

Global reach, local use

Design and use of electronic patient record systems
in large hospitals

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Dr. Scient. Thesis



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Abstract

The implementation of electronic patient records (EPRs) in large hospitals has for close to two decades been considered as a means for improving the exploitation of the health care resources. Both at the governmental level, in the hospitals, and in public institutions, there have been arguments about how an EPR should constitute a foundation for efficiency improvement, information systems integration and increased collaboration across departments and hospitals as well as for quality assurance in diagnostic work

The results have so far been disappointing. Despite a series of heavily funded national and international initiatives, there has only been very modest success in establishing working Electronic Patient Records (EPRs) in large hospitals.

The present study looks more closely into this phenomenon and seeks to explore and explain why large projects often fail. Subsequently, I seek to suggest conditions and mechanisms for more successfully establishing working EPRs.

A large-scale EPR will unquestionably inscribe certain behaviour in organisational practice, which might result in failures caused by rigidity and inflexibility. On the other hand, the EPR might in itself behave in unforeseen ways or be used differently than initially planned, thus posing new challenges for designers. Accordingly, the design and implementation of large-scale EPRs are not merely a technical effort. Such a process must take into account that large hospitals are very complex organisations. Clinical work is highly specialised. It is characterised by state-of-the-art knowledge, high levels of education, but also by a very complex division of labour. The heterogeneous user-groups and professionals are very often recognised with different agendas and interests

Broadly sketched, I address questions related to the organisation of large-scale IT-projects, strategies for integration of EPRs with existing IT-systems in hospitals, and strategies for how to perform standardisation processes. I also look into mechanisms for alternative organisation of work centred on EPRs. In addition, I discuss how the EPR might support collaboration among heterogeneous users in complex and specialised organisations.

From a theoretical point of view this study is based on the fields of Computer Supported Cooperative Work (CSCW), Science and Technology Studies in general and Actor

Network Theory in particular (ANT). ANT offers an apparatus for describing and conceptualising the relationship between technological and social components. The CSCW literature has focused quite extensively on how an information system can support distributed collaborative work among groups of users. This is an important point related to the use of EPRs because real usefulness can only be achieved if the different professionals in the hospitals share some comprehension of what an EPR should do, and agree to use it in certain ways. The term 'information infrastructures' has been valuable in illustrating the complexity of organisations and IT-systems and how they are mutually intertwined.

The six papers

The dissertation consists of an introductory chapter and the following six papers:

1. Lærum, H., Ellingsen, G. and Faxvaag, A. (2001): Doctor's use of electronic medical records systems in hospitals: cross sectional survey. *British Medical Journal*, vol. 323, no. 7325, pp. 1344-1348.
2. Ellingsen, G. and Monteiro, E. (2002): Big is beautiful: electronic patient records in large Norwegian hospitals 1980s – 2001. *The Scandinavian Journal of Information Systems* (accepted for publication)¹
3. Ellingsen, G. and Monteiro, E. (2001): A patchwork planet. Integration and cooperation in hospitals. *Journal of Computer Supported Cooperative Work* (in press)²
4. Ellingsen, G. (2003): Knowledge work in hospitals. In Wynn, E.H., Whitley, E.A., Myers, M.D and DeGross, J.I. (eds.): *IFIP WG 8.2, Global and Organizational Discourse about Information Technology*. Boston: Kluwer Academic Publishers (in press).^{3 4}
5. Ellingsen, G. (2002a): Walking the tightrope between the global and the local: Standardisation meets local work-practice in a hospital. Presented at the 18th EGOS Colloquium, *Organisational Politics and the Politics of Organisations*, Barcelona, Spain, July 2002.
6. Ellingsen, G. (2002b): Information Systems support for interdisciplinary teams: Everyday interdisciplinary work in hospitals in an actor network perspective. In

¹ A shorter variant of the paper “Big is beautiful” is accepted for publication in *Methods of Information in Medicine* (2002). Another variant also appears in *Proceedings of the 24th Information Systems Research Seminar in Scandinavia* (IRIS 24), “Knowledge systems”, Ulvik in Hardanger, Norway, August 2001

² A former version of this paper appears in *Proceedings of the 23rd Information Systems Research Seminar in Scandinavia* (IRIS 23), “Doing IT together”, Lingatan, Sweden, August 2000 and in *Proceedings of the Norwegian conference for organisations' use of IT*, Bodø, November 2000

³ A former variant of this paper appears as “The role of trust in knowledge management” in *Proceedings of the Norwegian conference for organisations' use of IT*, Tromsø, November 2001.

⁴ Two other variants exist with Eric Monteiro as a co-writer. First, “Enacting knowledge work: the genealogy of knowledge representations in hospitals” in *Proceedings of the Third European Conference on Organizational Knowledge, Learning and Capabilities*, Athens, Greece, April 2002 and second as “Mechanisms for producing a working knowledge: enacting, orchestrating and organisation in *Information and Organization*, 2002 (accepted for publication)

Bødker, K., Kühn Pedersen, M., Nørbjerg, J., Simonsen, J., and Thanning Vendelø, M. (editors): *Proceedings of the 25th Information Systems Research Seminar in Scandinavia (IRIS 25)*, “New Ways of Working in IS”, Bautahøj, Denmark, August 2002.⁵

⁵ Another variant of this paper appears as “Coordinating work in hospitals in an EPR-context” (submitted for review). It was also presented at the *Conference on Ethnographic Organizational Studies*, University of St. Gallen, Switzerland, September 2002.

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Preface

During several years as an IT-consultant at the University Hospital of Northern Norway⁶, I regularly wondered why some IT-projects failed, why some turned out to be successful, or why others sometimes turned out completely differently than planned. I tried to look for explanations through, among other things, project management courses, but unfortunately, the explanations and methods provided proved insufficient in real life. I experienced how difficult it is to run projects in strict accordance with clear goals, well-structured plans and well-organised project organisations. As a result, I became increasingly aware that the technical challenges of IT-projects were only one part of the problem. It was not sufficient to have installed a well-functioning system in a workplace if nobody used it or paid attention to it. And although having apparently identical goals, people had different agendas and pursued different strategies and interests. In addition, the introduced IT-system often resulted in constraints for the people who were going to use it, or the system behaved a bit differently than intended.

With this background, I was genuinely interested in alternative approaches that could guide the design and implementation of information systems in complex organisations. Accordingly, this was my main motivation, although partly accidental, for joining the research project KVALIS⁷ that focused on electronic patient record systems (EPRs) in large hospitals. The KVALIS project appealed to me because it had a broad scope towards how to approach the challenges in this area. Three fields were brought together: medicine, sociology and informatics, each with one PhD student and supervisor respectively

During these three years, KVALIS has been an extremely important arena for me: as a place to present research, because of the fertile collaboration among the KVALIS members, and also the stimulating discussions with participants at the KVALIS-seminars, practitioners, vendors, researchers and students. This has strongly contributed to seeing the EPR implementation challenges from different perspectives and has of course shaped the present dissertation.

⁶ The hospital has changed its name during the study. The former name was “the Regional Hospital of Tromsø”

I owe my colleagues and friends in KVALIS, Aksel Tjora, Arild Faxvaag, Gro Underland, Hallvard Lærum and Eric Monteiro great gratitude. My supervisor Eric Monteiro has provided me with excellent guidance. He has always shown interest in my work, has stimulated to interesting discussions and has been a great a source of inspiration. Gro and Hallvard, my fellow students have been generous companions. I have enjoyed the informal talks, the exchange of frustrations, the social gatherings and all the “internal” e-mails.

In this period, I have appreciated to be introduced to a larger research network of people who also conduct research in health care. This has greatly extended my perspectives on IT in health care regarding national strategies and comparisons across countries. This network extends to Trondheim, Oslo, Rotterdam, Edinburgh, Gothenburg, Aalborg and Cambridge. In this regard I would like to mention Eva Walderhaug, Ann Rudinow Sætnan, Øystein Nytrø, Torbjørn Nystadnes, Line Melby, Hroar Piene, Ole Hanseth, Margunn Aanestad, Per Hasvold, Judith Gregory, Frode Løbersli, Miria Grisot, Edoardo Iacucci, Ulrika Josefsson, Agneta Nilsson, Matthew Jones, Marc Berg, Brit Ross Winthereik, Mirjam Faber, Samantha Adams, Rob Procter, Mark Hartswood, Marc Rouncefield and Christian Nøhr. Thanks to Margunn who commented on my finale draft of the dissertation.

In addition, there are researchers who work in partly the same theoretical field: Jo Herstad, Sundeep Sahay, Knut Rolland, Dixi Henriksen, Jens Kaaber Pors, Ingjerd Skogseid, Kåre Lines, Ola Henfridsson. Thanks also to Lucy Suchman who gave valuable feedback on my data at one stage of this study.

As I live in Tromsø, I have been dependent on frequent travel between Tromsø and Trondheim. In this regard, I have benefited from financial support from the University Hospital of Northern Norway. For this, I am grateful to Ernst Solvoll and the CEO of the hospital, Knut Schrøder. I have also benefited from a flexible part-time work arrangement at the hospital’s IT-centre where I have had my daily office accommodation. In this regard, I owe much gratitude to Hans Magnar Pettersen and Håvard Ballo.

⁷ KVALIS is short for Quality assurance of hospital-based electronic patient record systems. KVALIS on the web can be found at <http://kvalis.ntnu.no>.

Preface

Thanks to all my colleagues and friends at the hospital's IT-centre. I have appreciated the many practical discussions about the hospital's EPR-implementation. I would especially like to mention those who in some ways are affiliated to the local EPR project, Inger Andersen, Marit Knutsen, Gunvor Mikkelsen, Knut Hansen and Svein Minde.

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Last, but not at least, my thanks go to my family, my always-supporting parents, Klary and Kolbjørn, my wife Jorunn who has infinite belief in me in hard times, and finally, my “warriors”, my boys: Jonas, Martin, Tord and Anders.

Tromsø / Trondheim, November 2002

Gunnar Ellingsen

1 Introduction

The health service in Norway – as in other western countries with a public health service - is both considered an important social task and recognised as a political responsibility. Unfortunately, the public health service is costly and the prospects of the future are growing worse as there are social demands for improved quality in patient treatment and services. Also the introduction of new types of treatments and new technologies enforced by research results, induce costly methods of treatment. The increasing average age of the population in western countries (Dick, Steen and Detmer, 1997) also presupposes increased efforts in order to keep the quality of health services at a stable level. In sum, public expenses are bound to increase.

As a result of the constantly increasing and more costly health sector, several strategies have been employed in order to improve efficiency in the sector. The Government has over several years and in different forms established incentives in order to improve the exploitation of the healthcare resources. The implementation of electronic patient records (EPRs) in large hospitals has for close to two decades been considered as a means to achieving such goals. Both at the governmental level (SHD 1996:22), in the hospitals (Unified requirement specification, 1996), and in public institutions (elaborated in the second paper), there have been arguments about how an EPR should constitute a foundation for efficiency improvement, information systems integration (Hartswood et al. 2001; Grimson, Grimson and Hasselbring, 2000), increased collaboration across departments, hospitals and professions, quality assurance in diagnostic work, treatment and care, as well a foundation for research.

The results have so far been disappointing. Despite a series of heavily funded national and international initiatives, there has been only very modest success in establishing working Electronic Patient Records (EPRs) in large hospitals. Oddly enough, there does not seem to exist any systematic, comprehensive and critical evaluation of these efforts (although more narrow or restricted ones exist; see Massaro, 1993; Kushniruk et al., 1996; Safran et al., 1999; Sands et al., 1995). Accordingly a focus for me in this study has been to look more closely into this phenomenon. I seek to explore and explain why things have failed. Subsequently, I also seek to suggest conditions and mechanisms for being more successful in establishing working EPRs.

A large-scale EPR will unquestionably inscribe certain behaviour in organisational practice, which might result in failures caused by rigidity and inflexibility. On the other hand, the EPR might in itself behave in unforeseen ways or be used differently than initially planned, thus posing new challenges for designers and project leaders. Accordingly, the design and implementation of large-scale EPRs or other large systems are not merely a technical effort (as argued in Pressman, 1993 and Coad and Yourdon, 1991). Such a process must take into account that large hospitals are very complex organisations. Clinical work is highly specialised. It is characterised by state-of-the-art knowledge, high levels of education, but also by a very complex division of labour (Blume, 1991:17; Atkinson, 1995:7; Reiser, 1984:303). The heterogeneous user-groups and professionals are very often recognised with different agendas and interests

Accordingly, organisational issues are a central, and must be an essential part of the strategy of designing and using EPRs. Yet another argument is that large hospitals already have a huge amount of existing information systems that have emerged over time. These systems are assumed to be integrated in an effortless interplay with the EPR. However, looking more closely, apparently redundant information located in several information sources serves possibly slightly different purposes. This must also be addressed in design guidelines for integration and interplay.

I will return more explicitly to the research questions in the methods chapter, but broadly sketched, I will address questions related to the organisation of large-scale IT-projects, strategies for integration of EPRs with existing IT-systems in hospitals, and strategies for how to perform standardisation processes. I will also look into mechanisms for alternative organisation of work centred on EPRs. In addition, I will discuss how an EPR might support collaboration among heterogeneous users in complex and specialised organisations.

The national-based Norwegian EPR-project Medakis is an expression of the many and high expectations of what an EPR should contribute with. The five regional hospitals in Norway have from 1996 participated in a large-scale EPR project where a primary goal has been to develop a common and all-encompassing EPR for these hospitals. These hospitals all have a university role and are the largest hospitals in the country.

The Medakis project was, according to the contract, estimated to terminate at the turn of the year 1999/2000. However, the project is still running. Today the project has been

running for over six years, the final time-scale for the project is uncertain and despite heavy deployment of the technical solution - DocuLive EPR - the final outcome in terms of functionality and use is still uncertain. The delays serve very clearly as an illustration of both the high degree of complexity and the high ambitions, as well as the unexpected and unintended aspects with regards to design, deployment and use.

The empirical data in this study draws on both the Medakis-project and on everyday medical work centred around information in general and DocuLive EPR in particular. Although the Medakis-project spans five regional hospitals, the study draws primarily on empirical data from one of the hospitals, the University Hospital of Northern Norway.

The complexity of medical work, the huge amount of heterogeneous users and professionals, and the unnumbered amount of information systems implicate that implementing an EPR constitutes a formidable task. This environment serves as a starting point for the question of how to approach this phenomenon from a theoretical perspective. What is needed is a theoretical apparatus that embraces the complex socio-technical interplay of introducing EPRs in hospitals. As argued above, such an effort cannot be considered solely a technical endeavour or solely an organisational development project. There is a closely interwoven relationship between technical and social components that need to be smoothly aligned in order to make things work.

A theoretical framework that can handle this complexity is the socio-technical approach called Actor Network Theory (ANT) (Callon, 1987; Walsham, 1997; Latour, 1987; Law, 1987). ANT offers an apparatus to describe the relationship between technological and social components. It also provides mechanisms for the conceptualisation of technology on a fine-grained level, and promotes the viewing of phenomena in different perspectives and acknowledges that there are different ways to regard matters.

Another research area relevant for this study is Computer Supported Cooperative Work (CSCW). The CSCW literature has focused quite extensively on how an information system can support distributed collaborative work among groups of users (Berg, 1999; Carstenen and Sørensen, 1996; Grudin, 1989; Ruhleder and Jordan, 2001; Egger and Wagner, 1993). This is an important point related to the use of EPRs because real usefulness can only be achieved if the different professionals in the hospitals share some comprehension of what an EPR should do and agree to use it in certain ways.

I argue that both of these perspectives may contribute to an increased understanding of the design and use of EPRs in large hospitals. As a result, the combination of the two theoretical perspectives serves as my theoretical framework.

The rest of the dissertation is organised as follows: Chapter two presents the Health care context. Chapter Three elaborates on the theoretical foundation, which is placed in the fields of Computer Supported Cooperative Work, Science and Technology Studies in general and Actor Network Theory in particular. Chapter Four, on the method, presents the research questions, the research design, the actual context under study and how I collected the empirical data. Chapter Five presents the results based on the six papers. The implications, practical as well as theoretical, are outlined in chapter Six, followed by the conclusion presented in chapter Seven. The collection of the six papers follows directly afterwards.

2 Health care

2.1 Organisation of the Norwegian health care

The Norwegian health care system is a predominantly public one with marginal private services, which mostly are outpatient ones. Historically, the health care sector is organised into three levels: primary health care, small hospitals and five regional hospitals (together with a couple of national ones). The local municipalities are responsible for organising primary health care services in their area respectively.

From the turn of the year 2001/2002, the central Government has undertaken the ownership of the country's 85 hospitals (SHD, 2001a) from the counties. The former five health regions are replaced by five regional health enterprises, each with its own management, administration and board. Each of the enterprises contains several local hospitals together with one of the former regional hospitals. Some of the former autonomy in the hospitals is thus replaced by more centralised control. This control is supposed to promote improved coordination of health services among the hospitals, improve the exploitations of resources and accordingly reduce costs.

The causes behind this reorganisation are that Norwegian health care is considered costly, especially in hospitals. From 1980 to 1995 there was a 1.2 % increase in expenditures per year in somatic hospitals (included correction for inflation). From 1995, the increase in expenditure has been 4.8 % a year. In spite of a 50 % increase in the number of physician man-labour years in the hospitals since 1990 and growth in the patient treatment, the hospitals still face long waiting lists together with lack of treatment capacity (SHD, 2000-2001). The problem is explicitly stated as:

“Having to wait for long periods of time for elective treatment is a problem. The average waiting time for treatment is approximately 80 days” (SHD, 2001a).

Governmental control is also supposed to promote improved exploitation of existing resources in the hospitals and across hospitals such as ‘distribution of functions’ (SHD, 2001a) because:

“The hospitals are not to a sufficient degree willing to send patients to other hospitals with available treatment capacity (...) [and] the investments in equipment in the hospitals are not utilised because this equipment is unused in

periods” (SHD, 2000-2001).

2.2 Visions of improving health through IT

The concerns for curbing mounting health expenditures are omnipresent in Norwegian political life. The governments have fuelled and spawned a series of proposals and reforms. In 1995 the Government established regional collaboration committees within the health regions in efforts to streamline the health sector. 1998 was the first year where counties as well as most hospitals were funded by a combination of block grants and per case financing. The Government reimburses about 20% of the hospitals’ expenditures based on a DRG⁸ (Diagnosis Related Groups) coded account of their production.

Also, information technology has for several years been considered an important means for efficiency improvement in the National Health Service. Already 25 years ago the expectations towards the use of IT were widely acknowledged:

“In the middle of 1980s, considerable possibilities for the National Health Service were indicated if the potential in IT was utilised to a much larger extent” (former Director of KITH⁹)

Consequently in 1987, the Norwegian Research Council established a large research programme focussing on IT in health care and aiming at reforming. The focus was very soon aimed directly towards EPRs (see paper two). In a similar way, about 10 years later, in 1996, the action programme “More health for each bIT” (SHD, 1996:7) maintained the expectations towards EPRs and emphasised that:

“Experiences show that the employment of IT has considerable potential in freeing time for the health care workers”

This argument reappeared in the action programme 2001-2003 (SHD, 2001b), *Electronic Interaction in the Health and Social Sector*:

“The health care worker becomes more available because all information is

⁸ DRG is short for Diagnose Related Groups. The DRG system divides hospitalised patients into groups on the basis of diagnosis and treatment. Based on the hospital's operating costs, an expected price per patient discharged is estimated

⁹ Centre for IT in health care, a publicly owned agency aimed at establishing IT related standards in Norwegian health care

available wherever the health care worker and the patient are”

SHD (2001b) clearly identifies IT as a strategic and crucial tool in relationship to the recent situation where the Government has undertaken the ownership of the hospitals:

“The Ministry of Health and Social Affairs must be very clear in bundling IT with the governmental undertaking of the hospitals. This means that the Government as an owner promotes a desired technological development through the establishment of regulations, standards, funding arrangements and organisational incentives.”

Information technology (including EPRs) is supposed to induce changed or new work processes, redistributed power as well as quality improvement:

“The Government can through its ownership require employment of established standards when electronic patient records are implemented (...) further, that new equipment should result in new ways to organise the enterprise (...) In the hospitals the EPRs will be crucial in developing work processes, quality assurance and coordination of the patient treatment” (SHD, 2001b).

“The goal is to give the patient more ‘power’ (...) and IT must contribute in the democratisation process of the health services.” (SHD, 1996:8).

A global strategy to achieve all this is increasingly what seems to be chosen. On a European level (CEN TC 251), De Moor (1993:1) argues

“Where European Industry actually often supplies to local markets products which are ‘too much customised’, i.e. expensive in development, expensive to buy and having a short life-cycle. Agreements on common requirements at an international level will inevitably reduce the prices for healthcare information systems and open the market”

This mode of thinking may also be found in SHD (2001b). The action programme envisions a new way of organising health services through a so-called “network organisation” – an arena for selling and buying of health services:

“In the future there will probably be an increase of services in ‘networks’ where bidders can present services [for example on the internet] and those who want, for instance referral physicians, can search for services, check capacity and, if possible, make bookings. [Accordingly] the network will be a trading place.”

The 'promises' of a network organisation is related to efficiency improvement, better exploitation of the health care resources, replacement of local services with global ones. It is sketched in SHD (2001b) as follows:

“Network organisations will enable the replacement of three administrative levels with common national structures for the administration of economy and personnel resources. This enables large-scale administration of the health sector, such as national common waiting lists, national common patient databases, and national common support systems for diagnostics.”

"The network organisation will cause the specialist to spend less time directly on the patient. Instead the specialist will rather spend time in the virtual medical room. Consequently medical knowledge is transferred from specialists to general practitioners and further, from nurses to paramedical personnel.”

2.3 Standardisation activities

Standardisation is an important condition for integration between EPRs located in different hospitals and between EPRs and other information systems in hospitals. Standardisation enables integration of information systems based on various infrastructures, developed with different tools and running at different locations (see for instance KITH (2001a; 2001b, 2001c); prENV13606 1-4 (1999)).

In Europe the major part of standardisation endeavours in healthcare informatics is channelled through CEN/TC251 (European Committee for Standardisation/technical committee 251). In the US, the ANSI standard (American National Standards Institute) and member of ISO/TC 215 (International Organisation for Standardisation) are also responsible for a lot of standardisation work.

In 1999, the technical committee for health informatics (TC251) of the European standardisation organisation (CEN) approved a pre-standard (prENV13606 Electronic healthcare record communication) for exchange of electronic patient records between actors in health care. Major motivations with this pre-standard are firstly, to enable partial or complete transferral of electronic patient records. Secondly, to reduce the necessity of having duplicated information in different patient record systems and, thirdly, to reduce the expenses for exchanging record information between patient-focused information systems (KITH, 1999).

Also, in Norway an EPR standardisation project has been run by KITH on commission from The Ministry of Health and Social Affairs (SHD) as a part of the Department's program "Standardisation of information- and communication systems in public health service". The extent of the EPR is comprehensive as it is suggested that:

- The EPR shall as a minimum contain all information that exists in traditional paper-based patient records (KITH, 2001: 20)
- Even if the EPR-system is built of modularised – and stores data in different storing-units, it must be given the possibility for presentation of data in the form of a uniform record (KITH, 2001: 43)
- All information that is part of the EPR must have the possibility to be exported on a format that is described in part II of this standard (Part I-K2.5, 2000:43)
- Double- or multiple storing of data (redundancy) ought to be limited to a minimum (KITH, 2001: 44).

So far these endeavours, nationally and internationally, have not resulted in working solutions.

2.4 EPRs in large hospitals

The experiences with electronic patient record systems (EPRs; or synonymously computer based patient/health records, CPRs) in Western countries are at first glance confusing and begging question. EPRs have been developed and are in common use within primary health care. More than 90% of general practitioners in Norway are regular users of EPRs. When the seemingly same piece of technology is attempted introduced in a different social, technological and institutional setting - in large hospitals - the outcome is dramatically different (similar to the observations made by Barley (1986) for CT scanners and Tjora (1997; 1999; 2000) for medical emergency communication technologies). Despite a series of heavily funded national and international initiatives, there have been only modest successes in establishing working EPRs in large hospitals. Oddly enough, there does not seem to exist any systematic, comprehensive and critical evaluations of these efforts (although more narrow or restricted ones exist; see Massaro, 1993; Kushniruk et al., 1996; Safran et al., 1999; Sands et al., 1995; Lærum and Ellingsen, 2000). EPRs have repeatedly been identified as "essential" (Dick and Steen and Detmer, 1997) or "at the heart of the application of

IT in health care" (Grimson, Grimson and Hasselbring, 2000: 50). It has, however, proved remarkably difficult to establish more than fairly isolated pockets of use (Berg, 1998; Levitt, 1994; Szolovits et al., 1995).

During the last 20 years IT has been considered an important tool to restructure work in hospitals. In 1996, the five Norwegian university hospitals and the multinational vendor Siemens agreed on a project (the Medakis project) with a contract aiming at developing a common EPR for these hospitals. In spite of the agreed terminating point of the contract, the turn of year 1999, the project is still running.

The situation for approximately one year ago (in 2001) was that three of the university hospitals, Tromsø (UNN), Trondheim and Bergen had deployed the system quite extensively and had almost completed the implementation of version 4. Trondheim, for instance, regarded themselves as 100 % finished. The situation at the National hospital and Ullevål – the largest hospital in northern Europe – was different; only about 15 and 30 % respectively had been completed.

The users was primarily physicians and secretaries, and available computers were well covered for these user groups. The other disciplines within the hospitals, nurses, occupational therapists; physiotherapists, psychologists etc. were to a large extent still not users, although there were isolated pockets of use. Altogether, the university hospitals had nearly 6000 defined users in DocuLive EPR. And in a given moment in a normal working day they had nearly 1400 concurrent users. Roughly estimated, all in all about 2.5 million documents had been produced, which primarily were physicians' notes. Paper two, "Big is Beautiful", concerning the history of the EPR-project Medakis, elaborates more on this in detail.

So far, however, the use of an EPR has not proved to play the role as a core efficiency enabler. The usage for the secretaries has mainly been as a writing tool, like Microsoft Word. Regarding the physicians, their usage of the EPR has been disappointing. Their usage is mostly related to correcting and signing documents and reading singular results from the EPR.

A key concern in the Medakis project has been the role of DocuLiveEPR in relation to the rich variety of other local, tailored and non-integrated information systems. In the contract worked out in collaboration between the vendor and the hospitals it is emphasised that the EPR should replace many of the special purpose information

systems that exist in the wards, thus carrying out ambitions of making the EPR all-encompassing

This implies that DocuLive for the main part serves as a standalone system, a historical repository for the physicians' text notes. It offers very limited access to other hospital information systems, like patient administrative systems (PAS), X-ray examinations, laboratory requisitions and results etc. Accordingly, DocuLive EPR shares several similarities with the EAI-approach described previously in the section "A centralised model: Integration through an EPR-system".

However, the physicians do not only draw on the EPR in their work, but also on a large amount of other information sources (see paper three), for instance specialised systems for departmental use. There can be several motivations for these systems, for instance, clinical purposes, quality development, research or administration. The ownership of the systems is often associated with a medical speciality and interdisciplinarity. In that sense, the users have a more clear ownership with such a system compared to the enterprise-wide EPRs. Moreover, in ethnographic studies of medical decision-making situations (Tjora, 1997; Underland, 2001a; 2001b) it has been illustrated that the layout of documentation, both in paper and digital formats, does not well enough support collective decision-making situations, like meetings, which is of great importance in medical work.

The existence of such specialist systems indicates that there is a need for a certain functionality that is missing in the EPR, especially at the larger hospitals, which are extremely specialised and complex.

The vendor Siemens has during the last years transformed the Norwegian-based solution DocuLive EPR into a "global" solution and has promised to put a significant amount of resources into the project and make an international product out of it (see paper two for a detailed historical account). Already a major player, Siemens has in the last years acquired a number of international companies active within IT and health care, especially in the US. This implies that from a relatively slow start, Siemens is currently strengthening its efforts dramatically within this area. It is, in effect, one of the most influential vendors globally.

At this moment there are also clear indications regarding globalisation processes initiated both from the hospitals and from the regional health enterprises. There is an

increasing focus on common solutions and standardisation for whole enterprises, for instance through ASP-solutions (Application Service Provider solutions) of EPRs and other IT systems. The idea is to replace existing IT-systems with an ASP-system in which all the EPR data is stored in one single database. Such systems appeal to health because they promise to provide an integrated application environment with seamless access to a single unified database (Grimson et al., 2000:53). In that sense, users relate to only one system and only one interface, which is assumed to enable easy learning and information availability as well as reducing the fragmentation of information for the users.

As a result of increasing globalisation, however, EPRs lose the foothold in local contexts in each hospital. This is often compensated with the establishment of local systems. This both signals a dilemma and raises the question of how far it is possible to go in such standardisation efforts.

3 Theory

3.1 From small groups to large-scale information systems

Caused by developments in research, new technologies and subsequent new disciplines, today's organisations face increasing specialisation among their employees. Large hospitals, for instance, are both highly specialised and reflect a complex division of labour (Blume, 1991:17; Atkinson, 1995:7; Reiser, 1984:303)

Accordingly, the need for collaboration and coordination of activities is on the agenda in many organisations and has led to many efforts to identify tools and mechanisms that can support and promote collaboration.

Developments in computer technologies have intensified these efforts and have given new hope to ways of supporting cooperative work through information technology.

This has also been a core aim in several years in the field of Computer Supported Cooperative Work (CSCW) where the focus has been centred around the employment of tools, artefacts, protocols and mechanisms that are supposed to support distributed work such as coordination activities (Schmidt and Simone, 1996; Rogers, 1993), communication among interdependent actors (Carstensen and Sørensen, 1996) and video-based teleconferencing (Ruhleder and Jordan, 2001). More examples can be found in Heath and Luff (1992); Rogers (1993); Egger and Wagner (1993), Grudin (1994; 1989), Grudin and Palen (1995) and Ruhleder and Jordan (2001).

Often these tools are recognised as being singular or standalone like a paper-artefact, shared information displays and monitors (Heath and Luff, 1992:72), isolated information systems or concrete products such as Lotus Notes, Microsoft Schedule or project management tools or 'primarily off-the-shelf products' (Grudin, 1994; Grudin and Palen, 1995).

This focus on singular tools reflects a general trend in the CSCW tradition to focus on the activities of small groups (Symon and Ellis, 1996:3; Aanestad, 2002:7; Bannon, 1998:41, Kling, 1991; Grudin, 1994:93; Carstensen and Sørensen, 1996). This is also observed and criticised within the CSCW community itself. As Bannon (1998:41) underscores, the focus on small teams 'pay[s] little attention to settings in everyday organisational life where issues such as power and politics play a large role'.

Accordingly new problems arise as we scale things up and focus on larger IT-systems. In recent years we have observed a completely new class of information systems, for instance the internet, digital libraries or large-scale EPRs. Although there are similarities between groupware and large systems such as the need to tailor to local needs and the likelihood of mixed reactions by members (Grudin and Palen, 1995), these systems cannot be conceptualised the way the tool perspective is employed for a small group contexts. These systems feed directly into work-practice on a large or global scale, they inhabit different roles in different contexts and for various actors, and the outcome of the technology is impossible to predict.

In addition, it is increasingly required that these systems are interconnected with other information systems, accordingly making the limitations of the tool perspective more explicit. It is not 'the tool', but a collection of information systems with unclear borders as to what belongs to the system and what does not. What a user considers a system from a use perspective might clearly be different from the perspective of a system architect or completely different across contexts. Thus influenced by different use, different integration strategies, different context, defining the borders of one system is increasingly harder to do.

Many of the large-scale systems will be implemented in large organisations and will imply a close relationship with organisational practice, for instance an EPR that is supposed to be used across departments, hospitals and even countries. However, the experiences so far in implementing IT in large organisations have until now proved to be a real challenge where outcomes are hard to predict. When the same kind of technology is tried implemented in different social settings, the outcome may prove to be dramatically different (Barley, 1986). This underscores that it is important to take into account the social context, the relationship between the introduced technology, the organisation and the people involved

In sum, the internet, large-scale systems spanning various contexts in different countries (such as EPRs), and large digital libraries induce us to reconsider our perceptions of how to perceive information systems. Consequently, we need theories that can conceptualise these large-scale IT-artefacts (Orlikowski and Iacono, 2001:133).

3.2 From support to transformation

CSCW has strongly focused on how tools can *support* the distributed work. As Kling (1991:84) underscores:

“One of the striking features of the CSCW literature is the way many designers try to respect the ways people actually organise and use information”

or as Berg (1999:391) argues in a similar way:

“Struggling against a traditional mainstream of rationalistic and management-oriented system design, CSCW’s emphasis on ‘support’ rather than ‘replacement’, and ‘transparency’ rather than ‘self-sufficient automatons’ served important political goals”

In spite of this sympathetic perspective, studies have illustrated that several of the efforts to introduce groupware applications have failed as a result of “unforeseen ‘group’ aspects of the application” (Grudin, 1989:245) since an application must support the whole group and not only a single user. The additional work that is needed to make the constellation work is often underestimated (Gasser, 1986: Grudin, 1989:251; Rogers, 1993:310), which also might induce new roles and new work tasks. The benefits and the burdens might be redistributed, for instance that some do the work and others get the benefit (Grudin, 1989) In addition, use of such tools might also be hampered when they are considered to impose increased management control of work-activities (Symon and Ellis, 1996: 2, Hayes and Walsham, 2001).

The failed efforts outlined above and the implications underscore the fact that we need other ways to conceptualise design and use of IT both in groups and in organisations. The way CSCW literature conceptualises IT as a tool for supporting work ignores how the relationship between IT and work is transformed through use.

Accordingly, the need to accept the fluid relationship between context and IT – also in CSCW contexts – is pressing, but unfortunately, far from common in current research in the IS field today. It is rather pretentious with regard to the role of technology, which, according to Orlikowski and Iacono (2001:121), is either taken for granted or considered unproblematic. The conceptualisations of IT artefacts are either assumed to be stable, discrete, independent and fixed. Based on an evaluation of IT-related papers in the journal Information Systems Research (ISR), they have classified how the IT-

artefact is conceptualised in information systems research. The results are shown in table 1.

	Perspective	%
	• Tool	20,3
	• Proxy	18,1
	• Ensemble	12,5
	• Computational view of technology	24,3
	• Nominal view of technology	24,8

Table 1 Classification of the conceptualisations of the IT artefact (from Orlikowski and Iacono, 2001)

Much of the CSCW literature has focused on “tools” and “support” of distributed work in groups, and has to a minor degree focused on how this relationship might induce change, both in the context of work and in the tool itself or what Berg (1999:385) denotes as the tool’s transformative potential:

“The mutual activities of tools and staff members are made possible through their interrelation, and, at the very same time, this interrelation affords the emergence of an overall activity that surpasses the individual contributions that both could be discerned to have”

This goes beyond merely supporting work through the use of a singular tool, as both the tool and the work practice might change in relationship. It also draws attention to the limitations to conceptualising IT as a tool because it is generally considered to be something static or black-boxed and ignores that it can be translated differently in different contexts.

When IT is looked upon as ‘stable’, it is regarded as black-boxed and just another tool ready to be used, for instance as a hammer that serves identical purposes across contexts. Employing the tool perspective for information technology is insufficient as it more or less considers information technology independently of the social context (Orlikowski and Iacono, 2001:123). This also hampers the way information technology can be interpreted in different ways depending on contexts as well as among different users. This proves to be insufficient to explain the close and fluid relationship between the social and the technological, a relationship that is seldom stable, but will over time result in new interpretations, transformations, and shifting roles. The transformations

will typically not occur as discrete jumps from one state to another, but rather in a continuous, fluid and interleaved way and will even happen casually or even accidentally (Ciborra and Lanzara 1987; Orlikowski, 1992a).

Underscoring the fluid and complex ways in which the relationship between the social and the technological emerges makes it necessary to rethink strategies of IT design, implementation and use. It makes it difficult to plan future behaviour and properties down to a fine-grained level as organisational transformation can be seen to be an ongoing improvisation enacted by organisational actors trying to make sense of and act coherently in the world (Orlikowski, 1996:65). This stands in opposition to a general view of information technology as fixed and unproblematic.

3.3 Information infrastructures – an alternative framework

One approach that has been suggested to deal with large-scale systems, considers the technology as information infrastructures. This concept has originally a strong foothold in the “new information society”, as emphasised in the Bangemann report, *Recommendation to the European Council 1994*. It is, however, argued that information infrastructures must be extended into a social and relational context (see for instance Bowker and Star (1999) and Hanseth and Monteiro (1995).

Instead of considering IT as isolated tools or isolated systems, they can be conceptualised as information infrastructures which not only consist of myriads of databases, standards, routines and practices, and in that way underscoring the relational aspect of information infrastructure as it becomes into being in relation to practice (Star and Ruhleder, 1996:113). The relationship to practice means that information infrastructures have *enabling or supporting* functions that are shared by a large community (Hanseth and Lundberg, 2001).

The infrastructural perspectives on information systems acknowledge that it is not possible to build a system once and for all. Large-scale infrastructural systems are extremely difficult to build and cannot be performed as a top-down coordinated effort. They have to be extended a little by little or bottom-up in modular increments as:

“[Information infrastructure] is fixed in modular increments, not all at once or globally. Infrastructure is big and complex, thus meaning different things in different contexts. And changes take time and negotiation. That implies that it is

never changed from above. A top-down approach is not possible.” (Bowker and Star, 1999:35).

This implies that it is very difficult to predict future usage. Even a high degree of user-participation may be insufficient as even high user satisfaction with systems and extensive user participation systems may end up not serving the well-meant intentions (Star and Ruhleder 1994).

An interesting question is how we best may analyse information infrastructures, and what are the important things to analyse compared to, for instance, CSCW. This can be a real challenge as the better such large-scale infrastructural systems appear, the more difficult they are to analyse:

“Information infrastructure is a tricky thing to analyse. Good, usable systems disappear almost by definition (...) the bigger they are, the harder they are to see” (Bowker and Star, 1999:33).

However, I have chosen to elaborate on the following three key concepts that must be taken into account when dealing with large infrastructural systems. These concepts are also important for the current study.

- Global versus local. Global information systems always have a local side, as the system is supposed to be used in various contexts among different users and over time. Consequently there will be a tension between the global and local side of the solution. How should we balance the global level’s need for coordination and the local level’s need for flexibility?
- Integration. It is the prospect for widespread interconnection combined with a high degree of interoperability that makes the concept of Information Infrastructure so promising (Kahin and Branscomb, 1995). However, infrastructural systems consist of an heterogeneous amount of components and we must ensure that they can inter-operate
- Standardisation. Another part of the information infrastructure and interoperability is standardisation. Different technical components on different technical infrastructure and from different vendors are supposed to inter-operate. Accordingly there must be some agreements and rules about how technical components and human actors should communicate.

3.4 Global versus local

Often, the use of EPRs and other large-scale systems reflects local character, culture or jargon, which in itself increases efficiency and insight and supports a common group identity (Meehan 1980). Different medical schools, for instance, have developed their own ways to code patient diseases (Schneider and Wagner, 1993:241). In this perspective, information systems – EPRs - necessarily need to be designed to meet local, contextual or situated work settings (Suchman 1987).

