Analyzing User Satisfaction with the System in Use prior to the Implementation of a New Electronic Inpatient Record

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Introduction

User acceptance is generally seen as a crucial factor determining the success or failure for the implementation of new information technology [1]. It is especially true in the case of the electronic inpatient record. This system is not only used as the repository for all clinical information relevant to the care of a patient but also as the main communication tool for patient-related information among clinicians. This system is thus at the core of delivery of care and is critical for teamwork productivity, patient safety and quality of care. It is thus normal that the implementation of such new system monopolizes a great deal of attention. Frequently, however, little interest is left to evaluate user acceptance of the replaced system. This attitude is far from ideal given its potential impact upon the implementation strategy for the new system. Indeed the level of satisfaction or dissatisfaction with the current system affects the users' propensity to change and to efficiently use the new system. This oversight leaves out the first and critical stage of Lewin's field theory of organizational change that consists of three phases: (a) unfreezing old patterns, (b) moving and experimenting with new behaviors and (c) refreezing, so that new behavior becomes part of every-day business processes that are then considered normal [2]. We think that the period prior to go-live implementation is worthy of research attention because of its role in shaping users' attitudes toward the new system. Thus, similar to many models [3], this paper focuses on the users' attitudes or predispositions in the pre-implementation stage as possible significant determinants of implementation behavior. However, contrary to most of the research in this domain, we focused on the system in use rather than the attitudes toward the new system. This approach is original and promising in terms of its implications for how the electronic inpatient record can be more effectively framed to facilitate user acceptance.

Furthermore, the current patient record system is interesting to analyze because it is a hybrid system composed of both paper-based and electronic records. Although, more and more healthcare organizations are adopting electronic health records (EHRs) to overcome the weaknesses of the traditional paper-based record, we are still reproducing a dual workplace environment. We are still far from able to fully replace the paper-based record. Rather, electronic clinical documentation is usually used in addition to paper-based records. The "new" system remains a hybrid one that can be plagued with the problems of the "old" system. Earlier research suggests that the parallel use of electronic and paper-based patient records resulted in inconsistencies between the systems [4-5]. These inconsistencies can lead to significant problems for the healthcare staff in daily care. Understanding the strengths and weaknesses of the old system thus remains crucial to being able to better manage the system's transition and to ensure the successful implementation of the new system.

Objectives

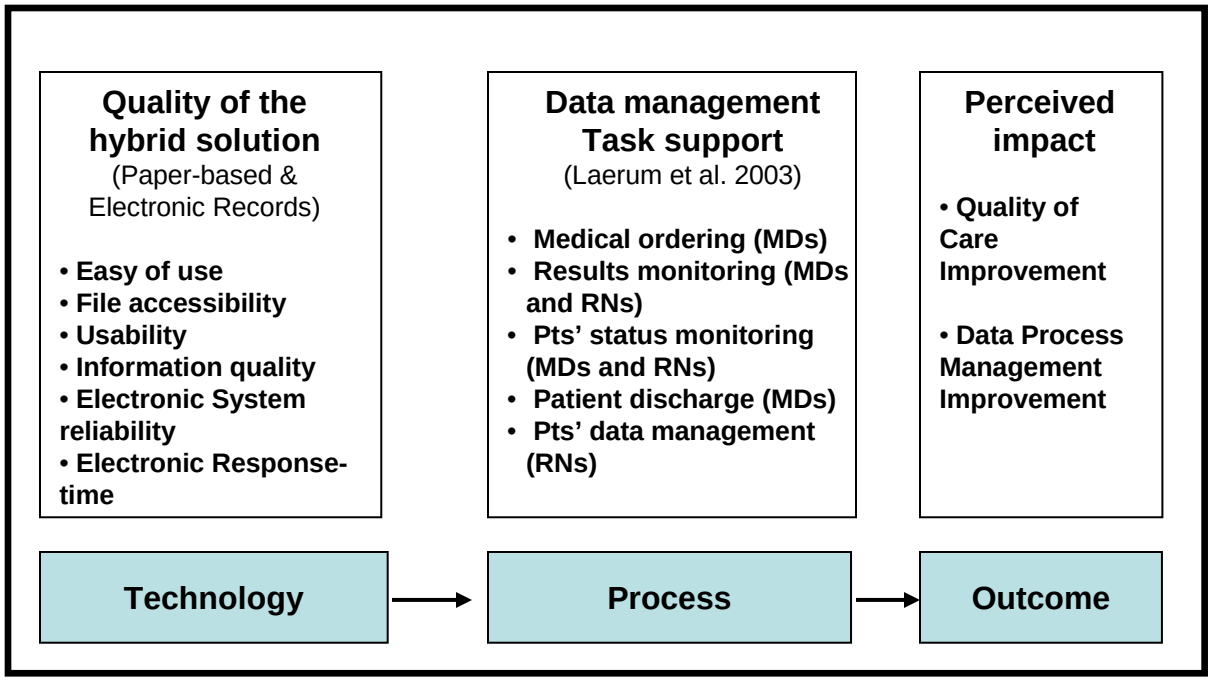
The study uses a survey to pursue three objectives:

