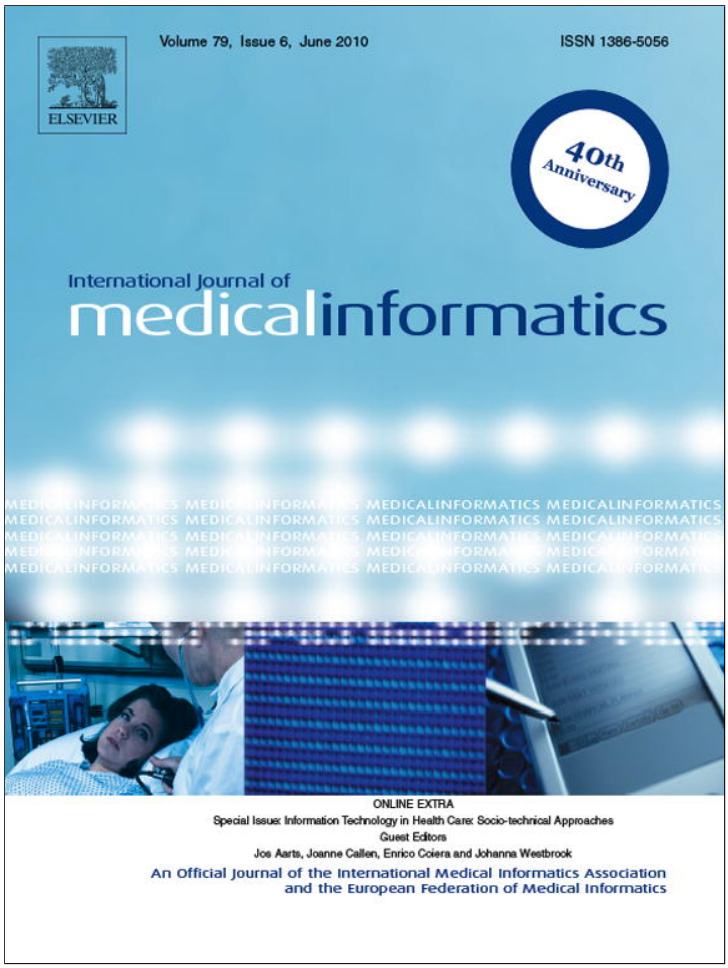

INTERNATIONAL JOURNAL OF MEDICAL INFORMATICS 79 (2010) e97–e108

journal homepage: www.intl.elsevierhealth.com/journals/ijmi

A cross-case analysis of technology-in-use practices: EPR-adaptation in Canada and Norway

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ARTICLE INFO

Article history:
Received 1 November 2007
Received in revised form
20 June 2008
Accepted 23 June 2008

Keywords:
Medical Record Systems Computerized
Hospital information systems
Medical informatics
Technology adaptation
Technology-in-use practices
Qualitative research

ABSTRACT

Purpose: To identify and characterize enabling factors that support a continuous adaptation of technology and work practices in the health care sector.
Methods: Cross-case analysis of two longitudinal ethnographic studies of managing the gradual adaptation of electronic patient records, one in Canada and one Norway.
Results: The cross-case analysis revealed that technology-in-use practices developed more rapidly in one of the cases, and one of the major driving forces was the establishment of a special committee and the associated project meetings. Based on the literature and grounded in the empirical observations, we complement and expand the notion of project meetings as composed of continuous reflection-on-practice activities to construct technology-in-use practices.
Conclusion: We characterize reflection-on-practice activities as frequent encounters of negotiations of work practices and technology use, providing internal actors a space for systematic evaluation of suggested changes. Further we argue that representatives of the affected professions should not only participate, but also have a mandate to make and evaluate decisions of the technology-in-use practices of the particular group.

1. Introduction

> "The electronic medical record has been pursued as an ideal by so many, for so long, that some suggest that it has become the Holy Grail of Medical Informatics" [1, p. 73].

Health care practitioners spend considerable time on activities such as documenting, archiving, retrieving, distributing, and reporting medical data. Medical data is used by clinicians to get an overview of patients' medical histories to determine their medical status, and serves as a basis for future treatments and interventions. Patient data have a long history of being written on paper, collected in physical folders and stored in archives [1,2]. The idea of computerized patient records emerged in the 1960s and 1970s [3], and many attempts have been made with various degrees of success and failures.[1] For the last couple of decades, the adaptation of electronic patient records (EPRs[2]) has been viewed as an immensely important, although highly challenging, task.

Among the prevailing visions for the role of EPRs are goals to use them as management tools that will support care logistics, to redesign work processes, and to improve quality of care [7]. However, the transition to EPRs has turned out to be an unexpectedly long and complex process where

[1] The concepts of 'success' or 'failure' in the context of technology implementation have been acknowledged as contested and have been problematized by several scholars, for example [4].

[2] For the purpose of this paper we chose to use the term electronic patient record (EPR), however this is just one out of many others (for e.g. computerized patient record (CPR); electronic medical record (EMR); patient care information system (PCIS)). Since the content of the medical record is not defined universally, there are various interpretations of these terms [1,5,6].

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1386-5056/$ – see front matter
doi:10.1016/j.ijmedinf.2008.06.008

many goals have not yet been met [8]. There are many examples of technology adaptation within the health care sector that have fallen victim to myths [4], and underestimate the complexity of implementing such systems [9–11]. Additionally, the governments of industrial countries such as Canada, the Netherlands, the United Kingdom, and Scandinavian countries use extensive amounts of resources on the implementation of information systems. There is, therefore, an increasing need for more research on the adaptation of technologies in the health care sector. More specifically, there is a need for investigating the great variation of adaptations and changes of work practices within real-life case studies, because these studies can enable rethinking of alternative approaches for managing the complexities of information systems in the health care sector [12].

