Clinical Information Systems:
Understanding and Preventing Their Premature Demise

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What hospital would not want a clinical information system (IS) where all information, orders and prescriptions for an individual patient are available in one place and accessible as needed? Many hospitals introduce these systems to much enthusiasm. Yet, a few months later, this positive attitude often deteriorates into frustration and even organized resistance. Sometimes, faced with outright rebellion, management is forced to withdraw the system or its most disrupting features, reverting to former practices. Indeed, many hospitals interrupt such projects after investing millions in software acquisition and implementation (Anderson 1997; Doolin 1999; Greene 2003).

Such failures are not exclusive to the healthcare domain. Studies have shown that IS project failure is an enduring problem in all sectors of the economy (Wallace et al. 2004). Yet characteristics of hospital settings are distinctive enough to warrant studying their particular IS implementations (Fogel 1989). In an attempt to understand and prevent such failures, we conducted three in-depth case studies at hospitals that had implemented clinical IS. We followed their story from project inception to project termination (see box for a description of the research methodology; see Lapointe and Rivard 2004 for a complete account of the study). We analyzed each case using three models, each one aiming at explaining implementation outcomes at a different level: 1. the individual; 2. the group; 3. the organization. We chose this multilevel approach to obtain a thorough understanding of the phenomenon (Coghlan 1998). We found that each level has to be addressed if these systems are to thrive in a hospital environment.

Methodology

Research sites were selected to maximize differences while ensuring an adequate basis for comparison (see Table 1). Three means of data collection were used: interviews, observation and documentation. Physicians, nurses, project managers and hospital administrators were interviewed starting with the project manager, the nursing director and the medical director. Each of the initial interviewees was asked to identify other respondents using the following criteria: the person was knowledgeable about the implementation process, was representative of a subset of the hospital population and/or had exhibited extreme behaviour – in terms of support or resistance – during the implementation project.

On average, interviews lasted one hour. They began with a generic question that allowed respondents to express how they had experienced the implementation process. Open-ended questions were aimed at securing a thorough understanding of the process. More specific questions ensured that the data from each case covered similar material and would allow cross-case comparison.

Complete transcripts were produced and coded. The chosen codes guided the analysis. Since qualitative data analysis is an open and iterative process, any modifications suggested by the data itself were allowed. When elements were not adequately represented by the selected codes, new categories were created.

THE THREE HOSPITALS

Case 1 was a new acute care hospital. Before construction began in the early 1990s, it was decided that the organization would be paperless. Physicians and nurses recruited for the hospital were advised that using the system would be a part of their daily working experience. The "Omega" system was selected, and implementation began two years after the official opening of the institution. The first module deployed met with only limited success and a second module became the source of major conflicts between physicians and nurses and, ultimately, the hospital's administration. After the physicians threatened to resign, the second module was withdrawn, the project was ultimately abandoned and the Ministry of Health put the hospital under trusteeship. The system was functioning at 25% capacity, and there were no plans for expanding its use.

Case 2 was a university hospital. Acquisition of a clinical IS was considered essential if the institution was to meet the challenges of a changing social, economic and scientific environment. Management chose the same Omega system as in Case 1. It was initially well received. Nevertheless, several months after project inception, major problems arose with the newly implemented pharmacy module. In response to demands by residents, management decided to withdraw it and make improvements. As we were collecting our data, the project was considered a success, and 75% of its functionalities were operational. The remaining modules were to be introduced in the near future.

Case 3 was also a university hospital. When time came to upgrade its admission, radiology and pharmacy systems, the hospital decided to implement a clinical IS. When the software Alpha was selected, the surgery unit volunteered to host a pilot project. At first, the surgeons demonstrated much interest and enthusiasm for the new tool, but this was short-lived. Using the system led to conflicts between physicians and both nurses and pharmacists. Surgeons quickly began to complain that the system was incompatible with how they practised medicine. They soon asked that it be withdrawn, while trying to convince physicians working in the pediatrics and geriatrics units, who had started using the system in a second phase, to do the same. Finally, the system was withdrawn from most of the units. At the time of our data collection, there were no plans to reintroduce it in the near future.