1- to assess user satisfaction with the "quality attributes" of the current – to be replaced – inpatient record system;

2- to evaluate user satisfaction with the capability of the current system to support the task of clinical data management; and

3- to measure the users' appraisal of the impact of the current system on quality of care. The sequential relationship between these 3 objectives is illustrated in Figure 1.

Figure 1 – Analytical Framework



Methods

The study was conducted at the two main teaching hospitals in the province of Quebec which is the second largest healthcare jurisdiction in Canada with 7.5 million inhabitants. Both hospitals are multi-site organizations (three and five-sites), each employing approximately 10 000 employees and 1 000 physicians. The two hospitals jointly purchased the same electronic inpatient record system in 2004 and are pursuing a collaborative implementation strategy. In May 2006, a first wave of six medical and surgical services, three in each hospital, started using the new system: paediatric general surgery, internal medicine, urology/nephrology, two services of neurology and a transplantation unit.

Between November 2005 and April 2006, prior to go-live of the new inpatient record system, a cross-sectional survey with all of the nurses and physicians of these six services was conducted. At that time, the physicians and nurses had access to a complete paper-based record. However, they were also currently using electronic systems to read the results of laboratory tests and radiology exams and to consult PACS images. In two of the services, the electronic systems even allowed the ordering of lab tests and radiology exams. Electronic systems were currently used in parallel with the paper-based record by both the nurses and physicians. As shown in Table 1, the self-reported usage of electronic systems was 7.3 for nurses and 8.8 for physicians on a ten-point scale (1 indicating a low level; 10, a high level).

Three hundred and forty six (346) questionnaires were distributed to the nurses and physicians working in the six medical and surgical services. Physician questionnaires were sent out to all 150 physicians and 196 nurse questionnaires were sent out to all regular nursing personnel (24hours/7days). Questionnaires were anonymous but marked so personal reminders could be sent to those individuals who did not respond. Survey responses were confidential. The appropriate institutional review boards approved the study.

Survey instrument

The survey instrument was designed to measure users' satisfaction according to the three research objectives. The survey included the following:

• Objective 1**: Four "quality attributes" (ease of use, usability, data quality and record accessibility) for respectively evaluating the paper-based and electronic record systems and two additional attributes (system reliability and response-time) specifically designed for the electronic record system.**

• Objective 2: **Approximately 20 attributes to measure the capability of the inpatient record system to supporting clinical data management. Due to task differences between nurses and physicians, two different sets of items were used: 21 items for physicians and 19 for nurses.**

• Objective 3: **Seize items to assess the impact of the inpatient record system in terms of quality of care.**

All survey questions were answered with 10-point likert scales, rating the above-mentioned attributes of the system. With regard to objective 1, variables such as ease of use, usability, quality of information were defined in line with the DeLone & McLean Model of Information Systems success [6-7]. Table 2 shows the psychometric qualities of these measures. Their reliability (internal consistency), measured with Cronbach's alpha, indicate that all of the measures surpass the usual 0.70 threshold of statistical significance. In relation with the second objective, we used a task-oriented questionnaire developed for evaluating electronic medical record systems [8]. The questionnaire has successfully been tested in terms of criterion validity and reliability. The key feature of this evaluation tool is a list of 21 general clinical tasks that are applicable to physicians of most specialties and that covers essential parts of their information-oriented work. We have adapted the questionnaire for nurses while maintaining its structure. The nurses' questionnaire included 19 tasks related to clinical data management. Lastly, for the third objective, a 16-item scale was developed for the specific needs of this study. The scale was aimed at assessing the outcomes with positive items such as quality of care, continuity of care, accuracy of clinical decisions and negative ones such as transcription errors and delays in patient care.