Embedding technology in a context requires knowledge and understanding of the situated work practices [13]. Situated actions are the actual practices, which are dependent upon the social circumstances. Plans, on the other hand, are representations of actions used as resources for formal description of processes. The situated actions are influenced by, but not equal to, the formal plans. Instead situated actions emerge from the actual situation. Plans and situated actions are highly interlinked; however, when identifying structures of organizations in the process of embedding technology, one should assume that organizational structures are located in the situated actions rather than in the formal plans [13]. Making situated action visible in the process of adapting technology is thus an essential activity. Initial planning of the adaptation process is important; however, one must recognize that it is impossible to predict and fully plan the socio-technical changes and the overall effect of the technology [4,7,10]. This unpredictability is due to the emergence of new possibilities and unanticipated patterns of use that are brought along by the new technology [14,15]. Thus, the impact of a new technology emerges only in use [10,16].

Adaptation of technology is highly influenced by peoples' perceptions [6]. Technology-in-use practices comprise people's understandings of the technology-use on a daily basis and the consequences of such use [16]. In adapting technology, people have to reconsider their context-dependent and invisible work practices, since context is highly dynamic and continuously changing, which might lead to success or failure of adaptation [17]. This is a dynamic and reflexive process where the technology is locally shaped and re-invented through situated use; it is an ongoing learning process where people try to configure ways of utilizing the technology [18]. For technology adaptation in the health care context this implies that clinicians should create and continuously renegotiate technology-in-use practices, re-aligning technology and situated actions. Renegotiating technology-in-use practices requires space for reflection-on-action activities. Reflection-on-action refers to the activity in which health care practitioners explicitly reflect on implicit experienced problems and articulate new strategies for actions [19]. Enacting the space for reflection-on-action activities requires health care practitioners to step back from their situated practices and to critically evaluate and reflect upon their technology-in-use practices and, on this basis, construct new technology-in-use practices.

Having access to rich empirical material from two longitudinal ethnographic field studies of managing gradual adaptation of EPRs, one in Canada and one in Norway, we had the unique opportunity to investigate various aspects of technology adaptation in the health sector. Previously we had argued that providing a space for constructing technology-in-use practices is essential for developing and strengthening the interrelations between technology and work practices [20]. Here we will extend this argument by characterizing this important space for continuous reflection-on-action activities. Grounded in empirical observations, we characterize reflection-on-action activities as being ongoing, frequent encounters of negotiations of work practices and technology-use providing internal actors a space for systematic evaluation of suggested changes.

We begin by presenting the method, including research design, empirical cases, data sources, collection, and analysis. This is followed by the results and discussion section, which includes three main subsections building up our argument. Finally, we describe limitations of the study and offer our conclusions.

2. Methods

2.1. Research design

The data collection method applied to both research projects was longitudinal ethnography. Ethnographic research seeks to place the phenomenon studied in a wider social context [21], with the primary focus on acquiring rich insights and in-depth understanding of human, social and organizational aspects of the phenomenon [22, p. 4]. Moreover, ethnographic research seeks to develop an understanding of how various aspects influence, and are influenced by, the context [23]. This method is particularly good for generating interpretive knowledge because social phenomena and actors are studied in their natural settings. Investigating real-life cases of EPR-adaptation is essential for understanding and constructing alternative strategies for adaptation and includes developing insights of the context in which the adaptation occurs. Furthermore, ethnography and qualitative research in general are good tools for exploring users' assumptions and needs about the technology, which is essential for preventing gaps between situated practices and technology [24].

2.2. Empirical cases

Both in Norway and in Canada, implementation of EPRs has been on the political agenda for a long time, as they are viewed as 'magic silver bullets' that can be applied to solve the various problems faced in the health sector. Table 1 summarizes the context surrounding each case and show how the initiative to develop an EPR was formed by both external and internal pressure.

In Case A, the adaptation of the EPR system was part of the MEDIKIS project. The aim of MEDIKIS was to establish a common EPR platform among all university hospitals in Norway. In 1996, the five regional hospitals signed a contract with one of the vendors chosen to implement the EPR system. The

Table 1 – Context of Case A and Case B

Context	Case A Norway Large hospital (acute sector)	Case B Canada Community health center (primary health care sector)
External factors		
Source of initiative/financial funds	Part of a larger national project (MEDAKIS)	Provincial project supported by the federal government
Political context	Health reform initiative: shift of focus from quality of service to costs saving and efficient use of resources	Health reform supported renewal initiatives to implement EPRs to achieve financial and structural benefits
Internal factors		
	Decreasing available space in the archive	Decreasing available space in the storage room
	Increase in number and size of paper charts	Increase in number and size of paper charts
	Paper charts' poor structure	Paper charts' poor structure
	Fragmented technical infrastructure	Fragmented technical infrastructure
Year of EPR implementation	2002	2004

initial plan was to deliver one final product for all university hospitals in 1999, however, due to many complexities and challenges, the project was terminated in the beginning of 2004. Instead, each hospital signed individual contracts with the vendor.

The intensified interest in implementing EPRs in Norwegian hospitals was generated, among others, by a major health reform initiative in 2002, where hospitals no longer were owned and managed by the county, but instead managed by five new regional health enterprises. This implied reorganization of the ownership and management structure and resulted in gathering various hospitals under one centralized regional health enterprise. The overall goal was to exploit existing resources within the various regions by increasing collaboration and centralization of services.