However, this argument has little to offer when it comes to designing large-scale, infrastructural information systems that have to operate across a number of unique contexts. As there is a growing trend for uniformity, globalisation and standardisation as a means for improved efficiency (Rolland and Monteiro, 2002), the gap between global and local solutions are increasing. As a result, constructing large infrastructural systems raise the question of how the functionality in these systems should be balanced with local variation and needs. This pinpoints the fact that there is tension between the desire to standardise on a global level and the need for flexible use on the local level (Bowker and Star 1994:188) and an infrastructure occurs when the tension between local and global is resolved (Star and Ruhleder 1996).

There exists a body of literature which addresses this tension between local and global needs from an infrastructural perspective. See for instance Bowker and Star (1999); Abbate (1999); Timmermans and Berg (1997); Lachmund (1999) and Rolland and Monteiro (2002). Bowker and Star (1999), for instance, address this perspective in their description of the history of the International Classification of Diseases coding scheme currently administrated by the World Health Organisation (WHO). The ICD is recognised as an important infrastructural component of medical and epidemiological software and tries to collect global information across several organisations and information sources.

Administration of the ICD has not been an easy task, because of the historical, political and international span. Cooperation has been hampered by different ways of recording and reporting. Different cultures, for instance, place different emphasise on causes of death, which influences the way causes of death are coded. In addition, different national schools of medicine may disagree about issues such as simultaneous causes of death (Bowker and Star 1994).

Various stakeholders have been involved with completely different interests, for instance the conflict of interests between government on the global level, and the individuals in each community, conflicts between doctors and statisticians and the interest of industrial actors like insurance companies and pharmaceutical companies.

The need for a global system to embrace different user groups and work contexts is not something static. Changing organisations require new technology behaviour. That means that infrastructural systems must easily adapt to changes in the environment as it is a product of continuing negotiation and change (Bowker and Star 1994). Unfortunately, changing global solutions may turn out to be very difficult because, as time passes, they gain momentum.

A changing infrastructure calls for flexibility. It must be possible to adjust it to new situations, which involve diverse actors with different interests. That increases the likelihood of conflict between different groups, which of course also hampers change. An important question then becomes how is it possible to enable change in heterogeneous communities?

If some heterogeneity is allowed, it will not necessarily imply losing complete control. Considering the infrastructural aspects of the ICD, it seems to have been sufficiently managed by acknowledging certain local needs. Bowker and Star (1994) present the follow in-use strategies in this regard:

1. *Garbage categories.* Their advantage is that they can signal uncertainty at the level of data collection or interpretation. A more precise categorising may give a false impression of positive data.
2. *Heterogeneous lists.* The lists must be as heterogeneous as possible to enable the different actors to find their own concerns reflected.
3. *Flexibility allowance.* When agreement on a standard is reached (internationally) local modifications to the standard will evolve. Rather than losing control of this process, the ICD committee has chosen to issue rules for how the list is to be modified. This gives them an algorithm for working back from the modified list to the ICD itself.
4. *The right level of standardisation.* Standards are essential to make ICD work, but these standards must not be over-precise in a way that nobody is able to use them. Standardisation must be tailored to a realistic level.

Several of these strategies are generally applicable. But more importantly, this case shows that strategy-makers responsible for the ICD have acknowledged heterogeneity as an indisputable fact. This has made them replace the question of “how to *suppress* heterogeneity” by “how to *manage* heterogeneity”.

3.5 Integration

When we conceptualise IT as information infrastructure we a priori acknowledge the need to interconnect components. Hanseth and Lundberg (2001) apply the term ‘open’ in order to emphasise this point when they argue that:

“there are no limits for the involvement of users, stakeholders, vendors and other technological components” (Hanseth and Lundberg, 2001:349).

This implies that it is difficult to draw a strict borderline around the infrastructure and say which component belongs to the infrastructure and which does not. In sum such a changing environment, requirements and varying alliances imply *heterogeneity* where nobody possesses global control, and nor does one specific application possess superior control over other applications. It is rather an infrastructural base for other applications (Leiner et al. 1997).

How then should we ensure interoperability and integration between the different actors and components, and which strategy is the most suitable to employ? In the following I will elaborate on three different integration strategies.

- 1) A centralised strategy
- 2) A distributed strategy
- 3) A socio-technical strategy.

Strategies and approaches to integration vary (Hasselbring, 2000) and include technical solutions like federated database systems, World Wide Web and EDI (Grimson et al. 1998:124) as well as ERP-systems (Grimson, Grimson and Hasselbring, 2000). In addition, technologies such as CORBA and COM have emerged as a promising way to enable integration, as they are independent of programming language and operating systems (Emmerich, 2000:125). Also XML is considered for integration (Coulouris et al., 1994:23; Bompani et al., 2000:305) in spite of insufficient reliability conformance (Emmerich, 2000:126).

Work on information system integration focuses to a great extent on three issues: autonomy, heterogeneity and distribution (Hasselbring, 2000; Sheth and Larson, 1990):

1. Distribution: hiding the geographical distribution of information systems.
2. Heterogeneity: hiding differences in platforms, programming languages and data models – as well as differences in perspective.
3. Autonomy: the extent to which the components are self-sufficient. The systems are autonomous in their design and meaning. Integration under such circumstances normally require organisational change

Usually, systems integration aims at approaching the origin in this system of coordinates in Figure 1.

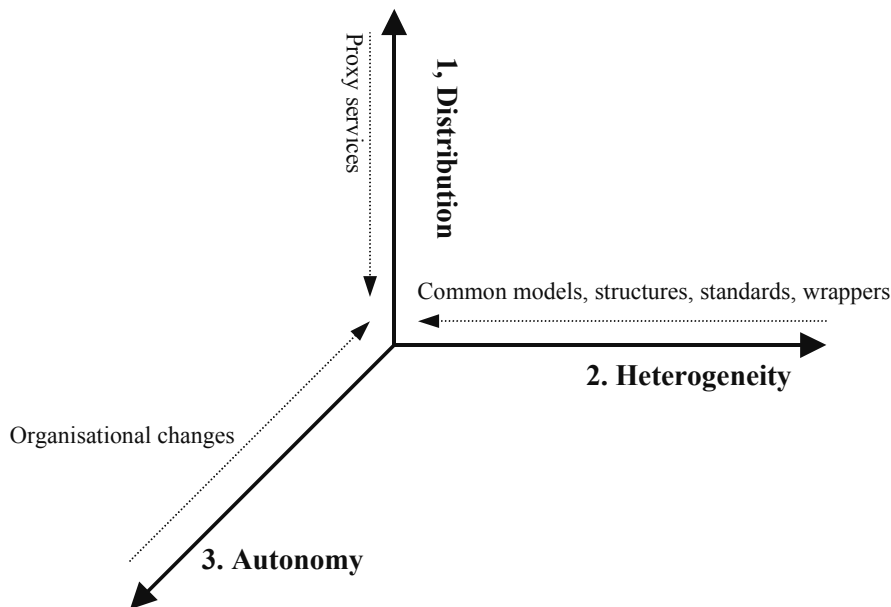


Figure 1. Integration problem dimensions (Hasselbring, 2000)

3.5.1 A centralised model: Integration through an ERP-system

In spite of being in direct opposition to the ‘open’ aspect of information infrastructure, I elaborate on a centralised model of integration. The reason for this is that this strategy is increasingly suggested and employed when dealing with large-scale systems. An instance of this is when Enterprise Resource Planning systems are considered a mechanism for achieving an integrated solution.

Enterprise Application Integration (EAI) implies integration between modules that is encompassed by the ERP-application. In short, the idea is to replace existing IT-systems with an ERP-system in which all the data is stored in one single database. This approach corresponds to the origin in the system of coordinates (Figure 1) for the integration problem dimensions (Hasselbring, 2000:54), which in practical terms means suppressing all of distribution, heterogeneity and autonomy.

An example of this is ASP solutions, where ERP applications are central (Takahashi et al., 2000) and ERP-solutions promoted by SAP R/3, the dominant vendor of ERP systems and the world's fourth largest software company. An example of Enterprise Application Integration (EAI) is the SAP R/3 module IS-H, which is deployed in a lot of German University hospitals. This module is specifically designed to support patient data management and some clinical functions and financing (Grimson, Grimson and Hasselbring, 2000:53). Integration with other R/3 modules can be achieved within the central database according to the general principle of SAP "everything in one database".

ERP systems appeal to health because they promise to provide an integrated application environment with seamless access to a single unified database (Grimson, Grimson and Hasselbring, 2000:53). In that sense, users relate to only one system and only one interface, which is assumed to enable easy learning and information availability as well as hampering fragmentation of information for the users and a more process-oriented organisation. Consider for instance the SAP website:

"SAP R/3 overcomes the limitations of traditional hierarchical and function-oriented structures like no other software. [All the functions] are integrated into a workflow of business events and processes across departments and functional areas" (www.sap.com).

3.5.2 A distributed model: Integration through CORBA

A completely different approach, but still in technical framework, is through component technologies such as CORBA and COM. In the following I elaborate further about one of them, the CORBA approach.

CORBA is promoted by the Object Management Group (OMG) as a part of a strategy to develop an Object Management Architecture (OMA) for object-oriented computing (Blair and Stefani, 1998:34). OMG is a non-profit organisation where a major goal is to

promote object technology for the development of distributed computing systems (Blair and Stefani, 1998:34-36). Currently, over 700 member companies support OMG (Szyperski 1998:178). Initially, OMG started out with a major goal in mind, “how distributed object-oriented systems implemented in different languages and running on different platforms interact?”, and in that way it seems suited to respond to the call for more integrated IT-solutions in health care.

The purpose of the Common Object Request Broker Architecture (CORBA) is to enable interaction between objects running on different technologies and implemented in different languages. The core part is an Object Request Broker (ORB) that provides this communication. The ORB intercepts the call and is responsible for finding an object that can accept the request, pass it the parameters, invoke its method, and return the results (Hasselbring, 1997:194).

OMG is also concerned with health by specifications through CORBAmed. CORBAmed’s purpose is to improve the quality of care and reduce costs by use of CORBA technologies for interoperability throughout the global health care community. A set of services has been defined, like Clinical Observation Access Service, Clinical Image Access Service and Health care Resource Access Control. Nonetheless, progress is slow – especially in Europe (ibid.). In that sense a record does not only consist of data, but may also include security, user validation services, patient identification etc, which constitutes added values for using CORBA (Grimson et al., 1998:137).

3.5.3 From purely technical to socio-technical integration approaches

From an information infrastructural perspective, a distributed model of integration employed as integration strategy is better than a centralised model as the distributed model (for instance CORBA) does not presuppose that any of the other components are in control and accordingly does not need to adhere to a top-down strategy.

However, such a strategy is not sufficient and cannot ensure that heterogeneous components inter-operate per se. We must also take into account how the information is perceived in different context. The meaning might be different.

Such a view goes beyond what some scholars describe as the causes for heterogeneity and the subsequently low degree of integration: differences in database management, operating systems and design autonomy among component systems (Hasselbring, 2000)

which, accordingly, may be solved by technological solutions as presented above. However, a broader approach suggests that incompatibility among information systems arises from differences in scope, use and responsibility across applications, sites and organisational units, that is moving beyond purely technical approaches because defining technical integration strategies per se does not solve the problem related to mutual *autonomy* between the components (Hasselbring, 2000; Sheth and Larson, 1990).

Then the challenge becomes something more than just integration of data. Boland and Tenkasi (1995:359) give us a clue when they argue (in relation to knowledge production) that:

“In summary then, the problem of integration of knowledge in knowledge-intensive firms is not a problem of simply combining, sharing or making data commonly available. It is a problem of perspective taking in which the unique thought worlds of different communities of knowing are made visible and accessible to others”

3.6 Standardisation

In order to ensure inter-operability between technological components, users and contexts, some agreement about how to do things must exist. For instance, how shall information be understood and how should we ensure that this information can be easily transported between different contexts. Hanseth and Monteiro (1995:327) argue that standards are the technical backbone of Information Infrastructure. In fact, they argue that if an infrastructure is not built on standards, but instead based on bilateral arrangements, then it is no real infrastructure.

A key question when dealing with standardisation is how standardisation efforts should be approached. It is not a given answer as there are no universals in the evolution of large information technologies (Star and Ruhleder 1996:111), which also underscores that we cannot always ensure that “the best technology wins”. Nevertheless, what we can say is that there is evidence that top-down strategies with uniformity as a goal very often are futile. Consider for instance the struggle between two different telecommunication standards in the 1970s. In the mid-1970s discussions about data communication focused on two alternative techniques for interconnecting networks (Abbate 1994).

The US PTT (Post, Telegraph and Telephone) administrations and their followers argued for a high degree of uniformity and therefore promoted a virtual circuit network, the X.25 as a network carrier. They believed they could extend their monopoly on telecommunications into public data networking. Attempts to connect dissimilar networks were viewed as a temporary stopgap on the way to desired uniformity.

Network researchers at ARPA, on the other hand, felt that different sub-net technologies were necessary to allow networks to be tuned to particular performance requirements. In their view, interfacing heterogeneous networks was not just a stopgap measure until networks could be made uniform, but also a permanent necessity (Abbate 1994:200). Moreover, the particular type of network protocol described by X.25 would require reliability and processing power in the subnet, which some networks could not supply (Abbate 1994:203).

In 1977, International Standards Organization (ISO) established a project called Open Systems Interconnection (OSI). The goals were to try to rationalise the networking debate by establishing a framework within which protocols could be developed (Abbate 1994). Unfortunately this initiative became no success. Mostly because of ISO's unwillingness to accept existing de facto standards combined with the fact that network owners did not show any interest in replacing their existing systems. This last part is easily related to the installed base. Evolving infrastructure reinforces the existing inertia and makes it stronger, and thus hampers change.

Today it is evident that TCP/IP has moved in as the primary network protocol. This did not occur by chance. Abbate (1994) shows that ARPA's acknowledgement of the heterogeneity in this environment encouraged the TCP/IP solution:

“While the PTTs were trying to incorporate different user services within their own network systems, ARPA was exploring ways to exchange data between different types of networks (...) by gateways (Abbate 1994:205).

Another point was to acknowledge a realistic level of expectations from these various components:

“The ARPA team decided that their Internet system should expect nothing more than datagram service from any network (...) [and they believed that] users would want to connect not only individual computers but entire local networks across an Internet” (Abbate 1994:196).

One lesson to be learned from the standards debate - and applicable in the process of designing EPRs as well - is that network protocols have no single, universal meaning. Technologies can only be evaluated in terms of particular users' needs, and there may be as many different evaluations as there are types of users (Abbate 1994:204). As for large hospitals there will always be diversity of technologies as long as there are significant differences in the users' requirements and use.

This makes it clear that as long as there are heterogeneous communities of practice, strong stakeholders and different interests - although huge efforts and push from legal authorities - all-encompassing solutions will fail. So-called universal and all-encompassing solutions must be grounded in local needs and use (Timmermans and Berg, 1997; Lachmund, 1999).

3.7 Actor Network Theory

Acknowledging the emergent view on information infrastructure and the need to take into account the fluid interplay between people and technology in different phases as design, implementation and use (Orlikowski and Iacono, 2001: 126) has, however, not been very much focused on in IS research. Only 12.5 % of the articles in ISR adhere to the "ensemble" perspective, which represents this interplay between people and technology.

The ensemble perspective is often conceptualised through social theories, such as web model (Kling, 1987), structuration theory (Giddens, 1984), the structurational model of technology (Orlikowski, 1992b) or Actor Network Theory (ANT) (Law, 1987; Akrich, 1992; Latour, 1987, 1991; Walsham, 1997). As ANT is an important part of this study, it will be further elaborated and placed in the context of Science and Technology studies.

In Science and Technology studies (STS) there are several approaches or theories that are employed to explain innovation. One of them is Social Construction of Technology (SCOT) (Pinch and Bijker, 1987). SCOT emphasises the "interpretative flexibility", that is, how different social groups ascribe various interpretations towards the design and use of technology (ibid.:40). The role of technology per se is accordingly to a minor degree emphasised, since social constructivism denies the obduracy of objects and assumes that only people can be actors (Akrich 1992), accordingly making this approach less suitable for emphasising the role of technology. SCOT also tends to have

difficulty in accounting for closure as the possibilities of interpretative flexibility seem endless (Williams and Edge, 1996: 870).

At the other extreme of the scale, technological determinism places high emphasis on the role of technology as it considers the relationship between cause and effect to be static. This implies that the implementation of an IT-system in an organisation will induce similar causes independently of the type of organisation. This conforms to what Markus and Robey (1988:585) categorise as the “Technological Imperative”, the belief that technology will have a strong impact on individuals and organisations, or what Winner (1980) emphasises as the “politics of technologies”. Technological determinism also has a strong foothold in some of the management literature as IT is supposed to be an essential means to implementing changes in organisations (Hammer, 1990; Davenport, 1993; Scott Morton, 1991). However, the major objection to technological determinism is that it pays no attention to what is brought together; it is a priori assumed that technology leads to changes in the social arrangements (Akrich 1992).

Another approach somewhere in between these extremes is the systems concept, primarily promoted by T.P. Hughes (1983; 1987; 1994). Similarly to SCOT, the systems concept also originated from the STS tradition. It endeavours to explain innovation through a systems perspective and through the role of the systems builders. This approach ascribes a central role both to the emergent technology and the people that surround it in a system. Hughes (1987:55) defines a system as a defined context that interacts with the environment by inputs and outputs. The environment is usually explained as the “social context of technology” or the “social background of technological change” (ibid.:52,) and as environmental might consist of factors that are beyond control of the system. As a result, the system builders try to control it by incorporating the environment into the system (ibid.:52-53). This clear distinction between the system and its environment, however, causes some difficult methodological questions (Callon, 1987:100) as it becomes a question of how to define the limits of the system, that is, what is inside and what is outside, and how does one explain the influence from the context.

As the system becomes larger and more complex it becomes more self-contained and autonomous and contains intentions and objectives – the system gains momentum. Consequently, the system becomes less shaped by - and more the shaper of - its environment (Hughes, 1994:108), and it becomes increasingly harder to change the

patterns of use and perform alternative interpretations of the technology. The conceptualisations of mature systems then become close to technological determinism, that is, the belief that the implementation of technology will cause a given effect on the social context. Hughes (1994:112) argues however that the 'momentum' concept is not a fixed measure, but is time-dependent and may accordingly better explain the growth of systems from young to mature ones.

Recognising a tight and dynamic interplay between social and technological elements irrespective of artificial borders such as inside and outside, the systems theory fails on these grounds.

The socio-technical approach ANT describes the relationship between technology and social arrangements (see for example Hanseth og Monteiro (1995), Callon (1987), Walsham (1997), Latour (1987; 1991)). ANT is also a derivative from STS (Williams and Edge, 1996) and bears affinity to both SCOT and systems theory. In contrast to SCOT, however, ANT emphasises the role of technology and allows researchers to be specific about technology, as advertised by Monteiro and Hanseth (1995) since it provides mechanisms for conceptualising technology at a fine-grained level.

When compared to systems theory, ANT disregards the inside and outside of the system. Consequently, actors can be humans, organisations, software, hardware and infrastructure standards, which (according to systems theory) sometimes are beyond control of the system. These actors, humans and non-humans, are regarded as interconnected, inseparable elements in an actor network (Walsham 1997) and emphasise that people and artefacts should be analysed with the same conceptual apparatus (*ibid.*). As a result, ANT considers the technological and the social on equal terms and, accordingly, balances the extreme points of social constructivism and technological determinism.

The actor is not a fixed entity in ANT. Depending on the scope of the research and the kind of problem that is in focus, various actors with various powers will come into play. Law (1987) argues that you become an actor when you make yourself counted on in the network. That is, the other actors cannot ignore you, but must relate to you.

A new actor entering a network will have its own content, like competence, interest and viewpoints. The actor is supposed to behave a certain way, but also makes presumptions about the other actors in the network. In ANT language this is called an inscription and

is a kind of script, scenario or “programs of action” (Latour, 1991:107). For example a large part of the work of system designers will be to inscribe the behaviour of new objects. It may however occur that some of the actors don’t want to follow the envisioned script and behave completely differently and unpredictably and instead follow an anti-program (Latour 1991).

A major concern in ANT is how different groups of actors come to an agreement or how a social order is established or why such networks fail to establish themselves (Walsham 1997; Callon, 1987). In actor network terminology, this is called *aligned* or *not aligned*. In this process the actors will change due to continuous negotiations and will never be the same (Latour 1991) or as expresses by Law (1987):

“The stability and form of artefacts should be seen as a function of the interaction of heterogeneous elements as these are shaped and assimilated into a network”

The success of aligning a network depends deeply on how successful these actors translate each other’s interests, which lie between the actors and their goals. Actors select only that which, in their own eyes, helps them reach these goals amongst many possibilities (Latour 1987:109). This means that different users with different goals may collaborate, compromise and negotiate depending on possibilities to reach their own goals respectively.

As the process of negotiations and translations evolves, the possibility for changing the network becomes more difficult and it may reach a stadium of irreversibility. The possibility to change an aligned actor network is dependent on the degree of irreversibility. This is defined by Callon (1991) as a) the extent to which it is subsequently impossible to go back to a point where that translation was only one amongst others and b) the extent to which it shapes and determines subsequent translations.

3.8 IT and everyday work

Although ANT has proven very effective in explaining how networks of humans and non-humans stabilise, it has more difficulties in conceptualising culture and everyday practice. Everyday life is not about solving a specific task such as implementing an EPR

in a hospital with some more or less specific intentions. It is rather a description of how technology gradually becomes a part of everyday life. These are approaches pursued by researchers such as Knorr-Cetina (1999); Hunter (1991); Atkinson (1995); Nye (1990); Silverstone, Hirsch and Morley (1992) and Hutchins (1994).

The notion of practice changes the focus from interests or intentions that inform concepts of action toward the conditions and dynamics of action of collective life (Knorr-Cetina, 1999:10). A way to explore how IT is socialised into everyday life – as is the case by introducing EPRs in hospitals – is to study how work is actually done in hospitals and how this work in various settings relates to the EPR. The acceptance of such a perspective implies that it is insufficient to promote IT as discrete (Orlikowski and Iacono, 2001) as the new technology in this perspective must be regarded as an extension of what is already in place (Monteiro, 1998:251) in terms of technology and work.

In the focus on practice, the additional work that is needed to keep it all together is often underestimated as this work is often both invisible (Gasser, 1986) and sometimes even illegitimate (Ciborra, 1987) with respect to what the actual work should contain.

A way to conceptualise daily work is domestication (Silverstone and Hirsch, 1992; Monteiro, 1998:251) where domestication is “intended to emphasise the naturalisation process, the way we cultivate and discipline artefacts when weaving them into the domestic sphere” (ibid.)

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4.1 Research approach

4.1.1 *Research objectives*

The overall ambition with this study is to respond to the following research questions:

- To explore the role of EPRs in everyday clinical practice, both in an interplay with other information systems as well as the interaction with users. With that as a basis I will suggest guidelines for how the information in these systems could be organised in order to arrange for improved exploitation of existing knowledge.
- To provide guidelines for the design of integrated information systems aimed at supporting collaborative work practices.
- To provide design guidelines for information systems capable of supporting both disciplinary and interdisciplinary work and in such a way reflect a changing organisational context.
- To suggest design strategies for standardisation of IT-systems in large organisational contexts.

4.1.2 *Research design*

This study is for the main part based on interpretive methods. Initially however, it draws on a survey that is based on a quantitative approach.

Quantitative research may include mathematical models, statistics measurement and analysis of causal relationships between variables. Quantitative methods often start out with a well-defined hypothesis and a carefully selected sample that represents a wider population. Based on the findings, the hypothesis is either falsified or confirmed both for the sample as well as for the whole population. A key point is accordingly that this framework allows the researcher to generalise his findings. The researcher stresses the neutrality of his own role (Denzin and Lincoln, 1998: 10-11). The data or informants should in no way be influenced by the researcher's meanings and comprehension, which may result in unreliable data. The results are supposed to be reproducible in another

study given that similar surrounding conditions exist. This, however, implies that quantitative researchers abstract from what is studied and seldom study it directly.

The research approach in interpretive research is diametrically different. Interpretive research is qualitative, it underscores that the reality is socially constructed, and emphasises the close relationship between what is studied, the influence of the context and the researcher himself. What is considered important is that our comprehension of reality is gained through social constructions such as language, consciousness, shared meanings, documents, tools, and other artefacts (Klein and Myers, 1999:69). Reality is also influenced by anyone powerful enough to legislate correct solutions to problems (Denzin and Lincoln, 1998:8; Law, 1987:131). In so doing I clearly acknowledge what Klein and Myers (1999:71) denote the “fundamental principle of the hermeneutic circle”:

“we come to understand a complex whole from preconceptions about the meanings of its parts and their interrelationships”.

The continuous iteration back and forth between the whole and the part is given a broad and liberal interpretation as it must be understood in relationship to the actual historical or political context as well as different understandings of both the researcher and the informants. Consequently, the reality is not value-free, it carries weight and can be interpreted differently (Denzin and Lincoln, 1998; Klein and Myers, 1999; Van Maanen, 1988:35). This ascribes a special role for the researcher as he must account for his own role in it, for instance by giving an account of his preconceptions that guided the original research design (Klein and Myers, 1999:82).

Interpretive field studies include in-depth case studies and ethnographies (Klein and Myers, 1999:69). The major difference between these two is the time spent in the field. Ethnographic methods rely substantially or partly on “participant observation” (Atkinson and Hammersley, 1998:110), but relies also on document analyses, interviews and video analyses, which enable the researchers to capture the actual events on a micro level, that is, how the users interact with each other and with the artefacts in the given social setting.

Traditionally quantitative methods and interpretive case studies are presented as fiercely antagonistic. This is not a big surprise as the characteristics of these two approaches are fundamentally different. In purely positivistic terms, quantitative methods are

considered to be the correct instrument for doing research as there exists one, and only one, reality to be studied, discovered and understood. This means that the data gathered and results obtained are supposed to be wrapped in a value-free framework (Denzin and Lincoln, 1998:8) with no alternative ways of interpretation. As positivist researchers strongly put emphasis on the possibility of generalisation from a sample to the whole population, they criticise interpretive researchers for being unable to do so. However, the strong focus on generalisation, neutrality and only one truth has raised some concerns. As a result, quantitative methods and even the scientific model are increasingly rejected as a result of a general cultural disillusionment with natural science (Atkinson and Hammersley, 1998:117).

Generalisation in interpretive research (in contrast to generalising from a sample to the whole population as in positivist research) strives at viewing the world in a certain way (Klein and Myers, 1999:75) for instance by the application of theories such as structuration theory or ANT. This enables the opportunity for considering the field from different viewpoints conditioned by your perspective as well as your theory. Atkinson and Hammersley (1998:110-111) underscore that ethnography is about exploring the nature of particular social phenomena, rather than setting out to test hypotheses about them. The actual empirical data tends to be unstructured and the phenomena studied typically draw on a small number of cases. This is clearly in contrast to quantitative analysis as interpretations and ascribed meanings play a central role.

By applying both quantitative and interpretive methods, I acknowledge the validity of both approaches and consider them to be complementary. Surveys are on the other hand criticised for failing to identify the causes behind the phenomena that are being studied (Galliers, 1992:151). However, the use of the quantitative methods may contribute to illuminate the empirical field in a broad sense, for instance, related to the use of information systems: what is the status of use, how many users; what functionality is used, how many computers are there, what is the competence level of the users, how satisfied are they etc. When it comes to more pinpointed questions about explaining a low degree of use, how knowledge is acquired, integration policy, the emergence of electronic patient records in hospitals' in-depth case studies may promote a more thorough understanding of the case studied and often paired with different meanings as encouraged when reality is considered to be socially constructed (Klein and Myers,

1999). As a result quantitative and interpretive methods may play different, but nonetheless important, complementary roles at different stages of a field study.

An ethnographical record is a written representation of a culture (Van Maanen, 1988:1). It has also been exposed to the researcher's interpretation. This implies that in interpretive case studies, not only local meanings matter, but also foreshadowed meanings and reader's consequential meanings are important (Stake, 1998:99). Accordingly, the researcher's style of presentation and his role related to the research context are important. Van Maanen (1988) describes several approaches to ethnography and how this research may be presented in textual form. First, the most common approach is the 'realistic' one. It places emphasis on 'thoroughly mundane details of everyday life among the people studied' such as 'the regular and often-observed activities of the group under study' (Van Maanen, 1988:48). The researcher typically does not emphasise his own role in these tales.

Secondly, 'confessional tales' focus far more on the fieldworker than on the culture studied (ibid.:7; Schultze, 2000), that is, these tales focus on how the actual process of the study was accomplished by the researcher. And the research often emphasises his own role, his personal biases and prejudices, but also moments where the researcher felt uncomfortable and distasteful (Van Maanen, 1988:80) or confessions of episodes characterised by shock and surprises (ibid.:77).

Third, 'impressionist tales' of the field have elements of both realistic and confessional writing (ibid.:7). They are not about what usually happens but about what rarely happens (ibid.:102). It is also very clear to the readers what is part of the story and what is not, accordingly inviting the reader to do his own interpretation:

Characters in impressionist tales must be given names, faces, motives, and things to do if a story is to be told about them. More important, when a story is at stake, these supporting players must be given lines to speak (Van Maanen, 1988:105)

Ethnographical researchers must always face the challenge of balancing between the role as a fieldworker and the danger of becoming too familiar with the field and thus forgetting the researcher's perspective. Van Maanen (1988:78) warns that:

"the fieldworker cannot stay in the field forever and still be considered a fieldworker (Van Maanen, 1988:78).

This fine line is not given once and for all. Other authors underscore that a long time in the field sometimes is a condition for fully understanding the delicate interplay between the people and professionals under study as meanings, viewpoints and discussions are very tightly connected to the particular context. Among professional poker players, Hayano (1982:155) asserts that:

“understanding poker players could not have possibly taken place in any way other than full, complete, long-term submersion, even communion, on the part of the ethnographer”

4.1.3 The University hospital of Northern Norway

The field study has been conducted at the University Hospital of Northern Norway (UNN). UNN is the northernmost of the five Norwegian university hospitals. It is the smallest of these hospitals, but it covers a vast geographical, albeit sparsely populated, area including Nordland, Troms, Finnmark and Spitzbergen. Because of, among other things, the vast geographic area, the National Centre for Tele-Medicine is located to this hospital in order to interconnect primary care with the hospital through electronic discharge letters, education and remote examinations.

The hospital has approximately 4000 employees, including 400 physicians and 900 nurses. The hospital has 600 beds of which 450 are somatic and 150 are psychiatric. It also manages the university clinic function for the University of Tromsø, implying that the hospital is part of a larger academic community with education and research.

4.2 Data collection

In the initial phase of my research, I participated in a national survey, employing quantitative methods and statistics in order to examine the degree of physician's use of electronic patient records in Norwegian hospitals. For the rest of the study I approached the empirical field through the use of interpretive case studies (Klein and Myers, 1999; Walsham, 1993).

Primarily, the work in the field has been conducted in several departments at the University Hospital of Northern Norway (UNN) supplemented with document studies at the Norwegian Research Council and scattered interviews related to the history of electronic patient records in Norwegian hospitals. I have relied on several types of data:

participant observations, interviews, documents, informal discussions and video analysis.

The participant observations were especially aimed at work situations involving physicians, as they are recognised as a particularly important user group for the success of the Medakis project, but the observations nevertheless often included secretaries and nurses as well as patients. In cases where the observations included examination of patients or discussion of a case with a patient, the patients were always asked by the health personals whether it would be all right to have an observer present. Whenever patients participated in video recordings, they were carefully pre-selected by physicians. In such cases, I had produced a one-page paper document with information about the recordings, which the health personnel gave to these patients, The document stated the purpose, kind of use, and who was going to analyse the material. The patient accepted the video-recordings by signing this document.

In sum, I conducted 111 hours with participant observation. The observations were distributed over three periods together with 10 hours initial observation of user-meetings and education of physicians in using DocuLive EPR. The three periods were accomplished in the following way:

- 1) The first period was accomplished in February 2000 in three different departments resulting in 19 hours of observed work.
- 2) The second period was accomplished in January-February 2001 in four different departments resulting in 42 hours of observed work
- 3) The third period was accomplished in January-Mars 2002 in one department resulting in 40 hours of observed work
- 4) plus 10 hours observation of user meetings and EPR-education of physicians.

I always took notes during the observations, after which I transcribed. I added questions, potential analytical points and interpretations to the transcriptions. During meetings and patient examinations I did not ask questions, I just quietly observed the situation. I also became used to bringing a camera with me as a means to document situations, premises, and archives that otherwise had been difficult to describe in words. In case of confusion I tried to clear it up afterwards when I could talk to a physician in private, which they willingly did if they had time. In the beginning of the field-study I tried to ask follow-up question by sending the actual physician an email. I experienced,

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however, that they responded badly to my email requests. I don't know why, but consequently I stopped using email as a means to asking questions. Instead I increasingly understood that the most efficient way to reach a physician was by putting my bets on the physician's beeper. The beepers are institutionalised part of every day practice and if the actual physician was present, he or she almost always quickly responded, and accordingly this enabled me to ask questions or make appointments.

In the last period of my case study, a part of the participant observation was conducted by video recording. Also this time I spent some time in the department, talking to people and reading documents as a way of narrowing down interesting topics. It appeared that interdisciplinary meetings where also the patient was included constituted an interesting setting for video recording. After gaining permission from the head of the department, the actual interdisciplinary team itself and the individual patients, it was possible to make the necessary arrangements. I conducted six hours of video recording, which mostly recorded work meetings in the interdisciplinary teams. These teams contained participants from different backgrounds such as physicians, nurses, physiotherapists, occupational therapists, speech therapist and social workers. This proved fruitful as different professionals discussed their current patient cases based on their various professional points of views, which inevitably presupposed discussions and negotiations. After the video recordings I more or less followed Suchman and Trigg's (1991:77) strategy of producing an indexed log of the videotapes where parts of the tapes were transcribed in more detail. I indexed the events chronologically by clock time in the log by marking interesting events, theme under discussing, change of topic etc.

As a supplement to the participant and video observations I conducted in sum 35 interviews, mostly with physicians, but also a few other health care workers as well as a group interview with two patients. These interviews must not be considered self-contained, as they served primarily as a means of obtaining a richer understanding of the case under study. What I as a researcher was unable to see for myself, I obtained by interviewing people who did see, or by finding documents recording it (Stake, 1998:99). The interviews were always conducted after I had started the participant observations, because then it was possible to found the interviews on a minimum of understanding of the context. Making appointments about interviews was sometimes difficult as a result of hectic everyday work. Occasionally I had to hang around in the department waiting

for an opportunity to conduct an interview. Even during the interview there were interruptions caused by the beeper, phone calls or colleagues passing by.

The interviews were open-ended and actually followed no well-defined interview guide. Instead I prepared myself with an indexed list of problem areas that I in advance had identified as interesting to talk about in more detail. I used a tape-recorder during all the interviews. After accomplishing the interviews I transcribed the tapes. To get an idea on the extent of these interviews, some of them became 22 pages long single space (16000 words).

However, often the informants continued talking after the tape recorder was turned off (especially related to controversial matters). Those things I just listen to, and instead, I tried to write them down after the interview was finished. And in the matter of use, I endeavoured to use this information carefully and discreetly.

During the study I have had access to a number of electronic and paper based documents. In the clinical work situations I have had access to documents, forms and sheets that are used in daily work, in which some are temporarily used in the process and then discarded, and others are stored in the paper-based patient record or in other archives. In connection with the history of the Medakis-project I have also had access to two comprehensive archives belonging to two of the key actors among the policy and decision makers. They were the Norwegian Research Council, a principal sponsor of EPRs in the years immediately preceding the Medakis project, and KITH, a publicly owned agency aimed at establishing IT related standards in Norwegian health care. In addition, I have had access to contracts, memos, specifications and documentation, and circular letters within the Medakis project. I also have access to the electronically based collection of drafts and reports within the CEN TC 251 activities within EPR.

I also participated regularly in informal discussions, both with members of the IT-department (where my office was located) and with health care workers, at coffee breaks and lunch breaks in the hospital cantina with clinicians.

Often during the study new ideas would pop up, not only in work situations, but also at home, on weekends, on travel or when I woke up in the morning. Thus I got used to having a notebook at hand, scribbling down ideas and thoughts. A lot of them were discarded at a later stage, but sometimes new approaches or ideas were based on what I had entered in my notebook.

As a researcher, I was recognised as already having a role. Before embarking on a research career, I have been employed as an IT-consultant at UNN for 10 years, and during this period I have participated for 1 year in the local project organisation of Medakis. In the research period I have also had a part-time position at the hospital's IT-department and have accordingly had an office in the hospital's IT-department which has been my daily workplace.

4.3 Reflections on method

The initial quantitative survey contributed to giving an increased understanding of the status of use in Norwegian hospitals in a broad sense, that is, what kind of electronic patient records exist in the hospitals, which functionality do they offer, what is the availability of the EPRs in the hospital departments and to what extent are these systems used. The survey also provided some suggestions with regards to the low level of EPR-usage, for instance, the flexibility of paper, the number of information systems in play and the stability of the professional boundaries in hospitals. However, the survey could on a detailed level explain the results per se. In order to achieve a deeper understanding of why and how these EPRs and paper-based patient records are used, I continued with an interpretative approach.

The rest of this section offers some reflections on the interpretive part of the study. It is loosely structured in accordance with the seven principles of Klein and Myers (1999). The third principle is that of the interaction between the researchers and the subjects, and it:

“Requires critical reflection on how the research materials (“or data”) were socially constructed through the interaction between the researcher and the participants.” (ibid.:72)

As a part of the interaction with informants, such as informal talks, suggestions and gossip, I managed to trace situations, projects, differences and occasions that I felt was interesting, as well as those informants through whom the case was known (Stake, 1998:90). This implies that each period in the field does not represent an extensive and continuous participant observation. Instead they reflect more pinpointed moments where presumably interesting things could occur, which corresponds to Van Maanen's (1988:78) argument when he points to that:

“The more targeted or limited the ethnography is to a particular and well-defined cultural problem, the less time in the field is thought necessary in order for revelation to strike”.

As an example, my last observation in a department was conducted when a project leader said that “this department is a bit awkward as its way of documenting things fits badly with the newly introduced electronic patient record – the personnel do not document things as usually practised in hospitals”. Typically, such things caught my interest and the ball started rolling, and this time with a special focus on interdisciplinarity. Although I did not have a clear research question in mind in these situations, they nevertheless greatly contributed to making explicit different points of view and, as atypical cases, they also formed a foundation for better learning (Stake, 1998:101).

Although I pursued interesting contexts or situations, I approached the field relatively open-ended with more or less an idea of exploring the nature of particular social phenomena (Atkinson and Hammersley, 1998:110), which means that I had no particular research question in mind. After these initial observations, however, some areas and situations appeared more promising than others, for instance meetings, patient examinations and occasions of the use of information, both paper-based as well as in information systems. Based on these reflections it was possible to pin down more detailed research questions.

Although the formalities around my participation were unquestioned, sometimes I had to negotiate access to the departments. Normally, I would take a phone call to the chief physician of the actual department and ask for permission to observe work at the department. Usually they accepted at once when I told them who I was, what I was doing and that the study was related to EPRs. At one instance, however, the actual chief physician was reluctant to let me in, as he believed that the field work of my research to a high degree would involve his department, and accordingly result in spoiled resources. When I instead suggested a one hour interview he refused. After a few minutes of negotiations, and in the mean time also having refused a request for 30 minutes interview, he accepted a 15 minute interview that had to be conducted at once. Although I was not prepared at such a short notice, I ran up to him and started the interview. The interview surprisingly, turned out to last for over one hour, after which he invited me to conduct participant observation in his department for as long as I wanted and even

suggested that I use his own office as my bridgehead in the department. I believe he had learned a bit more about my interests and realised that the participant observation just to a minor extent would interfere with the department's daily work.