Results

Survey Response & Characteristics of Respondents

Table 1 – Distribution of Survey Respondents

		RNs (n = 123)	**MDs** (n = 96)	
Gender	**Male** **Female**	12% 88%	74% 26%	$X^2 = 87.1$ (p<.000)
Age	**≤ 30** **31-40** **41-50** **51-60** **61 & +**	27% 23% 36% 14% 0%	10% 23% 33% 21% 13%	$X^2 = 24.1$ (p<.000)
Users' Experience with Computers	**A little** **2** **3** **4** **A lot**	10% 32% 27% 21% 10%	2% 4% 25% 43% 26%	$X^2 = 42.7$ (p<.000)
Electronic Inpatient Records Use (Scale 1 – 10)	**Mean (sd)**	7.3 (2.3)	8.8 (1.9)	t-test p=0.000***

Questionnaires were received from 219 (63%) of 346 eligible respondents, including 123 (63%) nurses and 96 (64%) physicians.

As shown in Table 1, significant differences were observed between the nurses and physicians in terms of gender, age and experience with computers. Also, the use of the current electronic inpatient record system was significantly different between the two groups. On a ten-point scale (1 indicating a low level; 10, a high level), the nurses' use mean rating of the electronic record system was lower (7.3) than the physicians' rating (8.8). But still, both groups showed a high level of electronic systems use.

Results

User satisfaction with the Inpatient System

Table 2 – User Satisfaction

Quality attributes of the record system	Nb of items	Cronbach Alpha	Mean	SD
Paper Record				
Ease of Use	3	.93	6.2	2.2
File Access	2	.65	4.2	2.2
Usability	3	91	6.3	2.0
Data Quality	7	.87	5.7	1.6
Total Mean	15	.91	5.7	1.5
Electronic Record				
Ease of Use	3	.86	7.7	1.7
File Access	3	.87	4.7	2.3
System reliability	2	.77	6.5	2.1
Response time	1	- -	6.9	2.4
Usability	2	.83	7.1	2.0
Data Quality	4	.73	7.7	1.5
Total Mean	15	.84	6.8	1.2

As shown in Table 2, the users were more satisfied with the electronic record. The global index of satisfaction for the electronic patient record reached a score of 6.8 while the paper-based record was just above the mid-point (5.7) of the 10-point scale. The electronic record system reached its highest scores for "ease of use" (7.7) and "data quality" (7.7) while the paper-based record reached its highest score for "usability" (6.3) and "ease of use" (6.2). "Data quality" was the attribute for which the electronic record showed the greatest difference (7.7 for the electronic record vs. 5.7 for the paper-based record). In both systems the least satisfactory attribute was "file accessibility" (4.2 for the paper-based record vs. 4.7 for the electronic one). The electronic record's unexpected low score was mainly attributed to the small number of PC stations available in each service.

Results

User satisfaction with the Inpatient System

Table 3 – Comparison of User Satisfaction between Groups

Quality Attributes of the Record System	RNs (n=123) *Mean(sd)*	MDs (n=96) *Mean(sd)*	*t-test*
Paper Record			
Ease of Use	7.0 (1.8)	5.1 (2.3)	p=0.000***
File Accessibility	4.2 (2.2)	4.3 (2.2)	p=0.742
Usability	6.9 (1.7)	5.5 (2.1)	p=0.000***
Data Quality	6.1 (1.5)	5.3 (1.6)	p=0.000***
Total Mean	6.2 (1.3)	5.2 (1.6)	p=0.000***
Electronic Record			
Ease of Use	7.3 (1.8)	8.2 (1.4)	p=0.000***
File Accessibility	4.3 (2.3)	5.1 (2.3)	p=0.027**
System Reliability	6.4 (2.2)	6.7 (1.9)	p=0.244
Response Time	6.9 (2.6)	7.0 (2.3)	p=0.814
Usability	6.5 (2.0)	7.9 (1.7)	p=0.000***
Information Quality	7.5 (1.7)	7.9 (1.1)	p=0.068*
Total Mean	6.5 (1.3)	7.2 (1.0)	p=0.000***

