Pre- and Post- Control Model Research on End-Users' Satisfaction with an Electronic Medical Record: Preliminary Results

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ABSTRACT:

This study reports early results of a project that addresses the process of computerizing medical records in multiple ambulatory care sites of a health system. The study focuses on end-user attitudes before, during, and after implementation, through the use of questionnaires, interviews, and participant observation.

Knowledge about end-user attitudes prior to computerization may contribute to planning for the training and implementation process. Tailoring these processes to meet the varying needs of user groups may result in a higher level of functional use of the system and less stress to the persons involved in its use. One implementation plan may not work for all sites when there are differences in size of the clinic, work flow patterns prior to implementation, and computer experience among personnel. Preliminary analysis of post-installation questionnaires and interviews six months after the installation point to a number of areas that might be usefully addressed in future installation efforts.

INTRODUCTION

Electronic Medical Records (EMRs) are a high priority item in information system (IS) planning in health care organizations.[1] At the same time, the development and effective use of the EMR face numerous challenges. Given the variety of practices and orientations among physicians, there are pitfalls in attempting a single design that will fulfill all of the relevant expectations.[2] As computer technology improves in speed, capacity, and programming versatility, numerous technology-based barriers may diminish. The expectations and experiences of end-users will become even more important in accomplishing successful installations. Closer attention to end-users experiences before and after installation may offer critical clues for future improvements.

Theory-based, empirical studies contrasting pre- and post-EMR conditions are scarce. The larger study on which this paper is based is intended to respond to requests for theory and research "for predicting *a priori* likely responses of users in advance of system introduction.[3]" A pre- and post-control design[4] is employed around a model emphasizing relevant attitudes and experiences of EMR end-users before and after installation in primary care clinics. The study focuses, as well, on three general types of personnel–physicians (and physician assistants), nurses, and support staff.

This paper provides a summary of the results of the first stage of one of several evaluation for medical computerization (EMC) projects. Commentary on post-installation data based on preliminary analysis of the second phase of surveys and interviews is provided, as well. Further statistical data will be published in a future report. Following an overview of the evaluation model, methods and the populations of respondents are described. Summaries of end-user satisfaction findings related to the three groups of respondents are then reported. The paper concludes with generalizations regarding lessons learned about end-users' expectations and satisfaction with EMR installation and use.

PREVIOUS STUDIES

Reluctance to use computers has been linked with the concept of "computer anxiety.[5]" Clinicians are often uncomfortable with their keyboarding skills[6; 7] and feel time pressures impacting on both training and implementation sessions.[8; 9] Nurses have been characterized as resistant to computerization, especially with respect to patient care.[10]

Observed relationships between willingness to use computers and social/economic characteristics (age, gender, occupation) of individuals have been inconsistent across studies.[7; 11-13]

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One study found persons with computer experience more positive about implementation but more negative about potential problems.[12] Computer experience also may be an indicator of those more likely to volunteer to become users.[13]

Successful installation is often measured in terms of end-user satisfaction, which is measured in a number of different ways. Some measure frequency or intensity of use; others use Likert scale questionnaires but focus on productivity issues rather than quality of care.[6; 8; 14; 15]

METHODS

This study focuses on selected sites of the PennState Geisinger Health System. The study is a work in progress and subject to all the vicissitudes of realtime research in natural settings, i.e., clinics in a volatile health care market. In this instance, these include delays and changes in plans and even a "time out" for a merger that contributed to a reduction in project momentum.

At the end of June 1998, the study includes data from over 200 personnel across 9 clinic sites, including nearly equal numbers of physicians, nurses, and support staff. Pre-installation survey data is available from seven of these sites. Reporting of post-installation comparison data is near completion from five implemented sites (three pre-tested installation sites and two sites untested prior to installation) along with repeat "pre-test data" from two of the original sites that have yet to install an EMR. Error in interpreting any observed differences or changes over time is reduced, in part, by the common membership of all of the primary care clinics in a single health care system. Additional validation of instruments and confidence in findings are pursued through a comparison of questionnaire results with qualitative data including personal interviews and observation of selected personnel during and after the installation process.

HELPFULNESS OF A COMPUTER SYSTEM

Prior to implementing an electronic medical record and scheduling system, all of the respondents were asked to rate (5-Very Helpful to 1-Will Not Help) the likely helpfulness of a computer system for improving 23 distinct office conditions. The 23 items addressed conditions specific to medical offices, such as medical records problems, tests, consults, patient waits, care reminders, billing, and other administrative tasks. Factor analysis of the 23 items produced four *Helpfulness Scales*. Comparisons of mean scale scores for physicians, clinical personnel, and non-clinical staff are reported in Table 1, Part A. Mean scores approximating a "3" indicate neutrality or uncertainty.