The introductory phase of the participatory observations was always of special interest as it would set much of the agenda for the following period. Usually I started this phase by joining the morning meeting where the physicians coordinate their daily activities, where they present the status of patients and where they discuss alternative strategies and further planning. At one of the first meetings I attended, the chief physician introduced me to the team of physicians as a Ph.D. student that focused on their use of the electronic patient record and invited me to say a few words. This resulted in a brief discussion with several of the physicians who complained about their difficulties in their daily work with the hospital's IT-systems. I also stated that I was a former IT-consultant at the hospital which, as I assess it, made the discussion even more relevant to them. At other departments, on the other hand, I was introduced as, "this is Gunnar, he will join us for a while", or "we have an observer today" after which the focus shifted towards the problems of the day. Sometimes this implied that the physicians did not know the purpose of my attendance and thus made the breaking-up phase from the meeting extremely critical. I was dependent on grabbing one of them whom I could "shadow" for a while or identify the ones that were assigned to practical work in the ward. In these situations, I had to quickly explain what I was interested in as well as the motivation for my work and finally ask whether it would be all right for him or her to have me follow them. Often it turned out fine. I managed to make quick appointments with the physicians. I also combined this by placing myself in a corner of premises with high activity, such as the on-duty room where a lot of daily ad-hoc coordination occurs.

A well known phenomenon to researchers within the field of medical sociology is the "power" of the physician's white coat. My first few times as a fieldworker, I did not pay attention to it and showed up in everyday clothes in the departments. A couple of episodes made me very explicitly aware of being a "stranger" in a clinical context. At one of the wards in one of my first observation periods I was waiting for one of the physicians in the corridor wearing everyday clothes. Then one of the physicians approached me and asked me whether I was one of his patients waiting for the consultation. This came as a surprise to me as he had participated at the morning meeting and was an even bigger embarrassment for him when I explained who I was.

Another instance occurred when a nurse asked me who I was and asked the reason for my presence when I sat in the on-duty room observing work. I explained it to her and told that that this was part of the deal with the department. This was not a unique experience. While sitting there, health personnel entered the room talking with each other, discussing, asking for information etc., and quite noticeably lowered their voices or kept quiet, sometimes looking at me. I felt like a stranger. Together with the fact that everybody else wore white clothing, I learnt the lesson and got myself a white coat which dissociated me from the patient or visitor role. This meant that I was now dressed like a health care worker, I might even pass for a physician with his badge lost. The result was astonishing, as I in one stroke became a community member, one that could circle around in the ward as a clinical worker and one that it was quite legitimate to talk to. Not least, I felt personally really comfortable with it.

At some examinations, newcomer patients had to explain more thoroughly their illness and related problems. Although I sat in a corner of the room and the patient had the back towards me, I felt a bit uncomfortable with it and felt like a voyeur. Based on these reflections I decided to try to solve my unease by talking with the patients, something which the physicians also invited me to do. This turned out to be a happy decision as it promoted a certain degree of informality towards the situation, both for the patients as well as for me as a researcher. At a later stage I also conducted a group interview with two of the patients.

The tight affiliation with the hospital has eased access to the field enormously. At the first few contacts with hospital departments, I always presented myself as an employee at the IT-department, whereafter I presented the purpose of the contact and could make the proper appointments. In this way the formalities with the potential field study were already settled as I as an employee had already signed the declaration of confidentiality. In addition, it was usually easy to agree on dropping by when it suited me. It also eased access as the hospital was in the middle of implementing a large-scale EPR system along with the fact that I had background knowledge about this project. Then the focus of my study was at the core of something the clinicians were concerned about. Accordingly, the informants at UNN found it natural to express their needs with regards to the new EPR-system, suggest improvements and make minor evaluations of the system. In this context I was supposed to have the proper knowledge and thus, in this respect, I was also considered an “insider”.

It can be argued that this study is influenced by my affiliation to the University Hospital of Northern Norway, to my former work-tasks in the Medakis project and my current part-time employment at the IT-department. However, this is unavoidable as the context will always influence the study in question (Klein and Myers, 1999). Nevertheless it was possible to co-ordinate the part-time job at the hospital in such a way that I would not have practical tasks related to patient records or tasks directly related to clinical departments. Instead I worked with projects related to the hospital's laboratory-systems.

The users challenged me, quite likely also influenced by my former role (which I still partly have), on how the IT-systems, on which they were dependent, should be designed. For the major part this concerned the EPR, radiology-system and the laboratory-system and how these systems should be designed in the interaction with the user and how they should interplay with each other. This made me reflect on how much of my work I could contribute with, in terms of practical design guidelines for IT-systems in hospitals. Therefore I also tried to have a practical focus in my papers in order to make them useful in a practical context. This illustrates, still in accordance with Klein and Myers' (1999:74), that:

“the participants, just as much as the researcher, can be seen as interpreters and analysts. Participants are interpreters as they alter their horizons by the appropriation of concepts used by IS researcher, consultants, vendors, and other parties interacting with them, and they are analysts in so far as their actions are altered by their changed horizons.”

As a former technologist, from time to time I got a bit frustrated not being able to help the users in a directly practical way. But during the course of my research, this changed a bit as my writings became more pinpointed. In addition, I could increasingly contribute in discussions at large-scale meetings with vendors, give users advice (based on my research findings), and could sometimes serve as an ally for some departments through internal presentations of my research for departments involved in the study. Increasingly, I am also asked to give advice in internal IT-projects (whom to include in projects etc.) as well as advising how to have their opinions listened to.

As a result, as the study progressed I felt increasingly loyal towards the users of the information systems. Using their clothes, a certain understanding of the work contexts

and the knowledge of the workers, contributed to this together with my involvement and engagement with some of the users.

As I had an office at my disposal at the IT-department, I could regularly discuss my field-data and interpretations with IT-practitioners, albeit in practical terms. This caused the gap between research and practice to become explicit. Accordingly, I had to translate back and forth between practical questions and theoretical terms in order to make things useful both in a practical context and useful for me as a researcher when I needed to discuss the case with my research community. With respect to the clinicians that participated in my observations, it was not possible to observe and interpret the data and at the same time remain “neutral”. They invited me to intervene; for instance, a head physician said: “It is not certain that we do the only right thing ...and we are open to suggestions”. At other times they challenged my opinion, as a head physician argued: “You do agree with me that this structure thing is useless ...”. Consequently, I could not play the role as the neutral observer. Nevertheless, in the beginning of the field study, I endeavoured being as “invisible” as possible. But as the study progressed, I felt more confident in stating my own opinions and engaging more in discussions based on my research.

The fourth principle that concerns abstraction and generalisation is already presented in the theory above, where I outline the use of information infrastructure and ANT. The fifth principle is the principle of dialogical reasoning. This principle presupposes acknowledgement of that prior understanding and preconceptions which guide research design. Most of this is already accounted for above: Firstly, in the theory section where I outline the employment of ANT. This guided the way I conducted the field study as I often looked for key concepts in ANT such as actors, interests and alignment. Secondly, when I outlined principle three, I presented the potential bias of being a former hospital employee and Medakis project member.

Principle number six is the principle of multiple interpretations. I presented my interpretations at conferences and seminars where the participants were health personnel, Medakis-project members, health care managers and policy makers. I also distributed earlier versions of papers to key informants in order to get a discussion around my interpretations. On the whole, there was agreement on how I interpreted the data. But there were a couple of instance, where informants challenged my interpretations. Firstly, one informant challenged the assumption that the Medakis-

Method

project had all-encompassing ambitions. Secondly, another informant disagreed that local user involvement had been marginalized in the project. This feedback made me realise that making sense of data in large-scale projects in complex organisational contexts may be performed in many different ways (Klein and Myers, 1999). Consequently the empirical material was carefully drawn from sources at each of the five university hospitals and from the vendor in order to both highlight potentially different interpretations and underpin the findings more elaborately.

5 Results

The six papers:

1. Lærum, H., Ellingsen, G. and Faxvaag, A. (2001): Doctors' use of electronic medical records systems in hospitals: cross sectional survey. *British Medical Journal*, vol. 323, no. 7325, pp. 1344-1348.
2. Ellingsen, G. and Monteiro, E. (2002): Big is beautiful: electronic patient records in large Norwegian hospitals 1980s – 2001. *The Scandinavian Journal of Information Systems* (accepted for publication)
3. Ellingsen, G. and Monteiro, E. (2001): A patchwork planet. Integration and cooperation in hospitals. *Journal of Computer Supported Cooperative Work* (in press)
4. Ellingsen, G. (2003): Knowledge work in hospitals. In Wynn, E.H., Whitley, E.A., Myers, M.D and DeGross, J.I. (eds.): *IFIP WG 8.2, Global and Organizational Discourse about Information Technology*. Boston: Kluwer Academic Publishers (in press).
5. Ellingsen, G. (2002a): Walking the tightrope between the global and the local: Standardisation meets local work-practice in a hospital. Presented at the 18th EGOS Colloquium, *Organisational Politics and the Politics of Organisations*, Barcelona, Spain, July 2002.
6. Ellingsen, G. (2002b): Information Systems support for interdisciplinary teams: Everyday interdisciplinary work in hospitals in an actor network perspective. In Bødker, K., Kühn Pedersen, M., Nørbjerg, J., Simonsen, J., and Thanning Vendelø, M. (editors): *Proceedings of the 25th Information Systems Research Seminar in Scandinavia (IRIS 25)*, “New Ways of Working in IS”, Bautahøj, Denmark, August 2002.

The six papers in the dissertation appear more or less in the order in which the practical work was performed. This underscores one aspect of the methodological approach. The initial scope was broad, but gradually the scope became narrower as interesting research areas emerged.

Paper one and two both cover the national context in which paper one elaborates on the current status of EPR usage by physicians in Norwegian hospitals. Paper two is a historical account of the national-based Medakis project. Paper three covers practices and use of information in a broad sense which includes the use of several of the EPR-related information sources beyond the EPR per se. The scope is now narrowed to the work context of only one hospital. Papers four and five focus more on the production of discharge letters – a more narrow perspective of information compared to papers one and three, but nonetheless a very important part of everyday medical work. The information is, however, not isolated to the EPR in hospitals, it is also a core element in the interaction between the hospital and the general practitioners. Paper six focuses on the heterogeneity of a medical context, and illustrates how a completely different organisation of work also materialises in a different way to how documentation is produced and employed. An important point, however, is that, collaboration with the rest of the hospital is still crucial and must thus be maintained.

I would like to emphasise that these paper are not the final outcome, “the grand achievement”, of a three year study. Rather, they are instances of a larger process. For example, earlier variants of these papers are discussed and presented in various contexts and appear in conference proceedings. Yet others are under construction. Instances of how and where these papers have appeared are illustrated below:

Paper two: A shorter variant of the paper “Big is beautiful” is accepted for publication in *Methods of Information in Medicine* (2002).

Another variant appears in *Proceedings of the 24th Information Systems Research Seminar in Scandinavia* (IRIS 24), “Knowledge systems”, Ulvik in Hardanger, Norway, August 2001

Paper three: A former version of this paper appears in *Proceedings of the 23rd Information Systems Research Seminar in Scandinavia* (IRIS 23), “Doing IT together”, Lingatan, Sweden, August 2000.

In *Proceedings of the Norwegian conference for organisations’ use of IT*, Bodø, November 2000

Paper four: A former variant of this paper appears as “The role of trust in knowledge management” in *Proceedings of the Norwegian conference for organisations’ use of IT*, Tromsø, November 2001.

Two other variants exist, with Eric Monteiro as a co-writer:

“Enacting knowledge work: the genealogy of knowledge representations in hospitals” in *Proceedings of the Third European Conference on Organizational Knowledge, Learning and Capabilities*, Athens, Greece, April 2002.

“Mechanisms for producing a working knowledge: enacting, orchestrating and organisation in *Information and Organization*, 2002 (accepted for publication)

Paper six: Another variant of this paper appears as “Coordinating work in hospitals in an EPR-context” (submitted for review). It was also presented at the *Conference on Ethnographic Organizational Studies, University of St. Gallen, Switzerland, September 2002*.

National-based EPRs are not isolated to only one department or hospital. On this level, several actors are influential and must be taken into account. The figure below visualises this complexity, the context the papers draw on and the dependability of Norwegian health care.

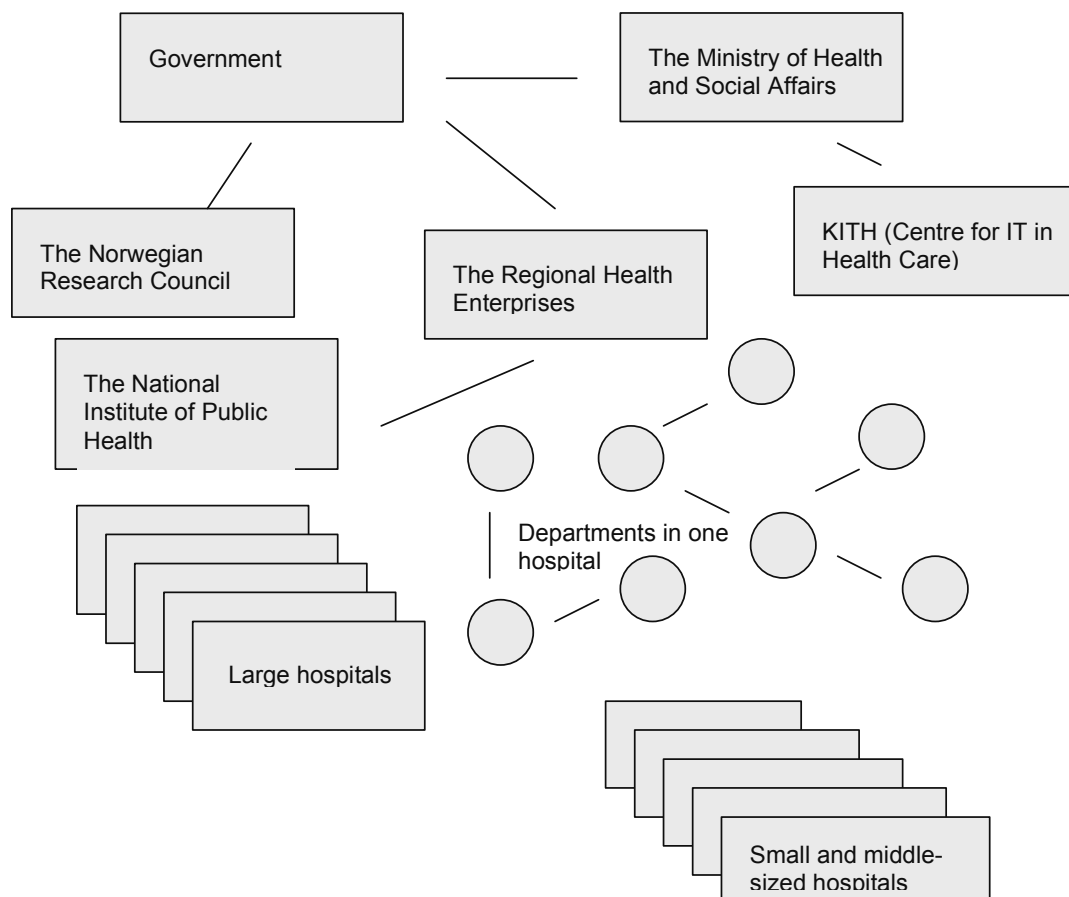


Figure 2 Actors in Norwegian health care

5.1.1 Paper one: Doctors' use of electronic medical records systems in hospitals: cross sectional survey

The background for this paper is a general comprehension of the lack of evaluations of EPRs as well as a need for looking at the current status of use in Norwegian hospitals. Accordingly, the paper is based on a survey aimed at identifying the status of EPR usage among physicians in Norwegian hospitals. It also compares the mutual use of the different EPRs from the three major vendors in this area in Norway.

Of the 72 hospitals in Norway, 53 had purchased a licence for an EPR system by January 2001, covering 77% of hospital beds. Among the three existing EPRs, the DocuLive system is installed in the five university hospitals and hence is associated with the largest hospitals in the country. None of the largest hospitals had completed the implementation of EPRs in all of their departments at the time of the survey.

A list of the 23 clinical tasks was generated based on the basis of 40 hours of observations in five hospital sections at two hospitals, taking into account the information needs of doctors (Gorman, 1995). Thereafter 32 hospital units were randomly selected (each with 4-22 doctors) in 19 of the hospitals with a licence for an EPR grouped by vendor. 314 questionnaires were distributed to doctors working in these units on 12 January 2001. The response rate to the questionnaire was 72%.

Key representatives of the 19 hospitals' information technology departments, involved in implementing the local EPRs, indicated through semi-structured telephone interviews whether each clinical task in the questionnaire was supported locally according to certain minimal requirements. According to the information provided by information technology staff, most of the clinical tasks listed in our questionnaire were in some way covered by implemented functions of the electronic medical records systems. In general, 15 of the 23 tasks were covered for at least half of the respondents.

The results showed that although the respondents scored high in computer literacy and had available computers in the workplace, their use of the EPR was limited. In fact doctors used EPRs for far fewer tasks than the systems supported, and when used, the systems were mainly used for reading patient data.

Despite widespread implementation of EPRs in Norwegian hospitals, our results reveal a low level of use of all three EPRs by doctors, especially in the largest hospitals. The systems were mainly used for reading patient data, and doctors used the systems for less than half of the tasks for which the systems were functional. Among these unused functions were repetitive tasks such as writing prescriptions, a task apparently well suited for computers.

When it comes to explaining the results it is clear that paper based patient records are still in daily use in Norwegian hospitals. In some situations it might be more convenient to use paper records, such as for writing short prescriptions, spreading records on a table, or carrying documents around. Another finding is that the computer use is conform to the traditional division of labour in hospitals, where writing is associated with secretaries, mediation of requests associated with nurses, and reading associated with doctors. None of the EPRs seem to have stimulated the development of new or more advantageous ways of doing medical work; they have simply reinforced existing routines.

In order to elaborate the background, motivations and strategies for implementing EPRs in Norwegian hospitals, I will in the next section turn to paper two, which covers a period of more than 15 years.

5.1.2 Paper two: Big is beautiful: electronic patient records in large Norwegian hospitals 1980s – 2001

Paper two focuses on the development of EPRs in the five Norwegian University hospitals. Currently these hospitals are involved in a large-scale project with the vendor Siemens where the goal is to develop a common EPR (DocuLive EPR) for these hospitals. However, this project, called the Medakis, can trace its origin back to the early 1980s in a situation where Norway was experiencing a period of relative economic stagnation and where the EPR was considered instrumental for efficiency improvement and economic growth.

At the time when the paper was written, three of the hospitals had almost completed the implementation of DocuLive EPR. The other two had completed only 15 % and 30 %, respectively. The users are primarily physicians and secretaries. The university hospitals together have nearly 6000 defined users of the DocuLive EPR with nearly 1400 concurrent users on a normal working day.

The paper considers the EPR efforts in Norway as negotiation processes involving a number of independent, and partly competing, initiatives with a varying set of allies. There existed two competing EPR initiatives, DocuLive EPR and Medina, which both aimed at the University hospitals as their primary market. These two alternatives were diametrically different along dimensions such as level of ambition and public funding. DocuLive EPR had for some time been heavily supported economically by the Norwegian Research Council and had clear ambitions about improving efficiency in hospitals and to make a product that could compete on the international market. A core strategy in this process was also to replace the paper-based patient record in one stroke. The other EPR initiative, Medina, was on the other hand small, characterised by moderate funding and with ambitions of augmenting existing work routines, not replacing them.

During the course of action, shifting sets of alliances appeared among the key actors, both among the hospitals, the vendors, the public institutions and among the hospitals themselves. The paper reveals the dynamics of these negotiation processes and analyses especially how the modest and evolutionary EPR initiative (Medina) “lost” to the bolder and more ambitious one (DocuLive EPR).

The paper also analyses how evolutionary approaches struggle to be perceived as legitimate and viable alternatives. It appears that as a condition for mobilising sufficient support for the DocuLive EPR initiative, it was essential to aim high and to expose grand ambitions in order to comply with the expectations from the Norwegian Research Council, which required means that could both contribute to revitalising the broken Norwegian economy and reforming health care.

Another focus in the paper is the implications for local control. The vendor of DocuLive EPR has during the last years transformed the Norwegian-based solution into a “global” solution. The hospitals, for their part, accepted to drop almost all local involvement as Siemens promised to put more resources into the project and make an international product out of it. Already a major player, Siemens has in the last years acquired a number of international companies active within IT and health care, especially in the US. This implies that from a relatively slow start, Siemens is currently strengthening its efforts dramatically within this area. It is, in effect, one of the most influential vendors globally. This change has, from the point of view of the Norwegian university hospitals,

primarily been perceived as a higher threshold to implementing changes, making local influence more illusory than ever.

5.1.3 Paper three: A patchwork planet: Integration and cooperation in hospitals

This paper picks up the leitmotif of making a uniform and all-embracing EPR. The paper will more deeply elaborate how difficult it is to implement a uniform solution, both through a strategy of replacing existing information systems as well as paper-based archives. It also endeavours that information systems integration is anything but a purely technical endeavour.

As information systems in large hospitals are characterised by poor mutual integration, this does not come as a big surprise. Big efforts have been performed in promoting increased integration as this is supposed to lead to increased collaboration and more efficient treatment and care for patients. On the European level, the standardisation organisation, CEN TC 251 has heavily emphasised integrated solutions through their conceptual model (prENV13606 1-4, 1999).

In the Medakis project, uniform solution has been a key argument. From the project documentation it is argued that the existing information systems only to a small degree have been integrated in a uniform solution; they are limited to departmental use and some of it exists only in paper-based archives.

The project has pursued a strategy that has aimed at replacing existing special-purpose information systems, patient records, nurse documentation and other paper-based archives with an all-embracing solution, the DocuLive EPR. DocuLive EPR is supposed to have a central role among the information systems in hospitals. The strategy is also, whenever it is inappropriate to employ DocuLive EPR, to implement EPR-controlled modules (from the same vendor) in order to limit integration to an endeavour between programs from the same vendor.

The paper analyses the conditions and strategies for integration of the EPR with the other information systems in hospitals. The analysis endeavours to illustrate the role of redundancy and fragmented and ambiguous information. Consequently, integration becomes something more than a purely technical effort. What becomes important is how apparently identical information is used in different contexts. The analysis centres especially on situations where the information in different information sources plays

different roles. Four analytical categories are chosen; redundancy, supplementary, ambiguity, and compatibility.

Regarding redundancy, the paper illustrates how similar not-integrated information may play a significant role in ensuring robustness of work, by ensuring availability of information if one component fails. As a result, the whole system does not stop if one of the components drops out.

The second category, non-integrated supplementary information, points to that information in the different information systems is not identical, but only “related”. Obviously, there are problematic cases of separating these two situations. Typical illustrations of this type include situations where the different professions have different versions of patients’ trajectories, or where one version is an abbreviation of another, for instance discharge letters or other summaries. Combining information from multiple, sometimes independent, sources of information, permits consistency checks of multiple representation with each other (Hutchins, 1994:35) or “framing” as denoted by Knorr-Cetina (1999:72) as it serves to check, control or extend information from different non-integrated sources.

The third category, ambiguity, deals with related integrated information (ICD¹⁰-codes) in the DocuLive EPR and the patient administration system. This section elaborates the different roles of these codes although they are supposed to be fully integrated and also illustrates the tension between management and clinicians in coding practice. From a management point of view the ICD codes are an extremely important means to ensure funding, while the clinicians’ motivation for coding is first of all based on clinical findings.

The next paper (four) shares some similarities with the second perspective through supplementary, related information, although the focus of the paper is different as it focuses on how information in different contexts needs to be internalised through work in order to be useful in a clinical context.

¹⁰ International classification of diseases as worked out by the World Health Organization (WHO).

5.1.4 Paper four: Knowledge work in hospitals

The point of departure in paper four is the knowledge management literature. The lion's share of this literature points to the strong relationship between industrial competitiveness and the companies' ability to create, organise and retrieve knowledge. Knowledge is often promoted as a thing, a tradable property of a firm, that is freely reusable across contexts.

The perspective in this paper is different as it argues that "work" is needed to make knowledge useful across contexts. This implies that the focus in this paper is not on knowledge as a thing per se, but rather on how people work, how they accordingly create knowledge and how they, under certain conditions, reuse it.

An essential part of physicians' work in hospitals involved summing up and reusing previous information. A critical instance of such work occurs when physicians produce discharge letters; they sum up the stay of the patients that leave the hospital. The paper presents four cases from four departments where physicians conduct this particular work. Physicians work with information that to a varying degree is related but slightly different, as information is created in various context. Different professions approach cases differently, and accordingly place different emphasis on different things.

More specifically the paper aims at identifying the conditions for when sharing and reuse of knowledge is productive. The question is pursued along the themes complexity of contexts, the trust attributed with the knowledge sources and the uncertainty, conditions in which physicians must often must put their decisions into action. These aspects will to a varying degree influence and shape the extent to which reuse of knowledge is possible and useful.

The complexity of contexts points to the fact that information is not freely given. Information that is to be used across contexts is objectified; meaning is detached from local contexts of interpretation (Smith 1990:211; Naur, 1985:254, Lam, 1995:989). This implies that when physicians read existing information, they must translate it to a new context and evaluate its relevance related to the actual case. Boland and Tenkasi (1995:351) denote such a process as 'perspective-taking', the ability or capability to take the knowledge of other communities of knowing into account.

Trust in knowledge sources analyses how various knowledge sources and various actors are associated with different degrees of trust. For instance, head physicians and

“regulars” are more trusted than the more inexperienced ones. Trust can also be associated with particular contexts, which means that knowledge created in a particular context will signal trust and confidence.

Uncertainty reflects that physicians have to deal with situations characterised by a high degree of uncertainty and limited amounts of resources. However, this uncertainty can also reflect uncertainty of diagnosis and prognosis as seen in departments treating a lot of chronic patients where diagnoses, courses and side-effects are difficult to predict. This implies that knowledge in these contexts is continuously constructed and reconstructed in order to remain valid.

The focus on “work” is also pursued in the next section where the tension between global and local solutions is explored in a broad sense.

5.1.5 Paper five: Walking the tightrope between the global and the local: Standardisation meets local work-practice in a hospital

This paper describes how a project failed as a result of high standardisation ambitions. A key focus in the paper is the tension between the global level’s ambitions of improved efficiency and standardisation, and the local practice’s need for flexibility.

Standardisation efforts are often put forward in a top-down and uniform manner with weak local influence. The people involved in such projects are often treated in a mechanical way where the focus is on the technology and the promised high gains. The social aspect of standardisation is often overlooked. Consequently, a lot of these projects fail as there is a lack of adoption, resistance in use or only temporary validity (Bowker and Star 1999: 293). As a standard is intertwined with local practice, it both shapes local practice and is being shaped by it. As a result, work is needed, both to reach agreement about a standard and subsequently maintenance-work to keep it ‘alive’.

The paper seeks to strike the balance between the global level’s need for increased co-ordination and control, and the local level’s need for flexibility. Defining such a balance implies to elaborate the ‘costs’ associated with standardisation, that is, the work that is needed to give the standard breathing space.

The actual project which the paper draws on aimed at making a common discharge letter template for the whole hospital of UNN, which of course involves a heterogeneous amount of hospital departments. A part of this strategy was to promote a

structured work practice to the physicians. That is, the physicians were asked to adjust their work in order to conform to the guidelines of the project.

The analytical dimensions are pursued along the themes of different comprehension about quality, a restructured work chain, and the marginalizing of rest categories.

As an important part of the project was to impose certain work routines on the physicians, the paper draws on the work of Leidner (1993) who elaborates the relationship between standardisation of work and quality in McDonalds franchising companies. It appears that quality is not a fixed thing; it depends on who is defining it and for which purpose. Another point is that the project in question had a quality dimension to their goals. The quality of the content of the discharge letters was supposed to be improved by focusing on the needs of the general practitioners. Gradually, however, it turned out that quality and efficiency was closely related to a managerial point of view. This paper focuses somewhat differently as it considers the positions of the different actors involved, physicians from various departments as well as the general practitioners, and elaborates how this shapes their comprehension of quality.

The second dimension, the restructuring of the work chain, analyses how the whole work chain was supposed to change as a result of the change in work practice. Drawing on CSCW-literature, the paper illuminates how some physicians had to conduct additional work that was not directly beneficial to them, but rather they did it for the physician responsible for next activity in the chain. This accordingly made it more difficult to accept the suggested change.

The third dimension, the marginalizing of rest categories, describes how global change has an impact on local contexts. The decision to promote certain categories will imply that other categories turn invisible, which often occurs for marginal patient groups with specialised needs.

5.1.6 Paper six: Information Systems support for interdisciplinary teams: everyday interdisciplinary work in hospitals in an actor network perspective.

The focus in the sixth and last paper is related to interdisciplinarity in hospitals. As today's organisations face increasing specialisation, work has to be conducted in the

context of interdisciplinarity. This has led to many efforts to formalise interdisciplinary work. However, in spite of the heavy emphasis on their superiority, several of these efforts have failed (Gibbons et al., 1994). One reason may be that interdisciplinarity is commonly considered a positive value per se and thus neglects criteria such as efficiency or usefulness, defined in terms of the contribution the work has made to the overall solution of transdisciplinary problems (Gibbons et al., 1994:33).

Drawing on semi-structured interviews of professionals (physicians, nurses and therapists) and video observations from the Department of Rehabilitation at UNN, the aim of the paper is to identify the conditions for achieving interdisciplinarity in a complex organisational context. The video observations have been conducted at interdisciplinary meetings in which different professionals participate (nurses, ergo-therapists, physiotherapists, physicians, social workers etc). At the turn of the year, this department has also started to examine patients in pairs; for instance, the physician and the physiotherapist, and also the nurse and the social worker. The health care workers also practice interdisciplinary documentation, that is, they document in the same place in their paper-based archives, as well as writing in the same Word-document on the their computers. This is an obvious distinction from ordinary disciplinary reports as practised in more traditional departments.

As professionals generally work in accordance with, and are evaluated in terms of, disciplinary guidelines, it is hardly surprising that interdisciplinary work requires negotiations. In order to ease these negotiations it is essential to have mechanisms that promote interdisciplinarity. The paper explores how artefacts, organisational structure, IT-systems and routines play a role in promoting interdisciplinarity in the everyday practice.

The paper also illuminates how a strong commitment towards interdisciplinary work shapes the relationship and collaboration among the professionals. Following an interdisciplinary approach is obviously different from strictly working in terms of “your own” discipline. Such devotion might break the traditional division of labour, redistribute power and control and consequently transform work. This is however not uncomplicated as professionals have the special privilege of freedom from the control of outsiders. One of the claims that justifies such a privilege is that “there is such an unusual degree of skill and knowledge involved in professional work that non-professionals are not equipped to evaluate or regulate it” (Freidson, 1970:137).

Results

The last point is devoted to an analysis of how an interdisciplinary organisation and commitments towards close collaboration manages to withstand a “traditional world”. There is by no means a free space where interdisciplinarity is allowed to grow freely. Work is needed, both to create and maintain such a constellation. By regarding the interdisciplinary organisation and its documentation as an actor among many traditional ones, I pinpoint the working conditions for such a collective. For instance, I point to how the maintaining of a gateway-role is one condition thereof.

6 Implications

6.1 Practical implications

6.1.1 Ambition is money, ambitions kill

IT has for several years been considered instrumental in enforcing organisational change in order to promote goals such as efficiency, control and collaboration. Employed strategies have been uniformity, standardisation, integration and large knowledge systems. These strategies, however, are often bundled with high ambitions about the role of IT. Often, these ambitions exceed what is possible to achieve and contribute in themselves to disaster.

Paper two describes how large-scale ambitions in the Medakis project (and its predecessor) not only propelled the goals in the project, but also mirrored ambitions on a governmental level about increased efficiency, uniformity and collaboration. Paper three describes how ambitions about an all-encompassing EPR marginalised the focus on other information systems in hospitals. Paper four describes how a purely simplistic view on knowledge management is inadequate since knowledge cannot be separated from work per se, but must be translated into particular contexts in order to be rendered useful. And finally, paper five analyses how ambitions about a standardised solution for the whole hospitals resulted in failure.

Unfortunately, there seems to be a clear relationship between the level of ambition and the possibility for obtaining funding and being legitimate. This is a major point in paper two which illustrates how two different EPR-projects with very different levels of ambition competed about money and attention. Consequently large and grandiose projects face better conditions with regard to money, resources and legitimisation compared to smaller ones in spite of their tendency to fail. This should serve as a lesson learned to policy makers, funding sources and the newly established Norwegian health enterprises in that:

- 1) IT-projects in health care should endeavour more realistic levels of ambition in order to minimise the huge gap between expectations and results.
- 2) It is essential to also promote and support projects with moderate levels of ambition because the chances of success might be vastly improved.

6.1.2 Plans or visions

Top-down-projects that are strongly controlled from above often have a mechanical approach towards how projects are run. These projects emphasise aspects such as well-defined goals, clear distribution of responsibility and predefined comprehension of how IT might affect organisations and human behaviour. Several of the papers (paper two, three and five) illustrate this point.

According to such a strategy it is presupposed that people behave in certain ways or act like humble servants closely adhering to project goals and plans. As a result, this perspective does not accept local control, as local control might cause unpredictable outcomes. However, this perspective is disastrous as a complete mapping of the “world” is impossible and comes close to a naïve technological deterministic view. Based on several of the findings in the papers it is fair to say that such an approach should be discarded as there are often huge gaps between initial goals and what finally turns out to be the outcome.

Instead of using terms such as project goals and plans, I suggest to use the term ‘visions’. This term is more vague and is to a lesser degree associated with a deterministic view of IT. It also makes it easier to argue that large IT-projects in health care should be recognised by uncertainties, improvisations, compromises and alliances (Latour, 1999). These aspects ought to form an essential part of the planning per se. It means that there must be an awareness and acceptance of negotiations, compromises and opportunities. Then it would also be easier to support and promote local initiatives, which of course might change the course of projects. It also implies relaxing managerial control in order to enable a change from a controlling perspective on organisational life towards a more coordinating perspective.

All this implies that there should be an acceptance of the fact that the final outcome is often different from the initial expectations. Consequently, the criteria for evaluating success might also change because of unforeseen consequences, side effects, compromises, new knowledge etc. A pinpointed example is found in paper six, where classification system ICF is used for something more than merely structuring the patient’s disease as aligned with its initial purpose. It is also used to ensure interdisciplinarity in the daily work in a hospital department. Such a way of using a classification system was by no means initially inscribed in the ICF or envisioned by the

designers. Success in this case was accordingly based on changed criteria and not by previously existing criteria.

6.1.3 Globalisation and loss of control

The motivation for global or uniform solutions or standardisation is often to obtain increased coordination and control. Paper two in particular illustrates how an uniform EPR is considered instrumental in streamlining and controlling the large Norwegian hospitals.

The outcome of the project so far illustrates that the opposite effect has taken place. Local user involvement is decreasing as the system increasingly becomes globalised, and it is accordingly more difficult for the involved actors (the hospitals, the vendor, the Government) to control the future course.

A corresponding example from paper three elaborates on how ICD-codes (diagnosis codes) are stored in several separate databases. Replacing the different databases with only one database, i.e. storing the ICD-codes in only one place will presumably increase control over data quality, as different version of the codes will vanish.

However, the paper shows that the opposite effect will be the outcome if a tight integration strategy is pursued. Establishing only one information source for these codes will lead to the loss of control as essentially different roles, meanings and interpretations will be crushed.

6.1.4 Global reach and local use

This study illustrates how large-scale IT-systems, in spite of having a “global” role where information is supposed to be used across contexts, must relate to local practice and the way information is used locally.

Even so-called explicit self-contained knowledge (analysed in paper four) needs to be made valid in a particular context in order to be rendered useful. Knowledge is not just given or ready to be used. A lot of work is being conducted in making sense of information, which will be used across contexts that often interpret identical information differently. This work involves concepts such as translation, understanding and trust as a part of making information useful and thus reusable. An important part of this is to accept that knowledge is not stand-alone and self-contained. It is rather

distributed among different professionals that participate in a process of sense-making and negotiating where also information from several sources are compared and evaluated.

Another point, directly related to integration is that apparently identical and redundant information sources might be understood in different ways as information can play different roles and is collected for several purposes (see for instance paper 3). For instance, the role of ICD-codes in hospitals is significantly different within areas such as clinical diagnoses, funding instruments and clinical research.

Consequently, pushing too hard on integration and global solutions means that several local roles disappear in the strongly enforced global solutions. Therefore, to make things work, new information sources (paper archives, IT-systems and electronic documents) are established locally to cope with roles of information that are not taken into account in a global system. Paper three offers examples on how local research databases of ICD-codes are established as a result of the lack of quality in corresponding global information sources. Accordingly, establishing IT-systems that encompass several contexts requires the careful balancing of the needs of the different perspectives. In addition, the study also shows that tight integration might result in additional invisible work for health personnel in order to keep the data completely integrated.

Global usefulness is accordingly dependent on local usefulness in order to ensure proper meaning and quality. This means that global solutions must allow a certain flexibility in its behaviour and allow local adjustments or amendments. This is emphasised in the present study where the global classification system ICD is translated into local contexts and how – in spite of various perspectives of its role – the ICD manages to be considered useful across professional boundaries. An example is where the global WHO-based classification system ICD is used differently on the global and local level. As a result, global usefulness is legitimised and enforced through local use.

6.1.5 Top-down or bottom-up

Replacing existing systems, paper-based archives and local special systems presupposes strict top-down control where local autonomy is suppressed in two ways:

- 1) To make the users accept the replacement of existing information sources

- 2) To not allow users to create local archives and local information systems.

This study points to the futility of such a strategy. Among other things, it is not possible because professionals such as physicians possess a high degree of autonomy and will only accept solutions that they consider to be useful. The second important point is that despite uniform and global solutions, a lot of work is required in order to keep such a solution alive. This is often supported by local information systems and serves to illustrate that local contextualised systems are not a problem per se. They are the symptom of a bigger or more general problem. The more global and uniform a solution becomes, the more work and local arrangements (archives) are needed both to serve the local and global context. Pushing too hard on uniformity and standardisation might lead to a lack of results and disillusionment.

6.1.6 Standalone or interplay

The study emphasises how the introduction of large-scale IT-solutions in hospitals must take into account what is already in place in terms of existing information systems and existing work practices. Consequently, the introduction of IT must be considered to be part of a bigger ensemble rather than an standalone system implemented in an isolated work-practice because:

- 1) It is simply not possible to construct solutions and routines that are completely self-contained since information systems and work-practices are closely interwoven, as well as being interwoven with other contexts.
- 2) It is not possible to make a system that covers all the required functionality. There will always exist local peculiarities that need to be taken into account in terms of existing IT-solutions and existing ways of doing things.

An important implication is that there must be ways of translating back and forth between the different contexts, work practices and IT-systems in play in these different places. Thus there must be a continuous interplay between new and old in terms of both technology and work. An approach acknowledging both old and new practice is a gateway strategy presupposing that IT, routines and people maintain such a role. See for instance paper six on interdisciplinarity.