Table 1. The Three Cases and Their Outcomes			
	Hospital Type	Software Package	Result of the Implementation Process
Case 1	community hospital	Omega	Abandonment
Case 2	university hospital	Omega	Success
Case 3	university hospital	Alpha	Failure

Our analysis built a complete picture of the sequence of events at each hospital and the practices that contributed to the final result. The analysis was conducted at three levels: the individual, the group and the organization.

INDIVIDUAL PERCEPTIONS AND SYSTEM USE

Many nurses and physicians are still reluctant to use electronic medical records and other clinical information systems (Gillespie 2002, Loomis et al. 2002), while others are using them regularly (Parekh et al. 2004; Dumas et al. 2001). To explain individual responses to IT implementation, behavioural sciences have been influential in the understanding of adoption of IS in organizations. One model, the Technology Acceptance Model (TAM), has been found particularly robust in explaining why individuals will adopt an IS (Davis et al. 1989; Venkatesh et al. 2003). In essence, the model posits that perceptions about a system's ease of use and usefulness play a central role in explaining a person's attitude toward the system and, in turn, in explaining its use. These factors indeed played a role in the cases we studied. In all three hospitals, physicians and nurses exhibited positive attitudes to the system when they believed it was useful.

Negative Perceptions Come From:

- Ongoing technical and response time problems
- Inflexible or inappropriate business processes
- No or limited immediate benefits

"I thought that it was a **good idea** … If it can simplify our work and give us more time with patients, that's great … At first, there was a computer in every room. You could take someone's blood pressure and enter it right away, you stayed with the patient. I found that **worthwhile**." (Nurse, Case 1)

"I'd say that it saved us time, particularly when writing prescriptions for medication." (Physician, Case 3)

On the other hand, many users did not perceive the system as useful, and this perception had a negative impact on their attitude toward the system:

"If the physicians had been able to have lab or radiology results, communicate directly with the pharmacy by computer, I think that they would have quickly found that the system had its advantages. Since they didn't, it hit a wall." (Manager, Case 3)

The role of ease of use is most significant in the early stages of implementation (Adams et al. 1992). As users become familiar with a system, their concerns about being able to use it effectively tend to disappear. In our cases,

using clinical IS was not perceived as being free from effort. However, for many, this concern disappeared over time.

> "For some nurses using the system took longer than using the paper file. Those who were not very good with computers, with a keyboard, found it took a lot of time, a lot more than it took to write. You saw these problems mostly at the start. As people began to get better at using the software, we heard fewer complaints about the time it took." (Nurse, Case 1)

> "At the beginning, it took two to three times as much time … I'd say that after a month it took about the same amount of time, and after a month and a half or two months, I'd say that I was saving a bit of time. Really, it was learning the system that was difficult." (Physician, Case 3)

> "You could say that even I came close to throwing one out a window a couple of times, because you go to do something, you're in a hurry, and you don't know how to do it. But now I've mastered it." (Nurse, Case 3).

However, perceptions that systems weren't easy to use also explained negative attitudes and even refusal to use them. A physician working in the emergency room in Case 1 commented:

> "Arriving at Emergency at midnight, I had a case of cardiac arrest. I go to the computer, select a new password, [that is,] the key. In the commotion of the cardiac arrest, I then forgot my new password. It was already quite tense, and when I had to write out a prescription after resuscitating the patient, I couldn't remember the new password; I didn't have time to memorize it or get it [into my head]. Then you have to call … the technician on duty. I had to leave emergency. It was very strict, I had to go down to the computer room in order for the technician to give me my password."

This lack of ease of system use and the way it was implemented in this hospital, led to negative perceptions of the system, which grew into a negative attitude among all emergency doctors.

Conversely, in Case 2, when problems arose with the residents because of difficulties with the system's technical features and characteristics, such as response time and prescription of medication, administrators reacted quickly. The problems were taken very seriously by the hospital's board, the general manager and the implementation committees. Everyone was aware that in a teaching hospital, residents represented the main system users. Luckily, the hospital took measures to improve response time even before the residents sent a threatening letter.

> "The residents' resistance went as far as signing a petition presented to the board, in which they took the position that the problem had to be resolved by a specific date or else they would not get on board. That's where we had to recognize that they had a point. We were able to make a system upgrade, and it went well." (Administrator, Case 2)

DISTRIBUTION OF POWER AMONG GROUPS AND RESISTANCE

In all three cases, individuals who had a positive attitude toward their clinical IS largely outnumbered those who had a negative attitude toward it. Yet, in two of the three cases, the system was abandoned after several months. Why did this happen?