*** p<.001; ** p<.05; * p<.10

Ratings of the systems' attributes varied by user group. The nurses were more satisfied than the physicians with all attributes of the paper-based record (p=0.000) with the exception of "file accessibility" that was poorly rated by both groups. The physicians were more satisfied with the electronic record (7.2 vs. 6.5; p=0.000). Four attributes were significantly different between the two groups: "ease of use", "file accessibility", "usability" and "information quality".

Results

Task-oriented Evaluation of the Inpatient Record System

Table 4 – Task-oriented Evaluation

Data Mngt Task Support	Nb of items	Cronbach Alpha	Mean	SD
Physician Tasks				
Medical Ordering	5	.93	5.1	2.5
Results Monitoring	4	.86	7.8	1.7
Pts' Status Monitoring	3	.79	6.3	2.0
Patient Discharge	3	.82	4.4	2.2
Summative Measure	15	.88	5.9	1.5
Factor Analysis = **67,2% explained variance**. Principal axis factor analysis with oblimin rotation. The detail of the factor analyses is not shown here.				
Nurses Tasks				
Pts' Data Management	10	.96	6.2	2.1
Results Management	2	.77	7.8	1.7
Pts' Status Monitoring	5	.84	6.4	1.7
Summative Measure	17	.94	6.4	1.7
Factor Analysis = **66,4% explained variance**. Principal axis factor analysis with oblimin rotation. The detail of the factor analyses is not shown here.				

The second aim of the survey was to evaluate the users' satisfaction with the capability of the record systems to support clinical data management tasks. Because it would have been difficult to distinguish the specific contribution of the paper-based record from the electronic one, their joint effect was assessed. A detailed survey instrument was developed to fulfill this objective [8].

Factor analyses were conducted to be able to group the tasks together in larger domains of activities. For the physicians, the analysis of the initial 21 items generated 4 factors with eigenvalues greater than 1.0. These 4 factors were composed of 15 items that all presented loading scores greater than 0.5, a clear evidence of the discriminate validity of the measures used (Table 4). Taken together, the 4 factors explained 67% of the variance.

For the nurses, the factor analysis generated 3 factors with eigenvalues greater than 1.0. The 17 items associated with these factors also presented loading scores greater than 0.5. Taken together, the 3 factors explained 66% of the variance. In both cases, these factors portrayed an interesting typology for identifying the main activities of clinical data management. The composite reliability coefficients (Cronbach alpha) of all the factors were very good, varying from 0.77 to 0.96.

The assessment scores were rather low, reaching a maximum of 6.4 on a ten-point scale (1 indicating a low level of "task usability"; 10 indicating a high level of "task usability"). The nurses rated "task usability" higher (6.4) than the physicians (5.9), a significant difference (p = 0.023). The only exception was for a similar factor, "physicians' results monitoring" and "nurses' results management" that reached a higher score of 7.8 in both groups.

Results

Impact Evaluation of the Inpatient Record System

The third objective of the survey was to assess the impact of the inpatient record system. Here also, the joint effect of both the paper-based and electronic records was assessed with a ten-point scale (1 indicating a very negative impact; 10, a very positive impact).

Table 5 – Dimensions of Impact Evaluation

Inpatient Record System	Nb of Items	Cronbach Alpha	Mean	SD
Impact				
Quality of care	7	.92	6.2	1.5
Data Mismanagement	5	.93	5.2	2.0

Factor Analysis = **67,5% explained variance.** Principal axis factor analysis with oblimin rotation. The detail of the factor analyses is not shown here.