6.2 Theoretical implications

6.2.1 Visible versus invisible work: legitimising peculiarities of everyday work

Work is needed both to implement IT in organisations and to change existing work-practice. This work is highly legitimised, as it is usually associated with the process of introducing new IT artefacts. However the study emphasises that work is also needed to maintain and keep IT-solutions alive in everyday work. This work is, compared with IT implementation work, more invisible, as it has sunken in as invisible routines of daily work. This work might even be work that is not considered legitimate when it does not conform to formal work procedures.

I have deliberately focused on the peculiarities of medical work as I consider it important to elaborate on detailed accounts of medical everyday work in order to understand how work is organised and performed. In this way, the present study positions itself in line with research conducted by Knorr-Cetina (1999); Hunter (1991); Atkinson (1995) and Fujimura (1996). Subsequently this is employed as a foundation for developing design strategies concerning IT-systems and EPRs. The argument is not only related to hospitals and EPRs, but is also applicable for the design and use of information systems in a wider organisational context. One has to come under the skin of daily work in order to give input to design.

6.2.2 Conceptualising implementation as domestication

Today, information systems are commonly employed in everyday work in hospitals. Especially the physicians possess a relatively high degree of computer literacy (see the results of paper one). Accordingly, it has been considered proper to employ IT as a mechanism for organisational change and especially for inducing changes that previously turned out to be difficult to achieve by other means. Thus the implementation of IT is often driven by high expectations of efficiency improvement, increased collaboration, increased information quality and increased centralised control. The fulfilment of these expectations is, however, associated with a given outcome of an introduced IT-solution, that is, where there is a cause (the IT-system) there is a given effect (the predefined outcome).

Such perspectives are necessarily wrong. A more realistic view is to consider the way these systems are continuously domesticated (Silverstone and Hirsch, 1992; Monteiro,

1998) in hospitals. As a result of these processes, technology and the social practice become transformed in a relationship and enable opportunities for changed practice. In that way the effect is not caused by technology alone. Rather, it is the conditions for change that is put in place as a result of the continuous interplay between technology and social practice.

6.2.3 From fixed to unlimited boundaries of information systems

A large body of studies within CSCW focuses on small-scale collaboration centred around singular tools. What is added in this study is, firstly, the encompassing of several contexts which imply collaboration on a much larger scale. Secondly, the information system in question, the EPR, constitutes not only a singular tool; it is rather part of a bigger ensemble of information systems already in place in hospitals (a main focus in paper three). An extensive part of this study elaborates on the collaboration in these broader contexts.

Acknowledging a broader scope, however, does also mean acknowledging increased complexity, which in more realistic ways mirrors reality. The complexity of collaboration increases. There is not a fixed amount of users that collaborate through one single information system. In a similar way, focusing on various numbers of information systems instead of only one, means to acknowledge the complexity of information systems integration or interplay.

The term information infrastructures (Bowker and Star, 1999; Star and Ruhleder, 1996; Hanseth and Monteiro, 1995) is conform with such a perspective, as information infrastructures underscore that there are no limits as regards technological components and users per se.

6.2.4 Heterogeneous networks and transformations

In the previous section I outlined some key strategies for how to pursue implementation, integration and standardisation strategies. I pointed to the fact that we now deal with complex large-scale solutions, which are impossible to implement in one stroke. Bottom-up, evolutionary development, local usefulness and control are all essential in order to make things work.

Fuelling STS and ANT into CSCW, one strategy for conceptualising processes of change is to apply a network approach where information systems, work-practices and

users are considered to be components linked together in a heterogeneous network (Law, 1987; Latour, 1987, 1991; Walsham, 1997).

Considering the “world” as a network poses no limitations of the extent of, for instance, an information system. The Internet is one such example, which in itself is a network consisting of a huge amount of sites. Broadening the scope also includes humans and practices as components. Consequently, EPRs are also components in a network together with other information systems, contexts, routines, peculiarities etc. The network concept is also nicely conform with information infrastructures, as:

“Infrastructures are heterogeneous socio-technical networks, including many networks in which both technical and social actors take part” (Hanseth and Lundberg, 2001:349)

Considering design as network maintenance makes it much easier to acknowledge how the “world” is interconnected and how the nodes in the network depend on each other. Then it becomes very clear that a total replacement of large-scale infrastructures is not merely a question of replacement.

Withdrawing or adding components (human and non-human) to the network will thus influence not only one other component but several - and in very unforeseen ways - as they are closely interwoven and often associated with very different interests (Latour, 1987, 1991). Keeping such a network together is not a matter of defining an overall goal that everybody can agree on. The network is rather kept together by components and actors that take part in a complex relationship with each other, recognised by negotiations, compromises and shifting allies. This illustrates why and how final outcomes of IT-projects might be difficult to predict, but nonetheless, this is more conform with the actual course of these projects.

6.2.5 Conceptualising change in heterogeneous networks

A possible strategy when inducing change in heterogeneous networks is to apply a gateway. A gateway technology is usually associated with the interconnection of incompatible technical systems:

“A gateway technology is some means (a device, or convention) for effectuating whatever technical connections between distinct production subsystems are

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required in order for them to be utilised in conjunction, within a larger integrated production system” (David and Bunn, 1988:170)

Among technologists and IT-personnel, gateway solutions echo badly because they usually are employed to establish ad hoc interconnection between incompatible protocols, technologies or standards.

However, I argue that the gateway approach is underestimated and, from a conceptual point of view, a gateway metaphor might contribute in establishing design and implementation strategies of information systems. Still applying a network approach, different incompatible networks might be interconnected through gateways. As a result, introducing a gateway might dramatically extend the extent of a network, which accordingly will broaden the use-domain for users belonging to different networks.

A related example may be found in paper six. Employees in a hospital department have decided to strongly commit themselves to interdisciplinary work, which is very different from what is practised elsewhere in hospitals. However, this department cannot ignore the way work is organised in more traditional departments, as there are connections and dependability between the departments. Consequently, gateway solutions are established, translating back and forth between “traditional” and “interdisciplinary” contexts in terms of both information and practice.

7 Conclusion

This study has centred on the area of implementation and use of EPRs in large hospitals. It has aimed to be a contribution for designers, users and key actors, as well as others, who work and have interests in this area. The study has also aimed to contribute to the fields of CSCW and STS.

The study has emphasised that there are no simple solutions to the challenges of designing and implementing large-scale EPRs. There are no bullet words or slogan-like recipes that ensure success when organising IT-projects in health care.

Large hospitals are very complex and heterogeneous organisations. The present study has emphasised this complexity. There is a continuous uncertainty in the implementation of large-scale IT-solutions in complex, highly specialised organisations recognised with a high degree of professionals. The EPR is supposed to span a multitude of contexts, not only different departments in a hospital, but also other hospitals and possibly even other countries. The EPR is also assumed to interact smoothly with other hospital-based information systems, with existing routines, regulations and practices. Thus an EPR implementation cannot simply be considered as a standalone system apart from what is already in place in hospitals in terms of information systems and practices. All these elements have to play together in order to make things work, and the EPR will be just another piece in the puzzle.

However, when analysing the empirical material I have stressed to take these issues into account, and I have pointed to the close interaction between technological and organisational issues and how this relationship possibly is transformed as a result of the interplay. I have also endeavoured to reveal the work-practice in the different departments. I have illustrated some of the peculiarities of the everyday work, and I have illustrated different ways of organising work. All this heterogeneity must be taken into account in the process of implementing EPRs.

I have also tried to focus on conditions that have relevance beyond the area of medical work. The study is also linked with more theoretical themes in the CSCW, STS and IS field. In this way, it has been possible to discuss the results in a broader and more theoretical perspective, for instance, collaboration, knowledge work, how stabilisation occurs, the tension between the global and the local and standardisation strategies. In

this regard, the term 'information infrastructures' has been valuable in illustrating the complexity of organisations and IT-systems and how they are mutually intertwined. The employment of ANT has also contributed to the conceptualisation of these issues through heterogeneous actors in a continuous interplay, which also very well illustrates and conceptualises change-processes and highlights the associated challenges. These theoretical concepts have fed back into in a practical setting and contributed to an increased understanding of the challenges the hospitals face when implementing EPRs.

It has been difficult to cover all the interesting and relevant areas. There are always interesting topics than could have been pursued more deeply. On one hand, this is avoidable in such a large and complex area as this. On the other hand, it serves as a motivating power for further research. One area that I consider extremely relevant to pursue further is to analyse the implications of the recent governmental take-over of the hospitals. The take-over has strongly implied increased centralisation, where IT in general and EPRs in particular still seem to be considered highly praiseworthy as “the means” for efficiency improvement, uniformity and global solutions. Such heavy focus on centralisation and uniformity will not only influence daily medical work in the Norwegian hospitals, but will also influence how national implementation strategies in the health sector are actually carried out.

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Paper one:

Doctors' use of electronic medical records systems in hospitals: cross sectional survey¹

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Abstract

Objectives: To compare the use of three electronic medical records systems by doctors in Norwegian hospitals for general clinical tasks.

Design: Cross sectional questionnaire survey. Semistructured telephone interviews with key staff in information technology in each hospital for details of local implementation of the systems.

Setting: 32 hospital units in 19 Norwegian hospitals with electronic medical records systems.

Participants: 227 (72%) of 314 hospital doctors responded, equally distributed between the three electronic medical records systems.

Main outcome measures: Proportion of respondents who used the electronic system, calculated for each of 23 tasks; difference in proportions of users of different systems when functionality of systems was similar.

¹ A letter on an Erratum is provided in Appendix C

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Results: Most tasks listed in the questionnaire (15/23) were generally covered with implemented functions in the electronic medical records systems. However, the systems were used for only 2-7 of the tasks, mainly associated with reading patient data. Respondents showed significant differences in frequency of use of the different systems for four tasks for which the systems offered equivalent functionality. The respondents scored highly in computer literacy (72.2/100), and computer use showed no correlation with respondents' age, sex, or work position. User satisfaction scores were generally positive (67.2/100), with some difference between the systems.

Conclusions: Doctors used electronic medical records systems for far fewer tasks than the systems supported.

What is already known on this topic

Electronic information systems in health care have not undergone systematic evaluation, and few comparisons between electronic medical records systems have been made

Given the information intensive nature of clinical work, electronic medical records systems should be of help to doctors for most clinical tasks

What this study adds

Doctors in Norwegian hospitals reported a low level of use of all electronic medical records systems

The systems were mainly used for reading patient data, and doctors used the systems for less than half of the tasks for which the systems were functional

Analyses of actual use of electronic medical records provide more information than user satisfaction or functionality of such records systems

Introduction

Electronic medical records systems are starting to be used in hospitals throughout Europe. However, there seem to have been few formal evaluations of them [1,2], possibly because of a lack of established evaluation methods [3,4]. We therefore investigated the usefulness of different systems by comparing their use in general

clinical tasks. Frequency of use is a possible indicator of how well such systems are adapted to clinical work in general [5,6] because a successful system ought to be used by most doctors for important tasks [7]. We developed a questionnaire to investigate and compare the use of electronic medical records systems among doctors in Norwegian hospitals.

Participants and methods

Electronic medical records systems in Norwegian hospitals

Of the 72 hospitals in Norway, 53 had purchased a licence for an electronic medical records system by January 2001, covering 77% of hospital beds. In practice, there were three main electronic medical records systems - DIPS, Infomedix, and DocuLive (table). The DocuLive system is installed in the five university hospitals and hence is associated with the largest hospitals in the country. None of the largest hospitals had completed implementing the electronic medical records system in all of their departments at the time of our survey.

Records system (vendor)	Nationwide			In survey		
	Hospitals (n=72)	Hospital beds (n=13 751)	Doctors (n=6700)	Respondents (n=227)	Hospitals (n=19)	Hospital units (n=32)
DIPS (DIPS)	23 (32)	2336 (17)	912 (14)	69 (31)	6	11
DocuLive EPR (Siemens AG)	9 (13)	4375 (32)	2829 (42)	77 (33)*	6*	9*
Infomedix (EMS)	20 (28)	3844 (28)	1550 (23)	81 (36)	7	12
Other	1 (1)	12 (0.1)	2 (0.03)	0	0	0
None	19 (26)	3184 (23)	1407 (21)	0	0	0

Table 1. Distribution of electronic medical records systems in Norwegian hospitals by January 2001, and respondents in survey. Values are numbers (percentages) (Hospital data from SAMDATA 1999 www.samdata.sintef.no)

* Two hospital units in two hospitals represented by eight respondents were excluded post hoc

Developing the questionnaire

The questionnaire consisted of eight sections (see Appendix A for details). In the section covering use of computers, we generated the list of clinical tasks on the basis of 40 hours of observations in five hospital sections at two hospitals, taking into account the information needs of doctors [8]. The section asked doctors to indicate their frequency of use of computers for 23 general clinical tasks on a five point scale ranging from "Never or almost never" to "Always or almost always." In addition, they were asked to indicate whether they were using the implemented electronic medical records system or another computer program (or both) for each task. We adapted existing, validated questionnaires to produce the sections covering computer literacy [9] and user satisfaction [10,11].

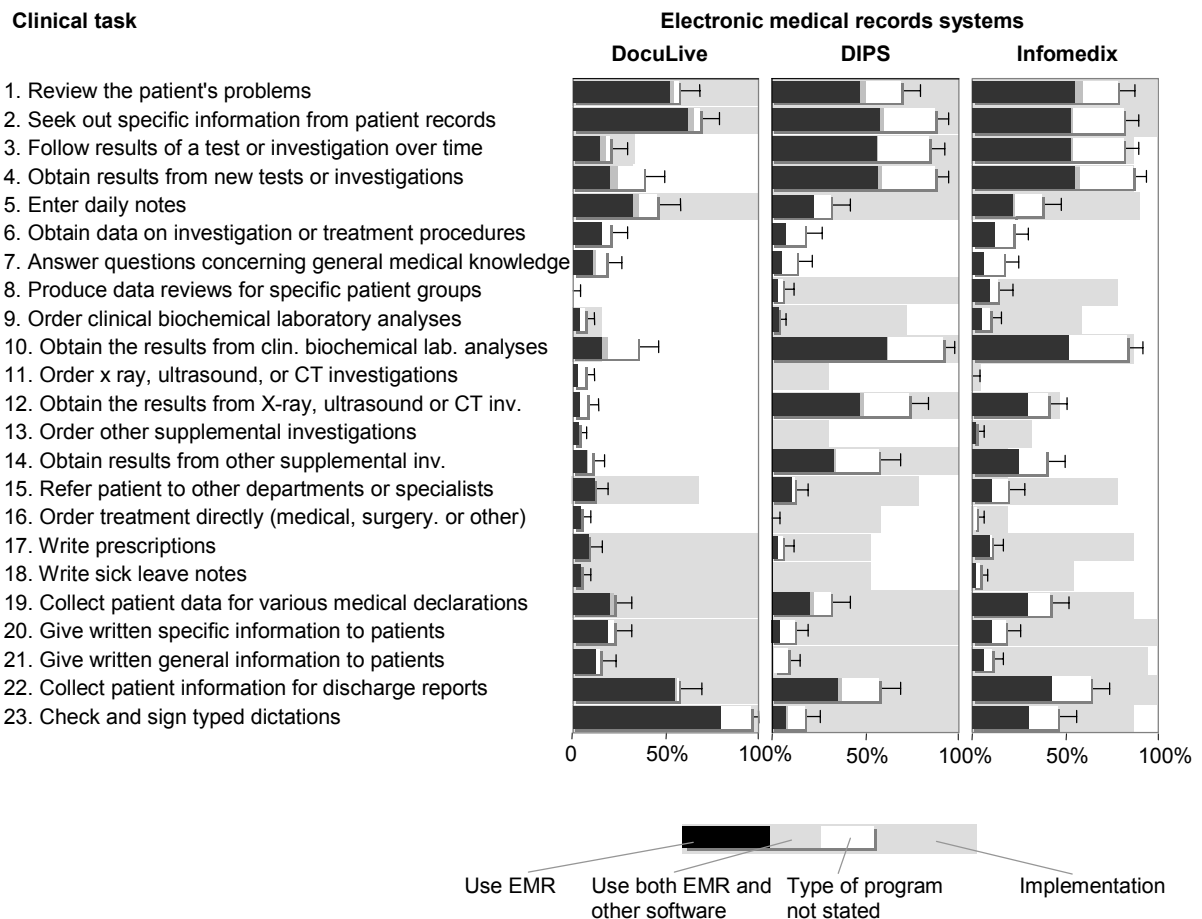


Figure 1 Reported use of computer programs for various clinical tasks by doctors from hospitals with different electronic medical records systems. Bars represent percentage of doctors who reported using computers at least half of the time for performing each task (black areas show those who used only the electronic medical records system, dark grey areas show those who used the system and other software, and white areas show those who did not state what program they used) and error bars show the confidence interval. Light grey bars in background show percentage of respondents for whom the electronic medical records systems offered sufficient functionality for the task.

Selection of participants, data gathering, and analysis

We randomly selected 32 hospital units (each with 4-22 doctors) in 19 of the hospitals with a licence for an electronic medical records system grouped by vendor. We excluded very small (<4 doctors) and very large units (>30 doctors) and those that had recently implemented an electronic medical records system (<3 months before). We distributed 314 questionnaires to doctors on 12 January 2001 and sent 134 reminders one month later.

The completed questionnaires were scanned with Teleform, and the data were analysed with SPSS for Windows version 10.0.8. We categorised the doctors' graded responses on their use of computers for general clinical tasks into two groups: those who used a computer for a certain task for at least half of the time normally spent on the task, and those who did not. The respondents who did use the computer for a certain task were further grouped by whether they used the electronic medical records system, another program, or both. However, some respondents (median 7%) did not state what program they used; we do not know whether these respondents overlooked the items or could not tell what software they were using.

Interviews with information technology staff

Key representatives of the 19 hospitals' information technology departments, involved in implementing the local electronic medical records, indicated through semistructured telephone interviews whether each clinical task in the questionnaire was supported locally according to certain minimal requirements (see Appendix B for details).

Results

Respondent demographics showed no effect on computer use

The response rate to our questionnaire was 72%, but we subsequently excluded two hospital units (eight respondents) because of problems with their implementing the electronic medical records system, leaving 219 respondents. Of the 208 who answered the question, 47 (23%) were less than 35 years old, 98 (47%) were aged 35-50, and 63 (30%) were aged over 50; 57/197 (29%) were women, and 140 (71%) were men; 123/205 (60%) were consultants, 74 (36%) were registrars, and eight (4%) were senior

house officers. There was no significant difference between different electronic medical records systems in terms of respondents' age, sex, or work position, nor any correlation between these terms and total computer use or user satisfaction.

Respondents scored high in computer literacy

To assess respondents' computer literacy we asked them about their computer ownership, typewriting ability, prior computing experience in solving specific tasks, highest prior frequency of computer use, and self rated computing skills. The mean summed score of this section was 72.2 out of 100, with little difference between the users of the three electronic medical records systems (69.6-76.0, analysis of variance $P=0.006$). The correlation with total computer use was 0.39, $P<0.001$.

Computers were available in the respondents' work places

Most respondents (203/218 (93%)) had computers in their offices, and 209/216 (97%) had computers available to them in other rooms used for clinical work. However, 85/214 respondents (40%) were weekly or daily prevented from using these computers because others were using them, and 94/214 (44%) were monthly or weekly hindered by computer errors or problems with passwords (3% were hindered daily).

Use of the electronic medical records systems was limited

Functionality of the electronic medical records systems

According to the information provided by information technology staff, most of the clinical tasks listed in our questionnaire were in some way covered by implemented functions of the electronic medical records systems. In general, 15 of the 23 tasks were covered for at least half of respondents: DIPS, Infomedix, and DocuLive supported 19, 16, and 11 of the tasks, respectively (fig 1).

The systems were mainly used for reading patient data

Only two tasks (tasks 1 and 2 on fig 1) were performed with the electronic records systems by at least half of the respondents. When we included those respondents who did not indicate what type of computer program they used, the number of tasks rose to seven (tasks 1-4, 10, 22, and 23). The median proportion of respondents using programs

other than the electronic medical records systems was 2% (interquartile range 1-5%); the highest proportions occurred in tasks where some of the records systems were particularly lacking in functionality (tasks 4, 7, and 10).

The number of tasks for which each respondent used an electronic records system was similar for each of the systems (mean number of tasks: DIPS 4.9, DocuLive 4.9, Infomedix 5.2; analysis of variance P=0.87). Only when we included those respondents who did not indicate what type of computer program they used did we find significant differences (DIPS 7.4, DocuLive 5.7, InfoMedix 7.8; analysis of variance P=0.002).

Considerable differences between systems in specific use

We found considerable differences in doctors' use of the electronic medical records systems when we compared respondents who were offered similar functionality (fig 2). Because of some functionality not being implemented locally, the groups of respondents are smaller than in figure 1, particularly for the DocuLive system.

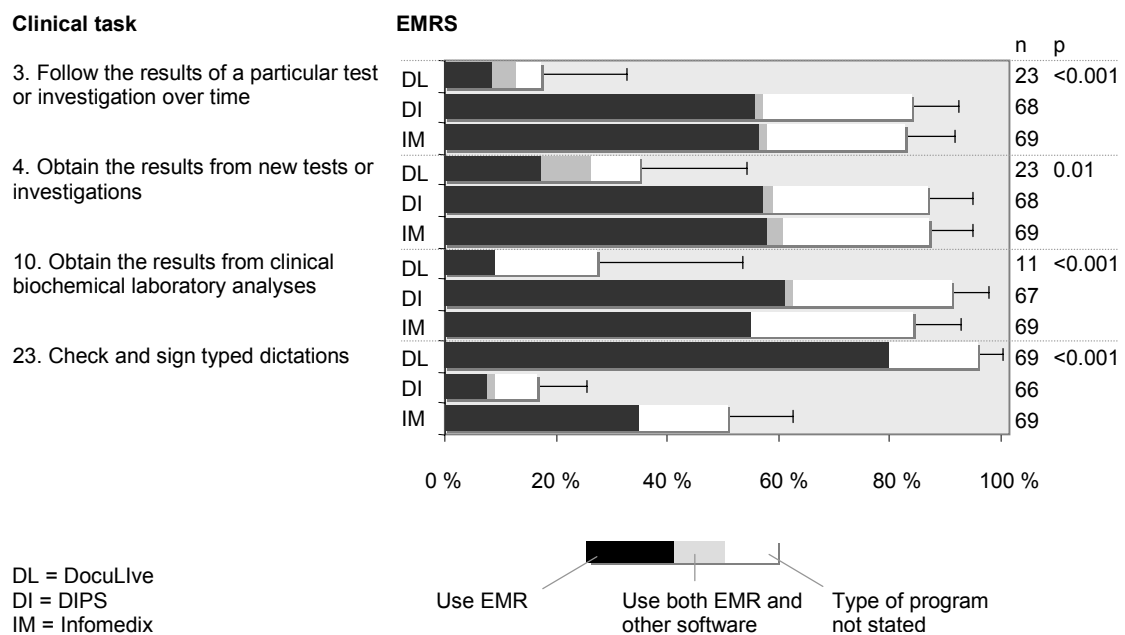


Figure 2 Clinical tasks for which significantly different percentages of doctors reported using three different electronic medical records systems that offered equivalent functionality. Bars represent percentage of doctors who reported using computers at least half of the time for performing each task (black areas show those who used only the electronic medical records system, grey areas show those who used the system and other software, and white areas show those who did not state what program they used) and error bars show the confidence interval. P values were calculated with χ^2 formula (equal P values were achieved with analysis of black areas of bars only and when grey and white areas were included).

Moderate user satisfaction

The user satisfaction scale consisted of five factors: content, accuracy, format, ease of use, and timeliness [11]. The mean overall score was 67.2 (SD 13.8) out of 100 (mean score for each factor: 56.9, 73.4, 70.4, 64.4, and 66.6, respectively). The DocuLive system scored significantly worse than the others (overall score 61.4 v 69.8 for DIPS and 69.7 for Infomedix; analysis of variance $P=0.001$), particularly in the content factor. The correlation of satisfaction with total computer use was 0.39 ($P<0.001$).

Discussion

Despite widespread implementation of electronic medical records systems in Norwegian hospitals, our results reveal a low level of use of all three electronic medical records systems by doctors, especially in the largest hospitals. The systems were mainly used for reading patient data, and doctors used the systems for less than half of the tasks for which the systems were functional. Among these unused functions were repetitive tasks such as writing prescriptions, which are apparently well suited for computers.

Essentially the same findings applied to all three systems, which suggests that similar results might be found in other countries. When the impact of an electronic medical records system is investigated, we suggest that its actual use should be considered rather than its claimed functionality.

Limitations of the survey

Our survey covered only doctors, but other healthcare workers probably also use the electronic medical records systems. We did not assess how frequently the various clinical tasks were performed nor how time consuming they were, making it difficult to weight them. Self reporting carries a risk of misinterpretation and bias, even when "value neutral" behaviour is investigated. Finally, the distinction between using the electronic patient records system and using a different computer application might not always have been clear to doctors.

Possible reasons for low level of use of electronic medical records systems

Access to computers and computer literacy

The low level of electronic medical records system use could be explained by a lack of available computers. This would, however, affect the use for all clinical tasks in a uniform manner. In addition, the majority of respondents reported that they had some computers available to them both in their offices and in the ward. The section covering computer literacy showed high scores, indicating at least a basic knowledge of computers. However, we cannot rule out potential unmet needs for specific training in electronic medical records system usage.

Flexibility of paper records

Paper based patient records are still in daily use in Norwegian hospitals. Thus the respondents could choose whether to use the electronic medical records systems. In some situations it might be more convenient to use paper records, such as for writing short prescriptions, spreading records on a table, or carrying documents around. Until a proper level of electronic integration is achieved, paper record will remain the most complete information source. In addition, the usefulness of an electronic records system for manipulating large amounts of data will not be apparent until historical information has accumulated for some time.

Traditional work routines

Our general findings of computer use conform to the traditional division of labour in hospitals - with writing (task 5) associated with secretaries, mediation of requests (tasks 9,11, and 13) associated with nurses, and reading associated with doctors. None of the electronic medical records systems seem to have stimulated the development of new or more advantageous ways of doing medical work [12], they have simply reinforced existing routines. This indicates that technology alone is not sufficient to achieve a well functioning electronic information system; organisational aspects must also be taken into account.

Working in new ways and performing tasks normally done by other professions often means disruption to established work roles, which may lead to local resistance [13].

Staff who take on extra duties do not necessarily enjoy the benefits of more efficient work patterns, and new reward systems may be needed for acceptance of new work roles.

Differences between electronic medical records systems

We found considerable differences in the frequency of use of the three record systems for certain clinical tasks (fig 2). DocuLive was often used for checking and signing, indicating that doctors were using it, but it was used much less than the other two systems for other tasks (3, 4, and 10). A possible explanation for this is the degree of integration with other computer software. Infomedix and DIPS were predominately installed in smaller hospitals, where the same vendor often supplied any other computer modules used, simplifying integration. DocuLive was introduced in the largest hospitals, where the organisational complexity is greatest and where many independent information systems already exist, making it difficult to develop an integrated information system [14].

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Contributors

HL and GE gathered background information on implementations of electronic medical record systems, and HL gathered background information on hospitals. HL and GE performed the observational fieldwork, and HL, GE, and AF defined the content of the questionnaire. HL designed the questionnaire, coordinated its translation, programmed the database, and registered the hospital data. GE and HL performed randomisation, information gathering on each hospital unit, and follow up for successful inclusion. HL distributed, scanned, and statistically analysed the questionnaires and interviewed information technology staff by telephone. HL, GE, and AF jointly wrote the manuscript. HL is guarantor for the study.

Footnotes

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Competing interests: None declared.

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Paper two:

Big is beautiful

Electronic patient records in large Norwegian hospitals

1980s – 2001

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Abstract

The introduction of electronic patient record systems (EPRs) has for many years spawned aspirations of improved quality and efficiency of health care delivery. Among general practitioners, EPRs are already in widespread use in most Western countries. Establishing EPRs in hospitals, especially the larger ones, has nevertheless proven notoriously difficult. The increase in organizational, institutional, political and technological complexity has been seriously underestimated. This paper describes and analyses the prolonged efforts – spanning close to two decades – of developing and using EPRs in the large, university-based hospitals in Norway. These EPR efforts in Norway should be recognised as negotiation processes involving a number of independent, partly competing initiatives with a varying set of allies. The investments involved were considerable, implying that a crucial aspect of these efforts has been the way alliances have been forged with public institutions and agendas. Based on a historical reconstruction, our aim is to explore three issues.

Keywords: electronic patient record systems, evolutionary approach, large hospitals, development strategies

1 Introduction

Reforming the health care sector, especially larger hospitals, is a high priority in all Western countries. It has, however, proved painfully cumbersome. As a result of the perceived lack of success by other means, the development, and subsequent

introduction, of electronic patient record systems (EPRs; or synonymously computer based patient/ health records, CPRs) has for many years represented a promising opportunity for implementing changes in work routines and organisation.

The experiences with EPRs in Western countries are at first glance confusing and beg many questions. EPRs are in common use within primary health care. Estimates vary, but around 90% of general practitioners in Norway are regular users of EPRs. When one attempts to introduce what is seemingly the same technology into a different social, technological and institutional setting – in large hospitals – the outcome is dramatically different. Despite a series of heavily funded national and international initiatives, the outcome has proven to be discouraging. Oddly enough, there does not seem to have been any systematic, comprehensive and critical evaluation of these efforts (although more narrow or restricted ones exist; see Massaro, 1993; Kushniruk et al., 1996; Safran et al., 1999; Sands et al., 1995; Lærum, Ellingsen and Faxvaag, 2001). EPRs have repeatedly been identified as “essential” (Dick and Steen, 1997) or “at the heart of the application of IT in health care” (Grimson, Grimson and Hasselbring, 2000: 50). It has, however, turned out to be remarkably difficult to establish more than fairly isolated pockets of use (Berg, 1998; Levitt, 1994; Szolovits et al., 1995).

This paper describes and analyses the prolonged efforts, spanning close to two decades, of developing and using EPRs in the large, university-based hospitals in Norway. In contrast to many other countries, the DocuLive EPR system developed in the Medakis project is actually used to a notable extent. Three of the university hospitals, Tromsø, Trondheim and Bergen have deployed the system quite extensively and have almost completed the implementation. (Trondheim, for instance regard themselves as 100 % finished) whereas at the National hospital and Ullevål (the largest hospital in Northern Europe) only 15% and 30%, respectively, has been completed.

The completeness of diffusion is however a non-reliable measure of the extension of usage. However, the users are currently – in line with the project aims – primarily physicians and secretaries. Available computers are well covered for these user groups. Computers are, for instance, placed in the physician’s offices, examination rooms and on-duty rooms. The other disciplines within the hospitals: nurses, occupational therapists, physiotherapists, psychologists etc. are to a large extent still not users although there are isolated pockets of use. The university hospitals together have nearly 6.000 defined users of the DocuLive EPR. And they have nearly 1.400 concurrent users

at a given moment on a normal working day. Roughly estimated, about 2.5 million documents are produced all in all, primarily physicians' notes.

The DocuLive project has been reasonably successful in the sense that the system has gradually been made available in an increasing number of the wards. In terms of organisational changes comparable to the initial ambitions, however, there are very few results. There has clearly been no revolution within these hospitals. Basically, the secretaries use it as a word processor while the physicians use it predominantly to read patient data and to sign previously dictated documents (Lærum, Ellingsen and Faxvaag, 2001). There is also very limited access to other hospital information systems such as patient administrative systems (PAS), X-ray examinations, laboratory requisitions and results etc. This implies that DocuLive for the main part serves as a stand-alone system, a repository for the physicians' text notes.

The EPR efforts in Norway were not part of one coherent IS project. On the contrary, these efforts should be recognised as negotiation processes involving a number of independent, partly competing, initiatives with a varying set of allies. The investments involved were considerable, implying that a crucial aspect of these efforts has been the way alliances have been forged with public institutions and agendas, including the Norwegian research council and the Ministry of Health and Social affairs.

Based on a historical reconstruction, our aim is to explore three issues. Firstly, we reveal the dynamics of these negotiation processes by analysing the translation strategies for enrolling allies, forging compromises and aligning initiatives. This draws on insights from science and technology studies in general and actor-network theory in particular. Secondly, we analyse how one modest and evolutionary initiative "lost" to a bolder and more ambitious one. More specifically, we analyse the way evolutionary approaches struggle to be perceived as legitimate and viable alternatives. Thirdly, we analyse implications for local control stemming from the vendor's recent emphasis on transforming the Norwegian-based solution into a "global" solution.

The remainder of this paper is organised as follows. Section 2 elaborates the research methodology. Sections 3 – 5 make up the historical reconstruction, formatted into three chronological periods. In section 6, the three issues outlined above are pursued. Section 7 contains concluding remarks.

2 Research method

This study belongs to an interpretative approach to the development and use of information systems (Klein and Myers, 1999; Walsham, 1993). Interpretive research methods adopt the position that our knowledge of reality is a social construction by human actors. That is, the data is part of a context that has influenced both us as researchers and the participants.

We rely on four types of data: participant observations, interviews, informal discussions and electronic and paper based documents. The participant observations were conducted over two periods by the first author at the University Hospital of Tromsø, one of the 5 participating hospitals in the Medakis project. The first observation took place during February 2000, and in total 19 hours were spent observing work. The second observation was conducted during January – March 2001, which included 4 different wards and 38 hours observation time. In sum: 7 different wards and 57 hours observation time. In all 7 wards the observations were especially aimed at work situations for physicians since they are recognised as a particularly important user group for the success of the project. Nevertheless, in some situations secretaries became involved, and in some meetings nurses were part of the group. On several occasions, patient examinations were also a part of the observation. During these periods, questions were posed in order to clarify and elaborate observations. The extent and format of the questions obviously varied with what was possible without intruding too much on the ongoing work. For instance, questions were postponed when the work was recognised as hectic, formal group meetings or in front of the patient. People did not seem to mind being observed. This resulted in a fluctuation between a fairly passive role, merely observing as non-obtrusively as possible, and a more active role when possible, posing questions for clarification and explanation.

In addition to the participant observations, we have conducted 9 semi-structured interviews during the spring 2000, each lasting at least 2 hours and during the spring 2001 we conducted 8 interviews.

In addition, during 1999 - 2001, both authors were engaged in more informal discussions with approximately 25 actors involved in the Medakis project.

Through students supervised by the second author, we have also had access to 12

transcribed interviews with the vendors.

We have had access to a number of electronic and paper based documents. We have gained access to two comprehensive archives belonging to two of the key actors among the policy and decision makers. They were the Norwegian Research Council, a principal sponsor of EPRs in the years immediately preceding the Medakis project, and KITH (centre for IT in health care), a publicly owned agency aimed at establishing IT related standards in Norwegian health care. In addition, we have had access to contracts, memos, specifications and documentation within the Medakis project. We also have access to the electronically based collection of drafts and reports within the CEN TC 251 activities within EPR.

3 Reforming health care through industrialisation (1980s – 1992)

The concerns for curbing mounting health expenditures are omnipresent, also in Norwegian political life. The government has fuelled and spawned a series of proposals and reforms. In 1995 the government established regional collaboration committees within the health regions in efforts to streamline the health sector. The goal was to exploit existing resources within regions, which meant more hospital collaboration and centralisation of services. 1998 was the first year in which counties as well as most hospitals were funded by a combination of block grants and per case financing. Treatment costs are calculated for groups of patients, and based on the DRG-system. In this way, the hospitals should be reimbursed in accordance with their activities and, accordingly, strive for more efficiency. The use of information technology was also pointed out to have an important role in striving for efficiency improvement (SHD, 1997). A recent governmental initiative is recognised as trying to centralise the administration of the Norwegian hospitals. The current role of the Norwegian counties as hospital owners is supposed to be replaced by a few health enterprises that will coordinate hospital activities and, in some sense, work according to market principles.

The early initiatives to develop EPRs in hospitals in Norway were formed by combining these (constant) concerns for rationalising health care with a perceived opportunity to foster commercially interesting industrial products.

Norway in the early 1980s was experiencing a period of relative economic stagnation. As a result, the Norwegian Research Council attempted to play a more proactive role in launching initiatives that were identified as having potential for commercial exploitation. To the slight surprise of some, the use of IT in the health care sector was identified as one such area. As one of the later seniors at the Research Council expressed it:

“I was a bit surprised that the highly technology-oriented [section of the Research Council] adopted this, and scaled it up to a rather large program (...) There were not many vendors and few eager users”

Nevertheless, the Research Council acted as a strong, proactive force in the mid-1980s. Especially important, a NOK 80 million major research programme aimed exactly at IT in the health care was established. As noted in the above quote, few if any vendors were present before this programme. But as outlined further below, they did surface together with this initiative by the Research Council.

The health care sector was, from the point of view of policy makers in the Research Council, a largely backward sector where organisational reforms were rare or absent:

“Health was a big and expensive sector with increasing demands for services (...) it was becoming even bigger (...) we could also see that the sector would not develop very fast by itself (...) and was in need of a push”

Or:

“This was a sector where, if you in one way or another did not do anything then, according to the way these sectors organise their services, everybody becomes either hospitalised or an employee (...) the productivity would become pretty bad – there has not exactly occurred something revolutionary lately”

In the more slogan-like formulation of one of the early initiatives, the aim was to

"make the same revolution for the national health service as word processing has done for office work"

In forming the large research and reform program “IT and health care”, crude estimations of efficiency gains were presented to:

"save 10% of nurses' time, 10% of the physicians' time and 20% of the secretaries' time...then the hospital will save about 4,2% of the total labour costs"

or, in a related, yet non-quantified manner:

“The manual information routines are no longer satisfactory (...) a lot of resources are spent searching for information, i.e. search for lost patient records (...) by appropriate use of information technology (...) by making information more available, it should be possible to increase health personnel's information management”

These expectations were not only present with the vendors and the Research Council. Also within the management of the larger hospitals, similar concerns were raised and the crucial role of IT emphasised as illustrated by the following letter:

"There are large efficiency gains in the Norwegian health sector through efficient use of information technology"

This was to take place by altogether eliminating the highly entrenched paper based work routines:

“To make a media change from a paper-based patient record to an electronic-based patient record”

The National Institute of Public Health (NIPH),¹ was an Oslo-based centre that was active in building up a centre for medical informatics and the use of IT in health care. The need for such a centre in medical informatics was supported by the Ministry of Health and Social Affairs as it was perceived as essential to facilitate the communication of problems and solutions in health care. This was expressed in an application to the Research Council as "a competence centre in medical informatics is important in order to achieve a constructive interplay between health professions and informatics". The NIPH itself perceived it as being of vital importance that the NIPH was assigned the role as such a centre, as one of their external project partner explains:

"The NIPH has strong, political interests in demonstrating that it can be a centre for medical informatics"

This role was not challenged by anyone in the years up to the mid-1980s, implying that at this stage, the NIPH was largely the de-facto centre for medical informatics in Norway, and accordingly played a central role in the activities in these years.