Indeed, in addition to individual factors, the distribution of power among the stakeholder groups involved in a system implementation can play an important role in influencing the outcome of the project (Silva and Backhouse 2003). In hospital settings, research has emphasized the importance of physicians' role in IT adoption (Geyer 2004; Trivedi 2002). To analyze the cases in this perspective, we used a model proposed by Markus (1983), which has been most influential in explaining system implementation outcomes using a political perspective (Lee 2000). In essence, the model posits that a group will want to use a system if it believes the system design supports its own position of power. If the group thinks that it undermines its power, its members will engage in resistance behaviours. Thus, it is crucial to pay attention to the distribution of power in an organization prior to a system's implementation.

In hospitals, physicians traditionally hold more power than nurses or administrators in part because they are legally and professionally responsible for prescribing care, tests or medication (Freidson 1970). Nurses, on the other hand, have to carry out tasks related to these prescriptions. While, according to regulation, doctors are supposed to write and sign their own prescriptions, the day-by-day reality of work in a hospital means that physicians often transmit their prescriptions to nurses verbally, and the nurses write them out in patients' files.

> "Nurses have always covered for the doctors a lot because, well, the doctors would say, 'I don't have time to do it,' or 'Do it for me....' What the nurses had to do was writing in the file that he had said this or that, and then sign for having received a verbal prescription." (Nurse, Case 1)

Creating Positive Perceptions
- Respond promptly to concerns.
- Recognize and resolve technical and design problems.
- Ensure the system provides useful functionality for all users.

In all three cases, the software package purchased had been designed to reflect the regulatory environment, which states that all prescriptions have to be entered in the patient file by physicians. Regulations also require that a physician sign any prescription for narcotics and to renew them as required by the patient's condition. To ensure compliance, therefore, a physician's password was needed to enter data in the prescription module. This feature introduced considerable change to existing practices. In Cases 1 and 3, both nurses and physicians felt that it resulted in a change in the balance of power.

> "Of course it changed the distribution of tasks. Given the way we entered prescriptions, we ended up creating their care plans. They no longer had to prepare any care plan. It just came out of the machine. By working this way, we were doing it for them." (Physician, Case 1)

In Case 1, several physicians resented the very notion of doing this type of work and asked the nurses to enter prescriptions instead. On the other hand, nurses were quite pleased with these system features, and several refused to comply with physicians' demands. Nurses took the introduction of the system as an opportunity to improve their work processes, and this led to numerous altercations and conflicts between physicians and nurses.

> "When they introduced Phase 2, things really got out of hand. You couldn't tell a nurse 'Take off his band-aid' without her telling you to enter it on the system." (Physician, Case 1)

This type of response was a political tactic on the nurses' part to support changes in the power structure. The nurses' strategy became even more apparent when they all signed a petition to oppose physicians' demands for a halt to the system's deployment. It was a tense situation, with conflicts flaring up between physicians and nurses in the units of care:

> "When they [the physicians] all wanted to resign, we signed a petition and called a meeting within 24 hours. I think that there must have been 160 or 200 of us there. Then the General Manager called a huge meeting, and everyone gave their opinion. There were a lot of doctors there, and a lot of nurses and everyone had a chance to speak. It was a bit like the Hatfields and the McCoys." (Nurse, Case 1)

In Case 1, the administration and the nurses joined forces against the physicians. After having complained at length about the system, the physicians finally demanded that the prescription module be abandoned. Faced with the administration's refusal to meet their demand and its

determination to follow through with the system implementation, the physicians sought external assistance through their professional corporation and the Ministry of Health, and they fought the administration until they had attained their objectives.

> "It was when they told me, 'It cost a lot.' I can tell you, if I say that it makes no sense, you better listen. If you don't want to listen, it'll be a nuclear war.... What was coming would be terrible, but the president of the Corporation said, 'It's OK, we're going to have [the General Manager] fired.'" (Physician, Case 1)

The physicians' strategies of resistance were successful and the system was withdrawn. Traditional power arrangements were maintained and this pleased the medical staff. Nurses, on the other hand, were extremely disappointed by this outcome and could not help but conclude that "the doctors had won again" (Nurse, Case 1).

