Dimensions Associated With Successful Implementation of a Hospital Based Integrated Order Entry System

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ABSTRACT

Implementation of an integrated electronic medical record requires direct physician order entry. This application involves multi-level changes in the whole system of care, from physicians attitudes to interdepartmental relations. This study reports the results of the first round of a modified Delphi, where a diverse group of individuals were asked to identify the most important facilitating and impeding factors associated with implementation of an order entry application. From a Q-sort of their responses, we identified 20 systemic, behavioral, and attitudinal dimensions perceived to be causal factors in successful implementation. We also explored how these dimensions may influence success by comparing successful with unsuccessful hospitals in terms of the frequency with which these dimensions were differently mentioned by respondents. We found that although available functionality was the most commonly mentioned factor by all participants, hardware availability, physician involvement, administration support, and medical administration involvement were more often mentioned by successful hospitals than by less successful hospitals. These results suggest that these factors were not present in the less successful hospitals.

We also found that the frequency of responses within each category varied depending on the institutional role of the individuals responding. Those involved in support tended to see organizational variables as more important than those in clinical positions, whereas clinicians viewed administrative support and involvement of the chief as more important. These findings support the notion that the changes involved in instituting a physician order entry system are system wide and involve individual as well as organizational factors.

INTRODUCTION

The Salt Lake City Information Service Center of the Veteran's Administration (SLC ISC) released their order entry system, Order Entry/Results Reporting 2.5 (OE/RR 2.5), to the field in March, 1993. OE/RR 2.5 integrated several clinical packages (e.g., pharmacy and lab) and provided a single environment where clinicians can enter clinical orders and obtain clinically relevant patient information. Response to the package has varied widely across institutions. A series of studies were planned to identify factors that discriminate successful from non successful implementation of OE/RR 2.5 in order to prepare for the next version. This paper reports on the first study of the series.

A fully integrated hospital information system is essential in order to maximize quality management activities, cost control, and clinical decision support. Full acceptance and implementation of an electronic medical record is often viewed as a direct function of physician change as these professionals must make radical changes in their everyday work [1,2,3]. However, the literature on physician change indicates that such change is difficult to achieve and often not long lasting [4]. Yet physician behavior change actually occurs in the context of a larger institutional setting. As work in Total Quality Management has illustrated, individuals are rarely the barriers to change [5]. Rather, it is often system level factors interacting with individuals that cause failures. The purpose of this study is to simultaneously identify both individual and institutional level variables associated with successful adoption by physicians of an integrated order entry system.

Specifying the causal variables of a multidetermined event, such as the successful change to on-line order entry, is difficult because people often do not have accurate access to the causes of their behavior [6]. Participants perceptions of a changing system will vary depending on whether the implementation was successful [7], and whether they had direct involvement in the process [8]. In addition, different cognitive and behavioral variables are important at different stages of change [9]. Individuals already committed to a change focus more on issues surrounding actual implementation, whereas those still contemplating the change are more concerned with the pros and cons [10]. Furthermore, each category of individuals has their

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own perspectives. Physicians will have their own unique perception of the value of an electronic medical record, one that is different from those developing the software, and different again from those in charge of implementing and supporting the change. No particular point of view or point in time may provide the complete picture.

In this first study, salient dimensions were derived from open-ended responses of people directly involved in implementation attempts of a direct order entry system. An effort was made to have participants represent all of the varied hospital departments that would be involved in such an implementation attempt. Physician representation included administrators, nominated opinion leaders [11], and randomly selected users. The results from this first study will allow the development of a questionnaire based on the identified dimensions in a second study.

METHODS

Two sets of hospitals were identified based on their relative success at implementing OE/RR 2.5 and their participation as either beta sites or with early implementation. The first set consisted of three hospitals judged to be successful at implementing order entry 2.5 and the second set consisted of three relatively unsuccessful hospitals. Success was defined two ways. The first consisted of nomination by OE/RR 2.5 software engineers working at the SLC ISC, and secondly by the percentage of providers directly using order entry at each institution as reported by participants of the study. The percentage of providers using order entry differed significantly between hospital sets [$F(1,37) = 34.97$; $p = .00$; Means: success = 74.4%; failure = 15.3%].

A questionnaire was mailed to the following individuals from each institution: 1) Medical Administration Staff, such as chiefs of staff and directors of bed services; 2) Administrators, including the director of the Information Resource Management department (IRM) which provides hardware and software support, Nursing, and Medical Records; 3) Support staff, such as the computer support staff from pharmacy and lab who had been assigned to assist with the implementation of OE/RR, specifically designeted coordinators responsible for training and implementing OE/RR 2.5, and IRM staff; 3) Users, including ward clerks, physicians, and nurses; and 4) Physician opinion leaders nominated by a random selection of 5 physicians from each institution. Over the 6 hospitals, ninety-two individuals received a questionnaire.

Fifty seven percent (n = 52) responded. Of those fifty-two, twelve reported that they did not know enough to answer the questions. This left a sample size of forty. Twenty responded from the predefined successful hospitals and twenty responded from the less successful hospitals. The response rate did not differ significantly by institution.