In addition to the external pressure from management to implement an EPR within the hospital, there was also an emergent internal pressure to make the EPR a reality. Over time the hospital's archive faced a problem with lack of space due to a yearly growth of paper charts in the active archive,[3] which was a direct consequence of the decision to merge the various paper charts into one record per patient stored in one centralized archive [25]. In summary, the archive department was suffering from a crisis in terms of both physical space and increased workload, and this generated pressure to migrate to a digital medium for storing information and implementing an EPR. Several departments were chosen to pilot and test the implementation of the EPR. Here we will provide empirical material from the neurology department and the neurosurgery department.

In Case B, the adaptation of the EMR was part of the health reform, where various health authorities provided transition funds to support renewal initiatives, including renovations of existing facilities, supplying a public health nurse and/or chronic disease manager, and implementing an EPR system.

Similarly to Case A, there was a strong external pressure for implementing EPRs, as these were seen as solutions for the various problems faced in the primary health sector. EPRs, were expected to provide annual system-wide cost reduction, and better access to patient information while reducing medical errors, which in turn, would increase efficiency and improve the quality of health care services [26].[4]

There was also an internal interest behind implementing an EPR in Case B. The clinic in Case B, like the hospital in Case A, suffered from a lack of space in the storage room. In addition, the clinicians were unsatisfied with their paper-based practice and had a clear ambition to achieve better organization and structure for their medical records. EPRs were expected to reduce staff resource allocation to searching and filling papers in the correct folders and locations.

The clinic in Case B applied and received transition funds for 3 years with an extension of 1 year. Representatives from the clinic attended a vendor open house to choose a vendor and an EPR system. A technical supporter[5] was hired, and adequate hardware and software were purchased and installed in the clinic.

In summary, the adaptation of EPRs in both cases was related to the decreasing available space in the physical archives combined with the increase in number and size of paper charts. The increasing size of the paper charts had various reasons, one of which related to a change in the medical practice. Enhanced focus on quality assurance in medical work expanded the number of regulations and procedures for medical documentation, which again increased the amount of information clinicians had to document. Furthermore, the

[3] The active archive contains recently opened or updated paper charts. The passive archive contains old records, which are rarely requested.

[4] Potential benefits of EPR systems are seen in a report prepared by PriceWaterhouseCoopers for the Canadian Medical Association (CMA).

[5] An internal staff member that was designated to provide technical support.

growth of physical chart size was also related to the shift in demographics caused by the escalating ageing population all over the world. The paper charts, in both cases, provided poor and limited support for data integration and transfer across health care organizations because they were fragmented, place dependent, and contained redundant information. In addition to the paper charts, various artefacts (notebooks, binders, folders) and routines were established to support the existing medical work practice. Fragmentation was also found in the technical infrastructure, which included in both cases several electronic applications (for e.g., patient administrative systems, systems for laboratory results, patient registries in Excel sheets). In sum, the infrastructure that existed in both cases prior to the EPR was highly complex and fragmented, characterized by loosely coupled systems (electronic and non-electronic) existing on top of hybrid paper charts.

Even though there were many similarities between the two cases, there were also differences in some aspects, such as institutional structures, organizational size, and technical architecture of the EPR system. While we acknowledge these differences, we believe that by comparing the organization of the adaptation process in these two different settings, we have the opportunity to provide important insights into the role and impact of the EPR meetings on the development of technology-in-use practices.

2.3. Data sources

Table 2 presents an overview of the empirical data sources collected as a part of the two cases studies.

2.4. Data collection

The fieldwork in Case A was initiated in October 2002 and lasted for 1 year. During this time the first author participated in various informal meetings with the IT department and observed the IT staff providing support to the different departments within the hospital. These observations provided the opportunity to establish initial relationships with the health care practitioners. The fieldwork was conducted in three phases. The first phase was on a small scale and was intended to investigate different actors' first impressions of the EPR system. The second phase was conducted to acquire deeper knowledge about the medical practice, and to identify changes that were brought along by the EPR. The third phase was conducted to acquire broader understanding of the situation after using the EPR at the neurology department for approximately 1 year and in neurosurgery for more than 1.5 years.

Various techniques were used for the collection of empirical data. This includes open-ended, semi-structured interviews conducted in both Norwegian and Arabic. All interviews were audio-recorded, fully transcribed, and carefully translated into English. To gain deeper knowledge about heterogeneous medical practices and to capture interactions that are inaccessible during interviews, they were supplemented with participant observations. In addition, the first author participated in a large range of formal and informal meetings during the study period.

Documents were collected from different sources, such as white papers distributed inside the IT department, product papers and web press releases from the IT vendor, and reports published by the Norwegian ministry of health. These sources provided a textual representation of the EPR project, the hospital, and the individual departments. Various tools were used for visual representations (photos, graphics, slides) to map activities and information flow. Finally, to become familiar with the EPR, the first author attended EPR-training sessions organized separately for each professional group.[6]

The fieldwork in Case B began in October 2004 and ended in March 2008. The first author followed the EPR-adaptation from the initial phase of installation until the process had reached stability, but this analysis will mainly focus on the first year of the adaptation process. During this time, the first author participated in several initial formal meetings with the executive director of the clinic and the technical supporter. In order to be introduced to all of the health care practitioners in the clinic, the first author attended their medical team meetings, which were monthly meetings for all clinicians and administrative staff. Gradually, the first author began attending the weekly EPR meetings, which were organized by a special EPR committee established after the technical implementation. The EPR committee consisted of representatives from each professional group who meet on a weekly basis to discuss the challenges faced during the adaptation process. Finally, the first author participated in various formal and informal meetings.