A similar scenario was observed in Case 3, where physicians felt that the obligation to enter prescriptions themselves was not appropriate to their status. The physicians resisted the system and began to complain openly about it, suggesting that the nurses should enter prescriptions. The nurses, who were benefiting from the shift in power, did not readily agree. "We wanted to put some pressure on them by saying that we wouldn't enter any prescriptions" (Nurse, Case 3). As in Case 1, the nurses' tactics sought to reinforce the power shift.

This situation created a great deal of tension and conflict between physicians and nurses:

> "As for those nurses who called us imbeciles, they're just lucky they're still alive. With comments in the cafeteria like 'Everybody knows you just aren't bright enough to learn how to use it', the work climate was deteriorating… The doctors had become the bad guys." (Physician, Case 3)

Once the surgeons started to refuse to enter prescriptions into the system, hospital management asked the nurses to do it for them. At first, some of them complained, and the union was not very receptive to the idea. After many negotiating sessions, the nurses decided to comply, in part because using the system was to their advantage.

> "Fortunately, the nurses finally agreed to enter prescriptions for some of the doctors instead of making them do it. If the nurses had really put their feet down […] there would have been some big problems, but it didn't come to that." (Physician, Case 3)

Although the dispute with the nurses was resolved, problems arose in another group – the pharmacists. In

principle, a pharmacist must review and approve a prescription before medication can be given to a patient. In practice, once a prescription had been written and sent off to the pharmacy, nurses often took the medication from a cabinet in the unit and administered it to the patient. The medication sent from the pharmacy was used to restock the cabinet. The system made this unorthodox procedure visible to the pharmacists who then reacted by insisting that the rules be followed to the letter.

> "The pharmacists said, 'Listen, we are responsible for prescriptions, we have to review them, there is no way the nurses are going to continue doing this like it was done in the past.'" (Administrator, Case 3)

This situation led to much conflict between physicians and pharmacists. The pharmacists' strategies reinforced the power shift embodied by the system, feeding the mounting resistance among the surgeons. Given the volume of prescriptions written by surgeons every day, the new restrictions resulting from the pharmacists' inflexibility intensified the surgeons' dissatisfaction with the system.

Finally, they gave the General Manager an ultimatum, demanding that the system be withdrawn. Management, however, had decided to keep the system in the unit, so the surgeons decided to refuse to have their patients admitted to the hospital. Many beds began to go empty, and after about two weeks, management offered the beds to physicians of other specialties.

> "We gave them an ultimatum. ... You better get it out of here, because if you don't, there'll be trouble.... Management literally didn't believe us. They said, they won't do it. Fine, we won't back down. And we gave our colleagues a very clear message: you guys better not take those beds, or there's going to be one helluva fight." (Physician, Case 3)

> "With many beds empty that led to mounting financial problems, management decided to withdraw the system from surgery. All the staff had to go back to working on paper. The nurses were disappointed and unhappy with this turn of events. "[The nurses said] they decided to take it out because the doctors didn't want to use it, so out it went." (Administrator, Case 3)

In Case 1 and Case 3, the introduction of the system was perceived by some as an opportunity to change the balance of power within the organization. Because the physicians already held considerable power, their resistance strategies were more likely to succeed. In both cases, the implementation process came to a halt, and there was no change in the power structure of the organization.

Interestingly, a similar power struggle did not occur in

Case 2. Why not? There were two apparent reasons. First, the organizational culture in Case 2 was one of collaboration, not only between nurses and physicians, but among all the staff, including the hospital administrators.

> "We have a general manager who is very sensitive to medical issues, without necessarily always taking their side. But he recognizes that, in a hospital, physicians represent the group of people that you have to deal with, the people who can play a decisive role in a project's success. We also have a DNS (a director of nursing services) who is very comfortable working with medical colleagues.... The unique nature of [our hospital] ... includes the unions, the employees, the physicians, a management committee that works well together, and positions that are coherent. … If it wasn't this way, things would be much more complicated." (Physician-Administrator, Case 2)

Second, the administrators were well aware of the power held by physicians when they introduced the system and were extremely careful to disturb the status quo as little as possible. As a result, they made two decisions at the outset: they encouraged physicians to accept work in teams, while emphasizing criteria that complied with their regulatory requirements, and they made an effort made to ensure that they had clear benefits by using the system. In other words, "there would always be a fair balance of sugar and vinegar in what we provided" (Physician-Administrator, Case 2.)