In terms of overall perceptions of helpfulness, all three groups tend toward positive expectations for the EMR--responses are near the "helpful" mark. Clinical personnel (C) and non-clinical staff (S) are more likely than physicians (P) to expect a computer system to be helpful. For all three groups, experience in using computers for one or more applications is strongly associated with helpfulness.

Preliminary analysis of post-installation survey data suggests that the end-users have not fully reached their expectations within six months of using the EMR. Physicians perceived increased time for medical recording, scheduling consults and tests, and supporting billing and other administrative tasks with EMR use.

COMPUTER UTILITY

Respondents were asked to rate agreement or disagreement (5-Strongly Agree to 1-Strongly Disagree) with 39 statements reflecting opinions about the likely impact of a computer system affecting their work, or organization conditions and processes. The 39 computer utility statements addressed issues such as the quality, efficiency, or productivity associated with patient care and administrative practices; communication, and finance and staffing. Factor analysis of the 39 utility items produced seven *Computer Utility Scales*. Comparisons of mean scale scores for physicians, clinical personnel, and non-clinical staff are reported in Table 1, Part B.

Responses to most of the utility scales tend toward agreement about an EMR's utility in various organizational functions and processes. In several instances in which there were significant differences among the three groups of respondents, the non-clinical support staff rated the utility of computerization higher than the physicians or clinical personnel. For all three groups, experience in the use of one or more computer applications was associated with expected utility of computers.

Again, preliminary analysis of post-installation survey data suggests that the end-users have not yet reached their expectations with respect to many measures of EMR utility. Among the physicians, in particular, the post-installation utility ratings of the EMR are lower than ratings on expected utility. This occurs less among the clinical staff and even less among the support staff.

Pre-installation interview information indicates that all groups of employees use terms such as easier, more efficient, and time-saving, yet seem to reference those expectations in terms of "front office efficiencies." Physicians expected EMR benefits from features such as reminders, easier access to records, and linking information from labs, x-rays, etc. At the same time, some physicians expected additional time may be required to use the EMR because of their own typing abilities and lost or difficult-to-access information in the system.

In post-installation interviews, physicians expressed disappointment that reminders for health maintenance are not flexible to customize for particular patients and that some warnings and reminders are too broad based to be helpful for specific patient needs. Physicians and clinical staff also report an increase in the amount of time required to enter data because of the numbers of screens that must be accessed and completed in order to document the patient encounter. Most end-users, however, credit the EMR with providing them with a more complete and legible record.

COMPUTER ANXIETY

Respondents were asked to rate their agreement or disagreement (5-Strongly Agree to 1-Strongly Disagree) with eight statements reflecting feelings of anxiety about using a computer. The eight statements address such issues as confidence in learning new computer skills, and discomfort with computer jargon. Factor analysis of the eight items produce a single *Computer Anxiety Scale.* Comparisons of mean scale scores for physicians, clinical personnel, and non-clinical staff are reported in Table 1, Part C. Responses from the three groups tend to suggest a low level of computer anxiety. Although the differences among the three groups are not statistically significant, clinical personnel demonstrated somewhat higher anxiety than physicians and noticeably higher anxiety than support staff, who registered the lowest anxiety of the three groups. Within all three groups, those respondents who reported lower levels of computer use tended to reflect greater computer anxiety. The post-installation surveys reflect a decrease in computer anxiety scores among all three groups of personnel.

Most participants had at least some level of computer experience. This prior experience with computers may reduce anxieties about "operating a computer," but may not necessarily increase confidence about reliance upon a computer for medical recording. In pre-installation interviews, some members of all three groups of respondents expressed fears about the computer "going down." Some clinical staff and physicians discussed a concern about the computer "depersonalizing" the patient encounter.

Post-installation interviews suggest little anxiety about typing and computer skills; but some physicians continued to be concerned about keeping the patient encounter personal while focused on data entry in the exam room. Physicians' difficulties regarding use of the EMR were frequently expressed in terms of maneuvering through the system's requirements.

CONCLUSIONS AND RECOMMENDATIONS

The pre-test results suggest that just prior to the installation of the EMR, most of the respondents held moderately positive expectations about the helpfulness and utility of computerization in their practice. Physicians', clinical staff's, and support staff's expectations most often registered near the moderately positive ("4" on a 5-point scale). And, although there are a few areas in the preliminary analysis where reported post-installation experience exceeded pre-installation expectations, there are more areas where that experience has fallen short of expectations, more so for physicians than for the other two groups.

Even as late as six months after an installation, one might anticipate some decline in "positive" attitudes simply because of the steep learning curve experienced by physicians and other staff. Certainly, anecdotal stories about the installation of various EMR systems suggest such conditions. Because an EMR affects so many elements of the physicians' interactions with patients, physicians may be expected to encounter more difficulties than clinical personnel and support staff. Also, a number of issues have been raised by these "first-mover" physicians that--if attended to effectively by the vendor, management, and the physicians themselves—may minimize the problems and concerns encountered by others.