During the first phase of fieldwork, initial interviews were conducted with various health care practitioners to acquire preliminary information about the context surrounding the adaptation of the EPR. Another set of interviews was conducted when the EPR had been used for 2.5 years. All interviews were audio-recorded, some were fully transcribed and some were interpreted through repeated listening and selective transcriptions. Interviews were supplemented with participant observations in various locations.

Various documents were collected, such as meeting minutes, emails, memos, reports, and project plans provided by the IT vendor and the provincial health authority. Photos were taken to allow visual representation of the context, and activities were mapped in various flow diagrams. Finally, the first author attended basic and advanced EPR-training sessions.

2.5. Data analysis

We conducted a cross-case analysis [28,29] and compared the empirical observations from both cases. We first organized all of the empirical data from the two cases (in Case A all material was collected within an ordinary folder structure, while in Case B all material was integrated into NVivo[7]). We then examined the empirical data from each case and extracted essential aspects related to the adaptation of technology. We coded the empirical data using one set of categories, first grouping

[6] For more details on the Norwegian empirical case see [27].
[7] A software for qualitative data analysis.

Table 2 – Data sources in Case A and Case B

Source	Case A	Case B
Open-ended, semi-structured interviews with		
Health care practitioners (secretaries, nurses, physicians)	19 (range 0.75–2.5 h)	11 (range 1–2.5 h)
IT department/IT vendor	2	1
The archive department	1	None
Policy makers	None	2
Participant observations in various locations (for e.g. the wards, the charting rooms and the reception areas)	14 sessions (39 h)	10 sessions (29 h)
Participation in formal and informal meetings		
Clinical/pre-rounds meetings for physicians	2	3
Medical team meetings for all staff	Yes	None
Hand-over meetings	Yes	None
Meeting with the IT department/vendor	3	2
Meetings between the IT department/vendor and the health care practitioners	Yes	Yes
Participation at EPR meetings	3	29 meetings (range 1–2 h)
Informal conversations with		
Various health care practitioners	Yes	Yes
The IT department/IT vendor	Yes	Yes
Participation in basic and advanced EPR-training sessions	5 sessions (18.5 h)	3 sessions (4.25 h)
Document analysis	Yes	Yes

and later comparing the empirical observations between the cases. During this process it became evident that the meetings held by the project-managing group in each case appeared as one of the most essential driving forces of the technology adaptation. We therefore decided to focus our analysis on this particular aspect. This analysis included a comparison of data sources concerning the types of meetings held during the adaptation process in order to identify diversities and similarities between the management, execution, and impact of the reflective spaces. To identify how the technology-in-use practices evolved over time, we carefully reinvestigated all of the data sources by applying the theoretical concept of technology-in-use. Having identified both the initial and the emergent technology-in-use practices within the two cases, it became clear that the meetings had different degrees of impact on the adaptation process in the two cases. The re-examination of the data material available from the two cases concerning the meetings lead first to our conceptualization of continuous reflection-on-action activities, and then later to our identification of the characteristics of the important space for reflection-on-action activities within technology adaptation.

3. Results and discussion

3.1. *Identifying technology-in-use practices*

We will now describe the adaptation process of the EPR as it proceeded in Case A and Case B, providing in-depth descriptions from our empirical material as to how the technology-in-use patterns developed over time. It is not our intention to determine which case was more successful, after all, the EPR is still in use in both cases. Our intention, rather, is to articulate the initial and emergent technology-in-use practices while identifying the role of the reflection-on-action activities in the development of technology-in-use practices.

3.1.1. *Technology-in-use patterns in Case A*

During the first few months of the adaptation, the health care practitioners in Case A acquired elementary and basic knowledge about the EPR by attending a 1-day training session. The adaptation process was lead by the IT department, and both secretaries and physicians were supposed to begin using the system on the same day. During this initial stage of adaptation, the IT department conducted several introductory meetings with the staff.

Our analysis of the initial technology-in-use practices in Case A revealed that, the work practices by and large remained unchanged. For example, physicians continued to dictate medical notes and hand them over to the secretaries for transcription. Upon completion, the secretaries printed out the notes and handed them back to the physicians who proofread the notes by marking corrections on the paper. They then handed the notes back to the secretaries who corrected the electronic version. Finally, the physicians would validate and sign the medical notes using the EPR. When the physicians needed access to the medical data of a patient that was previously admitted to the department, they would ask the secretaries to find the patient's paper chart. The request would go to the central archive and the chart would automatically be sent prior to the patient's admission to the department. The work practice related to retrieval of information remained the same as before the EPR, and staff continued to use paper charts alongside various books and folders.

After approximately 3 months, new technology-in-use practices slowly emerged in one department where physicians became responsible both for transcribing and for correcting their own medical notes using the EPR. However, no

other major changes in the technology-in-use practice were observed. Also, functionalities embedded within the EPR, for example, electronic prescriptions and physicians' notes, were only used to a very small extent. In an attempt to encourage physicians to use additional functionalities, some of the secretaries attended a training session and learned how to build templates for the physicians. However, the extent to which these additional functionalities were used by the physicians remained minor. There were no radical changes, especially since the health care practitioners were requested to keep both the paper charts and the electronic records updated. Thus, the secretaries spent considerable time grooming and updating both types of charts by reprinting the recent versions of notes and by shredding the redundant ones.

The technology-in-use practices slowly evolved, and the EPR was used not only for validating and signing notes, but also for retrieving patient data. So, when a physician needed data about a newly admitted patient, s/he would simply retrieve the information by logging into the EPR and searching for the patients' electronic record. Moreover, physicians gradually started using internal electronic referrals for the physiotherapy department. This meant that each time a physiotherapist treatment was requested, the physicians would simply log into the EPR, write a referral letter, confirm, and sign it. As soon as the referral letter was signed, it would appear on the physiotherapists' list of incoming internal requests.