Preventing Group Conflicts

- Involve stakeholder groups in finding solutions to problems.
- Be sensitive to the existing power structures.
- Balance "sugar and vinegar" for each group.

> "We made the medical staff understand that we were convinced we had a product that merited a continued investment of effort; […] But with doctors ... you can't use an authoritarian management style, because they are not employees. They have a certain freedom to act. You have to bring them to a point where they recognize that a project can be of collective interest, or they can even have a personal interest in it." (Physician-Administrator, Case 2)

After the deployment, everyone in the hospital agreed that the project was a success.

> "[It was] a huge success and I say that in all modesty, … [I know of no other case where] all the doctors, all the residents and all the students enter the data that they are allowed to enter, directly and without an intermediary of any sort. It doesn't exist . …. All of this goes on in something fully integrated and …

with the entirety of the medical group. You don't see that very often. There are no [other] cases in North America." (Physician-Administrator, Case 2)

ORGANIZATIONAL FACTORS

Numerous studies have emphasized problems with and even complete failures in implementing systems in hospitals specifically (Anderson 1997; Doolin 1999; Greene 2003). The Modern Physician and PriceWaterhouseCoopers Healthcare Information Technology Survey looked at IT use by hospitals and larger clinics and found that only 39% of respondents use computer-based patient record systems (Versel 2002). Why is this true if other types of organizations are able to employ computer-based record systems successfully? Results from prior research on the relationship between organizational characteristics and the adoption of innovations suggests that while professional bureaucracies, of which hospitals are one instance, provide a favourable environment for making innovations, paradoxically they have very little capacity to adopt them (Fogel 1989; Damanpour 1991). Such difficulties have been observed in other instances of professional bureaucracies, such as research centres (Silva and Backhouse 2003).

On the plus side, the large number of specialists provides a broad knowledge base, which fosters the emergence of new ideas. Their high level of training and the low formalization increases openness and a desire to overcome the status quo and encourages relative informality. This creates an environment that facilitates the emergence of new ideas. Finally, functional grouping helps promote the seeking of new solutions. Hence, it is not surprising that, in all three of the hospitals we studied, the idea of a clinical information system was well received by the physicians, sometimes with enthusiasm.

"Generally speaking, physicians are people who buy technology. If you tell us that we'll find the computer system useful, no doctor will say no. We always want the most advanced technology possible." (Physician, Case 1)

"My colleagues … bought into it with enthusiasm." (Physician, Case 2)

"People thought, all right, this is the future. We have always wanted our hospital to be a bit ahead of the pack. We saw this as another opportunity to be a bit cutting-edge, so we got on board." (Physician, Case 3)

Unfortunately, these same characteristics also tend to hinder the actual adoption of innovations. The absence of formal hierarchies and the diversity associated with specialist groups often generate conflicts over goals, resources and decisions. In these cases, each group of professionals and each specialty within these groups required and demanded different features and functionalities:

"[One] major problem faced by a hospital that is computerizing is the wide range of professionals who will be using the system, and their wide range of expectations. The needs of the physiotherapist, the respiratory therapist or the nurse, or the needs of the physician, psychologist or radiology technician, are vastly different." (Administrator, Case 1)

"After two days, the surgeons said they would never [work] with it. The system was too slow and not at all adapted to their needs. I continue to work with it because geriatrics isn't the same type of practice." (Physician, Case 3)

To overcome some of these issues, coordination mechanisms must be put in place (e.g., joint policy making by coordinating committees). These are relatively scarce in the medical core of a hospital, although there are more such devices in the administrative and nursing structures. This could explain in part why, in Cases 1 and 3, we saw the systems adopted by nurses but not by physicians.

Why then was the system implemented successfully in Case 2? In Case 2, all the same characteristics of hospitals were present to the same degree as in the other two hospitals. What differed, though, was the nature of the liaison devices and the specific planning and control mechanisms that were designed and implemented for the deployment of the system.

First, efforts were made to ensure that departmental heads played significant roles in the implementation process.

