information access included using the EMR to examine clinical data already present in the electronic record. Information input involved using the EMR to alter existing data or enter new data. Communication involved any use of functions of the EMR for the primary purpose of communicating with others. Use of informatics tools varied both within each group of providers and between the physician and nurse practitioner groups. There was substantial variability in HIT use through all three informatics purposes and ranged from no use to extensive use.

Information regarding degree of use of functions of the informatics tools by different providers is summarized in Table 1.

Similarities in usage behaviors

Providers typically gathered information from the patient chart prior to the patient visit. For new patients, this involved examining notes from other providers, laboratory results, and the reason for the referral in the EMR. For returning patients, the information gathering process also included reviewing the provider's previous notes.

While in the exam room, providers often consulted the HIT to clarify patient-reported information or to understand past medical and treatment history. For example, providers consulted the EMR to compare proposed treatments against previous and current treatments. Providers also corrected information in the record, such as medication and preventative care lists, when they became aware that it was inaccurate or incomplete.

All of the providers in the study utilized the secure messaging function of the EMR, although to varying degrees. This functionality allowed providers to exchange messages within the clinic and also with

staff and providers in other clinics. Providers had mixed opinions about the messaging functionality. One provider who stated that the functionality was useful and decreased phone calls also described it as a “time sucking pit” because of the time and effort involved in keeping up with messages.

All of the providers saw patients who utilized the patient portal, MyHealth@Vanderbilt. This portal allows patients to exchange secure messages with their provider and to retrieve laboratory results. The providers noted that the portal was useful for many patients, but one physician stated that it had been “a disaster” with some of her older patients. Other providers were concerned about the time required to use this new communications tool.

Variability in usage behaviors

Although the providers used many of the same informatics functions, their individual approaches to them varied (see Table 1). When accessing information in the EMR, a few providers frequently used graphical display options to view patients’ HbA1c values, cholesterol levels, and weight over time. Providers who used this functionality often used it as an educational tool for patients, to more clearly show patients their historical values compared to their current status.

None of the observed providers completed their notes while in the exam room with patients. In addition, of the four nurse practitioners, two started their notes while with patients, one occasionally entered information into the computer while with patients, and one never used this functionality while with patients. None of the physicians who were observed started their notes while in the exam room with patients.

One of the physicians stated that she had attempted to change to entering notes while with patients, but found the process too distracting. Another physician noted that his poor typing skills precluded him from entering information into the computer while with the patient. A fifth physician who was interviewed but not observed said that he typically completed the majority of his notes while with patients and felt this was the most efficient method of completing documentation in a timely fashion. Anecdotal reports from staff and providers in the clinic indicated that some providers in the clinic also completed handwritten notes that were later scanned into the patient’s record, although this practice was not directly observed.

Regardless of the extent to which HIT was used to generate notes, all providers took handwritten notes while with the patient and consulted these notes later while entering information into the EMR. Individual providers tended to utilize the same process from patient to patient. Several providers took notes on pre-printed forms generated by the clinic, one provider had his own note-taking form, and one provider recorded notes on a printout from the EMR of the patient’s problem list. In addition, all of the physicians had access to and made use of dictation software to varying degrees. Some physicians used the software for large portions of their notes, while others used it for small sections of their notes. The dictation software was not available to the nurse practitioners for administrative reasons, although two of the four nurse practitioners stated that they would have liked to use it.

| Functionality | Nurse Practitioner | | | | Physician | | | |
|---|--------------------|---|---|---|-----------|---|---|---|
| | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Category: Information Access | | | | | | | | |
| Look up information (in exam room) | ● | ● | ● | ● | ● | ● | ● | ● |
| Look up information (outside exam room) | ● | ● | ● | ● | ● | ● | ● | ● |
| Graphical views of patient data | ○ | ● | ○ | ○ | ○ | ● | ○ | ○ |
| Category: Information Input | | | | | | | | |
| Correct data in record (in exam room) | ● | ● | ● | ● | ● | ◐ | ◐ | ◐ |
| Started note (in exam room) | ● | ○ | ● | ◐ | ○ | ○ | ○ | ○ |
| Completed note (in exam room) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| Started note (outside exam room) | ● | ● | ● | ● | ● | ● | ● | ● |
| Dictation software | ○ | ○ | ○ | ○ | ● | ● | ● | ● |
| Category: Communication | | | | | | | | |
| Message basket communication | ● | ● | ● | ● | ● | ● | ● | ● |
| Write prescriptions | ● | ◐ | ○ | ○ | ○ | ○ | ○ | ● |
| Patient portal | ● | ● | ● | ● | ● | ● | ◐ | ● |
| Non-secure email with patients | ● | ● | ● | ● | ○ | ○ | ○ | ○ |
| Legend | | | | | | | | |
| ● Uses routinely | | | | | | | | |
| ◐ Uses sometimes (not routinely) | | | | | | | | |
| ○ Uses rarely or never | | | | | | | | |

Table 1. Informatics use by providers

The amount of time needed to complete notes after patient interactions related inversely to the amount of note capture while with the patient. The interviewed physician who reported completing the majority of his notes while with patients also reported that he spent minimal amounts of time completing notes later, although he still needed to complete other documentation tasks, such as writing patient laboratory results letters and letters to referring physicians. Several providers admitted to spending extensive time outside of normal work hours completing notes. One nurse practitioner commented,

“I’m ending up at the end of the day, if I’ve seen 11 or 12 patients, I may have 6-7 unfinished notes. And I’m taking it home and doing it. It’s not good.”