Replacing paper-based with electronic referral letters radically enhanced the way information was gathered, stored, distributed, and used, and it reduced the likelihood of losing or misplacing referrals. Using electronic referrals eliminated the need for physicians to hand over paper-based referrals to the head nurse, who then gave them to the ward secretary. The ward secretary would place the referrals on a shelf monitored by the porter. The porter would then pick up the referrals and distribute them to various departments where the secretaries would place the letters on the shelves of the corresponding physicians.

Although some physicians began using the internal electronic referrals, the degree of use varied between the different departments. Whereas some physicians used it extensively on a daily basis, others did not use it at all. In addition, there were different work practices in each department, and while some physicians dictated the referrals and handed them over to the secretaries for transcriptions, others physicians typed the referrals within the electronic system by themselves.

After using the EPR for approximately 1 year, the amount of print-outs from the EPR system grew dramatically and rapidly. This growth subsequent fostered discussions concerning the urgent need to begin scanning paper charts. However, at that time, scanning charts was viewed as a temporary, ad hoc solution for managing the existing hybrid information system comprising papers and electronic entries. Several scanning strategies were discussed and piloted, but, due to various organizational challenges, the actual implementation of the scanning project was postponed.

3.1.2. *Technology-in-use patterns in Case B*

In Case B the adaptation process of the EPR system began with 1-day training sessions for the health care practitioners. There were two separate training sessions, one for the secretaries and one for the physicians. In addition, the clinic established a special EPR committee responsible for following the adaptation process. Whereas the adaptation process in both Case A and Case B was initiated by a 1-day training session, it was only in Case B that the EPR committee was established. This committee consisted of representatives from each professional group, and they conducted meetings on a weekly basis. Their mandate was to discuss the various challenges faced during the adaptation process, evaluate the transition process, and make decisions.

The initial technology-in-use practices comprised the secretaries' use of the EPR for scheduling and billing activities. Billing within the clinic was not a simple task; it was a highly collaborative activity involving various people (i.e. physicians, secretaries, and patients). The collaborative task of billing was coordinated through a highly advanced paper flow within the clinic, however, when the EPR was introduced, the paper flow was replaced by the electronic system, which then became a coordinative artefact for billing activities.

Physicians were slower in developing technology-in-use patterns, and they initially used the EPR primarily for entering medical summaries. Some physicians completed the medical summaries with the patient in the consultation room, while other physicians wrote partial notes and completed the summaries at the end of their clinical day. In addition, the physicians followed an incremental adaptation process by using the EPR for one patient and then by gradually increasing the number of patients they would report upon within the electronic system. Shortly after the initial installation, some physicians began using additional functionalities of the EPR, such as writing prescriptions and using the search function (i.e., to retrieve the names of all patients with diabetes).

The increased use of the EPR by both secretaries and physicians also triggered an early discussion in the clinic concerning the need to scan old paper charts (those belonging to inactive patients). This need to make old paper charts accessible electronically became an issue of high priority early on in Case B long before the issue was even considered in Case A. Thus, physicians in Case B became responsible for going through their charts and carefully selecting the most pertinent documents that they wanted to have accessible through the EPR. Selecting pertinent documents was time consuming and lasted more than 6 months. The secretaries then began scanning the documents and linking them to the corresponding chart. This meant that over time the physicians' technology-in-use practices were progressively changing and their use of the EPR was gradually extended to include advanced functionalities (electronic billing and referrals). Moreover, there was an increasing interest in using and creating additional electronic templates (for activities such as preventive care and chronic disease management).

After approximately half a year, paper charts were barely visible in the clinic, and the health care practitioners were motivated to "go paperless". Having this goal, the EPR committee outlined a strategy for updating and integrating all of the

information into the EPR. This integration had a huge impact on the practice of grooming paper charts. Thus, in contrast to Case A, where secretaries groomed the *paper charts*, in Case B, secretaries groomed the EPR. Since the physicians' workload gradually increased with searching and filling patient information (tasks previously done by secretaries), the EPR committee decided to redefine some of the existing roles and responsibilities, redistributing tasks between the physicians and secretaries. In striving for an equal distribution of workload between staff, the secretaries became responsible for updating the EPR. This task involved going through each patient record and updating the narcotic agreement, and the allergy record, as well as information related to height, weight, and blood pressure. Since the secretaries had been scanning old paper charts for a period of time, the amount of information available through the EPR had expanded. This led the EPR committee to implement a new policy whereby physicians were expected to stop asking secretaries to pull paper charts. Instead they were expected to retrieve most of the information directly from the EPR. In addition, the EPR committee decided that physicians no longer should sign off on paper charts, but through the EPR.

At this point there was a sense of stabilization in the adaptation process and the number of challenges began to decrease. Secretaries were now responsible for shredding papers that were printed out from the EPR for faxing or mailing purposes. Some physicians started to use the advance functionality for writing quick referrals, which enabled reuse of previously entered information. Some physicians also adopted the graph- and diagram-generating functionalities, which translated numerical data (e.g., blood pressure) into visual information representing patients' progress over time. Furthermore, a few physicians began to share these graphs with their patients by turning the screen towards the patient to show the progress of the medical condition.

To ensure a balanced redistribution of tasks, the EPR committee developed a strict protocol for the secretaries about which information they have to scan. If a physician requested additional information not approved by the protocol, this information would have to be scanned by the physicians themselves, who were provided training sessions in scanning.