The questionnaire consisted of five questions:

1) What proportion of physicians, nurse practitioners, and physician assistants at your institution enter most of their orders directly using OE/RR 2.5?;
2) What proportion nurses directly use OE/RR 2.5?
3) How well do you think OE/RR 2.5 meets the clinical needs of practitioners? This question is answered on a 1 (not at all) to 5 (very well) scale?;
4) Please list 6 to 10 of the most significant facilitating factors for implementing OE/RR 2.5 at your institution?;
5) Please list 6 to 10 of the most significant barriers impeding the implementing OE/RR 2.5 at your institution?

To identify valid dimensions, the open-ended responses to the above questionnaire were sorted independently into categories by two clinicians (author 1 and author 3) working at the ISC using a modified Q-sort. The sorting was done separately for facilitating factors and for barriers. Neither the number of categories nor their content was specified a priori. One author produced 10 categories and another 14 for both facilitating factors and barriers. Two categories across both sorters had greater than 80% overlap in content and the remaining differences were essentially the inclusion of two categories in one by the third author. After discussion between sorters, the categories were agreed upon. Individual response items were then coded into these categories by two independent raters. Initial agreement between raters was acceptable with 78% of the items coded in the same category.

RESULTS

Identification of Dimensions

Table 1 and 2 list the identified categories in the order of frequency of response. Totals are greater than the number of respondents as some people mentioned items from the same category more than once. These are the categories that reflect the causal factors perceived to be most salient by the respondents. Functionality was an important factor for all respondents. This category had the most items for both facilitating factors and barriers. In addition, many of the categories of the facilitating factors are the inverse of the barriers. In other words, there were only twenty unique categories overall. For example, the presence of supporting

administration is a facilitating factor and the absence of a supportive administration is cited as a barrier.

The actual ranking of categories, however, differed between facilitating factors and barriers. Perceived benefits and helpful, experienced support support were most frequently mentioned as facilitating factors, whereas hardware and uncooperative physicians were mentioned as the next most common barriers.

Table 1: Number of times each facilitating factor dimension identified by respondents within success (S), Failure (F) groups and total sample (T)

DIMENSIONS FACILITATING FACTORS	S	F	T
Functionality (i.e. health summaries, discharge summaries)	20	24	44
Knowledgeable, cheerful support from IRM, on-line help	15	17	32
Perception of many potential benefits	14	7	21
Ability to customize software to meet physician needs	8	8	16
**Supportive administration, chiefs of staff, and attending	14	1	15
**Direct involvement of physicians, provider open-mindedness	13	2	15
Good working relationship with developers	10	5	15
An interdisciplinary, effective, implementation group	8	6	14
Good implementation strategies (e.g. good PR, bring all services)	4	7	11
**Support by medical administration and other allied fields.	7	1	8
**Implementation mandatory	6	0	6
Sufficient number of people hired to implement and train users	3	3	6
**Adequate Hardware, terminals, etc.	10	1	11
*Good training and instruction	4	0	4

Note: A single asterisk (*) indicates significance at the $p < .05$ level; two asterisks (**) indicate significance at the $p = .01$ level between successful and less successful hospitals using X^2 (39) .

Table 2: Number of times each barrier dimension identified by respondents within success (S), Failure (F) groups and total sample (T)

BARRIERS	S	F	T
Functionality not sufficient, software is not working well	17	22	39
Uncooperative or computer phobic attitude of physicians	18	15	33
*Insufficient terminals, system too slow, nonportable screens	21	8	29
System not user friendly, inadequate interface	13	15	28
Program takes too much time, too labor intensive	9	12	21
Inadequate training, insufficient material, residents rotations	11	8	19
Inadequate pharmacy application which interfaces with OE/RR	9	5	14
Poor implementation, e.g.. location where first introduced	5	6	11
Bureaucracy prevents change; Interdepartmental conflict	5	5	10
**Inadequate administration application, also interfaces with OE/RR	8	2	10
Lack of effective, cheerful IRM support	7	2	9
Non supportive section chiefs /Chief of Staff	3	5	8
Providers don't know how to type	5	3	8
Insufficient personnel to adequately implement and train	4	1	5

Note: A single asterisk (*) indicates significance at the $p < .05$ level; two asterisks (**) indicate significance at the $p = .01$ level between successful and less successful hospitals using X^2 (39).

Variables differentiating hospital group

To identify which variables differentiated successful from the less successful hospitals, a chi-square analysis was performed for each category comparing the number of individuals from each hospital group mentioning an item within that category. Those that were significantly different are note by asterisks in the table. Several categories differentiated the two hospital groups. Significantly more people from the successful hospital group reported supportive administration and supportive heads of medical sections as facilitating success. In addition, significantly more people from the successful hospital group

mentioned that direct involvement of physicians, mandatory implementation, adequate training, and sufficient hardware facilitated success. In terms of barriers, only inadequate hardware and lack of ability to easily do patient transfer and advance admission orders (medical records package) differentiated the two groups and in both cases the item was mentioned more frequently by the successful hospitals.