"[We addressed] the departmental heads, because it was with them that we were working, so we tried to convince them that the project was a good idea. Until they get on board, there's not much you can do. Once we had the departmental head on our side, he influ-

Why Hospitals Don't Cope Well with Change

- Coexistence of conflict over goals and resources
- Lack of coordination mechanisms, particularly among medical staff
- Failure to recognize the diversity of needs and expectations among hospital staff
- Relative absence of mechanisms to encourage mutual adjustment

enced the others. Although there are always some members of the staff who will tell their department to get lost, in general they respect [the departmental head] because they elected him." (Physician-Administrator, Case 2)

Second, a physician who was well respected by his colleagues was called upon to champion the new system and act as mentor to his colleagues. With a thorough understanding of the range of requirements and needs in the hospital, this physician made every effort to ensure that the various, sometimes conflicting system goals were integrated. As one hospital manager said:

"The [Physician-Administrator] had the patience of a saint. He and his whole team took [the physicians of the various specialties], one by one or sometimes in pairs or groups of three if they had common needs, sat them down and told them: 'Listen, we want to know what is getting on your nerves, what you want improved, how we can organize it better so it will be easier [for you to use].'" (Administrator, Case 2)

Third, existing liaison devices were adapted to improve physicians' involvement and participation:

"We have people called resident coordinators who are residents paid by the establishment; they receive extra pay … I used this group as a kind of focus group for getting opinions from the residents.... For us it was very important to get this type of feedback." (Administrator 1, Case 2)

Fourth, in Case 2, physicians became actively involved in the decisions that drove the implementation process. In Cases 1 and 3, though problems were rapidly identified, many physicians complained that they were not sufficiently consulted and did not have enough control over the implementation process.

"There were very few physicians on that committee. There was only one, a pathologist. This physician participated actively in system development and as a member of the committee, but had a perspective that was perhaps different from clinical practitioners. He put a great deal of energy into the project. He invested a lot of his time, but, because of this problem, his involvement didn't provide the anticipated results." (Physician, Case 1)

Fifth, they improvised coordination mechanisms and involved people in finding solutions when problems arose.

"We responded to the [residents'] letter very quickly.

We formed an ad hoc committee to oversee planning, organizational and installation issues with respect to the upgrade. And we included the residents in the process. We said, We have nothing to hide. You are going to be a part of it, and you are going to see if what we are doing … is the best way to do it. And it worked so well that the one-month deadline was ignored, and they accepted what we proposed. So we completely avoided having them carry out threats. Our approach to managing the problem became the norm. There were no confrontations; we just said, 'One, we'll explain what's going on, and two, we have nothing to hide; come take a look at the problem with us.'" (Administrator, Case 2)

Thus, while in general most characteristics of hospitals tend to hinder the adoption of information systems, the experience of Case 2 suggests that it is possible to overcome these by putting coordination mechanisms in place that circumvent these barriers.

Overcoming a Hospital's Natural Resistance to Change

- Be open with all stakeholders.
- Create coordination mechanisms specifically for the implementation.
- Ensure there is a credible physician system champion.
- Adapt existing coordination mechanisms.
- Recognize and plan for different needs and expectations.

CONCLUSION

These cases show that multiple levels of analysis work together to explain the outcome of a clinical IS implementation. Each of the perspectives examined illuminates a different aspect of what makes it successful or unsuccessful. There are three important lessons that can be drawn from this study.

First, when implementing such systems, those in charge of project management not only must understand the key organizational characteristics of hospitals, but they also have to devise mechanisms that will together take advantage of those characteristics that foster innovation, while circumventing those that nurture resistance behaviours. Since these organizational characteristics influence how open various groups will be to innovation in their organization and how challenging the actual implementation is likely to be, project management should design or select appropriate liaison devices to alleviate potential difficulties.

Second, the very distribution of power in hospital settings should be understood from the outset. Implementers should identify the main stakeholders and their relative power, as well as how a new system might affect existing power structures. This information will allow them to foresee potential resistance behaviours and eventually avoid them.

Finally, at the individual level, implementers will want to focus on the usefulness and ease-of-use aspects of the system they are implementing. They should not only assess the users' perceptions of ease of use and usefulness at the outset, but also monitor these perceptions as the implementation process evolves.

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