Problem areas with the project's software were mentioned by several physicians—needs for assistance in identifying the proper diagnostic and procedure codes on the EMR, needs for templates that might abbreviate the number of windows accessed during the patient visit, and need for improved standards in managing the clinical reminders. Still other issues can be expected to improve with increased numbers of sites and

personnel coming "on-line" with the same EMR and scheduling system. These issues include minimization of steps involved in the scheduling of tests and consults, improved connectivity with labs and with other office sites, and sharing of knowledge regarding EMR use. Some of these issues have been identified in other studies on this topic.[8; 16]

Simultaneously, however, the issue of time pressure and the perceived need to return as quickly as possible to pre-installation levels of productivity in patient volume is a point of strain on physicians in particular. Combinations of post-installation responses to selected survey items and to interviews conducted with end-users underscore the salience of time pressure as a significant limit on attaining greater capability and reaching higher levels of functionality in using the EMR. Interview data indicating that time pressures contribute to somewhat lower post-test ratings of EMR's helpfulness and utility at six months of use, will be explored in a more detailed analysis of post-installation survey data.

Triangulation of qualitative and quantitative methods--observation, lengthy interviews, and structured surveys--provides some additional confidence in the conclusions reached here regarding end-users' expectations and experience with the EMR.[4] At the same time, our recommendations call for closer attention in future studies, and future installations, to the fit of EMR with work processes employed by physicians, nurses, and other staff. At the "macro level" of clinic, linkages for consults and tests, for example, may result in ineffective use of the EMR or duplication of effort if existing work processes are not aligned with EMR functions. At the "micro-level" of medical recording by the physician, EMR software allows some variation in documentation and recording of supporting information. Providing flexibility is important given the complexity of medical practice and differences in physician styles. At the same time, however, ongoing attention should be given to monitoring EMR use for the purpose of assisting end-users to improve their comfort level and efficient and effective use of the EMR. Such attention might include sharing "best practices" information from one physician to another (and across the clinic site or system wide). It might include identification by the end-users of needs for software modification.

There is evidence of organizational learning regarding EMR installation. There appears to be a reservoir of interest and support among users for the EMR even as additional time costs and problems have been encountered. Project managers are working closely with the software vendor to identify possible software refinements and to improve the ability of end-users to make more effective use of existing EMR functions. The mechanism for coordinating and supporting installation across a number of clinics continues to be reexamined. Possibly because an EMR is so closely linked to physician's work processes, the installation process might best be viewed as long-term individual and organizational learning requiring continuous feedback and adjustment to approach optimal results.[16]

Formative evaluation studies of pilot site implementation, like the one reported here, are likely to identify many early difficulties and adjustments which can contribute to improved future implementations. One would anticipate, for example, that trainers become more proficient, template design becomes more useful and available to new users, work flow issues become more apparent, software refinements are made, and additional connectivity becomes available as installation occurs at more sites. In the study of pilot sites, pre- and post-implementation data are useful for alerting management to problems and for suggesting possible causal links and possible interventions. Continuing data collection and analysis over time at early installation sites and at new installation sites, are intended to both document and contribute to the process of organizational learning and the sharing of insights with others who pursue EMR.

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Table 1. Summary of Pre-Installation Responses: Means and statistically significant differences among occupational categories in each sub-scale.*

A. Computerization Helpfulness Scales:	**Physicians**	**Clinical**	**Staff**	**Significant Differences**
Time for Scheduling and Results of Consults	3.74	3.86	3.81	P<C,C>S
Patient Pre- and Post-encounter Waiting Time	2.67	3.15	3.24	P <C, P< S
Reminders for Follow up Care	4.22	4.22	4.29	P, C, S =
Medical Records Issues	3.88	4.01	4.13	P<C, P<S
B. Computer Utility Scales:	**Physicians**	**Clinical**	**Staff**	
Improve Patient Care and Productivity	3.42	3.72	4.09	P, C < S
Support of Organizational Goals	2.80	3.12	3.33	P < C < S
Coordination/Communication	3.49	3.53	3.67	P, C, S =
Relief from Menial Tasks	3.57	3.51	3.98	P, C < S
Timely Information Flow	3.78	3.83	3.84	P, C, S =
Information Accuracy	4.01	4.07	4.13	P, C, S =
Financial Performance	3.08	3.35	3.47	P, C, S =
C. Computer Anxiety Scale	**Physicians**	**Clinical**	**Staff**	
Computer Anxiety	2.20	2.29	1.93	P, C, S =

*The presence of a < or > indicates the direction of statistically significant differences among the three groups; an = indicates no statistical difference between the two groups separated by the comma.