3.2. *Technology-in-use practice across cases*

We have now presented how the technology-in-use practices developed over time in the two empirical cases. While we see that the practices around technology evolved in both cases, we also observed that the extent to which the work practices changed was different.

While the physicians in Case A initially used the EPR only to validate and sign notes, the physicians in Case B instantly used the EPR to enter medical notes, search for patient information, and write electronic prescriptions. This gap between the physicians in the two cases increased over time and delayed the development of emergent technology-in-use practices in Case A. In contrast physicians from Case B took the use of the EPR to a different level and created advanced emergent technology-in-use practices. They started creating electronic templates, using electronic referrals, and even scanning old paper charts, which in itself was a crucial step for achieving the goal of becoming a paperless clinic.

When investigating the emergent technology-in-use practices of the secretaries, scanning old paper charts was only piloted in Case A, whereas it was fully integrated into the secretaries work practices in Case B. The integration of scanning activities in their work practices was reflected through the creation of the protocols for redistributing tasks between staff.

In Case A, the health care practitioners managed to adapt the EPR to their work practices and develop technology-in-use practices over time. However, it is evident that in Case B, the amount of changes was substantially greater than in Case A, thus reflecting the increased use of the EPR in Case B. In Case B, the health care practitioners managed to develop highly complex technology-in-use practices over time, also evident by the replacement of paper charts with electronic charts. Table 3 summarizes the development in both cases from the initial and emergent technology-in-use practices.

3.3. *Factors promoting the adaptation process*

We have now illustrated how the technology-in-use practices developed rapidly into more complex work patterns in Case B compared to Case A. In this section, we will investigate the factors promoting the adaptation process. Examining our empirical observations, we found that one of the major driving forces in Case B was the establishment of the EPR committee and their meetings. It was during these meetings that the health care practitioners evaluated the adaptation process and continuously developed new and more advanced technology-in-use practices.

There were also meetings in Case A; however, these meetings were different in form and content, and they were organized by the IT department and not by a committee consisting of health care practitioners. There were two types of meetings in Case A, introductory and follow-up meetings. The introductory meetings were mainly intended for the IT department to introduce the various functionalities in the EPR to the health care practitioners. Follow-up meetings were conducted with contact personnel and 'super-users',[8] who were representatives from each professional group. Reaching consensus in these meetings was profoundly challenging because every time a new functionality was introduced, each professional group claimed their workload was already so high that they could not adopt additional tasks. The staff from the IT department would often turn to the department head to ask for support. During these follow-up meetings, the participants had a tendency to discuss each task in isolation and were reluctant to making concrete decisions that had impact on redistribution of tasks.

In Case B, the process of reaching decisions was radically different. Here, continuous discussions and negotiations took place with all committee members. Typically, when a new

[8] 'Super-users' refers to a group of individuals that were expected to acquire more advanced knowledge and were assigned additional responsibilities (e.g. providing daily support to the staff, downloading updates, and informing the staff of any changes).

Table 3 – Initial and emergent technology-in-use practices for each professional group in the two cases

	Initial technology-in-use practices		Emergent technology-in-use practices	
	Physicians	Secretaries	Physicians	Secretaries
Case A	Validating and signing notes	Transcribing and correcting notes	Transcribing and correcting notes Retrieving information Partial use of prescriptions Partial use of physician's notes Internal referrals	Piloting scanning Creating templates
Case B	Entering medical notes Prescriptions Search function	Scheduling Billing Scanning	Entering medical notes Retrieving information Prescriptions Search function Referrals Scanning Creating templates Partial use of visual graphs and diagrams	Grooming and updating the EPR Scanning

functionality was put into use, the committee members would request comments from the individuals specifically impacted by the change. This was often followed by a testing period where the new work practice was piloted. The committee would then request feedback on the pilot testing, thus evaluating whether the changes were feasible and/or beneficial. For example, when the committee discussed the need to fully update the EPR, they decided that it was not feasible to ask the health care practitioners to enter all of the information found in the paper charts, as this demanded a considerable amount of time. Instead, the committee decided to prioritize which parts of the information should be entered. Hence, decisions were reached through a mutual and dynamic process of negotiation and renegotiation of technology use [30]. These meetings encouraged increased collaboration across professional groups. The committee meetings in Case B developed a process of continuous alignments, adaptations, and fine-tuning of local work practices to the technology (and vice versa). In situations where the workload evolved, new decisions were made based on new evaluations. Scanning, for instance, was initially conducted by the secretaries; however, as the number of requests increased, new strategies were established to redistribute the workload between the secretaries and the physicians. The meetings in Case B enforced systematic evaluation mechanisms through iterative feedback loops. In Case A, when the IT department managed to reach a consensus and a final decision, the changes in the work practice were not always followed by the health care practitioners. While the changes in Case A were 'top-down' and came from the IT department, who struggled with forcing changes, the changes in Case B were initiated internally by the health care practitioners, following a 'bottom-up' approach.

The meetings in Case B were very different in nature compared with Case A. The participants in the EPR meetings consisted of individuals who freely volunteered to participate in weekly meetings and to dedicate their time to testing the EPR. It was, therefore, a group of committed and enthusiastic individuals who took responsibility for dealing with various challenges and actively defined new goals for further development. Since there were rapid changes applied to the technology-in-use practices, the committee acknowledged the importance of disseminating knowledge to all of the health care practitioners.