The two hospital groups also differed in terms of two other variables. Individuals responding from the successful hospitals had higher ratings of the clinical value of OE/RR 2.5 than those from the less successful hospital [$F(1,37) = 10.76$; $p = .002$; Means: success = 3.33; failure = 2.22].

Respondent Role

To determine the impact of an individual's role, two groups were created from the full participant list. The first group consisted of support personnel and included directors of resource management, who are responsible for providing support for hardware, customization of software, and training needs, and individuals hired specifically for support in specific departments or overall for OE. The second group consisted of clinicians and included users, opinion leaders, and medical administration. For each dimension, the number of individuals from each group reporting items was compared using a chi-squared analysis. The results of this analysis are represented in Table 3. This table only reports those dimensions found to be significantly different.

TABLE 3: Percentage of people in the support (S) and clinician (C) groups identifying each category for both facilitating factors and barriers.

DIMENSION	S	C
Facilitating Factors		
Organized, interdisciplinary implementation group	50	5
Support of Chiefs of Staff and medical administration	21	63
Mandatory Implementation	0	33
Sufficient personnel	50	10
Barriers		
Bureaucracy, such as interdepartmental infighting	50	17
Pharmacy package did not meet clinician needs	75	4

Note: Cell entries refer to the percent of respondents endorsing each item.

As can be seen from the table, the support personnel were more sensitive to institutional variables, such as the presence of an interdisciplinary implementation group, the resistance of the VA bureaucracy to change, and the availability of sufficient personnel for training and support. The one exception was the factor, "mandated implementation", which refers to the administrative policy of requiring physicians to enter orders. This factor was only mentioned by clinicians (and only in the success hospitals), suggesting that the clinician respondents felt that encouraging full participation by all physicians was important to success. This is reasonable if a fully electronic medical record is to evolve from a physician order entry system. The support personnel also mentioned the difficulty of the interface with the pharmacy application, significantly more than the clinicians. This finding is most likely a function of the role of support in maintaining that interface.

DISCUSSION

The results from this study support the finding of others that a major factor in successful implementation of physician order entry is the patterns of organizational policy development and implementation[3]. Commitment from top leaders and administrators is essential to making the necessary cultural and social changes required for physicians to evolve into the necessary roles and to adopt the needed practice patterns. Measurement of the influence of different variables, therefore, must be done within the complete context of implementation, using the perspectives of all participants in order to capture each individual's unique contribution. The differing perspectives of the respondents illustrates the importance of taking a system level approach.

For the most part, the pattern of responses reflected the more in-depth experience that the more successful hospitals had with implementing a new application. The impact of problems with hardware, training, and support from medical administration are issues that become apparent as implementation unfolds. However, the impact of involved physicians, committed administration, and mandated implementation are factors more likely present prior to the decision to implement and thus are system variables predictive of success.

The importance of involvement of physicians at all levels was also identified more frequently by successful hospitals than less successful hospitals and this finding is also congruent with other work[8]. The support and interest of medical administrators, the existence of at least a small group of interested and active physicians, and the mandating of order entry for all physicians are

individual and system factors that all point to a great deal of physician involvement. It is also important to note that how valuable OE/RR 2.5 was perceived differed depending on the success or failure experience of the institution.

REFERENCES

1. Lundsgaarde, H.P. Evaluating medical expert systems, Soc. Sci. Med. 24: 805-819, 1987
2. Massaro TA. Introducing physician order entry at a major academic medical center: I. Impact on organizational culture and behavior. Acad Med. 1993;68:20-5.
3. Sittig DF, and Stead W.W. Computer-based Physician Order Entry: The Sate of the Art. J. of Am. Med. Infor. Ass. 1994;1:108-123.
4. Hodge MH. Direct use by physicians of the TDS medical information system. In Blum BI, Duncan K (eds). A History of Medical Informatics. New York: ACM Press. 1990: 345-56.
5. Williamson, J. Medical quality management systems in perspective, pp 23-72. In Couch, JB (ed.) . Health Care Quality Management, Tampa, Florida:Hillsboro Printing, 1991.
6. Nisbett, R. W., & Wilson, T. D. (1977). Telling more than you can know: Verbal reports on mental processes. Psychological Review, 84, 231-259.
7. Hirt ER, Zillmann D, Erickson GA, Kennedy C. Costs and benefits of allegiance: Changes in fans' self-ascribed competencies after team victory versus defeat. JPSP, 1992: 63; 724-738
8. Eisenberg JM. Doctor's Decisions and the Cost of Medical Care. Health Administration Press: Ann Arbor, Mich. 1986.
9. Bandura A. Social foundations of thought and action: A social cognitive theory. Englewood Cliffs, NJ: Prentice-Hall. 1986.
10. Gollwitzer, P. M. Action Phases and Mind Sets. In E. T. Higgins and R. M. Sorrentino (Eds.), Handbook of motivation and cognition: Foundations of social behavior . 1990: 53-92. New York: Guilford Press.
11. Lomas J, Endin M. Anderson G. Opinion leaders versus audit and feedback to implement practice guidelines: Delivery after previous cesarean section JAMA, 1991; 265(1): 2202-2207.