¹ Norwegian: Statens institutt for folkehelse

The ideas of reforming health delivery at the largest hospitals through the establishment of EPRs were first picked up by the NIPH. In collaboration with Norsk Data, the flagship of the Norwegian IT industry (but nonetheless in a desperate search for supplements to their mainframe based portfolio), they initiated the NORA project aimed at designing EPRs. The Research Council was generous in sponsoring this work as NORA was perfectly in line with the ambitions of dramatically reforming, if not revolutionising, health delivery. It aimed at capturing all relevant medical information as indicated in an early status report:

“Principally the project will embrace all patient related information, but will in the first run focus on the medical information. Such information is to a higher or lesser degree related to the nurse record, the physician record and the patient chart. Most of the medical information exists in one of the three information elements, or is connected to routines that are based on one of these [elements]”

The high ambitions regarding what NORA was to accomplish in terms of reforms was not obvious to all the designers, as one of them later recalls:

“Suddenly we got a much broader scope – now it should be a patient journal for a whole hospital (...) and what happened was that in the beginning we used a very long time in order to establish a requirement specification. Our project leader emphasised that it was necessary to really focus on the essence – what is needed to make a system that can replace the paper-based patient record in hospitals”

The primary goal of the NORA project was to replace the paper-based patient record by making a complete electronic version; “a Rolls Royce in the first round” as a lobbyist put it. Two of the hospitals (The National hospital and The Norwegian Radium hospital) withdrew from the project, as they were frustrated with the lack of results in efficiency. Especially the investments in terms of training came as an unpleasant surprise.

4 The battle of systems (1992 – 1996)

The Norwegian Research Council did eagerly and proactively back the NIPH-based NORA project. It was portrayed, on the one hand, as a crucial vehicle in reforming the reluctant health care sector, and, on the other hand, a commercially interesting product

to market. What remained at this stage in the early 90s, was to materialise this vision to a suitable vendor. Given the bias of the Research Council towards national players, this translated into a quest to identify and enrol a Norwegian vendor.

What unfolds during this period spanning the former half of the 90s is that two competing projects emerge. The former is based on NORA but eventually gets aligned with an industrial partner. The latter, called Medina, develops in opposition and alongside NORA. Medina emerges with a different set of allies among the university hospitals, a different vendor and a different vision for EPR. We describe the formation of these two in turn.

NORA's search for an industrial partner coincides crucially with beginning of the end of the Norwegian pride in the IT industry, Norsk Data (ND). ND was experiencing mounting difficulties and were desperately seeking a new opening to supplement its mainframe-based portfolio.

“ND had begun a decline (...) and they needed a PC commitment/effort – that was clear. And Rolf Skår was very interested – he felt that it corresponded well. Thus it was supported by the leadership in ND. That is why it was pushed into ND (...) and they became the industry partner.”

With its traditionally tight relations with the Norwegian Research Council, ND was early on identified as the "obvious" industrial partner in the NORA initiative. The commercial goals were explicit:

“The project has failed if the result is not taken to the Scandinavian market (...) the product should be prepared to be adjusted to other European countries”
(revised project plan 14.10.88)

ND's engagement in the NORA project was a bit hasty; they were more or less thrown in with the existing group at NIPH. This group quickly took over control as a result of their experience within health care:

“I believe that things could have been very different if ND had used their own experienced development resources in the project and not only used the development team on NIPH (...) then I believe that the technical solution would have been different, as well as the drive to get a product that both worked and was stable”

As a result of ND's continued (and subsequent fatal) problems, ND was reorganised into independent business units. One of these units was InfoMedica, which was to deliver IT solutions to the health care sector. The responsibility for the NORA project was now transferred to InfoMedica. InfoMedica was generously supported from the start as they effectively consumed the significant part of the Research Council's new programme on IT and health. As one of the seniors at the Research Council recalled:

“According to my predecessor, it was they who had created InfoMedica, i.e. it was the program board’s intervention that resulted in the establishment of InfoMedica.”

Similarly, as expressed by the first CEO of InfoMedica:

“InfoMedica was the result of a lot of Research Council money, NOK 15 million a year during 1990 - 1992 ”

Unfortunately, the results continued to lag behind expectations. In 1992, the Research Council’s money was spent and InfoMedica had no real interest in continuing the project:

“there was no more money left [of public funding] (...) and it became a question of survival (...) the project-time in NORA was continuously extended and more resources were needed (...) they had to concentrate on those products that they had income from. They could not manage, economically”

This, obviously, was a severe setback for NORA/ InfoMedica. For NORA, this was the beginning of a few years of uncertainty until they again were backed by a vendor (see below). In the meantime, several key figures within NIPH/NORA engaged heavily in international standardisation of health information within ISO/CEN. From 1992, Petter Hurlen became the project team leader for CEN TC251 (Medical informatics) project team 011, Medical records. He also became the Norwegian representative in the European Standardisation Organisation's Technical Committee for Medical Informatics (CEN TC251), member of CEN TC251 workgroup 1 and 2 (WG1 and WG2), responsible for WG1’s task force about journal notions, member of TC 251’s project team PT001, Introduction and PT003, Model for representation of semantics. He also participated in the National standardisation work. In this sense, much of the rationale behind NORA was fed into, and influenced, the international standardisation efforts in these areas.

After failing to hook NORA up with InfoMedica, and after the moderate success of marketing the NORA concepts through international standardisation activities, NORA was really up for grabs. Public funding had dried up. Without much ado, Siemens acquired NORA, the product along with the design team at NIPH, at a symbolic price. Hence, one solution for EPRs emerges, namely Siemens' NORA (repackaged as DocuLive to be closer aligned with Siemens' existing portfolio of electronic archiving systems).

During this period, an alternative EPR project called Medina emerged. This project had started off more modestly and was rooted in some of the university hospitals. Previously, these hospitals had explored the usefulness of templates in the production of text. Medina was intended as a supplement to the already existing paper-based patient record. This was a pragmatic approach that would give them a solution in 1-2 years' time. The primary aim for the hospitals was to create a tool that could help them in their daily clinical work, that is, to improve the production of text and even to automatically generate discharge letters. As a result, the initial primary target group became the secretaries, who were explicitly identified as the "easiest" user group to deal with, compared to nurses and physicians. Another important feature was that, as this project was anchored in the university hospitals, the hospitals had ultimate control of design and implementation strategy.

The Medina project was formally established in 1992 and included three of the five university hospitals in Norway. The hospitals were RiTø (Tromsø), RiT (Trondheim) and Haukeland (Bergen). In establishing such a project, they realised the need for political and economical support. Therefore they involved KITH (a publicly owned agency aimed at establishing IT related standards in Norwegian health care). KITH supported the initiative and got the role as the project leader. GPI (Gallus Plessner Industries) became the industry partner because they had worked for the hospitals in other IT-related projects. SND (a public agency aiming at supporting regional industrial initiatives) supported the project with NOK 1.7 million.

Medina explicitly adopted a bottom-up, not top-down approach. It aimed at supplementing and augmenting the existing work routines rather than radically changing them. The Medina project decided that they did not regard the patient record as the primary system in the hospital. Instead they regarded the electronic patient records as just one element in the total documentation constituted by the patient record (Ellingsen

and Monteiro, 2001), both in terms of paper documentation and other information systems. In addition, there was a very conscious aim to postpone major organisational changes as long as possible. For instance, Medina focused primarily on secretarial work and text processing (not images, ECG, and so forth). As captured by the later vendor's roadmap, this translated into:

“aim[ing] especially at the secretaries’ need for document-production support. The use of “standardised” information elements (sections, variables, standard texts) in the template construction and document production [discharge-letters] organises a detailed and effective information retrieval (...) the system presupposes the establishment of on-line communication for the retrieval of information from the current PAS-system” (vendor’s Roadmap, 1996)

In Medina, the structuring of the content enabled retrieving of information cut across all other archive keys. This was connected to pre-indexing of the content in the EPR, a concept that was later known as TIEs (Tagged Information Elements). For instance, if the user was interested in the “heart” of a patient, then it was possible to get all information related to the heart. One from the development team said about TIEs:

“In a way we managed to introduce it in the system without the secretaries noticing because they got only the templates. And those templates contained hidden information about how the content was constructed. Thus, it was no extra work for them”

By the mid-1990s, then, the situation was characterised by two alternatives: Siemens’ DocuLive and GPI’s Medina. They were significantly different along key dimensions such as: level of ambition (bold versus modest) and public funding (massive versus moderate). At this time it also seemed clear that two fronts had appeared in the Medina project. The two university hospitals in the north (RiTø and RiT) were strongly united while the third (Haukeland) now turned to the National hospital as an ally. The two fronts were characterised by different objectives and strategies. As a means to break the tie, the hospitals decided to extend the project to include all of the five university hospitals into one common project. The project name was changed from Medina to Medakis since the National hospital at that time was working on an activity management system (Akis). ‘Medina’ + ‘Akis’ were transformed into ‘Medakis’.

Strong political pressure contributed also to the extension of the project. The situation in the mid-1990s was influenced by the efforts of the Ministry of Health and Social Affairs Minister (Gudmund Hernes) to streamline the health sector. One objective was to promote more collaboration within the health regional clusters (health regions) and thus regional committees within each region were established. A lot of public funding was allocated to these areas. Thus, in order to get funding, a joint EPR project was crucial, as pointed out by a manager from one of the former industrial partners:

” there was considerable political pressure towards the hospitals to enforce collaboration in order to get funding”

A national EPR project like Medakis, however, cut across the health regions and thus did not exactly comply with the requirements for funding, but as the director of KITH emphasises:

“The Ministry said that this is so important that we put aside the capital for common use in the project”

Accordingly, there was a strong incentive to find a uniform solution, as the Ministry took it for granted that uniformity was an important goal:

“Regarding such an EPR project, it was clear that I had considerable support in him [Gudmund Hernes]” (ibid.)

Beyond supporting the development of a joint information system, the Ministry recognised this as a test for the hospitals’ ability and willingness to cooperate as explained by one of the managers from KITH:

“The Ministry was not only interested in the IT-part. They were also interested in assessing the university hospitals’ ability to cooperate, something valuable in other projects as well”

However, the major challenge still remained – the choice of a vendor, Medina or DocuLive. This became a materialisation of the strategy of the north-south block, as a project member from the north block recalled:

“Haukeland and the National hospital wanted to go straight ahead to Siemens and DocuLive, but the rest of us had objections to varying degrees”

The reason was that these hospitals considered the GPI to be both too small to manage the joint project as well as being a vendor that lacked ambitions. With that, the hospitals

agreed to invite a bid for tender. Before the bid for tender was closed, however, Siemens “strengthened their position” by buying Medina from the GPI. In other words, Siemens acquired their only serious competitor. As a Siemens leader expressed it:

“If the Medina project had slipped away to one of our competitors while we held on to DocuLive, we would have got more fragments in the market – a market that already was too fragmented and too small for doing something”

Obviously, this was a big risk, which Siemens recognised:

“[In this phase], I believe that the hospitals felt that we overruled [them] (...) and that it was the ‘power’ and the ‘capital’ that was in control – because after all Medina was their project and their initiative”

As a ‘carrot’ in this process, Siemens suggested a unified requirement specification. This point was crucial in order to get the contract. Nonetheless, it provided the hospitals with a lot of freedom in shaping it, because, roughly speaking, they could dictate the unified specification themselves. Another factor that enabled Siemens to persuade the hospitals was that Siemens presented a development plan – a merge-plan - that stated that the functionality of DocuLive 2.1 and Medina 4.0 should be merged into one product.

This merge-plan constituted a compromise, a boundary object (Bowker and Star, 1999) that allowed the Medina lobbyists to recognise “their” product in the Medakis product. The plan spelled out a step-wise integration of the two earlier, independent initiatives. In this way, Siemens managed to present themselves as enrolling everyone's interests.

The contract between Siemens and the university hospitals was signed in May 1996. Also this time the effort was strongly supported by public funding. The Ministry of Health and Social Affairs supported the project with NOK 20 million. Siemens was also able to get NOK 1.6 million from SND that had been set aside for the second phase of Medina.

5 Going global (1996 – 2001)

Having flattened the opposition and gained control of the Medakis project, the next task for Siemens was to deliver what was promised in accordance with the uniform

requirement specification. A key ingredient here was integration of DocuLive and Medina, both in terms of functionality as well as design approach (through the development teams), together with keeping the university hospitals satisfied. These challenges were significantly underestimated.

A major point that hampered the deployment in the hospitals was that considerable adjustments had to be made for each hospital, a process that took more time than estimated. An employee from Ullevål expressed himself in this way about the progress in local accommodation of DocuLive:

“First, we asked for a ‘BigMac’, but that became difficult and was too much. Accordingly we accepted a ‘regular hamburger’ instead, which also became difficult. So we ended up with only the bun” (M1)

This resulted in 1997 in a delivery "crammed with errors" which the hospitals were close to rejecting. Payment was at one stage held back.

Siemens, for their part, felt that the hospitals did not adopt a sensible tactic because, as a manager in Siemens argued, “situations do not improve whenever payment is retained” (SPL1). And according to the contract, “there was no acceptance period”. That means that *when* the product was delivered, *then* it was accepted. That implies that, from the point of view of Siemens:

“[the hospitals have got what they have asked for even if the hospitals believed that they got [should get] something else” (SPL1)

In response, Siemens attributed the problems to the contract itself:

“The specified requirement for the product was quite hopeless; just ask anybody. It was completely horrendous, and only about ten percent of what should have been considered was thought of. This, then, was our starting point; that it was meant to be a synthesis of Medina and DocuLive. And then a little more than first meets the eye will happen. And it certainly did.” (DEV1)

In this phase, according to Siemens it was the “responsibility of the vendor to define what the merge should contain – and then, in the final phase, the hospitals should be included in further development of the product” (DEV 1). However, the implications of not including the hospitals appeared to be an inadequate strategy, as one of the developers recalled:

“When we delivered something to SiA² we knew the outcome because we had continuous discussions with the users (...) But I would never have felt sure [of the outcome] if I was supposed to develop something without presenting it before delivery” (DEV 2)

The leadership in Siemens now argued that a merged version of the functionality in Medina and DocuLive 4.0 was beyond their scope:

”DocuLive 4.0 [the merged software] did not have the possibility to do what each of them did separately (...) If we should include everything in the 4.0 we would be making a 4.0 as a 5.0 before we made the 5.0. Then we would be doing the job twice. That means that a part of the functionality will not come before 5.0”

which is further emphasised by one of the developers:

“The hospitals may have thought (...) that we agreed on what was supposed to be delivered and that it was included with several known errors. Of course it was not a system ready for production, but it should reasonably demonstrate the system” (DEV1)

which is clearly stated in a letter from Siemens to the hospitals:

“It was never the intention that the product should be placed into regular operation 01.09.97” (letter from the hospitals’ attorneys referring a letter from Siemens to the hospitals)

Obviously, the task appeared to be far more complex than anyone had predicted and Siemens had difficulties in delivering what the hospitals expected, and had underestimated the requirements of the university hospitals and their complexity.

In an effort to get out of a cramped situation, Siemens has recently aimed more explicitly for a “global” product. In this way, the influence of the five Norwegian hospitals was downplayed and marginalized although the level of ambition has increased. The objective is now to make DocuLive a “global” product in the world market. Siemens has lately acquired a major US-based company (Shared Medical Systems) within the health market and is currently one of the largest vendors within

² The Central hospital of Akershus, a middle sized hospital in terms of size and functionality

health care and IT. DocuLive EPR (or Common EPR as it was renamed) has been incorporated as their major application in this portfolio. A part of this global effort has also been to align Medakis with another large Siemens EPR project in Sweden (Melior).

For Siemens, the Norwegian based Medakis project is but a stepping stone – an arena for exploration and testing – what they see as part of their global strategy for incorporating the product, DocuLive EPR (or Common EPR as it recently has been renamed) as the health care application in their portfolio.

As outlined above, the Medakis project has aligned with earlier EPR initiatives in Norway and Europe in aiming for EPRs as the integrating cornerstone in organising hospitals' information systems. After four years, there are few signs of any decrease in this level of ambition. On the contrary, the recent strategy of Siemens to use Medakis as an element in their international promotion of EPR has reinforced the pressure on Medakis to subsume other information systems and replace them by EPR-controlled modules. A senior manager explained:

“Instead of having many specialised systems you get a system that contains modules that can be added when needed. In that way you can let go of many specialised systems that have to be mutually integrated (...) [for instance] a PAS-module is planned in the next version of DocuLive EPR”

As a result of the global strategy, the five Norwegian hospitals agreed to downplay and marginalize their own role vis-à-vis Siemens in the Medakis project, as was underscored by a hospital project member:

“the hospitals have chosen to let go of control in order to get an international product”.

Accordingly, the implication is, as underscored by another hospital project member:

“Our responsibility is reduced to follow up milestones. The only thing we can do now is to wait for results”

According to senior Siemens executives, the loss of local control that the hospitals have in the Medakis project is more than compensated by the increased resources and attention Siemens pays to Medakis to prepare it for global sale.

6 Analysis

6.1 Compromises and allies

As iterated within studies of technology in the making, the process of developing and introducing EPRs in large Norwegian hospitals is characterised by improvisations, compromises and alliances (Law 1992; Latour, 1999).

The efforts of rationalisation within the large hospitals in Norway were initiated due to an alignment of the perceived potential for commercial value generation (initially by the Research Council, later by the then primary representative for the Norwegian IT industry, ND) together with health managers' ambitions for cost-cutting and improved quality.

The proactive role of the Research Council, aligning the reformation of the health care sector with an industrialised product for EPR, was in the early stages essential, as were the prolonged efforts of enrolling a Norwegian vendor.

The vital step in 1996 of signing a contract for the joint development of EPRs would not have materialised without conditions arranged by the Ministry of Health and Social Affairs, like the commitment to uniform solutions, cooperation and the associated funding opportunities. The seemingly perfect solution of "merging" the competitors DocuLive and Medina - essential as it avoided confrontation - was seriously underestimated. As a manager of the KITH states in hindsight:

”Afterwards we have realised how difficult it actually was to integrate the Medina- and the NORA philosophy, [both] professionally and technologically. It is not merely a question of melting communities of practice together”

This implied that the merge only applied at an espoused level, never in substance.

6.2 Big versus small

In the initial stages, NORA needed grand ambitions to mobilize support for their EPR-project. There were two obvious reasons for this. Firstly, the Research Council needed means that both could contribute to revitalize the broken Norwegian economy and reform health care. Secondly, as Norsk Data in the early 90s experienced financial

difficulties they strongly needed new commercial markets. Consequently, both of them were looking for partners that could fulfil their ambitions. NORA was seemingly capable of filling such a role, and managed to enroll both the Research Council and Norsk Data by leveling up their own goals accordingly.

In the middle of the 90s, two competing projects existed, the grand DocuLive (the former NORA) and the moderate Medina. The contest ended as Siemens flexed economic muscles and basically outplayed its competitor. This acquisition could occur without much ado for two reasons. Firstly, the Ministry of Health and Social Affairs would fund the EPR project provided that the hospitals collaborated on a common EPR. Secondly, two of the hospitals considered the Medina project to be too small and with a vendor that lacked ambitions. The “smallness” in Medina was, for instance, expressed in an explicit focus on secretaries' work, based on the assumption that changes would be easiest there, and the comprehension that after a couple of years' use the EPR would be more attractive for the physicians as the information base would have increased. Another such expression was that Medina aimed for co-existence with the variety of PAS systems rather than aiming for their substitution.

An important strategy for Siemens, in order to match the widespread high ambitions, was to incorporate the existing variety of information systems into an all-encompassing EPR, as it was emphasized in the project documentation:

“Create a common platform for a multitude of customized EPRs; Powerful enough to support all health-related information and legal aspects; General enough to serve as a basis for a wide variety of hospital information systems”
(Siemens, 1997)

It is clear that such a strategy also would suit Siemens' own interests, as an international industrial player, of grabbing the lion's share of the Norwegian EPR-market.

However, the visions of an international product and an all-embracing hospital system are not the end point – the prospects of an Application Service Provider (ASP) model are transparent in the current plans as a hospital manager emphasized:

”Now, we challenge Siemens to elevate DocuLive to a concern level. We believe in jointly running DocuLive for all our hospitals in the region. That implies that we wish to have the patient record for Odda, Stord and Voss in the same database as Haukeland (...) for us it is essential that the small hospitals shall have

the same as the big – in that way we can over time include them in a complete concern”.

6.3 Local involvement, global reach

By buying Medina, Siemens had put themselves in an exposed position as regards future negotiations with the hospitals. After all, the local influence in Medina was rather high. Nevertheless, if Siemens could come to terms with the hospitals the position could prove to be beneficial. They managed - but as a part of the deal Siemens had to offer a unified requirement specification almost solely shaped by the hospitals. In other words, Siemens had to tolerate a high degree of local involvement. As a result, this merge-plan constituted a compromise, a boundary object (Bowker and Star, 1999) that allowed the Medina lobbyists to recognize “their” product as a part of the Medakis project.

The combination, however, of the project’s high ambitions and high degree of user involvement proved to be catastrophic. The espoused vision of an equal merger between DocuLive and Medina never materialized. When Siemens realized that the cost of such a merger were far beyond the estimated benefit, they marginalized the hospital influence by stating that the vendor should decide the integration strategy solely. The hospitals, for their part, accepted to loose almost all local involvement as Siemens promised to put more resources into the project and make an international product out of it.

Already a major player, Siemens has in the last years acquired a number of international companies active within IT and health care, especially in the US. This implies that from a relatively slow start, Siemens is currently strengthening its efforts dramatically within this area. It is, in effect, one of the most influential vendors globally. This change has, from the point of view of the Norwegian university hospitals, primarily been perceived as a higher threshold to implement changes, making local influence more illusory than ever.

7 Conclusion

The history of EPRs in Norway has been, and still is, characterised by competing agendas and a range of actors. It is anything but a tidy project with clear goals and well-defined phases. The conditions for small-scale, bottom-up and evolutionary approaches

- signalled by the Medina initiative - never succeeded in constructing themselves as a viable alternative to the larger, more sweeping DocuLive initiative, reiterating a more general tendency to privilege the more comprehensive and daring projects.

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Paper three:

A patchwork planet

Integration and cooperation in hospitals

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Abstract

The “seamless” integration of a collection of information systems has been recognised as vital in promoting and realising the collaborative aspects of work. This emphasis on the collaborative role of integration supplements other studies in CSCW focusing on more singular tools for collaboration. Empirically, we analyse the design and use of an electronic patient record system (EPR) in large hospitals in Norway. We discuss the conditions for and types of integration of EPR with the host of related information systems in hospitals. We formulate design principles for the integration of collaborative information systems based on a pragmatic study of the productive role of redundant, fragmented and ambiguous information.

Keywords: Electronic patient records (EPR), integration, hospital information systems, collaborative work practices, redundancy, fragmentation, ambiguity

1. Introduction

A by now thoroughly re-iterated lesson is how coordination, communication and sharing of information in organisations is inhibited by the proliferation of non-integrated, incompatible information systems (McNurlin and Sprague, 1997; Schmidt and Bannon, 1992). Clearly, collective work in organisations presupposes a minimum of compatibility of understanding and practices. Incompatibility among information systems arises from differences in scope, use and responsibility across sites and organisational units and spawning counter-measures, i.e. strategies of integration.

Despite prolonged efforts, it is fair to hold that “integration has been the Holy Grail of MIS since the early days of computers in organisations” (Kumar and van Hillegersberg, 2000:23). A pregnant and relevant expression of how integration is expected to enhance collaboration is embedded in the recent interest into Enterprise Resource Planning (ERP) systems as they “promise the seamless integration of all the information flowing through a company” (Davenport, 1998:121). Despite early awareness of the collaborative aspects of integrated information systems (Schmidt and Bannon, 1992:21-22), a substantial fraction of studies within CSCW has focused on singular tools, artefacts, protocols and coordination mechanisms. Our focus on the collaborative aspects of integrating information systems feeds into the revitalisation of this early agenda (see also Hartwood et al. 2001; Symon, Lang and Ellis, 1996).

Strategies and approaches to integration vary (Hasselbring, 2000) and include technical solutions like federated database systems, World Wide Web and EDI (Grimson et al. 1998:124) as well as Enterprise Resource Planning systems. In addition, object oriented technologies such as CORBA¹ and COM² have emerged as a promising way to enable integration, as they are independent of programming language and operating systems.

Defining technical integration strategies does not, however, solve the problem related to the mutual *autonomy* between the components (Hasselbring, 2000; Sheth and Larson, 1990). In the following, this is a key aspect as we focus on one approach – historically influential and currently exemplified by Enterprise Resource Planning systems – based on a dominant, central database, which other information systems need to comply to. The modest success to date of curbing fragmentation, redundancy and heterogeneity of information systems warrants a critical examination of the implicit and explicit assumptions in the pursuit of “seamless” integration.

Our analysis is aimed at addressing the following set of issues: how do users cope with non-integrated information systems; what are the “costs” and benefits in practise of information systems that are fragmented and contain redundant information; to what

¹ The OMG (Object Management Group)’s CORBA (common object request broker architecture) is a wiring standard that enables communication among objects that are programmed in different languages and supported by different operating systems (Szyperski, 1999:22-23).

² COM (component object model) is a standard maintained by the Microsoft dominated Active Group, a part of the Open Group (Szyperski, 1999:23).

extent should such core systems subsume and include other information systems; under what conditions is redundancy of information productive. The overall ambition of this paper is to provide guidelines for the design of integrated information systems aimed at supporting collaborative work practices. This amounts to specifying the conditions; extent and nature of integration taking into account the role of redundancy and fragmentation in practical, everyday, collective work settings. We pursue these issues through a particular instance of this problem, namely a study of electronic patient record systems (EPRs; or synonymously computer based patient/ health records, CPRs). This paper is drawn from the ongoing, large-scale Medakis project promoted by the Ministry of Social affairs in Norway establishing EPRs (dubbed DocuLiveEPR) at the 5 largest hospitals in the country³. Exactly as with Enterprise Resource Planning systems, EPRs in large hospitals are expected to promote collaborative work configurations by integrating information and information based processes across departments, among different types of users and over time (Hartwood et al. 2001; Grimson, Grimson and Hasselbring, 2000). Currently, hospitals typically have an abundance of poorly integrated information systems including patient administrative systems, laboratory systems, specialist systems of numerous kinds, a range of sensory/ graphical input devices such as X-ray, ultrasound, EKG and computer-tomographic images together with paper based records and indices (Grimson et al., 1998:124)⁴.

Despite a series of heavily funded national and international initiatives, there is only very modest success in establishing working EPRs in large hospitals. Oddly enough, there does not seem to exist any systematic, comprehensive and critical evaluation of these efforts (although more narrow or restricted ones exist; see Massaro, 1993;

³ The Norwegian health care system is a predominantly public one with marginal private services, mostly outpatient ones. There is a growing pressure, supported by a set of targeted efforts, in transforming the budgeting of the public health sector to a more production oriented mode, in an attempt to curb rising expenditures. On a trial basis, the Government reimburse about 20% of the hospitals' expenditures based on a DRG (Diagnosis Related Groups) coded account of their production. The health care sector is organised into three levels: primary health care, small hospitals and five regional hospitals (together with a couple of national ones). Our study covers two of the regional hospitals.

⁴ At one of the two hospitals covered in our study, paper records are estimated to occupy 16 km of shelves. The number of distinct information systems at the two hospitals is estimated to be 40-60 by the IT departments.

Kushniruk et al., 1996; Safran et al., 1999; Sands et al., 1995; Lærum, Ellingsen and Faxvaag, 2001). EPRs have repeatedly been identified as “essential” (Dick, Steen and Detmer, 1997) or “at the heart of the application of IT in health care” (Grimson, Grimson and Hasselbring, 2000:50). It has, however, proved remarkably difficult to achieve “seamless” integration and to establish more than fairly isolated pockets of use (Berg, 1998; Levitt, 1994; Szolovits et al., 1995).

In section 2, we briefly outline the collaborative aspects of integration of information systems. We discuss how the strategies of integration for management information systems, for EPR in general and for DocuLiveEPR in particular share important similarities, namely privileging centralised solutions. Section 3 describes the setting of the case and reflections on the research design. In section 4 we present three case vignettes containing illustrations of collaborative work with and around DocuLiveEPR. Section 5 analyses the conditions for collaboration through “seamless” integration. It is structured along two dimensions – integrated/ non-integrated systems and identical/ related but similar information – and aimed at identifying the “costs” and benefits of the 2 x 2 generated matrix of situations. Section 6 contains concluding remarks including guidelines for design of “seamlessly” integrated information systems in collaborative work settings.

2. Collaborative work and the integration of information systems

In an effort to highlight the similarities, we outline the collaborative aspects around integration of information systems at three levels: the general level of management information systems (MIS), the level of EPRs in general and a specific instance of an EPR represented by DocuLiveEPR.

2.1. Management information systems (MIS)

The source of the problem with non-integrated information systems and subsequent hampered organisational communication is hardly news. It follows immediately from

“incompatible data definitions from application to application, department to department, site to site, and division to division” (McNurlin and Sprague, 1997:198).

This incompatibility, stemming from distinct situations of use, is identified as a key challenge for enhanced collaboration in organisations – and the problem where tighter integration is perceived as the solution (Davenport, 1998; Hartwood et al., 2001). In principle, one approach to integration is a non-centralised one with interchangeable components; modules and objects similar to middleware software like CORBA, COM or like the Internet suite of protocols (see above). In practise, however, an approach based on a central, comprehensive database as found in Enterprise Resource Planning systems is often compellingly attractive as “the promise of an off-the-shelf solution to the problem of business integration is enticing” (Davenport, 1998:121). SAP, the world’s leading vendor of such systems, advocates their product as a way to enhance collaboration across functional boundaries:

“SAP R/3 overcomes the limitations of traditional hierarchical and function-oriented structures like no other software. [All the functions] are integrated into a workflow of business events and processes across departments and functional areas” (www.sap.com).

Rephrased into the vocabulary of systems integration (Hasselbring, 2000), approaches with one dominating component, which the others have to comply to, are attractive to many.

2.2. Electronic patient record systems (EPRs)

The discourse around collaboration and the integration of information in connection with ERPs mirrors exactly the more general and long-standing debate in management information systems and Enterprise Resource Planning systems outlined above (Hartwood et al., 2001; Hanseth and Lundberg, 2001). Perfectly aligned with the arguments for Enterprise Resource Planning systems, the project Synapses funded by the European Union points out that:

“[U]sers performing diverse tasks (...) [in] different department within a hospital may have deployed different (...) systems that should be integrated in

order to support the business processes adequately” (Grimson, Grimson and Hasselbring, 2000:52-53)

Similarly, the W3 EMRS project (1995) sponsored by the United States National Library of Medicine aims at:

“tam[ing] the Tower of Babel in current medical databases [by] defining a common medical record (...) [that enables] meaningful queries across patient information databases in multiple hospitals”

As for the more general case of management information systems, there are, in principle, different routes to the integration of information systems in hospitals. Yet, EPRs are – and have been for some time (Dick, Steen and Detmer, 1997) – perceived as essential in achieving this integration; EPRs *are* the nexus for integration. To illustrate this mode of thinking, Szolovits et al. (1995: 16) explain that it implies:

“establishing a canonical electronic medical record structure with supporting data abstraction processes to provide consistent views of medical information independent of underlying database structures (...) [which allows] a common API for heterogeneous data sources”

This emphasis on the role of the conceptual model with associated interfaces has been heavily advocated also by the European standardisation organisation, CEN TC 251 (prENV13606 1-4, 1999). The problems with fragmented and non-integrated information systems in hospitals have largely spawned approaches building on abstracted and highly idealised models of clinical work as a result of premature standardisation following from the urge

“to make sure that unsuitable circumstances (e.g. proliferation of incomplete solutions) are not allowed to take root...[so] standardisation must be started as soon as possible in order to set the development in the right track” (De Moore, 1993:4).

Such efforts represent unwarranted purifications that neglect the full complexity of clinical work. There exists to date little systematic, comprehensive and critical assessment of the experiences with practical EPRs. What exist are more restricted studies of particular projects and prototypes (Kohane et al., 1996; Massaro, 1993; Kushniruk et al., 1996; Safran et al., 1999; Grimson et al., 1998). Despite high

aspirations, Berg (1998:294) fairly accurately characterises the situation when he maintains that “fully integrated [EPRs] ...are hard to find”.

2.3. DocuLiveEPR

A key concern in the Medakis project has been the role of DocuLiveEPR in relation to the rich variety of other information systems, in other words, the strategy of integration. The crucial problem – reiterating the theme from management information systems and EPR in general – is the proliferation of local, tailored and non-integrated information systems and their apparent hampering of collaboration.

In the requirements specification worked out in collaboration between the vendor and the hospitals, the presence of special purpose information systems is recognised. This produces fragmentation as:

“There is a tendency that the specialist functions create their own information system to store and systematise data. In Norwegian hospitals today, these systems are only to a limited degree integrated or available in a uniform interface ” (Unified requirement specification, 1996)

This leads up to formulating a main goal of Medakis:

”to give access to, and produce the documentation that exist in the paper-based patient record. The EPR should replace many of the special purpose information systems that exist in the wards” (ibid.)

The basic premise for EPRs, as captured by the Medakis project specification and documentation, is of course to contribute to an overall improvement in productivity and quality (Unified requirement specification, 1996). The crucial element, however, is for the EPRs to function as the core information system and to

“collect all clinical patient information in a uniform computer system (...) and offer a common interface to all other IT-systems” (ibid., emphasis added)

As the more general cases outlined above, integration could in principle be achieved without delegating a pivotal and ambitious role to DocuLiveEPR. In practice, however, DocuLiveEPR was delegated a central role as:

“Even an electronic patient record with a relatively narrow functionality will gain a unique position in a hospital as it deals with the most sacred information” (M1)

Thus, from the outset the strategy of integration was given and “the EPR was supposed to be at the centre of information systems in the hospitals” (L1). Tellingly enough, another important source of information, namely the patient administrative systems (PAS) was assumed to be subsumed rather than integrated with the EPR:

“We expected that the EPR eventually would include the registration functions of the PAS (...) and that the registration forms of PAS instead became schemas in the EPR” (L1)

Given that PAS contains basic demographic information and support for budgeting, accounting, resource allocation, planning, waiting lists for procedures, appointments as well as patients’ visits and stays, this delegates the central means of integration to DocuLiveEPR.

This is reinforced by the vendor’s current strategy of subsuming specialist systems by replacing them by EPR controlled modules. As explained by a senior manager of the vendor:

“Instead of having many specialised systems you get an ERP that contains modules that can be added when needed. In this way, you get rid of many specialised systems from different vendors that otherwise had to be integrated (...) [hence] it is planned a PAS module in the next version of DocuLiveEPR” (S1).

3. Methodological considerations

3.1. Setting of the study

The Medakis project of the Norwegian health authorities has a long history (see (Ellingsen and Monteiro, 2001) for details), but has run since 1996 with Siemens as the privileged vendor. The DocuLiveEPR system, developed as part of the Medakis project is used to an interesting extent, especially at the regional hospital in Tromsø (RiTø) and

the regional hospital in Trondheim (RiT). These two hospitals have used DocuLiveEPR for the shortest time (since February 1999), but nevertheless with the most widespread use among the five regional hospitals (Lærum, Ellingsen and Faxvaag, 2001)⁵. Both RiT and RiTø have completed their installations of DocuLiveEPR. Aligned with the development strategy, the users are currently primarily physicians and secretaries. Computer availability is reasonable for these two groups. The 5 regional hospitals together have about 6000 defined users of DocuLive EPR. On a normal working day, there are approximately 1400 concurrent users. A rough estimate suggests that there are about 2,5 million electronic documents, mostly physicians' notes but also sick notes and prescriptions. It is possible to import certain information from the patient administrative system (PAS) into DocuLiveEPR, but not the other way around⁶. With the upcoming (v5.0) version, the laboratory systems will be integrated and accessible through DocuLiveEPR. DocuLiveEPR also includes a workflow module that is strongly encouraged by management. A principal function here is the (digital) signing of notes by the physicians.

3.2. Data collection and the process of interpretation

This study belongs to an interpretative approach to the development and use of information systems (Klein and Myers, 1999; Walsham, 1993). Although broadly oriented within this tradition, this study is shaped by our analytic affinity with science and technology studies (STS) in general and actor-network theory (ANT) in particular (Latour, 1999; Bowker and Star, 1999). Traditionally and predominantly, employed as a vehicle in historical reconstructions, ANT is increasingly used as we do here to also make sense of unfolding, real-time practise in much the same way as ethnographic studies (see Berg, 1999; Knorr-Cetina, 1999; Timmermans and Berg, 1997).

⁵ The National hospital and Ullevål – one of the largest hospitals in northern Europe - are different with only 15% and 30%, respectively, installed.

⁶ DocuLiveEPR imports demographic data like name, date of birth and addresses from PAS. In addition, the diagnostic and procedure codes may in principle be imported. This is seldom used, however, as these codes are normally recorded in the patient record before PAS. The integration mechanisms are not based on standards like CORBA or COM, but are rather hardware and language dependent solutions.

We rely on four types of data: participative observations, interviews, documents and informal discussions. The participative observations by the first author took place during two periods (February 2000 and January – February 2001) at the University hospital of Tromsø (RiTø) resulting in 61 hours of observations. During the observations, 105 pages of handwritten notes were taken and subsequently transcribed. Photographic documentation highlighted work situations of particular interest. Additional reflections, comments and questions were added to the notes, resulting in 45 pages of documentation. The observations were especially aimed at work situations involving physicians as they are recognised as a particularly important user group for the success of the Medakis project, but nevertheless often included secretaries, nurses as well as patients. Questions were posed to clarify and elaborate observations to obtain the kind of background understanding that is emphasised by Klein and Myers (1999). The extent and format of these obviously varied with what was possible without intruding too much with the ongoing work, often postponing them to less hectic periods.

We have conducted 27 in-depth semi- and unstructured interviews with users (coded as U1-U16), Medakis project members (M1-M6), EPR lobbyist prior to the Medakis project (L1-L2), policy and decision makers (D1-D2) and senior management of the vendor (S1). Through students the second author has supervised, we have also had access to 12 transcribed interviews with the vendors. These have been used for background information only.

We have had access to a number of electronic and paper based documents. We have gained access to two, comprehensive archives belonging to two of the key actors among the policy and decision makers. Firstly, the Norwegian Research Council, a principal sponsor of EPRs in the years immediately preceding the Medakis project, and, secondly, KITH (centre for IT in health care), a publicly owned agency aimed at establishing IT related standards in Norwegian health care. In addition, we have had detailed access to contracts, memos, specifications and documentation within the Medakis project.

In striving to adhere to Klein and Myers' (1999) principles of multiple interpretations and suspicion, we have relied heavily on validation through iterated discussions with 25 involved actors challenging our interpretations: 3 policy and decision makers; 8 users; 1 EPR lobbyist prior to Medakis and 13 Medakis project members. In addition, earlier versions of this paper have been circulated and discussed with these involved and

engaged actors who provided extensive feedback, which in one instance resulted in 12 pages of written comments.

Klein and Myers' (1999) principle of interaction between researchers and the field raises highly relevant concerns about how we were conceived and how our roles influence our interpretation. Neither of us were perceived as detached observers as the first author used to be part of the local Medakis project organisation in Tromsø and the second author is heading a research project assessing EPRs in Norway through an emphasis on the Medakis project. This has involved a delicate, and at times problematic, balance between engaging constructively in debates with the Medakis project members at various levels while simultaneously keeping a critical distance.