In contrast to Case A, where most of the meetings were held at the beginning of the adaptation process, the meetings in Case B were held on a weekly basis for half a year. It was only when there was a sense of stabilization and the number of challenges decreased that the committee changed their schedule to biweekly meetings, which were later reduced to monthly meetings. This allowed the health care practitioners to deal with unexpected challenges as they emerged along the adaptation process. Such challenges and unanticipated use could not be predicted in advance [31]. For example, use of the messaging feature brought along challenges regarding how to deal with electronic urgent messages that were sent to physicians who either had their computer turned off, or were not in front of the computer. In other words, a new mechanism had to be established to assure that urgent messages reach the physician in a rapid manner.

Thus, the weekly meetings in Case B constituted continuous reflection-on-action activities [19], which were essential for dealing with concrete, local, and situated complexities related both to the technical implementation and the necessary adaptation activities. Because of these meetings, technology-in-use practices were gradually emerging from situated actions [13]. Furthermore, the meetings in Case B provided space to engage in critical debates and question existing rigid and duplicated routines. For example, the secretaries at one point questioned the physicians' redundant routine of signing paper charts when this also was done through the EPR. In other words, secretaries were questioning patterns of work that were the result of old habits.

In Case B each new function was always discussed in relation to other existing functionalities. Hence, if a new functionality increased the workload for one professional group, it was always evaluated in relation to the overall context of

changes. Decisions concerning changes in the distribution of practices were based upon the existing workload at a certain point in time. When the health care practitioners discussed the need for updating the EPR, for example, the physicians suggested the secretaries do this task since their workload decreased dramatically when they stopped grooming paper charts. Hence, the committee acknowledged the continuous changes in the workload and strived to balance the distribution of the tasks among the staff. On the contrary, in Case A, each development of a new functionality was discussed in isolation from the overall context of changes. Hence, when a new functionality was introduced, it was more easily rejected by the staff. The process of reflection was essential for enabling and assessing the management of the adaptation process and for cultivating technology-in-use practices. One of the secretaries expressed:

> "If we didn't have this [EPR] committee in the beginning of things, I don't think we would have made any changes or implementations. (...) Also [the process of] add[ing] rules, different responsibilities for different people. That's what the program [EPR] brought forward. (...) That's why those [EPR] meetings are great. You can bring aboard issues, or try to fix them. Sometimes there's just problem, but then we fixed it, or we tried something for a while and then we fixed it ourselves. Then it's not an issue". (Secretary from Case B)

While, in Case A, the technology was viewed as something that took the practitioners' time and disrupted the medical practice, in Case B, new technical knowledge was articulated through use and influenced peoples' perceptions and understanding of the technology and its use. Gradually, technology-in-use practices became embedded in the medical practice and were viewed as an important aspect for enhancing quality of care. The below Table 4 summarizes the differences between the meetings in Case A and in Case B.

3.4. *Characteristics of the space for reflection-on-practice*

We have now identified the EPR committee and their meetings as one of the key factors promoting the adaptation process. These meetings provided a space for ongoing reflection-on-practice activities cultivating emergent technology-in-use practices. In this section, we will characterize this space for reflection-on-practice activities grounded in the empirical observations from the two cases and discuss several essential issues related to this important space for reflection.

As previously mentioned, both cases had organized meetings, however, the nature and characteristics of these meetings were very different. Thus, we argue that the essential space for reflection-on-practice activities existed only in Case B. The EPR meetings in Case B, were organized by internal actors representing clinical staff, whereas the EPR meetings in Case A were organized by an external actor.[9] So, although both groups organizing these meetings (the IT department and the EPR committee) followed a participatory approach, working closely with health care practitioners, the internal/external relation to the organizers strongly impacted the outcome. In Case A, because the staff from the IT department were viewed as external actors ("outsiders") having their own political agenda, they faced a larger degree of interdepartmental resistance for change [32] and were challenged when trying to reach consensus amongst the health care practitioners. On the contrary, in Case B the EPR committee constituted a group of internal actors ("insiders"), thus changes were perceived as something that was intended to benefit the internal and situated needs of the health care practitioners.

The participants in the EPR meetings in Case A were randomly chosen, whereas the participants in Case B were a group of self-selected, committed individuals who actively and collectively defined new goals to achieve. Thus, the changes in Case B came from within the organization, from the health care practitioners in the clinic. Changes did not emerge from pre-defined standards or formal protocols, but rather from the local and situated practice. This reflects a bottom-up approach according to which formal protocols were created based upon situated practices. These changes were neither static nor implemented 'once and for all,' but rather were continuously modified and adapted to the work practice that existed at a certain point in time.

Since there were many challenges and rapid changes in the technology-in-use practices in Case B, the frequency of the EPR meetings was essential because these meetings functioned as a supporting infrastructure for the overall changes by enforcing systematic evaluation mechanisms through iterative feedback loops. Also the frequency created a strong and solid platform for ongoing negotiations and crucial reflections of unexpected challenges. This is especially important because implementing an IT system always brings along unexpected challenges, which are impossible to predict before the actual use of the system [33]. Additionally, these meetings created a framework that contextualized changes, and changes were therefore always discussed in relation to the overall redistribution of tasks between staff.

The IT department in Case A had no centralized management control and followed a mixed strategy of both imposed and voluntary control. This implied that the health care practitioners were expected to use the functionalities of the new EPR, however, the degree of use was voluntary. Each department was given the local autonomy to decide and chose preferences related to the actual use of particular functionalities of the EPR. This decentralized approach to the adaptation had a price, namely poor control and management of the adaptation process. Further difficulties arose from this issue because the IT department was an external actor without any form of anchoring and regular relations to the departments after the technical implementation. Thus, in Case A there was no follow-up mechanism to assure that changes were actually adopted in practice. Based on the empirical material from Case A, it is evident that some of the decisions that were taken by the IT department were either only partially adopted or completely rejected by the health care practitioners. This decentralized approach for control and management, as well as the distance and disrupted follow-up mechanism by the IT depart-

[9] In spite of the fact that the IT department is part of the hospital, it is viewed in this case as an external actor because it is not a clinical department.