We also proceeded with a factor analysis to identify the dimensions of impact present among our 16-item scale. The analysis generated 2 factors with eigenvalues greater than 1.0. The composite reliability coefficients (Cronbach alpha) of both factors were excellent reaching over 0.9 (Table 5). All of the 12 items associated with these variables presented loading scores greater than 0.5. Taken together, both factors explained 67.5% of the variance. The first factor referred to positive items associated with the quality of care while the second one included negative items associated with the mismanagement of clinical data.

As shown in Table 5, the two scores were near the middle of the ten-point scale. Thus, respondents did not perceive that the record system had a negative impact on the quality of care and the occurrence of data management errors. At the same time, the contribution of the record system to the quality of care is weak. The only significant difference between the two clinician groups was with respect to the "quality of care" which received a higher rating by the nurses (6.4 vs. 6.0; p=0.054).

Table 6 – Comparison of Impact Evaluation between Groups

Inpatient Record System	RNs n=122 *Mean(sd)*	MDs n=95 *Mean(sd)*	*t-test* * p<.10
Impact			
Quality of Care	6.4 (1.4)	6.0 (1.8)	p=0.054*
Data Mismanagement	5.1 (2.0)	5.3 (2.1)	p=0.423

Discussion and Conclusion

The main results of the study are summarized in this section. A first positive result is that the electronic record was rated higher than the paper-based one. The positive ratings are congruent with other studies evaluating user satisfaction toward other electronic clinical systems [9-11]. This situation should facilitate the implementation of the electronic inpatient system. However, it is also important to note that physicians and nurses had rated the two record systems differently. The nurses rated the "quality attributes" of the paper-based record higher than the electronic system. This highlights the need to consider both perspectives when implementing a new system. This lesson is important for developing a successful implementation strategy in the domain of electronic clinical information systems. It means that the management of users' expectations should be tailored to take into account differences among various groups of users. In other words, the readiness to adopt a new system varies between user groups. In Lewin's terms, the unfreezing challenge may be different between user groups and requires different implementation strategies. It underscores the importance of specifically targeting different user groups in the implementation of a new system. The unfreezing strategy used to encourage users to give up the paper-based record should be narrowly framed according to the positive and negative attributes associated with it. We note that for the present case, "data quality" and "ease of use" were attributes showing the greatest differential in favor to the electronic record over the paper-based system. This finding is congruent with the importance given to these attributes in the research conducted with the renowned DeLone & McLean model of information system success [6-7].

Further, we also note that the presence of a hybrid record system, necessitating a joint usage of paper-based and electronic records, was poorly appraised. Indeed, the task-oriented evaluation of the hybrid record system was rather low remaining under a 6.5 level on a ten-point scale. These results are congruent with previous studies that have shown that the parallel use of electronic and paper-based patient records can result in inconsistencies between both systems that lead to significant problems for the healthcare staff in daily care [4-5]. It is thus of the utmost importance to take special care to reduce the possible impact of this conflict when implementing a new electronic clinical system. It is important to note that even if most healthcare organizations are in the process of increasing the use of electronic systems to manage their clinical data, the paper-based record is still present.

Similarly, the results also show that the impact of the hybrid record system was halfheartedly received as demonstrated by the users' ratings which remained near the mid-point of the scale. Here again, it is thus important to take supplementary efforts to conceive the means by which the new system can correct the weaknesses of the system in place.

Prior to concluding, limitations must be acknowledged. First, the response rate (63%) could have been higher even if it can be considered satisfactory in comparison with similar studies which vary between 56% and 85% [9-11]. It will also be important to replicate the study with other medical specialties and organizational contexts. We also acknowledge the usual limitations and generalizations associated with the cross-sectional nature of the study. However, we intend to use this survey as a baseline and we plan to pursue user satisfaction assessments during the new system implementation.

In conclusion, the results presented in this paper have implications for both nurse and physician information technology adoption theory development and practice. With regard to theoretical development, it would be useful to analyze in greater depth the relationship between user satisfaction with the current system, their consequent readiness to change and the latter adoption of a new system. Our results can also guide clinical information system project managers whose objectives are to further use among clinicians in their organizations. In this respect, our results suggest that users' expectations with the new system should be carefully framed in relation to their current experience with the system in place.

Acknowledgments and References

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