4. The case vignettes

Medical practice varies enormously across different domains, departments, hospitals and countries (Atkinson, 1995; Strauss et al., 1985; Berg, 1998; Grimson, Grimson and Hasselbring, 2000). We have no ambition of paying justice to this variation in any systematic or comprehensive manner. Rather, we merely aim at motivating for an appreciation of this variation through a sampling of 3 wards at RiTø. This variation in practice also translates into a corresponding variation in the use and type of information sources. Characteristic features of the work situation in the wards are

1. Outpatient clinic, Dept. of Medicine: a hectic environment marked by a constant improvisation to cope with unplanned events (and patients). As a result, much of the clinical record keeping takes place in parallel, not finishing one patient before attention needs to be shifted to the next.
2. Department for Eyediseases: a largely self-contained department conducting highly specialised work. This takes place with relatively little interruption and interaction with other wards at the hospitals, promoting an emphasis on research oriented activities.
3. Department of Rheumatology: dominated by chronic patients that require extensive, collective and inter-disciplinary discussions among the health professionals rather than instantaneous, individualistic decision-making.

4.1. The outpatient clinic: improvisation and fragmentation

The Outpatient clinic is an integral part of the rest of the Dept. of Medicine. Hence, they have responsibilities for patients already at the hospital as well as those arriving. Only the secretaries and nurses are assigned to the Outpatient clinic on a permanent basis. Admittance is predominantly based on referrals (i.e. letters) from local general practitioners. Other patients turn up for scheduled checks following a period of hospitalisation. The offices in the Outpatient clinic are small and crowded, implying that they are often shared among different user groups. To illustrate the work of physicians and their use of information sources, consider the following vignette involving the chief physician.

His office contains two desks, containing 12-15 stacks of paper-based, patient records and a computer (see figure 1). On the shelf above the desks, there is an additional stack of patient records with a yellow post-it label stating “to be signed”.

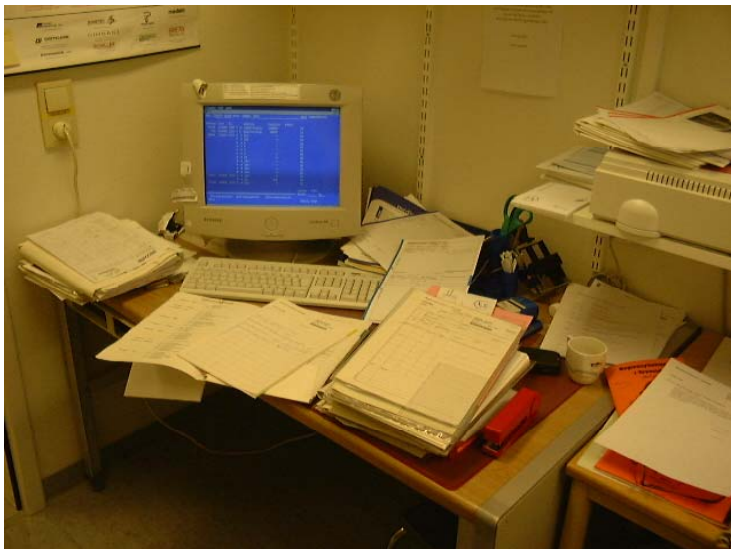


Figure 1. The workplace in the Outpatient clinic, Dept. of Medicine.

Immediately upon entering the office, he starts looking for a specific patient record, calling out “Where is it? I was just working on that record”. He leaves the office to inquire at the secretaries’, but quickly gives up and instead starts to dictate reports from one of his own consultations. He examines the EKG-printouts turning them back and forth while continuing to dictate. He studies the physicians’ text notes in the patient record, and alternates by looking in the notes and dictating. He turns to the computer and logs onto the PAS system to

check laboratory results through an established interconnection between the PAS system and some of the laboratory systems.

He selects an A4 paper form and enters values from a myocardial scintigraphy procedure. He fills in why and how the investigation was done, the result, and its impact on his final assessment of the handling of the patient. When he is done, he places the form in a paper archive on the shelf immediately above him. The chief physician and one of his colleagues use this archive both as an element in their product quality system and as material for their research. This paper archive has been used for eleven years and contains almost 1900 patients.

Logging onto DocuLiveEPR, he activates his personal working list (part of the workflow system) and locates the appropriate patient record. Frustrated by not finding an electronic record for a blood test, he turns to the paper record, hoping that a note has been included. Still without any luck, he turns to the PAS system to continue his search. Upon finding it, he inserts paper in the empty printer and prints it together with 2 previous results from the same patient. He places the three copies in a sequence on the desk in order to assess possible progress of the results. Next, he picks up a small picture and studies it. It is a nuclear medical examination. By now his desk is covered with several text notes, the renogram and 3 A4 sheets of blood results. Appearing in different windows on the screen, the patient's information is showing in both DocuLiveEPR and in the laboratory system. He proceeds by typing his final evaluation into the polyclinic note in DocuLiveEPR, about 6-7 lines of text and signs it electronically. To finish, the paper based patient record is extended with a letter, a post-it note, the hard-copy laboratory result from PAS and an A4-paper-sheet draft. They are all attached to the front cover of the patient record with a paper clip.

Someone from the accounting department is on the phone requesting help to change diagnostic codes. The ICD⁷ and NCSP⁸ codes are stored in the patient record but also in the PAS. But these codes take on quite distinct meanings in these two contexts of use. In the patient record, the ICD codes relate to the care

⁷ International Classification of Diseases as worked out by the World Health Organization (WHO).

⁸ NCSP is an abbreviation for NOMESCO Classification of Surgical Procedures. The Nordic MEDico-Statistical Committee was set up in 1966, following a recommendation by the Nordic Council. An aim of NOMESCO is to promote the coordination of health statistics in the Nordic countries.

and treatment of the patient and are the basis for subsequent discharge letters. In PAS, however, the ICD codes are used in a carefully designed way as the basis for governmental reimbursement according to the US adapted DRG⁹ coding scheme. If the ICD coding fails to translate into the predefined DRG scheme, the hospital will not be reimbursed.

The accounting department routinely checks the validity of the codes and reports back to the wards about errors or other reasons to make modifications such as the last phone call. RiTø estimated a loss of 15MNOK in 1999 due to “incorrect” ICD/DRG coding. As the consultant from the accounting department explained to us afterwards, they requested this particular chief physician to make the changes in the ICD/DRG codes in PAS because they knew he was willing and “quick in the head”.

4.2. Dept. for Eyediseases: stability and specialisation

The Dept. for Eyediseases has ten affiliated physicians and is fairly self-contained. There is little need for laboratory results and X-ray examinations. Typical patients groups are those related to age, diabetes and circulatory disorders as well as lens disturbances such as cataract, a disease often leading to surgery. Again, we present a vignette to illustrate the work.

After having seated the patient, an elderly woman, in the examination chair the light is turned off. Two physicians are present, the head physician and an assistant physician. In preparation, the head physician has read the paper-based letter of referral as well as the patient’s paper-based patient record. He has interviewed the patient and obtained relevant background information.

A digital retina camera is placed between the patient and the physician. The camera is connected to a near-by computer, which runs a digital image processing system called OcuLab. OcuLab is used to process black and white pictures that are transferred from the camera and subsequently stored on a networked server (Figure 2).

⁹ DRG is short for Diagnose Related Groups. The DRG system divides hospitalised patients into groups on the basis of diagnosis and treatment. Based on the hospital’s operating costs, an expected price per patient discharged is estimated.



Figure 2 The laser room with the assistant physician placed in the patient's position.

Behind the patient, there is an archive of negatives of colour pictures. The use of this archive has been reduced after the introduction of OcuLab. But it is still in use, especially in situations where a colour photo may explain more than black and white photos, for instance, in identifying leakage from the blood vessels.

The patient's pupils have been pharmacologically enlarged to ease the inspection of retina. On her right arm is placed a syringe in which the assistant physician injects contrast fluid. After approximately 10 seconds, the fluid reaches the eyes. The head physician studies the patient's pupil through the camera. He starts taking a sequence of pictures with intervals of one second. After a while, the pictures slowly appear one by one on the computer screen. Already in the first picture it is possible to see abnormal blood vessels. They briefly discuss if they need to proceed but quickly agree that it is unnecessary.

Up till now the computer has processed about 40 pictures. Just a few of them need to be stored for future usage. The head physician makes his selection, stores these and discards the rest.

He logs off OcuLab and the examination is over. Had it been necessary, this is when colour pictures would have been taken, but with a different camera. He immediately dictates the result of the examination on his tape recorder. A secretary will subsequently type this into DocuLiveEPR, for the physician to electronically sign afterwards.

A possible further action for the patient is to receive laser treatment in the adjacent laser room. In these situations, the physician will use OcuLab to

retrieve the pictures of the patient on the computer screen. To burn the laser marks correctly in the retina, he would be aided by the pictures from OcuLab.

In the laser room, the patient's record is usually placed on the shelf right behind the patient. Next to it, there is a large logbook that contains information about patients treated with this equipment containing date, type of treatment, anaesthetic used, result and responsible physicians. In addition, there are corresponding logbooks in the ward's other laser room and the surgery room. This information is used on a regular basis to report the activity in the ward, both internally and externally to the administration of the hospital. The information in the log-books overlaps with corresponding information in the patient record, but formatted to promote the readability of accumulated data.

If a cataract operation is necessary, an artificial crystalline lens is placed over the eye by the surgeon. Attached to each lens is some technical information (producer, model, length and serial number) about the same size as a post-it note, which will be glued to the patient's record to document which type of lenses was used.

The Dept. for Eyediseases participates in an international cataract research project. In connection with cataract surgery, a special paper form is filled in and archived. The ward is in the process of developing a new database system in collaboration with the IT-department. The system is to handle information obtained prior to, during and after cataract surgery. Printouts from this system will be placed in the paper based patient record. The chief physician in the ward emphasises the local context of use:

The cataract record is made for specialists, which means that this information is meant for insiders and nobody else. And unlike an ordinary free text note in the patient record, the cataract record contains predefined categories for 'no remarks', 'ok' and numbers. This information is possible to measure and process statistically afterwards

4.3. The Dept. of Rheumatology: the collective effort

Dept. of Rheumatology is a medium-sized ward at RiTø consisting of 23 beds served by cross-functional personnel: physicians, nurses, physiotherapists, ergo-therapists and social workers. There are a vast number of different rheumatological diseases, which combined with its gradual character and fluctuating symptoms often prohibits exact

diagnosis at an early stage. This implies that the personnel have to deal with uncertainty. The ward has a lot of chronic patients. The vignette that follows illustrates the mode of work in the ward.

This Friday morning, 10 physicians are present at the previsit meeting. Everyone brings their paper notes and makes additional ones as they discuss the latest about the patients. On the table, there are stacks of patient records. Some of the records are very thick, up to 15 cm each, as the ward has a lot of chronic patients. Some of the physicians skim through the patient record. There is also a book containing nurse documentation on the table. A nurse brings in a booklet with laboratory results.

After working through all the inpatients, it is time to discharge patients. Being predominantly a working day unit, most patients are discharged on Fridays. This creates a lot of work associated with discharges on Fridays with subsequent admittance the following Monday. Another nurse joins the group with a nurse patient record and they start discussing the cases more thoroughly. At one instance, they discuss what to do about a specific patient who regularly forgets to take her medicines. Based on their different information sources about this patient (the nurses' documentation and the physicians' notes), they discuss how to cope with the situation. One of the physicians underscores the importance of taking the prescribed medication while the nurse argues that pushing medication now is of no value since they are not able to follow her up after she leaves the hospital.

Nurse: She forgets to take her medicines.

Physician: But it's important that she takes them!

Nurse: Why bother? She forgets it anyway when she returns home.

Physician: She has all signs of depression and has been suicidal.

The group studies the patient's chart containing important information during the stay of a patient (pulse, temperature, blood pressure, medications prescribed and given). They discuss the current medication. One of the physicians writes something on the patient chart. The nurse makes some notes on her own paper, which she later on will write into the nurse documentation. Explaining the role of nurse documentation, a nurse in the Medakis project points out:

"The nurses document continuously, 24 hours and from shift to shift. This distinguishes their documentation from the physicians' (...) The

purpose of the nurses' running notes is to make the care of the patient in a dynamic process." (U1)

After a while, the table is covered with paper from the patient records, or more specifically from the chart book. The chart book contains information about all the patients associated with this working group. For each patient, essential information from the patient's paper record is extracted. The chart book also contains the patient chart, abstract sheet and laboratory results. There are also copies of the physician's text notes that have previously been entered into DocuLiveEPR. When a patient is discharged, a letter is produced and sent to the general practitioner. The letter contains a description of the stay but also functions as a "memory" for the physicians in the ward. However, due to incomplete information and lacking personnel resources, it often takes a week (sometimes even longer) before the discharge letter can be produced. To compensate, a preliminary discharge letter, a so-called discharge form, is produced before the patient leaves. The discharge form is an A4 paper sheet with several carbon copies. It is hand-written and very brief containing information to the patient, the general practitioner and the secretary at the Rheumatology ward. In addition, one copy is placed in the patient's record until the formal discharge letter is written.

Discharge letters from the Dept. of Rheumatology tend to be long due to the chronic character of the illness. However, detailed discharge letters seem to be only partially useful for general practitioners, which usually prefer to get answers as quick as possible prior to getting a complete discharge letter. This is illustrated by the fact that often the general practitioners only include the most important parts of the discharge letter in their own EPR system.

Let us return to the Friday's round of discharging. Physician A has three patients to be discharged. To support the writing of the discharge form, she uses information from the chart book (e.g. laboratory results), consultations written by other specialists, EKG printouts and physician's text notes. She frequently examines the patient-chart and the abstract sheet to get the proper information for the discharge form. The abstract sheet is an outline for a stay of a patient and as physician A expresses it:

"It is a tool for us (...) It contains information about the history of the case, reason for referral, patient diagnoses, internal referrals, test results, problems etc".

The abstract sheet is also an important tool in the communication with the other professions in the hospitals, like nurses, physiotherapists, ergo therapists and social workers and used in interdisciplinary meetings both as a summarised version of the case and as a place where to put short notes. It is also used as a mean to provide continuity between shifts:

“The nurses will go through the abstract sheet in the evenings to check whether something has to be done” (physician B)

as well as continuity between the wards because “when a patient is referred to another ward a copy of the abstract sheet will follow”.

5. Analysis

The lack of integration in hospitals is, and has always been, a principal motivation for the efforts into EPRs towards “seamless” care (De Moore, 1993). “The present inability to share information across systems”, Grimson, Grimson and Hasselbring (2000:49) maintain, “represents one of the major impediments to progress towards shared care and cost containment”. We analyse the conditions for and strategies of integration at play around EPRs in hospitals. Two concerns are highlighted in our analysis, concerns which underlie strategies of integration. First, we distinguish between cases where the different *sources* of information are integrated or not. Second, we distinguish between the cases where the *contents* of the information (from the different sources of information) are identical from the cases where they are related, but slightly different. This gives rise to the following four types of situations:

		source	
		<i>Integrated information</i>	<i>Non-integrated information</i>
contents	<i>Identical information</i>	compatibility	redundancy
	<i>Related, but different</i>	ambiguity	supplementary

5.1. Redundancy (identical information, non-integrated)

The abundance of redundant information duplicated in different, non-integrated information sources is a major motivation for the pressure for integration. It has traditionally signalled potential consistency or communication problems (De Moore, 1993). It represents the “obvious” occasion for tighter integration. Before jumping to conclusions about the need to integrate, it is instructive to analyse how practitioners cope with redundancy. Only through an appreciation of this may reasonable strategies for integration be formulated.

An immediately and striking first observation is the relative modest level of problems actually caused by redundancy. On the contrary, there are a rich set of artefacts and routines that perform the invisible work, fill in the gaps and glitches (Gasser, 1986; Bowker and Star, 1999; Latour, 1999; Atkinson, 1995). Users are highly competent in bridging these gaps. In her studies of control rooms, Suchman (1993:119) underscores how collaborative work draws on different information sources as “work in operations makes artful use not only of computer technologies, but of a range of other communications and display technologies as well”.

A particular instance of redundancy is that between paper and electronic form. There are several studies that focus on the physical properties of paper and the way this afford a number of effective and flexible capabilities in clinical work (Nygren and Henriksson, 1992; Luff, Heath and Greatbatch, 1992; Harper et al., 1997). At the Outpatient clinic in our study, the paper folder in the paper-based patient record integrates the various notes, texts, pictures and printouts in such a way that redundancy of information is worked around by sifting through duplications.

Beyond working around redundancy in the manner outlined above, Hutchins (1994:223) argues for a productive role played by redundancy as a principal reason for the robustness¹⁰ of work because if “one (...) component fails for lack of knowledge, the whole system does not grind to halt”. Going back to the Department for Eyediseases,

¹⁰ This corresponds closely to the debates on fault tolerance as discussed in systems theory. E.g. Perrow (1984) argues that breakdowns regularly occur in complex industrial work systems but are usually efficiently repaired as a part of daily work.

the overlapping of (ordinary) colour pictures, electronic black and white ones, the notes in the logbooks, avoids making the work vulnerable to the failing of any one of these.

This all adds up to demonstrating that redundancy is not necessarily and automatically the kind of problem portrayed in traditional management information systems. This should not, however, be misconstrued as an argument that any redundancy is acceptable. It is merely the argument that the pros (largely by-passed) and cons need to be assessed before judgement is passed. The episode from the outpatient clinic (section 4.1) where the physician searches for the laboratory results demonstrates how redundancy of information – presenting the test results in DocuLiveEPR, in the paper-based patient record or in the laboratory system accessed through PAS – enables him to conduct his work even if he did not find the test results immediately. Turning around in his chair, logging onto a different non-integrated system he locates the information. After locating it, he prints the results and includes a copy in the paper-based patient record thus filling the glitch. Yet, the fact that he is able to bridge the gap and maintain the redundancy is not an argument for preserving the situation. As pointed out above, design decision regarding redundancy need to assess both costs and benefits. In the present case, the benefits (robustness) do not compensate for the amount of work involved in maintaining the redundancy. Hence it seems reasonable to require the laboratory results to be tightly integrated with DocuLiveEPR¹¹.

5.2. Supplementary (related information, non-integrated)

These types of situations resemble those analysed above but are distinguished by the fact that the information in the different information systems is not identical only “related”. Obviously, there are problematic cases of separating these two situations. Typical illustrations of the present type include situations where the different professions have different versions of patients’ trajectories or where one version is an abbreviation of another. The task is to pragmatically assess how users cope with information that is closely related, partly duplicated but distributed across different information systems or even within the same system. As in the case above of redundancy, we hope to demonstrate that supplementary information plays an often

¹¹ This is exactly the direction taken in the next version (v5.0) of DocuLiveEPR.

overlooked, productive role that warrants closer scrutiny. We accordingly need to analyse its role in collaborative work settings.

The Dept. of Rheumatology represents a typical illustration of the present type of situation where the physicians, nurses and physiotherapists work together discussing each patient. The different professions have their own documentation that slightly overlaps with the other professions' documentation, which they refer to in their spoken performances (Atkinson, 1995:91). The episode outlined in section 4.3 with the forgetful patient illustrates the role of the related but different information (the nurses' documentation and the physicians' notes). It illustrates an important characteristic of the work at the department, namely how decisions are negotiated among (and within) the professional groups based on their related, but different written accounts. As one of the physicians pointed out:

“Rheumatology is a kind of oral and assessing profession (...) it is important to have meetings, discussing which treatment that is most important or correct [and] whether it should change or not”

This is closely related to what Nonaka and Takeuchi (1998:230) denote ‘learning by intrusion’, a mechanism for promoting collaboration which implies the

“existence of information that goes beyond the immediate operational requirements of each individual. The redundant information enables individuals to invade each other's functional boundaries and offer advice or provide new information from different perspectives.

In her recent book, Knorr-Cetina (1999) makes a similar observation when she explains how knowledge work presupposes information in different, related formats to enable the necessary “narrative encapsulation” of knowledge. Collaboration and mutual understanding presupposes “the general strategy of mixing together [results] from very different origins in an attempt to come to grips with the limitations of specific data or approaches” (Knorr-Cetina, 1999:76). Hence, both Nonaka and Takeuchi (1998) and Knorr-Cetina (1999) underscore the productive role in relation to collaboration of this kind of supplementary information.

Supplementary information, related but different versions that are not integrated, also allows for competing agendas as the case of discharge letters at the Dept. of Rheumatology illustrates. General practitioners often prefer rapid answers at the

sacrifice of completeness, thus conflicting with the need for the physicians at the ward to use complete discharge letter in reconstructing the case when the patient reappears at the ward. Today, the discharge form functions as a convenient boundary object (Bowker and Star, 1999) serving both of the communities: rapid responses for the general practitioners and accumulating experiences for the hospital physicians

Another example, also from the Dept. of Rheumatology, is their actual use of the abstract sheet in their daily operations. It provides supplementary – abbreviated, condensed – information. Given the vast volume of documentation associated with chronic patients dominating the ward, summaries represent essential, supplementary information, particularly across different communities of practise (or professions).

“The abstract sheet is very useful in achieving quick overview of the case. It contains an extract of the status from the patient record as well as brief notes from interdisciplinary meetings. Then we don’t need to go back to the patient record (...). It also outlines what has happened and what is planned” (physician A)

Another aspect of supplementary information is that it allows collaborative needs and interests to be tailored to local, situated contexts of use as illustrated by the proliferation of local archives and indices. In the three wards, there were archives for quality insurance of a specific procedure (outpatient clinic), colour picture backup archive (Dept. for Eyediseases) and research related archives. For instance, the Dept. for Eyediseases is involved in developing an IT-based cataract surgery archive. The reason is that DocuLive EPR does not include the flexibility to manage all their special needs, especially regarding *accumulated* data, reports and quality assurance (see section 4.2).

Combining information from multiple, sometimes independent, sources of information permits consistency check of multiple representation with each other (Hutchins, 1994:35) or “framing” as denoted by Knorr-Cetina (1999:72) as it serves to check, control or extend information from different non-integrated sources. This was the case for the cataract surgery research project at the Dept. for Eyediseases. The participants of the research team perceived the quality of the codes in PAS as not sufficient for their purposes and accordingly created their own research database maintaining their own diagnose and procedure archive.

In sum, we have pointed out and argued for the productive role supplementary information plays in facilitating robust, collaborative work configurations (establishing shared understanding, allowing local flexibility and performing consistence checks). These benefits, we argue, tend to override the costs associated with maintaining this supplementary information, implying that the inclination towards tighter integration should be curbed.

5.3. Ambiguity (related information, integrated)

A well-known aspect of technology is how it may be interpreted, conceived of or used differently across distinct local situations (Blume, 1991; Barley, 1986). Hence, notions like interpretative flexibility (Pinch and Bijker, 1989), boundary object (Bowker and Star, 1999) or situated action (Suchman, 1987) all, in slightly different ways, underscore this. To merely reiterate this for EPR is accordingly hardly news. We want to pursue this further by spelling out how these differences in use feed into the coordination, delegation and organization of work (Berg, 1999). This amounts to tracing the productive role of the ambiguity in interpreting and using this information.

Many have pointed out how medical work in general and patient record keeping in particular get caught up in an increasing number of roles (Berg and Bowker, 1997; Bowker, Timmermans and Star, 1995). Beyond a resource for diagnostic purposes, it functions as a vehicle for coordinating work, as a source for cost- and income generation and become relevant for insurance companies.

The example from the Outpatient clinic in section 4.1 of how ICD codes, appearing first in DocuLiveEPR before being registered in PAS, illustrates this. The difference across the communities of practise should be clear: the economical incentive of management vs. clinical-diagnostic motivation among the physicians. This explains why there are, as so compellingly demonstrated by Bowker and Star (1999), competing agendas and accordingly difficulties in making them unique. In addition, had the ICD/DRG coding been uniquely defined across the PAS and DocuLiveEPR, this would have generated additional work for the physicians. If the ICD codes were identical in both systems, any changes of coding would have to be carried over to patient record as well. This includes, for instance, the discharge letter that is sent to the general physician. This is by no means a straightforward task as nothing that is signed by a physician can be changed.

The changed code would have to be written to DocuLive before sending new copies to the general physician with the updated codes. From a clinical point of view, this work is irrelevant as it only relates to economy.

The coding of ICDs is not necessarily “wrong”, but has to be continuously updated according to new guidelines from the Ministry of Social affairs or misplaced main and secondary diagnoses. Often these aspects influence reimbursement. As the accountant explains:

“We correct codes regularly (...) [and] the Ministry of Social affairs acknowledge that the hospitals can correct these codes going back the whole year. For instance, in September, new guidelines were issued that were supposed to be valid already from January 1. the same year”.

An observed example from RiTø is the sequence of the two ICD codes C91.0 and Z51.1. The former expresses a type of cancer while the latter expresses appearance to chemotherapy related to the disease. Before the change, with C91.0 as the main diagnose and Z51.1 as the secondary, no reimbursement was generated. After correcting, i.e. swapping the sequence of the two, the reimbursement produced 11952 NOK.

Another example has recently surfaced related to the surgical departments. Partly by luck and partly by chance it has been discovered that the hospital had missed reimbursement through the lack of coding of “cutting time”¹². Cutting time that exceeds 3 hours is entitled to a larger amount of reimbursement. Adding these procedure codes in retrospect will increase reimbursement with ½ MNOK a month.

In the Medakis project there has been a heated disagreement about how to make PAS and DocuLiveEPR interoperate. The issue circles around which of the two should be delegated the status as a "reference system", i.e., which should dominate the other whenever inconsistent information existed across the two, integrated systems. This disagreement surfaced in one of the Medakis project groups in 1998 where the hospital participants wanted to maintain the role of the PAS as the primary repository for some part of the information to comply with earlier days. The memo from the working group states that:

¹² Norwegian: knivtid

“PAS is a reference system for defined patient administrative information, like demographic data, diagnostic codes and so on. This means that the information in the PAS system at any time is taken to be the most correct” (Workgroup II, 1999: 3)

To avoid being ignored, the hospital participants really pushed the integration issue. The resulting document underscores that PAS must be seen as a reference system (rather than DocuLiveEPR) and that access to this system shall be done by the use of a COM interface. The end result, however, has been to promote DocuLiveEPR as a centralised system, including its planned PAS module. This reiterates the theme outlined in section 2, namely that even if non-hierarchical integration is conceivable in principle, more often than not a centralised mode of integration is privileged.

This centralised approach to integration of information systems ban systems adapted to more local use, including the option to change coding scheme as illustrated above with DRG.

This example is not exceptional. Participants in clinical research often perceive that the quality of the diagnostic codes in PAS and even in the patient records are insufficient for their research projects and henceforth create their own clinical research databases where they maintain their own diagnose registers. These codes are also compared to the actual patient record text in order ensure the right quality. The former head of the clinical research department underscores this:

“If you base clinical research solely on diagnose codes from the patient record [and PAS] then the validity will be challenged as it is well-known that the quality of these codes is poor (...) it was bad also before DRG was implemented¹³, but has since deteriorated further (...) as the physicians are under pressure to code to maximise reimbursement”

This goes to the heart of their problems as it is essential to select patients belonging to certain diagnose categories in their research. This spawns local improvisation:

“You may wonder, then, how it is possible to locate the patients when it is not possible to use the diagnose codes! We cope by using the laboratory results (...)

¹³ The DRG reimbursement schema was introduced in 1997.

[as index and subsequently] read through the patient record text in order to see what this is all about ”

An additional point that influences the perceived quality of coding and the danger of integration is changes over time:

“The categorising of the diagnose codes is in continuous change and the clinical picture for a disease get new definitions. For instance: what you define as a heart attack today is not identical with the definition 5 years ago.”

Counter-intuitive for many perhaps, ambiguity is often the basis for a sound division of labour. Referring to the case discussed above regarding the ambiguity of coding, the benefits are, we argue, greater than the costs, implying that forcing compatibility by flattening ambiguity is dysfunctional.

5.4. Compatibility (identical information, integrated)

These situations are represented by those instances where “seamless” integration is indeed achieved. They are included for the sake of completeness. An illustration from the Outpatient clinic is when the chief physician logs onto PAS in order to check laboratory results. The laboratory system and PAS are distinct, integrated information systems with compatible data formats. The laboratory results are stored in the laboratory system but can also be accessed from PAS. The laboratory results are uniquely given, regardless of which information system you use to access them. In fact, laboratory values are regarded as “facts” as demonstrated in the last quotes of the last section.

Successful integration of laboratory values, however, presupposes that it is possible to identify information related to the same patient from one system to the next. Normally, this requires conformity in demographic data (name, date of birth and personal identity number). An example of this is from the Outpatient clinic (section 4.1) where only one set of demographic data is stored as DocuLiveEPR imports this from PAS.

6. Conclusion

In terms of analysing how (lack of) integration influences conditions for and contents of collaborative work, the two situations involving related but not identical information

(dubbed supplementary and ambiguity) are the essential ones. Counter-intuitively for many, they underscore how collaboration is undermined by centralised, “seamless” integration. Supplementary (non-integrated, related but not identical) information fosters what Boland and Tenkasi (1995) call perspective taking, the backbone of the mutual understanding that underpins collaboration, communication and coordination.

Ambiguity (integrated, related but not identical) information plays a different but equally important role in promoting robust, collaborative work arrangements. In striving to eliminate ambiguity, one introduces a number of dependencies between communities of practise that imply considerable – and largely unanticipated – additional work. Ironically, tighter integration in these cases, aimed at fostering collaboration, end up (unintentionally!) producing additional work in stead (Beck, 1992).

The ideal of “seamlessly” integrated hospital information systems relies on unwarranted purifications. An analysis of how users cope with duplicated, fragmented and related information provide guidelines for design. Design and intervention strategies for EPR need to balance on a tightrope: on the one hand, to avoid promoting unrealistic, futuristic aspirations, overly emphasising the potential of the technology, and on the other hand, to move beyond a description of the immense richness of medical practise that may easily infuse the impression that any intervention would necessarily upset this elaborate and delicate play. Intervention, then, need to take seriously the transformative – not merely the “supportive” (Berg, 1999:391-393; Berg, 2000:500-501) – aspects of EPRs but proceed evolutionary (Atkinson and Peel, 1998).

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Paper four:

Knowledge work in hospitals

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Abstract

Slogan-like arguments from knowledge management literature suggest that reuse of externalized knowledge is fundamental for improved efficiency, reduced costs and reduced dependency on individual know-how. Rather than considering knowledge as a specific thing the paper relates knowledge to the work people do. The aim of the paper is to identify conditions for sharing and reuse of knowledge in large organizational contexts. The paper analyses how knowledge reuse is influenced by complexity of contexts, trust, and uncertainty. Based on the findings, the paper also seeks to make suggestions for information systems design. Empirically, the paper draws on different medical contexts at the University Hospital of Northern Norway.

1 Introduction

A common argument today is that many organizations have become so complex that their knowledge is fragmented, difficult to locate and share, and therefore redundant, inconsistent or not used at all (consider for instance Zack, 1999). There are also arguments about increased market competition, which make it necessary for organizations to focus on knowledge as an important resource. According to these arguments, knowledge creation, representation and diffusion are key mechanisms in ensuring modern companies' and organizations' competitive advantages (Blackler, 1995; Davenport and Prusak, 1998).

Aligned with a relatively high share of the knowledge management literature, this knowledge is associated with so-called knowledge-intensive firms and their knowledge workers (see for instance, Alvesson, 1995). In this way knowledge is considered a

property of the firm or a specific entity (Blackler, 1995) that typically is stored in large databases as externalized and codified know-how. At a later stage, it is assumed that this knowledge will be readily reused in various contexts associated with the firm.

Considering the knowledge concept as outlined above is both narrow and too optimistic. Several studies have reported the shortcomings of such a perspective and pinpointed that it is essential to take an alternative or broader approach (Atkinson, 1995; Hunter, 1991; Knorr-Cetina, 1999). From this point of view, it is insufficient to focus on knowledge as a thing; the focus must rather be on what people do and *how* they create knowledge. Atkinson (1995:45), for instance, places emphasis on medical knowledge production as work. This work is achieved not only through the content of collegial talk, but also through the form of that talk. Thus the knowledge creation and translation process is not only based on journals and textbooks (ibid:90-91) but also includes talks between colleagues such as clinical lectures, ward rounds, morbidity reviews, and a surgeon's comments to juniors and students.

The study reported in this paper focuses on physicians' work producing discharge letters in four different contexts at the University Hospital of Northern Norway (UNN). In contrast with the traditional view on knowledge work (Alvesson, 1995) clinical work, and especially as practiced at large hospitals like UNN, is highly specialized. It is characterized by state-of-the-art knowledge, high levels of education and organizational complexity. As knowledge originates from a myriad of different contexts and information sources, a large part of knowledge work in hospitals involves summing up and thus reusing previous information (Berg, 1998:298). This is particularly the case when physicians sum up patient stays through dictating discharge letters. At UNN the discharge letters are an important part of the hospital's electronic patient record, accordingly placing this study at the core of the hospital's most critical information system.

Regularly summing up cases also makes the medical context relevant in a broader perspective - for complex organizations in general, and for the general question of how and when knowledge is reusable and in what shape. A critical indicator of how externalized knowledge is useful is the degree of 'reuse'. Thus the aim of this paper is to identify the conditions for when sharing and reuse of knowledge is productive and subsequently to make suggestions for information systems design. More specifically, the analyses is pursued along three themes.

First, I analyze how the degree of reuse is influenced by the multiplicity and complexity of contexts. As large hospitals are both highly specialized and reflect a complex division of labor (Atkinson, 1995:7; Blume, 1991:17), it affects the extent knowledge is reusable from one context to another. One expression of the complexity of the various contexts is the number of information sources involved, another is that new technologies increasingly are used to link different contexts together, and accordingly affect shared meanings among the participants involved (Ruhleder and Jordan, 2001:132).

Second, I analyze how the degree of reuse is influenced by the trust attributed with the knowledge sources. Atkinson (1995:127) points out that “ Not all knowledge is treated as having equal value. It has different sources, and has different weight attached to it, and may be regarded as more or less warranted”. This corresponds with Cicourel (1990:222) when he argues that “ the perceived value of medical information is related to the perceived credibility of the source”. This means that trust in knowledge might fluctuate with who has produced it, where it is produced and how it is produced.

Third, I spell out how the degree of reuse is influenced by uncertainty and unpredictability of medical work (Atkinson, 1995:111; Hunter, 1991:28). Medical work is hectic and has to deal with a lot of emergency cases as well as patients with complicated, uncertain diagnosis and prognosis. The documents produced in the patient record are shaped accordingly: they reflect what the physicians know at a given moment. This means that what is considered knowledge today may be irrelevant tomorrow.

The remainder of this paper is organized as follows: the next section elaborates more thoroughly on the theoretical foundation and is followed by a reflection on the research design. Four case vignettes, which illustrate physicians’ work in different departments, are then presented. The last two sections contains the analysis and the conclusion. The analysis focuses on the conditions for reuse along the themes presented above and the conclusion contains implications for information systems design.

2 Theory

2.1 Knowledge, knowledge organizations and knowledge workers

Some of the information technology (IT) literature categorizes knowledge into ‘data’, ‘information’ and ‘knowledge’. From this viewpoint ‘data’ is a set of objective facts with no associated purpose (Davenport and Prusak, 1998:2). ‘Information’ is more value-oriented. ‘Knowledge’ is considered to possess key properties like experience, truth and judgement, and is typically associated with so-called knowledge-intensive firms (Alvesson, 1995:6). It is further argued that such companies, including their knowledge workers, are characterized by frequent problem solving, creativity, reliance of individuals, high levels of education, and a high degree of professionalism. This is an aspect of knowledge that falls into a category that Blackler (1995:1023) denotes as ‘embrained’ and promotes knowledge as a specific entity that is tradable (ibid:1033).

IT is considered to have a central role in organizing knowledge, both in order to enable sharing and collaboration, and more explicitly through the storing and categorizing of different knowledge units which can later be retrieved and presented as meaningful across contexts. This kind of knowledge is generally described as explicit and is possible to codify. Tacit knowledge, on the other hand, is individual and context-specific and is accordingly hard to formalize (Nonaka and Takeuchi, 1998:218). Enabling the transition from tacit to explicit knowledge both in order to enable collaboration as well as to make it conform more to IT is considered to be a major challenge.

In software engineering, there also is an extensive comprehension about using IT as a means for sharing and reuse of knowledge. In these contexts, however, reuse of knowledge translates into constructing new programs from existing program code, and it is quite common to find arguments that go like this:

“40 to 60 % of code is reusable from one application to another” (Sametinger, 1997:11).

Nonetheless, in spite of object-oriented design, standards and component-based software, the design of flexible and reusable systems is still a challenge (Correa et al., 2000:336).

2.2 Medical practice as knowledge work

A growing amount of literature argues that a broader approach to the knowledge concept is necessary. This implies relating knowledge to practice or as something people do (Blackler, 1995:1023; Brown and Duguid, 1991:40; Czarniawska, 1997; Knorr-Cetina, 1999:8). In order to underscore the complexity around the issue, Blackler (1995) categorizes knowledge as embrained, embodied, encultured, embedded and encoded. He further underscores that the implication is that not only limited groups (see Alvesson, 1995) are regarded as knowledge workers, but that all individuals and all organizations are knowledgeable (Blackler, 1995:1026). Being a knowledge worker thus means being involved in learning and the creation of new knowledge through becoming an 'insider' in the community (Brown and Duguid, 1991:48), that is, they are acquiring not explicit, formal expert knowledge, but the embodied ability to behave as community members. Knorr-Cetina (1999:1) extends this by arguing,

“By many accounts, Western societies are becoming “knowledge societies”, and “a knowledge society is not simply a society of more experts, more technological gadgets (...) it is a society permeated with knowledge cultures, the whole set of structures and mechanisms that serve knowledge and unfold with its articulation”

One such society is the medical context. As a complex organization, there are good reasons to look more closely into how and when and under which conditions knowledge is used and reused. A factor that influences the complexity of medical work is its richness and messy character (Atkinson, 1995; Berg, 1998; Strauss et al., 1985) and its continuous uncertainty (Atkinson, 1995:111; Hunter, 1991:28). Related to patient records, this uncertainty translates into making problems manageable within the hospital's working routines as:

“Through [the physician's] activities of reading and writing (...) he narrows down the plethora of potential tasks and divergent data into a clear notion of what to do next” (Berg, 1996).

An important part of problem solving in hospitals is related to determining the diagnosis of patients. In simple cases a disease will be easily recognizable when its major symptom is readily apparent, but in many other cases the diagnosis is far more complex (Hunter, 1991:70). A way to deal with this uncertainty is to use a narrative approach as

every event in medicine, potentially at least, has both oral and written narratives (Hunter, 1991:69). There is no way to solve a difficult problem and have it known without telling the story because stories make sense of ambiguous situations (Orr, 1990). This underscores the close relationship between written and oral accounts in the everyday organization of medical work (Atkinson, 1995:90; Hunter, 1991:5-6). Work, based on narratives, also underscores that work is obviously communal and thereby collaborative. In this sense the acquisition of new knowledge (learning) is inseparable from working, but also individual learning is inseparable from collective learning (Brown and Duguid, 1991:46).