Table 4 – Differences between the meetings in Case A and Case B

	Case A	Case B
Organization of EPR meetings	IT department (external actors)	EPR committee (internal actors)
Source of change	External	Internal
Management control	Decentralized	Centralized
Follow-up mechanism	Distanced and disrupted	Close and continuous
Communication channels for dissemination of new technology-in-use practices	Super-users and contact personnel disseminated information in different ways (sending emails, printing out messages and hanging them on the blackboard in the wards, etc.)	The EPR committee disseminated information through the medical team meetings and clinical meetings
Approach	"Top-down"	"Bottom-up"
Participants	Randomly chosen	Self-selected
Decision	Challenging	Collaborative through negotiations
Frequency of EPR meetings	At the beginning	On a weekly basis (then biweekly and monthly meetings)
Evaluation	Absent	Systematic evaluation mechanisms through iterative feedback loops

ment, created greater gaps between the formal decisions and the actual practices within the department. In Case A, the IT department expected the contact personnel to communicate decisions to all the health care practitioners; however, it is evident in the empirical material that the information was not always channelled properly. It is also evident that the absence of close and continuous evaluation of the adaptation process in practice contributed to lack of involvement, commitment, and motivation of the health care practitioners. In Case B, the EPR committee followed a more centralized approach and all health care practitioners were expected to follow decisions that were taken by the committee.[10] Furthermore, the fact that the EPR committee constituted internal actors ("insiders") from the clinic implied that they could monitor and take action if changes were not followed in practice. Also, the EPR committee integrated communication of decisions related to the EPR into their medical team meetings and in this way assured that all of the health care practitioners were aware of any new changes.

3.5. *Limitations of the study*

The paper is based on two cases, which are disparate in nature, thus results may benefit from additional comparative analysis of empirical cases in different health sectors. While the empirical data in both cases was collected solely by the first author, the analysis was conducted by both researchers to enhanced the confidence in the findings and added to empirical grounding as well as to reduce bias [28]. This meant that the analysis had the advantage of supporting different perspectives and bringing complementary insights from an investigator external to the cases, which increased richness and credibility of the data [28,29].

[10] It is important to note that the EPR committee in Case B did allow space for so-called personal preference by, for example, letting each physician decide how many consultation notes he or she wanted to do using the EPR. This was intended to provide physicians with the flexibility to gradually get used to the EPR. However, after a period of time, a formal and centralized decision was made, according to which all the physicians had to chart their notes electronically using the EPR.

4. Conclusion

Previous research found that large-scale information systems adaptation in health care should be managed by a project-group including not only IT-developers, but also representatives of future users and management [e.g., 14]. They also found that negotiations of system specifications, as well as organizational changes, should be discussed frequently at project-group meetings [4]. While we also argue for the importance of these meetings, we additionally complement and expand the notion of project meetings by providing a conceptualization of the essential aspects of these meetings. Previously we have conceptualized the meetings as continuous reflection-on-practice activities constructing technology-in-use practices. Reflection-on-practice activities are internally initiated and involve critical reflections by the participants, who continuously evaluate and question work practices in relation to technology.

Here we ask: How can we characterize and operationalize the space for reflection-on-practice activities? Based upon the analysis of the empirical material, we found that reflection-on-practice activities are essential for cultivating emergent technology-in-use practices. Moreover, we argue that reflection-on-practice activities can be characterized by ongoing, frequent encounters of negotiations of work practices and technology use, providing internal actors a space for systematic and iterative evaluations of suggested changes. We further argue that it is essential that the reflection-on-practice activities are based upon a contextualized understanding of the overall changes and redistribution of tasks. Finally, we found that making centralized decisions about technology-in-use practices, as well as having mechanism for communicating new changes and closely following the actual integration of these changes into the daily work, strongly supports the adaptation process. We found that our conceptualization of reflection-on-action activities has been helpful in understanding our two cases of technology adaptation by health care practitioners, and it is important for constructing and developing technology-in-use practices. Moreover, we hope that our characterization of the space for reflection can be used by both practitioners as well as by researchers when imple-

Summary points

What was known before the study:

- Technology adaptation is a socio-technical transformation process in which existing work practices influence and are influenced by the technology.
- In order to understand the adaptation of complex technologies, we need to investigate the realities of introducing technology in specific organizational settings.
- Large-scale information systems adaptation in health care should be managed by a project-group, including not only IT-developers, but also representative of future users and management.

What the study has added to the body of knowledge:

- An illustration of the socio-technical transformation process of work practices and technologies.
- An expansion of the notion of project meetings by providing a conceptualization of the essential aspects of these meetings. Our conceptualization is composed of continuous reflection-on-practice activities to construct technology-in-use practices.
- Characterization of reflection-on-practice activities as frequent encounters of negotiations of work practices and technology use, providing internal actors a space for systematic evaluation of suggested changes. Further we argue that representatives of the affected professions should not only participate but also have a mandate to make and evaluate decisions of the technology-in-use practices of the particular group.

menting or investigating new technology in health care practice.

Acknowledgements

We are grateful to the Social Sciences and Humanities Research Council of Canada, for their support of the ACTION for Health Research Program, Grant #512-2003-1017, funded through the Initiative for a New Economy Collaborative Research Initiative.

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