Providers also frequently completed EMR documentation during their lunch hour and at other free times during the day. One physician commented that although he was concerned when patients failed to show up for appointments, he valued this extra time as a chance to catch up with his documentation.

Some of the providers viewed the EMR more as an information repository, while others more fully integrated the available tools into their practices. One nurse practitioner expressed how important the EMR was for her by saying,

“I love the electronic medical record. I love having access, point and click access, to the problem list, the medication list, all the labs, all the previous entries from other clinicians, appointments. I just couldn’t live without it now.”

The nurse practitioners used non-secure email to allow patients to transmit several days of self-performed glucose readings via spreadsheets because, at the time of the study, the patient portal did not allow for transmission of attached files. Nurse practitioners stated that many patients preferred to keep this information in an electronic file. The physicians typically had patients gather this information using a paper log form, and then requested that they fax or mail the completed form.

DISCUSSION

All eight of the providers had access to the same HIT in the same clinical environment and were treating the same disease process in the same patient population. If the tools fit the workflow, needs, and capabilities of this user group, users might be expected to have similar adoption patterns or more consistent reasons for their pattern of HIT use. The EMR allows providers to adopt and utilize tools in the manner that fits their needs and preferences. This

approach acknowledges that a “one size fits all” strategy is unrealistic. However, as evidenced here, there continues to be unanticipated variation, resulting in patterns of use that do not take full advantage of HIT features. It is interesting that more efficient strategies used by some clinic providers in the same environment did not disseminate to others. For example, a provider who had discovered a way to complete the majority of notes while with the patient may have uncovered an integration approach that is more appropriate for the clinic workflow. Yet he was the only one using this strategy in this clinic. The various user adaptations may also provide powerful data for redesigning the tools, which can further improve HIT usability and efficiency.

There is another side to this variation—is there a difference in use related to having not completed the goals that originally drove system design and implementation? In the case of EMR development, several core values, such as reducing unnecessary variance in clinic workflow and delivering pertinent information in a timely fashion guided the process of system design¹¹. Three years after widespread deployment of the system, the observations in this clinic indicate continued, and possibly more, clinic workflow variation. Cognitive artifacts such as the binder maintained by nursing staff regarding individual provider preferences demonstrate unanticipated system-level workarounds and potential inefficiencies and signify areas where the EMR might not function as intended.

The type, quality, and timeliness of provider documentation also varied depending on factors such as familiarity with the system, typing ability, workload, patient needs, and personal preferences. Although preferences of patients and providers should have been anticipated, variability in these other factors underscores the importance of evaluating implementations and addressing other user needs, such as typing skill classes and techniques to make patients more comfortable with the use of computers in the exam room.

All of the providers suggested that the ability to see the entire patient chart and information from other providers was a valuable benefit of the system. However, several providers noted difficulties finding specific pieces of data among the volumes of information in some patient charts. The existing informatics tools may meet the institutional need to gather patient documentation in a single record, but the sorting and searching functions do not fully support clinician needs to retrieve and synthesize longitudinal data. Without enhanced functionality, as more information is added to each patient record over

time, this disconnect will become increasingly difficult to manage effectively.

The variable approaches developed by users indicate areas where the system can be redesigned to better meet user needs and workflow. Some of the observed workarounds, such as continued use of non-secure email to communicate with patients, demonstrate where new functionality is needed. Automating processing of paper-based data such as glucose meter downloads could save appreciable time. Enhanced graphical presentation of longitudinal patient data such as laboratory values and treatment changes could also improve patient care.

The data suggest that some HIT functions could be modified to promote standardization. There are multiple approaches to documenting patient visits, from scanning handwritten notes to completing electronic notes during the patient encounter. New approaches to data entry could ameliorate some of the barriers to information input in the exam room, promote rapid entry of data, and potentially help to relieve some provider stress. Technological solutions might include tablet PCs¹² and digital pen and ink technology¹³. Non-technological solutions, such as redesigning data entry forms to better match workflow, could also promote more standardized use of informatics tools.

Limitations

A single observer and interviewer carried out the study, although the study process and the data were discussed extensively among the authors and with others. Those providers not included in the study may have alternate approaches, perspectives, and needs. The informatics systems described in this paper are unique to Vanderbilt and are under continual development, with on-going modifications to and additions of functionality.

CONCLUSION

The notion of “complete adoption” of tools may mask a substantial number of clinicians who are underutilizing or even misusing the informatics system, thereby jeopardizing the potential maximum system benefits. Variability of HIT use has implications both for patient care and informatics design. Applying techniques such as direct observation and interviews in studying end users of informatics technology yields critical data about whether informatics systems are meeting user needs and supporting their workflow.

This research was supported by a National Library of Medicine Training Grant, #T15 LM007450.

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