3 Method

This study belongs to an interpretative approach to the development and use of information systems (Klein and Myers, 1999; Walsham, 1993) relying on four types of data: participative observations; interviews; informal discussions; and documents. The observations took place between January and March, 2001 in four departments at the University Hospital of Northern Norway. The hospital has 600 beds and has approximately 4000 employees (400 physicians and 900 nurses)

In total, 42 hours were spent observing work. In addition, in February and March, 2000 I conducted 19 hours of observation in three other departments that were used for background material.

I participated in several morning meetings with physicians and nurses, and in coffee and lunch breaks. I also joined groups of physicians having discussions in corridors, in on-duty rooms and examination rooms. In one department, I observed several patient examinations. People did not seem bothered by being observed. This resulted in a fluctuation between a fairly passive role merely observing as non-obtrusively as possible, and a more active role, when possible, posing questions for clarification and explanation. All together I conducted 27 semi-structured interviews during the periods mentioned above. Each interview lasted from 1 to 2 hours.

4 The cases

4.1 Department of Ear, Nose and Throat: overview and stability

Ear, Nose and Throat is a surgical profession with many small operations. This makes the cases relatively predictable. In order to ensure efficiency in the production of discharge letters, the department routinely reuses documentation from the electronic patient record. The mode of work in the department is illustrated below.

The chief physician and a nurse, both wearing white clothes are present in one of the examination rooms. They prepare for the examination of six patients. The room seems very much like an ordinary examination room, light colors on the wall, glaring light, a large desk with a pile of documents, notebooks, short lists and one computer.

The patients have been at the department for a short stay and will leave today. The patients are admitted to the room in turn and asked to sit in the examination chair. Every one of them moves normally as well as looks healthy indicating that their current illness is marginal in relationship to their total health condition. As an example, one of them, a young student, was hospitalized due to complications from tonsil surgery but, as the discharge letters states, "beyond that, the patient is in good health". The chief physician very quickly examines the throat and the nose of the other patients.

The conversation between the health personnel and the patients is easy-going and the chief physician often adds jokes to the conversation with the patients. The atmosphere appears stable, relaxed and well-organized. The actual computer is not used during the work, indicating that the chief physician has a clear sense of the patient's condition (he does to a minor degree need to look up x-ray reports, laboratory results etc.).

Between patients, the chief physician dictates the discharge letter associated with the previous examination. To be more correct, he only dictates the last part of it, the conclusion, which is carried out within 45 seconds and amounts to five lines of text. This work also includes specifying diagnosis and procedure codes drawn from a short list of regularly used diagnosis codes.

The rest of the discharge letter is reused from documentation already produced during the stay, indicating a certain stability of the knowledge. He checks off on a

paper form, to instruct the secretary, which previous documentation from the electronic patient record to include in the discharge letter.

4.2 Department of Cardiac and Thoracic Surgery: hectic and highly specialized

The Department of Cardiac and Thoracic Surgery is responsible for cardiac surgery for adults in the Northern Health Region of Norway. Most of the patients admitted to the department have received in advance a full examination by another department or (local) hospital. The patients normally stay for six days. After their surgery they are transferred to another department within the hospital or to a local hospital. In this situation it is imperative to include the discharge letters in order to inform others of the patient's condition, medications and further follow-up. The following vignette illustrates the work in the department:

About 10 persons are present at the morning meeting, one head physician and three assistant physicians, the rest are nurses who enter and leave the room depending on whether 'their' patients are involved. The discussions circle around the patients' heart surgery. The atmosphere appears hectic and effective. Any disagreements about changes in prescribed medications, further treatment strategies and whether patients are capable of leaving today are quickly settled.

One of the assistant physicians, Pasi, breaks from the morning meeting in order to produce a discharge letter on a patient who is leaving today. He goes to the on-duty room bringing with him the paper-based patient record which he places on a desk. First of all, he picks out the admittance report and the surgery report from the previous day. He also picks out and reads the discharge letter from a stay at the Department of Medicine one month earlier where the patient had a full examination prior to his surgery.

The on-duty room is busy and crowded. Physicians and nurses pass through all the time contributing to a hum of questions, advice and discussions. The phone is constantly ringing. This is the place where Pasi usually dictates the discharge letters. While ignoring the noise around him, he starts to dictate the social status for a patient that has had heart surgery: "72 years old fisherman that lives together with his wife...". The dictation is very short. As one of the head physicians puts it, "It has to be short in order to quickly point to what this is all about." In his dictation, Pasi did not reuse the summary from the admittance

report (as some do). He says, "I use it if it is good, but not always. Anyhow, most of the time goes to obtaining an overview of the case and then I have to read in the patient record. It might be that documentation produced some time ago is important. Surgical and medical texts are also very different, which means that sometimes I have to turn to old documentation to get the whole picture." He also tells that as a very inexperienced assistant physician at this department, he often had to read for 2 hours to get an overview of a case.

He continues to dictate. It is rather staccato since he tries to make sense of information from several sources, both from the pile of papers as well as from the electronic patient record. He realizes then that he needs the patient chart. He stops dictating, walks to one of the examination rooms, finds the chart and continues to dictate. He also reads and picks information from the nurse report. Once more, he stops dictating, and goes to the patient in order to measure her talus arm index. One moment later he is back and comments "no pulse in the foot, there is better circulation in the minor arteries, but not in the large ones." As the last point, he has to check whether the patient needs to be summoned to a control. He leaves the room, searching for the chief physician. He finds him in one of the patient rooms, gets the necessary information and finishes the dictation.

4.3 Section of Nephrology, Department of Medicine: specialized work for chronic patients

The Section of Nephrology is a part of the Department of Medicine. The section has a lot of patients with chronic diseases such as kidney failure who come for periodic controls. In addition, as a part of Department of Medicine, the section has to relate to a lot of emergency patients with unclear problems. Presented below is work from an experienced physician.

In an office in the Department of Medicine, a physician is making himself ready to produce discharge letters. The patients involved were discharged from the hospital a couple of days ago. On the desk in front of the physician is a pile of patient records and one computer. On the front cover of several of the paper records, written in large letters is RETURN DIALYSE. It means that these paper records are stored in the Peritoneal Dialysis section in a special archive. Patients having these records come regularly as they are special patients. As a result,

only the secretaries in the Peritoneal Dialysis section write these letters in order to ensure that everything is done right.

Laboring through his workload, it becomes clear the several of the cases are quite complex: unscheduled emergency cases, several examinations in other departments, contacts with psychiatric sections, or relying on results from several laboratories. He keeps pausing to check information from several sources: blood results from the laboratory system; running notes from the electronic patient record, results from referrals, and patient charts from paper records. Together they constitute pieces in a puzzle that need to be assembled, evaluated, and assessed closely with the patient's current condition.

He reads extensively. Reading and dictating are interleaved. The physician also needs to consult a couple of his colleges by phone.

For some of the patients he accesses the electronic x-ray system. He studies the x-ray pictures and examines the x-ray reports before making a summary of it on the fly while dictating. He also includes his own assessments. Retrospectively explaining, he states that, "Sometimes I can cut and paste from parts of the x-ray report. It depends on how much of it is important."

One of the discharge letters is based on an emergency admission. This time he dictates partly the same information that is in the admittance report (located in the electronic patient record). He explains that the reason he did not instruct the secretary to reuse the first sections was because the information in the admittance report was incorrect. He had to correct this information based on conversations with the patient and his wife. He also studies the nurse reports and says, "You have to do that often to check whether it says something important, well ...nothing important this time". For the next patient, however, the physician instructs the secretary to copy from named sections of the admittance report. Now the secretary will reuse this text. The physician explains afterward that he knew what the documentation contained because he had dictated this admittance report himself.

The final patient is a chronic Peritoneal Dialysis patient. In addition to the dictation he retrieves the patient's completed Peritoneal Dialysis form (see the figure below) from the computer. He copies it and pastes it into the discharge letter. It contains a lot of important measurements related to the patient's condition. And, as he says, "This is a patient that regularly returns to the section and he needs clear cut rules for who is responsible for what."

Date	10.01.01
Estimated dry weight	87-88 kg
weight	87-88 kg
Quantity of urine	2000 ml
Quantity of dialyse solution	12730 ml
Ultra filtrate	1000 – 1400 ml
Blood pressure	172/106
KT/V –own	1,16
-total	3,09
Kreatin-clearance	74,6 l/week
PET	Not performed at this stay
Prealbumin/albumin	35
HB	12,6
iron	17
TIBC	62
ferritin	205
Ca /ion. Calcium	2,36/1,22
Phosphate	1,92
PTH	20,4
Bag strength	CAPD bag strength Locolys 2,3 % 4 x 2 liter at day time, 2,5 liter Extraneal at night time
Exit-site	Good
Next control	1. At Medical polyclinic. With MRU, 2 month With measuring of rest function. 2. New PD-control with PET in May-02
Signature	NN
Date	10.01.01

Figure 1 The Peritoneal Dialysis form

4.4 The Department of Oncology: collective sense-making

The Department of Oncology is the only one in Northern Norway and has the major responsibility for cancer treatment in the region. Most of the patients are examined at a local hospital before they are admitted to this department. Due to the nature of the disease, some of the patients are hospitalized for a relatively long time. Others, depending on the treatment protocols, receive periodic treatment such as radiation or chemotherapy. This makes most of the daily operations planned. However, the personnel experience a very hectic work environment during the day as a result of the large percentage of patients with extremely complicated conditions. We follow an assistant physician with four months experience.

We are in the assistant physician's office outside the ward. It is six o'clock in the afternoon. It is quiet. The room is semi-lit. The computer screen beams brightly at the desk. The daytime workload makes discharge letter production prohibitive. They end up as evening activities and are dictated in her office. The physician is relaxed, neither the beeper nor the phone interrupts the work and at regular intervals she allows time to explain what she is doing.

The discharge letters from this department are extensive. There is little given structure to the text; they come close to free-text descriptions. The first patient is a newcomer, requiring extra time to study. She spends some time going through the paper record as well as retrieving information from the electronic patient record. She dictates extensively, describing the current situation for the patient. She logs onto the electronic x-ray system and reads the CT-description, makes a summary of it and continues to dictate. Part of her dictation shows that during the stay, the physicians have discussed possible treatment alternatives. The patient has also been involved in these discussions and has insisted on trying a special treatment that the patient has become aware of that may have an effect on his diagnosis D1. The patient is now discharged from the department without any documented effect of the current treatment.

After the stay, the physicians have continued to evaluate the case and have agreed to invite the patient to an ongoing research study outside the given protocol. This implies that the patient will receive treatment T1. A complication is that the patient may also suffer from diagnosis D2. If so, normally treatment T2 would have been given, but the physicians have never previously combined treatment T1 and T2. One of the involved head physicians recommends that they order treatment T1 (and not treatment T2) even if the patient also suffers from D2.

The assistant physician works over half an hour with this discharge letter, producing two pages of closely spaced text. Afterward she explains that they treat many different types of cancer, some of which are rare for general practitioners. It is therefore difficult to know what to be aware of, for instance possible side effects of certain treatments. These are rather specialized things that should be included in the discharge letters.

5 Analyses

5.1 The complexity of contexts

Producing discharge letters implies reading textual documents like previous running notes, admittance reports, etc. A basic point with reading such texts and thereafter reusing them is to understand their content. The chief physician in the Department of Ear, Nose and Throat underscores that

“the conditions for systematic reuse are existing documents that are brief, concrete and simple.”

Such documents are shaped by the context in which they are produced. As the context in Department of Ear, Nose and Throat illustrates, when the context is relatively self-contained, a narrow set of diseases and with patient cases that are relatively clear cut, the potential for reuse of knowledge increases. In fact the knowledge in this department reflects a certain stability and then the knowledge, as the chief physician argues

“becomes first-hand facts as it is very much in accordance with what really happened during the stay rather than producing a story out of it afterwards.”

In this way, a high degree of reuse is associated with a known context. Knorr-Cetina (1999:97) use the notion of ‘acting body’ as a way to increase understanding and illustrates this as “a person insisting on meeting a phenomenon face-to-face in order to understand its properties and procedural implications.” Another example is when the physician in the Section of Nephrology decides to reuse existing information because he knows the context in which information was created. He knows the patient and has dictated the admittance report himself.

However, as the number of contexts increases (expressed as a myriad of information sources or different departments), ‘body-experience’ becomes difficult to achieve. Texts that are to be used across contexts are objectified; meaning is detached from local contexts of interpretation (Lam, 1995:989; Naur, 1985:254; Smith, 1990:211). Thus, reading means to relate and translate - and understand - a text to a new context. This makes it imperative to participate in what Boland and Tenkasi (1995:351) denotes a ‘perspective-taking’ process, the ability or capability to take the knowledge of other communities of knowing into account. Consider for instance Pasi (Department of

Cardiac and Thoracic Surgery) when he dictates the discharge letter, how he strategically picks out the 1-month old discharge letter from the Department of Medicine and underscores that information produced a while ago might be important. As Pasi says about getting an overview of a case:

“The discharge letters from the Department of Medicine are very thorough. Reading them is a good way to obtain overview of a case.”

As the Department of Medicine gives the patients a full examination prior to their surgery at the Department of Cardiac and Thoracic Surgery, this is hardly surprising. However it illustrates that Pasi takes another perspective when reading. He does not only produce the facts related to the current surgery in his discharge letter, he also obtains the conditions for the surgery in the first place. Yet another example of perspective taking is when the physician in the Section of Nephrology uses the x-ray report. He sums up what he considers important and adds his own assessments, thus translating the knowledge to the current context.

Different degrees of tacit knowledge between communities might also hamper knowledge sharing. Some knowledge may not be migratory because it is highly embedded in complex social interactions and team relationships within organizations (Lam, 1997:974-975) as is illustrated from the receiving end of the discharge letters (among the general practitioners):

“Sometimes we receive discharge letters from highly specialized departments where it is difficult to know what the conclusion is; whether the patient has as disease or not. A specialist can read more between the lines (...) but to a general practitioner, it is not clear what the assessment is and how close the patient is in the process towards a diagnosis or the current status of the treatment.”

This underscores that ‘understanding’ can be reconciled with ‘explanation’ in text (Czarniawska, 1997:141) and that understanding is related to the knowledge-creators abilities to explain and justify the knowledge (Naur, 1985:256). It also underscores that it is necessary for the producers of knowledge to have another perspective in mind when they dictate. Sometimes this becomes expressed explicitly as is the case when the assistant physician in the Department of Oncology dictates discharge letters. She underscores that her own half year of experience as a general practitioner, as a part of

their training, has made her aware of what kind of knowledge the general practitioners need:

“The head physicians possess a lot more routine than us, but maybe we [assistant physicians] are more concerned about how general practitioners think and pay more attention to its content (...) [And as a former receiver of discharge letters] I try to imagine what kind of information I would have appreciated.”

5.2 Trust in knowledge sources

Collaboration in complex organizations presupposes trust (Atkinson, 1995:118; Davenport and Prusak, 1998:34-35). Trust is related to how and when information is achieved and to personal experience. Knorr-Cetina (1999:97-98) denotes it

“the acting body (...) [where] sensory performance and action go together (...) [From this viewpoint] the body is trusted to pick up and process what the mind cannot anticipate.”

Knorr-Cetina (1999:131) argues that trust classifies participants in terms of what is known about them, that is, whose work can one build upon and whose results are believable – a point also made by Smith (1990:217) related to trust in textual sources. The degree of trust, in information from the patient’s chart or advice given, depends very much on whose observation or opinion it was (Atkinson, 1995:57). This draws an important distinction between experts and nonexperts (Knorr-Cetina, 1999:131) or the distinction between head physicians and assistant physicians:

”If it is some of the regulars that have produced the summary then I might accept it at face value and use it as is. But if it is produced by an inexperienced physician, then I have to read more thoroughly to check whether it can be used.”

The assistant physicians can be complete novices, just graduated from medical school, or have several years experience in other fields but are completely new to the current one. The implication, regarding the content of the admittance reports may be as follows:

“Often it is the novices that receive the patients [which means] that assessments can be turned around the following day and thus resulting in worthless summaries” (Physician, Section of Nephrology).

This implies that the assistant physicians' current trustworthiness has to be built and reinforced. One way of doing this is through alliances with head physicians, as is the case in the Department of Oncology when the assistant physician gains force from a head physician when further treatment of a patient has to be decided.

However, in complex collaboration forms it is not only people that must be trusted. Certain contexts and being a part of that context ensure better trustworthiness. Consider the practice at the Section of Nephrology and their use of the Peritoneal Dialysis form:

“We have dialysis-patients that come in regularly for treatment, and every time there are certain things that must be carried out (...) partly some extremely important computations which indicate if it is necessary to change modus and whether their medication is sufficient. (...) We paste the results into the discharge letter.”

For these chronic patients, it is in fact imperative to reuse the computations to ensure proper quality. It is also enabled by a reasonable level of overview of what is going to occur with the patient during the stay. In these cases, trust is not only related to physicians, but also to the particular context. This is the only place where these records are archived and only the secretaries in this section are trusted to write these letters.

In some contexts, a high share of the knowledge only exists in an oral and distributed form as is the case when Pasi at the Department of Cardiac and Thoracic gathers information for the discharge letter. The discharge letter is not only based on existing documents but also on solely verbal accounts. Pasi gathers necessary information from the morning meeting (such as current status, change in medications, and further treatment strategy) as well as halting his dictating in order to ask his colleagues about follow-up information. He also stops in order to measure the patient's talus arm index, which shows that knowledge is produced 'in-the-making'.

The on-duty room in Pasi's department also serves as an illustration of how knowledge is orally produced and reproduced. Physicians and nurses regularly come and go, they ask questions, discuss cases, coordinate activities and talk on the phone with patients. Knowledge is then created through a collective process in a community (Brown and Duguid, 1991:46) and trust is ensured by being a part of this community (Van House et al., 1998:339). Such a context contains discourse that transforms individual knowledge

into a sort of distributed cognition or a stream of collective self-knowledge recognized by a constant humming with itself about itself (Knorr-Cetina, 1999:173).

5.3 Uncertainty

Often physicians have to deal with situations characterized by high degrees of uncertainty and limited amounts of resources. Hunter (1991:28) underscores this:

“uncertainties of diagnosis and prognosis are fundamental to medicine, the methods physicians have devised to meet them are a fundamental part of medicine as well.”

Consider for instance the following quote denoting an unplanned patient admittance:

“If the admittance report summary produced in the emergency department is a mix of previous case history (the reason for admittance and what the physician believed was the patient’s problem) and then afterwards it appears to be something completely different, then the summary of the admittance report becomes completely useless and wrong - both in professional terms and in terms of being uninteresting for the one receiving the discharge letter to know what the admitting physician believed in that situation.”

However, as a patient ”develops” in the department, shaped by a rising or falling temperature, pulse, blood pressure, lab-results and x-ray diagnoses, the physicians get to know the patient. In addition, there are meetings where they discuss and assess further care and treatment. In this way, through collective sense making uncertainty is reduced and knowledge is created.

“Based on new information in the process we discuss the case with pathologists, radiologists and hematologists as well as internally in our department (...) the outcome is regularly documented as a note in the patient record” (Assistant Physician, Department of Oncology).

In spite of distributed knowledge of a case, however, physicians may experience uncertainties of diagnosis and prognosis. Such a situation is familiar for the Department of Oncology where the diagnosis is uncertain; the treatment also is uncertain and they both are a matter of negotiation. Possible side effects are difficult to predict. The uncertainty and the whole process of negotiation is even reflected in the extensive

discharge letter. The letter reflects the outcome of the negotiation process, this time between the patient, the assistant physician and the head physician, where alternative assessment and treatment are discussed and where they try to make sense of an uncertain case. Still, the conclusion is not obvious. The content is more analogous to a narrative that is capable of embracing ambiguity (Boland and Tenkasi, 1995:357; Hunter, 1991:28; Orr, 1990).

Knowledge in these contexts is thus constructed and reconstructed in an ongoing process of targeted investigations and information gathering, a process that is supported by continuous discussions of the case. As one physician puts it:

“We are a kind of oral and assessing profession (...) it is important to have meetings, to discuss which treatment is most important or correct and whether it should change or not (...) [for chronic patients] we have medications that will not be effective within 3 months or 6 months time” (Physician, Department of Rheumatology).

During such a process some of the discussions and their outcomes are stored as notes in the patient record, especially abnormal results and carefully improvised treatments. The discharge letter (the collective consensus) then is the result of continuous negotiation of the meaning of the case. It also means that the possibility for reuse also has increased during this process.

6 Conclusion

The paper shows that knowledge is fluid, shaped by processes of discussions and negotiations where knowledge and trust are interwoven. Work is needed to make information credible and trustworthy, for instance by interpreting, assessing and validating the information in order to make it relevant and reusable for a given purpose.

In order to consider information for reuse, it appears that predictability and overview are key conditions. However, as is shown, this is not always the case. Uncertainty in diagnosis and treatment strategies as well as fluctuating competence influences many work situations. Designing information systems under such conditions must take this into account. This underscores the point of moving beyond just making information available.

First, as the analysis suggests, reusing information across contexts can be complicated as information in different contexts sometimes is comprehended differently (Ruhleder and Jordan, 2001). Whenever there are difficulties in understanding some information (for instance, in the discharge letter), the information system should offer links or references back to previous related information (if it exists) that more thoroughly elaborates the conditions for the current situation or assessment. From a general practitioner's point of view, for instance, this would mean potentially accessing information systems, such as electronic patient records, radiology systems or other specialized information systems, facilitated by the proper link or reference.

Second, as the analysis has illustrated, overview and stability enhances potential for extensive reuse. In such situations, it might be possible, promoted by an information system, to structure the knowledge in predefined categories, thus making it possible, on a more detailed level, to reuse some of these knowledge elements at a later stage. At the point of production of the information, it is possible to have reuse in mind and carefully adhere to the agreed-upon knowledge categories. It seems likely that such a strategy would also imply that the process of interpreting and validating information would become more structured, regulated and disciplined – as well as more transparent.

Third, keeping *track* of what kind of information has been reused and in what situations (e.g. checking off from a list), might demonstrate the usefulness of reusing certain information elements, for instance by counting how many times information has been reused and who has produced it.

Fourth, as a part of their training, it is the assistant physicians that normally receive the patients, which sometimes results in worthless summaries in the admittance report (see the analysis section). Therefore it seems reasonable to demand that the electronic patient record provide a feedback loop for the assistant physicians, offering a list with reference to the corresponding discharge letters. Consequently, the assistant physician would get an evaluation of earlier assessments such as insufficient description of status, disregarded things or incorrect planning.

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Paper five:

Walking the tightrope between the global and the local

Standardisation meets local work-practice in a hospital

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Abstract

Traditionally, uniform and standardised IT-solutions are considered mechanisms for increased control, efficiency and quality. Unfortunately, in spite of existing studies of the actual experiences of standardisation, such as how they come into being, and how they are intertwined with local practice, unreasonable belief in standardisation seems to prevail. Acknowledging the origin of standardisation and its local character, however, does not mean that standardisation is futile or should be avoided. It rather means that standardisation efforts should be targeted to a reasonable level; that is, striking the balance between the global level's need for increased co-ordination and control and the local level's need for flexibility. The aim of this paper is to strike this balance as it elaborates the implications and the 'costs' for local practice in order to make a standard work. Empirically, the paper draws on a standardisation effort of discharge letter production in the University Hospital of Northern Norway.

Keywords: standardisation, information infrastructure, work-practices, quality, healthcare

1 Introduction

As information systems increasingly are employed across heterogeneous work contexts, they are dependent on standardisation. From a technical point of view, standardisation

enables integration of information systems based on various infrastructures, developed with different tools and running at different locations. Related to use of the information systems (the social aspect), standardisation serves as means for collaboration, shared meaning and far-reaching coordination.

Standardisation efforts are, however, often promoted in a top-down and uniform manner with weak local influence. This is unfortunate as standards are not merely a technical or neutral device ready to be put into use. Rather they are socially constructed, achieved as results of negotiation processes (Abbate, 1994; Bowker and Star, 1999; Lachmund, 1999). Failing to acknowledge how standardisation comes into being often results in lack of adoption, resistance in use or only temporary validity (Bowker and Star 1999: 293). As a standard is intertwined with local practice, it both shapes local practice and is being shaped by it. Consequently work is required to reach agreement about a standard and, subsequently, maintenance-work is required to keep it 'alive'.

Acknowledging the local and partly unpredictable character of standardisation does not mean that standardisation is futile. It rather means that standardisation efforts must be targeted to a reasonable level. This means striking the balance between the global level's need for increased co-ordination and control and the local level's need for flexibility. Striking this balance is the major aim of this paper. More specifically, the paper will elaborate the 'costs' in a standardisation effort, not as an argument for discarding standardisation, but as an argument in the process of defining a balance between a global and a local solution. This paper argues that the 'costs' involve both additional work for some actors, restructuring of work and implications for quality. Such a focus positions the paper in line with work performed by Bowker and Star (1999); Abbate (1999); Timmermans and Berg (1997); Lachmund (1999) and Rolland and Monteiro (2002).

Empirically, the case draws on the work of physicians at the University Hospital of Northern Norway, with special focus on the production of discharge letters. The discharge letters are summaries of patients' stays and play several roles. Firstly, they inform general practitioners and local hospitals what has happened during the stay, current status and prognosis. Secondly, they distribute responsibilities for follow-ups between the hospital and the general practitioner. And thirdly, the hospital physicians themselves frequently use these letters whenever the patients return to the hospital, or when they for other reasons need to reconstruct the case.

The management at the hospital aimed at both increased efficiency and improved quality through standardisation of the discharge letters. As a part of this, it was necessary to instruct the physicians to work in a routine way. This turned out to be difficult because work practice in a large university hospital is extremely heterogeneous. Heavy resistance surfaced among the physicians who felt that the interests of the management were not aligned with their own. As a result, the initial strive for a completely standardised solution was translated into a recommendation.

The remainder of this paper is organised as follows. Section 2 elaborates more thoroughly the theoretical foundation. Section 3 illuminates the background, motivation and current status respectively. Section 5 presents three case vignettes, which contain illustrations of physicians' work in three different contexts (two departments at the hospital and a general practitioner's office). Section 6 analyses the 'costs' involved in the standardisation effort. The conclusion is presented in section 7 and provides a few guidelines for design.

2 Theory

Traditionally, uniform and standardised solutions are considered key mechanisms for increased control efficiency, simplicity, quality and collaboration. A large body of research underpins the relationship between standardisation and control. An interesting example may be found in David and Bunn (1988:184), outlining the struggle between AC and DC in the so-called 'battle of systems'. Abbate (1994) correspondingly outlines her account of the computer networking debate in the mid-1970s. US PTT¹'s promotion of standards was in this context supposed to secure their monopolisation of public data networking.

Like standardisation of technology, the routinisation of work is regarded as a foundation for increased managerial control. In her book about extremely routinised service-work in McDonalds franchising companies, Robin Leidner (1993) describes how management maximises its control of the work process in order to predetermine how to conduct those tasks and thus promote increased efficiency and simplicity. The argument

¹ Post, Telegraph and Telephone

echoes very well the motivation for a uniform solution in the struggle between the computer networking protocols X.25 and TCP/IP (Abbate, 1994:200).

Leidner (1993) also elaborates the relationship between standardisation of work and quality. Standardisation of work and services in McDonalds franchising companies are considered a key tool for offering a proper level of quality to the customers. A precondition, however, is that the customers accept standardisation of themselves as customers and play their role defined by McDonalds (ibid: 25). This implies that customers parting from the predefined script and instead wanting a more flexible service might easily experience that they 'equate quality with greater customisation of service interactions than the companies will allow' (ibid: 34). Consequently when both efficiency and quality are major goals, quality becomes subordinated (ibid: 173).

Physicians represent an autonomous profession. This implies that imposed routines are doomed to fail if they are not conformable to the physicians' own interests. Studies from CSCW literature, partly in a similar way, warn that collaborative aspects of introducing new technology are often overlooked. Despite careful planning, many of these efforts fail as a result of unforeseen 'group' aspects. What comes into play is, according to Grudin (1989) that:

"Designers' main focus has been aiming at support for the group as a whole and less on the individual user" (Grudin, 1989)

Rejecting unrealistic expectations of standardisation does not imply that standardisation is superfluous. On the contrary standardisation is a condition for making things work together over distance (Bowker and Star 1999:14) as well as it promotes both local and shared meaning (ibid: 293). However, standardisation efforts must be approached with soberness. It means acknowledging the work involved in establishing information infrastructures, about how standards come into being; about who becomes visible and invisible and why. It also means acknowledging that standards have no single universal meaning.

How standardisation both shapes and being shaped by local practice is a major issue for several researchers. For instance, Timmermans and Berg (1997) in their study of the development of clinical protocols, Lachmund (1999) in his study of auscultation sound, Winthereik and Berg (2001) in their study of the use of diagnostic codes in primary care and Rolland and Monteiro (2002) in their study of an infrastructural information system

in a global maritime classification company. Lachmund (1999:440) argues, for instance, that:

“The universalization of medical knowledge and practice and the forging of vernacular particularity went hand in hand as part of one single process”.

This implies that it is not possible to achieve standardisation without some tinkering with the imposed structure (Timmermans and Berg 1997:291) because, as they argue:

“this tinkering with the protocol, however, is not an empirical fact showing the limits of standardisation in practice, but rather a condition for the functioning of the structure in the first place (ibid.:291).”

The key question, then, becomes how to balance local use and heterogeneity against uniform solutions; and at the same time take into account how these extremes transform and influence each other. This question is at the core of the work on information infrastructure (Bowker and Star 1999; Ciborra 2000; Kahin and Abbate 1995). Bowker and Star's (1999) study of how the World Health Organization's global efforts to capture the variety of death certificates in a single form, serves as an exemplary expression of this kind of work. The involved classification scheme, International Classification of Diseases (ICD) constitutes an impressive attempt to co-ordinate information and resources about mortality and morbidity globally (Bowker and Star 1999:21). Accordingly, the ICD is recognised as an important infrastructural component of medical and epidemiological software, as it tries to collect global information across several unique contexts. The historical, political and international span has complicated administration of the ICD and co-operation has been hampered by different ways of recording and reporting. Different cultures, for instance, place different emphasis on causes of death, which influence the way coding has been conducted, and different national schools of medicine may disagree about issues such as simultaneous causes of death (Bowker and Star 1994). The achieved level of standardisation has been influenced by, and balanced against, the interests of various stakeholders. For instance: the conflict of interests between government on the global level, and the individuals in each community on the other.

3 Reflections about methodology

This study belongs to an interpretative approach to the development and use of information systems (Klein and Myers, 1999) relying on four types of data: participative observations, interviews, informal discussions and documents. The observations took place from January to March 2001 in two hospital departments as well as observation in one general practitioner's office. The major observation was conducted in the Dept. of Cardiac and Thoracic Surgery. In total, 42 hours were spent observing work. In addition, from March to February 2000 I conducted 19 hours of observation in three other departments, which were used as background material.

I was allowed to move freely around in the wards. I participated in several morning meetings with physicians and nurses and participated in coffee- and lunch breaks, I joined groups of physicians discussing in corridors, on-duty rooms, examination rooms and pause rooms. In one department, I also observed several patient examinations. Sometimes I "shadowed" voluntary physicians in their work. In these situations I could pose questions in order to clarify and elaborate observations. The extent and format of these questions varied with what was possible without intruding too much with ongoing work. Questions were postponed when the work was recognised as hectic, during formal group meetings or in front of patients.

In sum I conducted 27 semi-structured interviews during the periods mentioned above. Each interview lasted at least two hours. Sometimes it was difficult to make appointments for interviews because of the hectic everyday work. We solved it by agreeing that I should be in the surrounding area, for example waiting and observing in the ward until there was some time available. Even during some interviews, interruptions occurred, caused by incoming phone calls or colleagues that needed to talk. One interview with a surgeon was also interrupted as a patient was in immediate need for surgery.

4 Setting the stage

At the University Hospital of Northern Norway, a quality standard for discharge letter production time is considered to be maximum seven days. Unfortunately, two

accomplished time studies², in 1999 and 2000 respectively, revealed that about 50 % of the discharge letters were sent after this limit. The bottleneck was identified to be delays in physicians' dictating, proofreading and signing. Lack of formalised practice was also promoted as a key problem:

“The departments have very different practice when they produce discharge letters. The extent of the letters fluctuates between one and six pages and some departments do not use templates. Accordingly some discharge letters are badly adapted to the receivers”

In the autumn of 2000 the management initiated the discharge letter project as a means to improve the situation. Three hospital departments participated in the project. Two of them are referred to in this paper, the Dept. of Cardiac and Thoracic Surgery and Dept. of Medicine. Four general practitioners from two health centres participated. The project also asked the eleven other hospitals in Northern Norway, as receivers of discharge letters, to respond to some of the project's suggestions. The project had two objectives.

- 1) Increase efficiency in discharge letter production.
- 2) Improve the quality of the content of the discharge letter (in order to make them more useful and readable for the general practitioners).

To deal with the problem, the project management suggested deploying a standardised discharge letter template for the whole hospital (a strategy that is also suggested on the national level (KITH, 2001)). The text in the discharge letter should then be classified in accordance with the template and should be a foundation for routinised reuse of information from the electronic patient record:

“A patient stay will accumulate several documents, like an admittance report, several notes, surgery report and lastly a discharge note. The discharge letters can be produced by reusing [categorised] information” (project documentation)

The idea is illustrated in Figure 1.

² Both in 1999 and 2000, The Centre for Research, Quality and Development (FoKUs) at the hospital accomplished a time study in order to estimate discharge letter production time. The number of involved departments was 7 and 16 respectively, and the number of discharge letters was 565 and 1368 respectively.

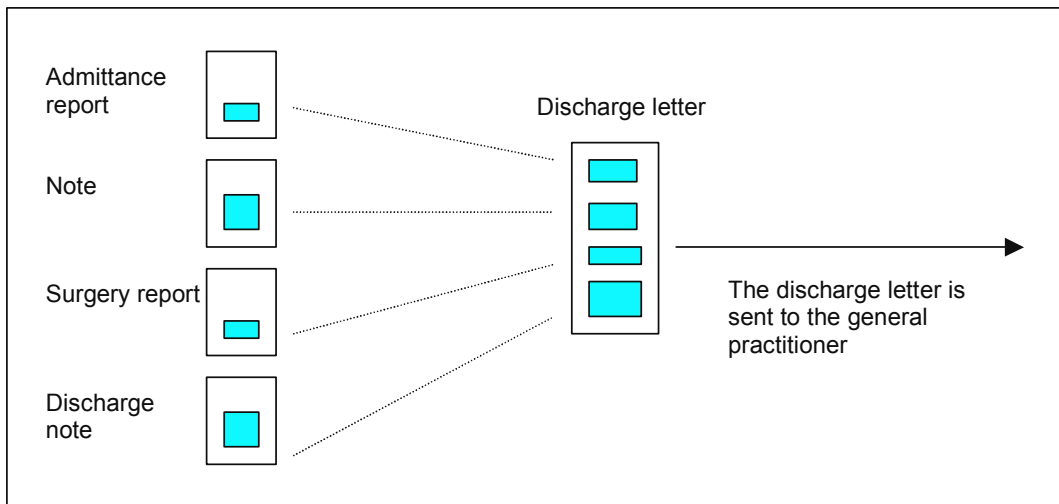


Figure 1 The suggested strategy of producing discharge letters. The shaded area represents predefined extracts or summaries from existing documents.

The commitment towards routinised reuse of existing information came as a surprise for the physicians. One of them tells:

“They presented some examples where they had saved 70-80-90 % time in the production of discharge letters by “cut-and-paste” and reuse of information. All you had to do was to just flow through this template with this kind of built-in structure.”

It soon turned out that the idea of a standardised template for the whole hospital was too ambitious. As one physician argued, “it is not possible because the departments are so different”. As a result, the strategy of a standardised template for the whole hospital was abandoned and the focus on routinised reuse was de-emphasised. Instead, each of the involved departments established their own template, which was put into use in their respective departments around the turn of the year 2000/2001. The primary aim was now to increase readability for the discharge letter receivers.

5 The cases

Medical practice varies enormously – within different domains, departments, hospitals and countries (Atkinson, 1995; Strauss et al., 1985; Berg, 1998). I have no ambition of justifying this variation in any systematic or comprehensive manner. Rather, I merely aim at motivating appreciation of this variation through the sampling of 2 wards at the

University Hospital of Northern Norway and the work context for a general practitioner. The observations are targeted at the process of producing and receiving discharge letters. Characteristic features of these work-situations in the different contexts are

1. *Dept. of Cardiac and Thoracic Surgery:* A hectic, highly specialised department with relatively narrow problems of concern, where most of the patients have had a full examination in another department. This is reflected in the discharge letters, which are short, precise and usually based on free-text.
2. *Section of Nephrology, Dept. of Medicine:* A section with a lot of control patients related to chronic diseases, like kidney failure. These discharge letters are extensive and sometimes require a high degree of structure.
3. *The general practitioners' offices:* The general practitioners are the receivers of discharge letters in the health centres. They often read extracts of the discharge letters prior to, and during the patient consultation.

5.1 Dept. of Cardiac and Thoracic Surgery – highly specialised

The Dept. of Cardiac and Thoracic Surgery is responsible for cardiac surgery for adults in the Northern Health Region of Norway as well as regionally responsible for general thoracic surgery. Most of the patients have already received a full examination by another department or (local) hospital. The patients normally stay for about a week. After their surgery, they are transferred back to another department within the hospital or to a local hospital. The discharge letter is the key vehicle for communicating to the recipients the relevant insights gained and further follow-up. The following vignette illustrates the work in the department:

Olivera is seated with a pile of patient records in front of her in one of the patient examination rooms. She has been a junior doctor in this ward for only two weeks. There is a computer on the desk with the electronic patient record system, DocuLive EPR. The new discharge letter template is nailed to the wall right behind the computer. It has been in use in the department for two months. The necessity of being brief is strongly emphasised as the template only contains eight sections, and for several sections, there are constraints on the number of lines. For instance:

Anamnesis (maximum 4 lines)

Examinations (maximum 2 lines)

Treatment (maximum 3 lines)

This is followed up at the bottom of the template where it is written in big and bold types, “the discharge letter must not exceed one page”.

Olivera uses the template actively when she dictates, looking up at the wall and following the sections downwards. She dictates pretty slowly. She stops at each new section and looks at the template in order to be guided to the next section. She says aloud: “personalia”, “receivers”, “diagnoses”, “treatment codes” etc. She takes her time and spends almost half an hour in dictating this report. In the middle of the dictating she also stops and leaves the room in order to get advice from one of her senior colleagues.

Being explicit about the use of the template and its structure, she has also instructed the secretary to follow it. Figure 2 shows the discharge letter after it has been written by the secretary. The fonts in bold represent the section headlines in the template. Olivera has dictated precisely in accordance with the template

<p>Background: <years> year old man, unmarried, no children. Polio in <year>. Subsequent paralysis in the left lower extremity. Low-degree angina pectoris, not examined. In May <year> femorodistal bypass. The patient has had a postoperative fistula, which has not dried up through conservative treatment, and he had now been admitted for operative treatment.</p> <p>Examination: Angiography performed the <date> indicated that the applied graft had clogged up. It was decided that this graft be removed without risking the circulation in the lower extremities.</p> <p>Treatment: Surgery <date> with revision of the infected vessel prosthesis in the left lower extremity (see enclosed surgery description).</p> <p>Progress, complications: The patient was sent to the infections ward because of infection in all wound cavities</p> <p>Supplementing examination: Microbiological examination of the wound secretion showed yellow staphylococci. Recommended anti-bacterial therapy Diclocil and Claforan.</p> <p>Medication at discharge: Ismo 50 mg 1 tabl. daily, Fragmin 2500 IN x 1, subcutant, Diclocil 500 mg x 3, Keflex 500 mg x 3, Paracet 1x4 tabl. daily.</p> <p>Status at discharge: The patient is released in relatively good general condition without signs of infection around the edge of the wound. The patient requires further antibiotics treatment and also physical therapy in order to better mobilise and especially because of paralysis in the left foot caused by polio. The patient is sent to (...) nursing home.</p> <p>Follow-up: The patient has been called for post-surgery examination in 3 months.</p> <p>If complications should occur within 30 days, we ask to be notified.</p>

Figure 2. The discharge letter written by the new junior doctor Olivera

Steinar, a head physician rushes into the on-duty room. He sits down by the desk and starts to dictate. He is very fast; there is no pause in his dictation. He knows exactly where to look for information and does use the template for support. This also implies that he does not instruct the secretary to reuse text from the admittance report. The dictating is accomplished within 3 minutes and Steinar asks the secretary to write it immediately. One of the nearby junior doctors comments that Steinar's discharge letters are "state-of-the-art": they are very surgical, they are short, precise and do not contain anything superfluous. The nurse responsible for the discharge of the patient asks for the discharge letter since the ambulance plane is waiting. The secretary has just finished writing the discharge letter into the electronic patient record and she calls Steinar and requests him to sign the letter. This is done electronically. She says that Steinar and the rest of the head physicians normally do not need to proofread the discharge letter because they are so experienced. She adds: "Did you notice that I did not use the template? The reason is that I knew that Steinar did not use the template; still it follows the structure in the template except from that he has exchanged "blood results" and "medications". The literal part of the discharge letter looks like this:

The patient is married and lives with his wife. Some coronary disease in the family.

Angina pectoris from <year> Inguinal hernia. Possibly infarkt in -<year>.
In the beginning of January 2001, he has had unstable angina pectoris. Examination has indicated <disease-1> and <disease-2> as well as EF in the lower normal area. Pseudo aneurism in the groin.

He received surgery in <date> with a coronary bypass and surgery to a pseudo aneurism in the groin.

Postoperatively, this has proceeded well. He has had a short period of self-terminating auricular fibrillation. He may according to plan be moved to <local hospital> hospital today <date>90.

Medication:
Zocor 10 mg vespere. Albyl-E 160 mg x 1. Mycomust *tablets* x 4. Sotacor tablets 40 mg x 2.

Hb 11.6. Whites 10.7. CRP 217. Na 141. K 3.8. Temperature 38.0°.

The patient has had reaction with CRP and some temperature, but we are unable to give a good explanation why. He is in good shape. We have not administered antibiotics, but leave that, if necessary, to the colleagues at <hospital>

No appointment for control here. Will be followed up by cardiologists locally in the regular manner.

If any complications should arise after the initial 30 days, we would like to be notified.

Figure 3. The discharge letter dictated by the head physician

5.2 Section of Nephrology, Dept. of Medicine –structure for chronic patients

The Section of Nephrology is a part of the Dept. of Medicine. The section has many patients related to chronic diseases (such as kidney failure) who come for periodic controls. In addition, as a part of Dept. of Medicine, the section has to respond to emergency patients with undiagnosed problems. Excerpts from the work of an experienced physician are presented below.

The physician has just managed to break away from the daily buzz of patient-related work to produce discharge letters. The patients involved have been discharged from the hospital a couple of days ago, but this is his first opportunity to finish off work related to their departure. He is able to find an unoccupied office at the ward where he brings his pile of paper-based patient records. Obviously, the others at the ward know where he is as they pop into the room to make inquiries. He also has to respond to his beeper, but this does not force him to leave the room.

“RETURN DIALYSE” is written in large letters on the front covers of several of the paper records. This means that these paper records are stored in the Peritoneal Dialysis (PD)-section in a special archive. They belong to a special type of patients who come in regularly. As a result, only the secretaries in the PD-section write these reports in order to ensure that everything is done right.

Samuel points to two different discharge letter templates and says that they use both of them. One is general for the department while the other is special for PD-patients.

The physician starts by looking up laboratory results from the laboratory system, then dictates the results while reading them from the screen. After that he turns to the x-ray-system, reads the x-ray description and makes a summary of it on the fly as he dictates. He follows the structure in the general discharge letter template when he dictates and he marks it by explicitly naming each section headline. Afterwards he says “Sometimes I can cut and paste parts of the x-ray description, it depends on how much is important - the short ones I dictate”.

The following discharge letter is based on an emergency admission. This time he dictates partly the same information that existed in the admittance report. He says that the reason why he did not instruct the secretary to reuse the first sections (the summary) was incorrect information in the admittance report. He

had to correct this information based on conversations with the patient and his wife.

For the next patient, on the other hand, the physician instructs the secretary to copy from X to Y in the admittance report. Now the secretary will reuse this text. Afterwards the physician says that he knew what the documentation contained because he had dictated the admittance report himself.

The physician does not know the last patient, nor does he know who has discharged her. There is no hand-written discharge form either (a form that is written by hand and functions as a preliminary discharge letter). This complicates the dictation. After quite a while reading, he starts dictating. He dictates the first part of the discharge letter all over again, that is, he decides not to use part of the existing text because, as he says, "I made a summary of it because there was so much there. There is no point reusing all that once more". He dictates in the category 'admittance findings', after which he stops and says, "no ... this is a comment and must be put into another category". He explains later that it is important to distinguish between facts and assessments. He also studies the chart and dictates current medications. He works for about half an hour with this letter.

The final patient is a chronic Peritoneal Dialysis patient. In addition to the dictation he retrieves the patient's Peritoneal Dialysis form (see Figure 4) from the computer. He copies it and pastes it into the discharge letter. It contains a lot of important measurements related to the patient's condition. It acts as a working 'memory' as: "This is a patient that regularly returns to the section and he needs clear cut rules for who is responsible for what. As is possible to see here [pointing], PET analysis is not performed during this stay, but down here [pointing to the bottom of the form] you can see that it has been decided that it will be carried out during the next stay". When Peritoneal Dialysis patients are hospitalised, it is standard procedure to check the most recent discharge letter in order to see whether any special tests are planned.

Date	10.01.01
Estimated dry weight	87-88 kg
weight	87-88 kg
Quantity of urine	2000 ml
Quantity of dialyse solution	12730 ml
Ultra filtrate	1000 – 1400 ml
Blood pressure	172/106
KT/V –own	1.16
-total	3.09
Kreatin-clearance	74,6 l/week
PET	Not performed at this stay
Prealbumin/albumin	35
HB	12.6
iron	17
TIBC	62
ferritin	205
Ca /ion. Calcium	2.36/1.22
Phosphate	1.92
PTH	20.4
Bag strength	CAPD bag strength Locolys 2.3 % 4 x 2 liter at day time, 2.5 liter Extraneal at night time
Exit-site	Good
Next control	1. At Medical policlinic. With MRU, 2 months. With measuring of rest function. 2. New PD-control with PET in May-02
Signature	NN

Figure 4. Reused documentation from the PD-section

5.3 The general practitioner's office

Centrum Health Station is located in the middle of the city, a couple of kilometres from the hospital. The health station consists of a co-localisation of 9-10 general practitioners that offer first level services to the public. This means that the general practitioners serve as the first-line gatekeepers to the hospitals. Although the major part of the discharge letters is paper-based, the health station increasingly receives discharge letters electronically.

We are in the office of one of the general practitioners. The room is sterile, white and equipped with a lot of medical devices. Two examination benches are placed beside two of the walls. In one part of the room there is also a desk containing a computer. As the desk lacks huge piles of papers and patient records, the work context reflects tidiness and order. On one side of the desk there is an empty chair, signalling that this is the patient chair. The general practitioner is in-between two patient consultations and just has time to read a discharge letter from the hospital concerning one of his patients. He sits behind the desk and reads it on the computer screen. He does not wear the usual

physician's white coat, just ordinary clothes, signalling a certain level of informality.

The discharge letter is relatively extensive and the content of the letter is divided into sections, but the headlines are not in boldfaced types and the letter lacks underlining. The general practitioner reads the discharge letter thoroughly, following the sections in the letter. After a while, he makes a halt and says that the structure in these letters is important, because structure makes extensive letters more readable and, as he says, "then you can just jump to the section you are most interested in, but if they are very unstructured and extensive you might lose important information as a result of the limited amount of time available"

He also underscores that "what is also very important and which is often missing in the discharge letters, is an understandable conclusion for how to follow up things, with a clear distribution of responsibility between the hospital and the general practitioner". Such a conclusion or summary encompasses information about what has happened during the hospitalisation, treatment given, prognosis, further plans and treatment strategy, sick notes and what kind of information is given to the patient about his condition. The summaries are also useful as they very quickly can reconstruct the patient cases before and during short patient consultations (typically 15 minutes). The general practitioners put these summaries into their own electronic patient record where they can be read directly from the computer screen.

The general practitioner rounds off by reading the conclusion (summary) aloud from the current discharge letter, "status ...ok ...follow-up...in fact, here I miss something about the loss of blood and the follow-up, as this is a condition where I understand that this patient must have lost a lot of blood".

Incomplete summaries such as the current one force the general practitioners to compose the summaries themselves based on bits and pieces from the discharge letter. In relation to the current discharge letter, the general practitioner says, "the fact that they [hospital physicians] haven't made a summary where the treatment is included forces me to more advanced cut-and-paste. I have to cut and paste the CT-description, the treatment, medications by departure, and the follow-up". Correspondingly, if the discharge letters are based on paper then the physicians use a yellow marking pen to mark the

sections and sentences they want included in the electronic patient record, whereupon the secretary will do the actual writing.

6 Analyses

In this section I take the perspective of the different key actors and analyse how the degree of standardisation influences their comprehension of quality. The point is to illustrate that quality is not globally given, but measured in accordance with local practice and in accordance with whoever is ‘strong’ enough to make his viewpoint valid. This also means that when quality for some actors decreases, this will amount to the ‘cost’ by introducing the standardised solution. In a similar way, standardisation and classification processes also become a question of promoting and hampering different perspectives. Promoting a certain perspective implies de-emphasising others. Promoting a perspective too strongly then, also becomes a question of how useful it is, for whom and whether the ‘cost’ is acceptable. Estimating the total ‘cost’ that is added to the beast of burden, however, is difficult since both standards and work practice are interwoven and have the potential to transform the mode of work as well as reflect back, and possibly shaping the form of the introduced standard. As we also know, introducing a new standard for producing and reusing information feeds directly into the core of physicians’ documentary work as summarising and thus reusing previous information is common in medical work (Berg, 1998:298).

6.1 Quality – for whom?

An important motivation for the project is to increase the quality of the discharge letters. Superficiality, quality is a term that is easy to agree upon. Focusing on the different key actors, however, highlights the heterogeneity of comprehension of quality. There are some partly different, some partly aligned and some completely different opinions of quality. From a managerial point of view, quality is tightly connected to efficiency:

“We could save considerable time for the patients and the general practitioners if the departments use templates together with more cut and paste [automatically reuse predefined information]”

The hospital management tries to hook up the general practitioners’ interests with their own interests. On the surface there seems to be some sort of alignment of interests as both pursuit structure in the discharge letter. The general practitioners prefer structured

discharge letters as a means for more surveyable reading than discharge letters based on free text. The hospital management, on the other hand, considers a common structure an opportunity for routinised reuse of information and as a means to reduce discharge letter production time. The alignment of hospital management and general practitioners, however, is only valid up to a certain point as a general practitioner complains: “Predefined reuse is possible, but very easily it becomes repetition of things and inclusion of information that is irrelevant”. On the contrary, what is considered a quality discharge letter from the general practitioner’s point of view is:

“What is very important and which is often missing in the discharge letters is an understandable conclusion for how to follow things up and with a clear distribution of responsibility between the hospital and the general practitioner.”

When turning to the Dept. of Cardiac and Thoracic Surgery and their mode of work, quality discharge letters are considered “short, precise without containing anything superfluous” and as you may recall, produced very quickly. Usually they are also based on free text. The head physicians of course represent the concrete expression of this kind of quality. One of them puts it like this:

“We are an expedition department. We don’t give a total assessment of a patient, and the discharge letters are shaped accordingly. They become relevant for the current condition, where the status of departure and follow-up for the patient is important”

This illustrates that good quality is evaluated in close relationship with the role of the department. The template that has recently been introduced in this department illustrates very well both how the template and the work influence each other and how this relationship is transformed. Even if this template contains structure, it reflects the mode of quality work in this department. The number of categories is low, for several sections it is recommended to be “just a few sentences”, and finally at the bottom of the template page it is emphasised that the discharge letter must not exceed one page. On the other hand, the actual use of the template also influences work for the physicians. In spite of how preciseness and brevity is underscored in this template, adhering to it shapes the mode of the work, as the head physician puts it:

“The discharge letters become twice as long when I use the template. I can express myself much better in three sentences about how the patient stay has been, rather than using a template that induces a whole page.”

For the junior doctors, however, standardisation and a certain degree of routinisation serve as a means to ensure that the quality of their work is compatible with the standard of the department. The junior doctor, Olivera, is a typical example when she lets herself be completely guided by the template. Similarly, the junior doctor Pasi, who has some experience, uses the template more superficially. Consequently the standard may be seen both as giving the junior doctors skills (Leidner 1993:175) and as a carrier of prescriptions for ‘good medical practice’ (Timmermans and Berg 1997:296) as

“The junior doctors that come to the department from for instance the Dept. of Oncology are used to very long discharge letters, generally 2-3 pages. Therefore they include things that are not that relevant. They must learn to dictate the discharge letters once more and when they use the template, their discharge letters become shorter.”

In this way the template not only prescribes quality measures, but also influence, and transforms the way the junior doctors conduct their work

Turning to the Dept. of Medicine illustrates very well how the quality of the discharge letter is linked to everyday work. The physician underscores how difficult it is in emergency cases (50% of the department’s patients) to structure information in accordance with predefined rules:

“It is a very big difference from a surgical point of view, with clear cut cases and fixed surgical procedures, to the internal medical point of view, with a lot of emergency cases [and the corresponding uncertainty]” (physician, Dept. of Medicine).

6.2 Restructuring the work chain

In medicine, an important part of the work is regularly summarising previous (and thus reusing) information (Berg, 1998:298). A typical situation is when the physician in the Dept. of Medicine “on the fly” makes a brief summary of the x-ray description, which a physician from the Dept. of Radiology has produced. He selects the information, which he considers relevant and uses it as a part of the discharge letter. Another place in the

work chain, but nevertheless a similar example, is when a general practitioner composes a summary by using a yellow marker pen on the discharge letter as a way to instruct the secretary what to put into their electronic patient record. An illustration of the work chain is presented below:

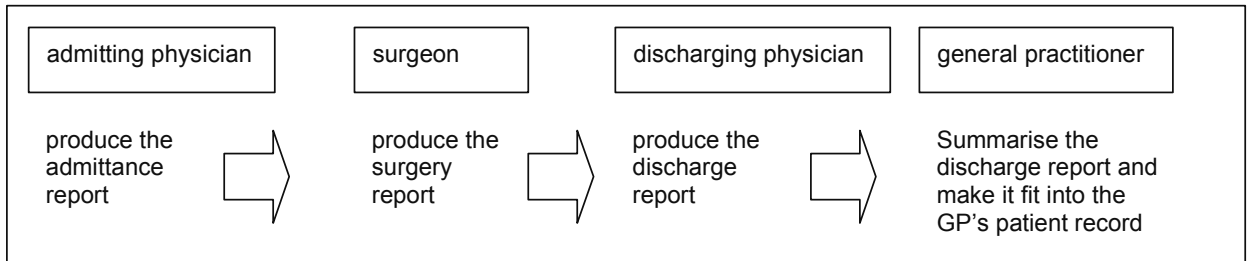


Figure 5. An instance of a usual work chain in the hospital.

This underscores that the physician who produces the summary is different from the physician that has produced the actual text. The suggested new way of producing summaries is that the physician that originally produces the whole text also produces a well-written summary that can be automatically reused by the “next physician in line”. In this way, discharge letter production time is expected to decrease. Correspondingly, with summaries of discharge letters – if they are well-produced by the hospital physician, they can automatically be put into the general practitioner’s electronic patient record. A typical instance of such a work chain is illustrated in Figure 6:

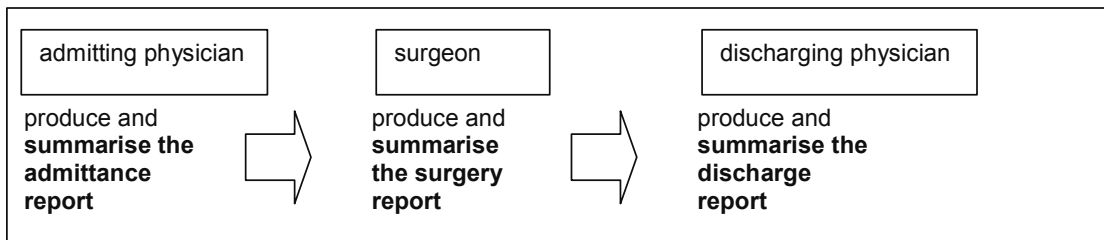


Figure 6. The suggested restructured work chain.

The major point here is that the responsibility for a piece of work is handed over from the consumer of the information to the producer. This implies a major restructuring of the work chain because responsibility for work along the whole chain will change. Physicians who write a document regarding a patient must now do some additional work that is not directly beneficial to them. Rather, they do it for the physician responsible for next activity, which is supposed to improve efficiency in the whole work chain. Suggesting this way of doing things is however not without costs:

“The physicians use a lot of time when they dictate the summary.” (head physician)

It becomes even harder when the discharge letters cover complicated cases, as a junior doctor puts it:

“I would have difficulty in saying in 3 sentences what I have used over 2 pages to express.”

Suggesting that the hospital physician should summarise the discharge letters for the general practitioner, is not unproblematic, as a general practitioner puts it:

“Why should the hospital physicians do the work for us, they have probably enough other things on their mind. It also implicates extra work for them to express the discharge letter in a few sentences”.

This is perfectly aligned with Grudin’s main point, when he argues that groupware might fail, as “it requires that some people do additional work, while those people are not the ones who perceive a direct benefit from the use of the application” (Grudin 1989:248). This additional work would not be immediately visible to ‘outsiders’ or decision-makers because of little or no sociological illumination of most of the back regions of medical institutions (Atkinson, 1995:34). Emphasising too strongly that the hospital physicians should produce a discharge letter summary for the general practitioners, and the general practitioner’s use of just extracts of the discharge letters, may have some unexpected side effects, as a general practitioner puts it:

“It is not uncomplicated. It becomes a question of how we manage this information, i.e. that we simultaneously expect to achieve comprehensive discharge letters from the hospital and that we only choose to use a tiny part of the information.”

6.3 Marginalizing the rest categories

Depending of the level of granularity of the discharge letter template, there will be a fluctuating tension between what is considered general and what is considered special templates. The structure represents in itself selections. Somebody has chosen to visualise exactly these categories. What is left implicit becomes doubly invisible: “It is the residue left over when other sorts of invisible work have been made visible”

(Bowker and Star, 1999: 247). An example of this is when a head physician from a local hospital for efficiency reasons suggests that:

“In order to save space, I would have collapsed [the two template headings] *family* and *social* into one, *family and social*” (head physician, Bodø hospital)

The motivation behind this suggestion is obviously to obtain a more readable discharge letter, but what appears natural, eloquent, and homogeneous in this context may appear forced and heterogeneous outside the context (Bowker and Star 1999: 131). The implication may be marginalizing the needs of certain patient groups, like the small amount of chronic PD patients from the Section of Nephrology:

“In our section we have split up *family* and *social* in order to be conscious towards the social and medical initiatives a chronic patient needs. One loses that consciousness if everything is squeezed together in one category that maybe contains a sentence that informs about marital status and whether they have children. This is not sufficient in the follow-up of these patients”

These discharge letters directly reflect the need to make explicit certain kind of information, which directly opposes the suggestion above. This is even more evident when the patients belong to the PD-category in the Section of Nephrology. The context and the characteristic of the patient group shape the structure of their discharge letters. Consider for instance the PD-patients (dialysis) where the disease is chronic in character and where the patients need a lot of follow-up. Discharge letters for these patients function as a quality assurance in the follow-up, since the template for this patient group is extremely extensive (see Figure 4), as the physician in the Dept. of Medicine underscores:

“We have dialysis patients who come regularly for inspection. Every time certain things must be carried out (...), in part some extremely important computations. (...) Those computations are extremely important because they indicate if it is necessary to change modus and whether the medication is sufficient.”

In fact, he argues that discharge letters from this section have been very structured because this kind of patient requires a certain structure, allowing an increase in the overall activities through taking co-ordinating tasks out of the hands of the medical staff (Timmermans and Berg 1997:296). The complexity is also emphasised by the fact that the discharge letters for these patients need to be written by a special secretary.

7 Conclusion and some implications for design

This paper has illustrated how an ambitious standardisation effort has been transformed into separate recommendations for the hospital departments. Comparing the results with the original visions of increased efficiency, the project must be regarded a failure. However, a positive side effect occurred. Establishing local templates in each of the involved departments has made explicit the actual work-practice within each of the involved departments. Especially for junior doctors, this might speed up their learning curve in adhering to the quality standard of the department. Secondly, the project has spelled out the general practitioners' point of view and their experiences as receivers of discharge letter. This has made the hospital physicians more aware of what to include, and how to present the content, when they produce discharge letters. This promotes what Boland and Tenkasi (1995) call 'perspective taking', the ability or capability to take the knowledge of other communities of knowledge into account.

It would, however, be frustrating for practitioners and disappointing for IS researchers to deny the possibility of transformations, of changes to the contents and organisation of knowledge work. Socially informed accounts of design and use of information systems should not, as Berg (1999) compellingly argues, be misconstrued as an (implicit!) argument that existing practise is a contingent, delicate balance too fragile to be touched. In the following, I outline the implications for standardisation processes in general.

Firstly, everyday practice may change as a result of standardisation, signalling that the standard itself must be prepared for changes. This is hard if the standard is common for all the hospital departments, thus making it more difficult to change and more difficult to accommodate the interests of the local contexts. A possible design strategy is to define a template on a broad level that is general enough for mainstream use, and, when needed, allows special or heterogeneous templates. Such a strategy will support change, as changes can be made to the special template while the broad common template can remain relatively stable.

Secondly, there will always be a small amount of special departments that have less interaction with the other hospital departments, and have very special needs. An example is the Section of Nephrology that is completely dependent on their PD-template, which serves a pinpoint purpose. In such cases, it seems unnecessary to

impose a hospital-wide standard for discharge letter production. Thus, standardisation of the discharge letters should then primarily include mainstream hospital departments.

Thirdly, physicians themselves must recognise some purpose with standardisation and imposed routines. As one physician emphasised, “If it is meaningful, we can always do additional work”. This is illustrated by the reused PD-information in Figure 4. It is picked from a local context and as a whole pasted into the discharge letter. However, more generally, every piece of information cannot be remembered, since “the whole story exceeds anyone’s knowing, anyone’s telling” (Stake, 1998:94), which, taken seriously, would include the whole patient record. This implies that interpretations must be conducted and summaries written. Given that the conditions³ for producing a well-written summary are present, the question then becomes how to encourage physicians that produce a text to also make a summary of it. One way is to demonstrate the advantages of this way of work, for instance by illustrating that discharge production time for a department decreases as a result of reused summaries. Another possibility is to keep an *overview* of those information elements that are reused in order to illustrate that reuse does in fact occur. Keeping track of the summaries that are reused would also illustrate how a good summary should be written, and under what conditions it is reusable.

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³ Primarily the conditions reflect a stable and clearly set patient case. The course is to some extent known.

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Paper six:

Information Systems support for interdisciplinary teams

Everyday interdisciplinary work in hospitals in an actor
network perspective

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Abstract

As today's organisations face increasing specialisation, work has to be conducted in the context of interdisciplinarity. This has led to many efforts to promote interdisciplinary work, among other things supported by information systems. However, in spite of heavy emphasis of the superiority of interdisciplinary work, several of these efforts have failed. The study reported in this paper focuses on interdisciplinary work in the Department of Rehabilitation at the University Hospital of Northern Norway. As large hospitals are both highly specialised and reflect a complex division of labour this department differs to a high degree from the rest of the hospital. The Dept. of Rehabilitation is very successfully organised in accordance with an interdisciplinary approach and it practices interdisciplinary documentation. The aim of this paper is to identify conditions for obtaining increased interdisciplinarity in a complex organisational context recognised for high specialisation

Keywords: Electronic patient records, interdisciplinarity, Information systems, professions, collaboration

1 Introduction

As today's organisations face increasing specialisation, work has to be conducted in the

context of interdisciplinarity. This has led to many efforts to promote interdisciplinary work, among other things supported by information systems. However, in spite of the heavy emphasis on the superiority of interdisciplinary work, several of these efforts have failed (Gibbons et al., 1994). One reason may be that interdisciplinarity is commonly considered a positive value *per se* and thus neglects criteria such as efficiency or usefulness, defined in terms of the contribution the work has made to the overall solution of transdisciplinary problems (Gibbons et al., 1994:33).

The implementation of Electronic Patient Records (EPRs) in large hospitals may well serve as an illustration of these efforts. The EPRs are expected to support seamless or shared care through the integration of information across highly specialised and discipline oriented departments. EPRs are also supposed to promote more collaboration and interdisciplinarity among different types of professionals and compensate for increasing specialisation and discipline orientation in hospitals. However, in spite of a series of heavily funded national and international initiatives, there has been only very modest success in establishing working EPRs in large hospitals. The recent years' efforts to introduce an EPR in Norwegian university hospitals also appear to be a failure in regards to increased interdisciplinarity. The EPR only seems to support the existing division of labour in hospitals, as information still is organised in accordance with existing disciplines and not across them (Lærum, Ellingsen and Faxvaag, 2001).

The study reported in this paper focuses on interdisciplinary work in the Department of Rehabilitation at the University Hospital of Northern Norway. As large hospitals are both highly specialised and reflect a complex division of labour (Blume, 1991:17; Atkinson, 1995:7; Reiser, 1984:303) this department differs to a high degree from the rest of the hospital. The Dept. of Rehabilitation is organised formally in accordance with an interdisciplinary approach and practice interdisciplinary documentation. This case illustrates that despite being a part of a highly discipline-oriented organisation, this department has been successful in achieving a high degree of interdisciplinarity.

The aim of this paper is accordingly to identify the conditions for obtaining increased interdisciplinarity in a complex organisational context recognised with high specialisation and with professionals with high levels of education - and how an information system can play a role in such a process. More specifically, the analyses are pursued along three themes.

First, I analyse how the employment of documentation and information (paper and electronically) play a role, as a part of a bigger ensemble in promoting interdisciplinarity in everyday clinical practice. As professionals generally work in accordance with, and are evaluated in terms of disciplinary guidelines, it is hardly surprising that interdisciplinary work requires negotiations. In order to ease these negotiations it is essential to have mechanisms that promote interdisciplinarity. Careful organisation of the information in use can prove to be such a mechanism. I focus on how artefacts, organisational structure, paper-archives, IT-systems and routines play a role in promoting interdisciplinarity in everyday practice.

Second, I analyse how a strong commitment towards interdisciplinary work shapes the mutual relationship and collaboration among the professionals. Following an interdisciplinary approach is obviously different than strictly working in terms of “your own” discipline. Such devotion might break the traditional division of labour, redistribute power and control and consequently transform work. This is however not uncomplicated as professionals have the special privilege of freedom from the control of outsiders. One of the claims that justifies such a privilege is that “there is such an unusual degree of skill and knowledge involved in professional work that non-professionals are not equipped to evaluate or regulate it” (Freidson, 1970:137).

Third, I analyse how interdisciplinary organisation of work on one hand has to withstand a “traditional world” and on the other hand be an essential part of it. Some would argue that such devotion undermines traditional disciplinary work. There are also indications that a traditional EPR hampers interdisciplinary work as it primarily supports traditional disciplinary work in hospitals. The decision to work in accordance with an interdisciplinary approach does not mean that isolated pockets of organisational units are created. The type of patients involved presupposes a continuous interplay between people that is part of several contexts. I focus on how they employ documentation as a means to translate back and forth between different communities and therefore maintain a kind of gateway role. This implies that work is needed, both to create and maintain the constellation of interdisciplinarity. By regarding the interdisciplinary organisation and its documentation as an actor among many traditional ones, I pinpoint the working conditions for such a collective.

As a framework I use Actor Network Theory (ANT) (Latour, 1999; 1991; 1987; Law, 1987). Generally ANT has been employed as a means to analyse the ensemble of people

and technology in a process towards alignment or decomposition. In this case ANT will be used a bit differently as it is used to analyse the daily clinical practice in a hospital department where mutual negotiations among the professionals and between professionals and patients constitutes a major and continuous part of the work. I also analyse how micro-actors (professionals, artefacts, routines) at the same time are influenced by macro-actors (traditional departments, recruitment, EPR) and how these actors are interwoven with each other.

The remainder of this paper is organised as follows: section 2 elaborates more thoroughly on the theoretical foundation; section 3 reflects on the research design; section 4 illustrates the hospital context and the department. Section 5 presents two case vignettes that illustrate clinical work in different stages of a patient stay. Section 6 contains the analysis and the conclusion, including implications for designing information systems, is presented in section 7.

2 Theory

The discourse around the integration of information in connection with ERPs mirrors exactly the more general and long-standing debate in management information systems and Enterprise Resource Planning systems (Hartwood et al., 2001; Hanseth and Lundberg, 2001). Perfectly aligned with the arguments for Enterprise Resource Planning systems, the EU-funded project Synapses points out that:

“[U]sers performing diverse tasks (...) [in] different departments within a hospital may have deployed different (...) systems that should be integrated in order to support the business processes adequately” (Grimson, Grimson and Hasselbring, 2000: 52-53)

As for the more general case of management information systems, there are, in principle, different routes to the integration of information systems in hospitals. Yet, EPRs are – and have been for some time (Dick and Steen, 1997) – perceived as essential in achieving this integration; EPRs *are* the mechanism for integration. To illustrate this mode of thinking, Szolovits et al., 1995: 16) explain that it implies:

“establishing a canonical electronic medical record structure with supporting data abstraction processes to provide consistent views of medical information

independent of underlying database structures (...) [which allows] a common API for heterogeneous data-sources”

Improved integration and information exchange might serve as a foundation for increased collaboration or interdisciplinarity among the myriad of users. Unfortunately, the EPRs in Norwegian hospitals are strictly organised in accordance with the existing disciplines as they adhere to the recommendation from the Norwegian Board of Health (NBH, 1994). An example is given in Figure 1.

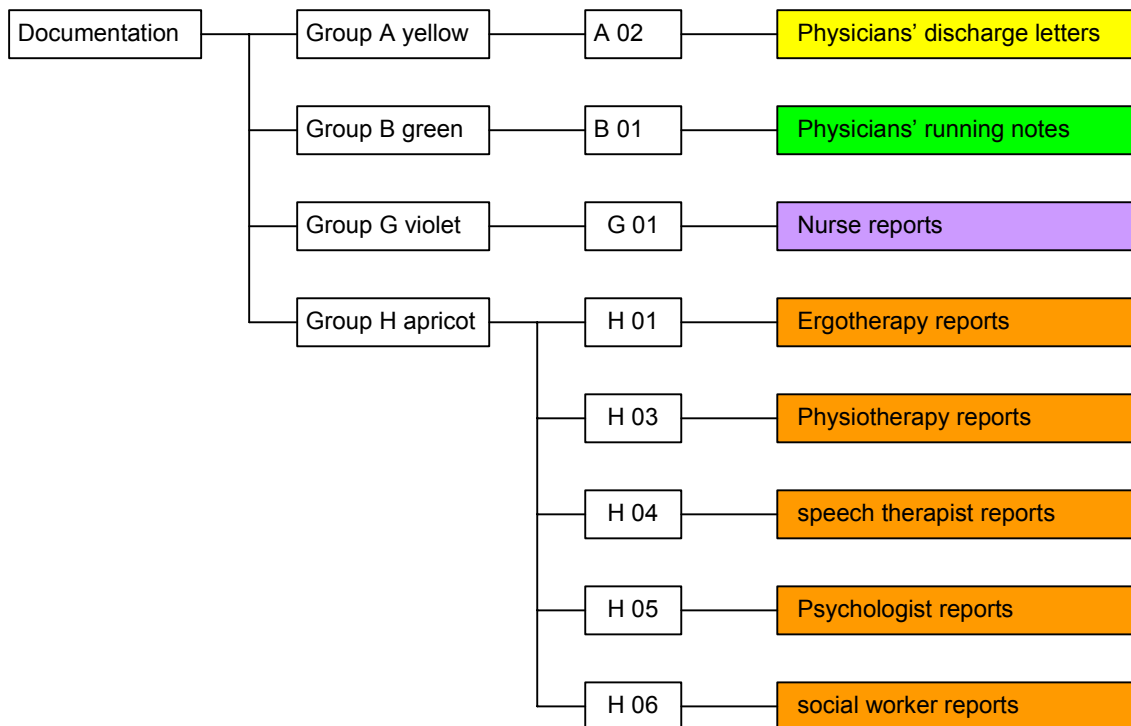


Figure 1. The traditional way of organising information in Norwegian hospitals.

The explanation for this kind of structure in the EPRs may be that it conforms with how the paper based records are organised. Nevertheless, such a strategy only enables support within disciplines and not across them as a survey of EPRs in use in Norwegian hospitals suggests (Lærum, Ellingsen and Faxvaag, 2001). This may in fact enforce the existing division of labour in hospitals as information technology tends to make work more explicit (Rolland and Monteiro, 2002).

This is unfortunate as Gibbons et al. (1994:3) points to that there is a broader tendency in society of change in the mode of knowledge production from what he denotes mode-1 towards mode-2 knowledge production. “Mode 1 problems are set and solved in a context governed by (...) a specific community. By contrast, Mode 2 knowledge is

carried out in a context of application. Mode 1 is disciplinary while Mode 2 is transdisciplinary. Mode 1 is characterised by homogeneity, Mode 2 by heterogeneity. Organisationally, Mode 1 is hierarchical and tends to preserve its form while Mode 2 is more heterarchical and transient” Gibbons et al. (1994:3).

According to Gibbons et al. (1994:6) “Mode 2 knowledge production is heterogeneous in terms of the skills and experience people bring to it”. This draws the attention to the heterogeneity aspect of bringing together people with different disciplinary education and the complexity of how and contingency of the ways in which these elements interrelate (Law, 1987:111). Making things work in an interdisciplinary setting is difficult as people from different backgrounds measure quality in different ways, see different problems and where their contributions are evaluated in accordance with their professions’ norms and values. Thus when they make things work, it is not in accordance with some “given best solution”, it is rather an emerging actor network, a process of negotiation where everyone has to give and take:

In the construction of [the solution] there is a necessary process of negotiation among all groups that are part of the network of resources and that have an “interest” in the design process (Bucciarelli, 1994:143)

Every one of them possesses a set of interest in which represent the rationale behind their actions. This also implies that whenever solutions and agreements are negotiated it does not mean that it is the best solution for everybody. The enrolled and disciplined heterogeneous actors have then to be maintained as a network of stable linkages by constant and careful work (Fujimura, 1996:239) as also Law (1987:114) reminds us:

“Vigilance and surveillance have to be maintained, or else the elements will fall out of line and the network will start to crumble. The network approach stresses this by noting that there is almost always some degree of divergence between what the elements of a network would do if left to their own devices and what they are obliged, encouraged, or forced to do when they are enrolled within the network”

Rather than try to fix group membership and group interests, the actor network approach asks us to follow the actors and describe their actions in terms of network-building (Fujimura, 1996:242). This implies that continuous negotiating and enrolling allies means that ‘interests’ are not necessarily a fixed thing as

Major changes in commitments mean transforming work organisations and “retooling” workplaces and practitioners. These transformations require significant time, effort, and financial resources (Fujimura, 1996:10).

As large hospitals reflect a complex division of labour (Blume, 1991:17; Atkinson, 1995:7; Reiser, 1984:303), transformations have the potential to feed directly and change this structure as results achieved are communicated to those who have participated in the course of that participation and not through institutional channels (Gibbons et al., 1994).

Obtaining real interdisciplinarity is however not uncomplicated as professionals have the special privilege of freedom from the control of outsiders. One of the claims that justifies such a privilege is that “there is such an unusual degree of skill and knowledge involved in professional work that non-professionals are not equipped to evaluate or regulate it” (Freidson, 1970:137).

3 Method

This study belongs to an interpretative approach to the development and use of information systems (Klein and Myers, 1999, Walsham, 1993) relying on four types of data: participative observations; interviews; informal discussions; and documents. The observations took place from January-Mars, 2002 at the Dept. of Rehabilitation at the University hospital of Northern Norway. In total, 40 hours were spent observing work. Six of those hours were based on video observations of meetings and teamwork. Patients also participated in these meetings. In general people did not seem bothered by being observed.

Predominantly the study can be denoted as ‘realistic’ as it focuses on ‘thoroughly mundane details of everyday life among the people studied’ such as ‘the regular and often-observed activities of the group under study’ (Van Maanen, 1988:48). It is in part also inspired by the ‘impressionist’ style as we try to give the story’s supporting players lines to speak (ibid.:105).

Previously I have conducted several observations in hospital departments and I have become used to the common white clothing nearly every health care worker in hospitals wears. My experience has taught me how the white coat serves as a “key” or as an

enabling tool to become an “insider”. Thus prior to my first visit to the department I borrowed a white coat and wore it when I entered the department. To my very surprise, one of the therapists looked at me, smiled, and said, “in here you will be taken for a physician if you wear that”. As I looked around in the department I understood what she meant. Very few of the people were wearing white. They wore ordinary clothes or clothing specially designed for this department, either blue or red. So instead of a white coat I was dressed up in a red coat that afterwards I used on several occasions.

In addition, I conducted 12 semi-structured interviews during the period mentioned above. Each interview lasted from one to two hours. As background material I have also conducted observations at several other departments at the hospitals. These observations constitute 60 hours of observation.

4 Setting the stage

The Dept. of Rehabilitation was established in 1995 and is accordingly a relatively new department in the hospitals. The diagnoses for the patients are usually very complex and fall in categories like: stroke, long-run damages as a result of polio, chronic pains, complicated amputations, multitraumatic damages and damages in the brain as result of accidents or diseases. Consequently, many of these patients stay for a relatively long time and some will never be fully recovered.

This department has a broader and more interdisciplinary approach to problems and treatment strategies compared to traditional departments. They like to say “we focus on the whole human”. This means that body functions, daily activities and environmental factors are important factors in patient evaluations and treatment strategies.

The department has regular interdisciplinary meetings where also the patient is present and where a common ground is established. From the turn of the year they also have started to examine patients in pairs, for instance, the physician and the physiotherapist and also the nurse and the social worker.

The health care workers are very untraditionally (and surprisingly) organised directly in the department, which includes seven different professions: nurses, occupational therapists, physicians, physiotherapists, one speech therapist, one psychologist and one social worker. All in all they are about 40 employees. Most of the employees are

women including the three physicians. The relative number of physicians however is small compared to other departments.

The department practices interdisciplinary documentation. The interdisciplinary rehabilitation plan serves as a common place for documentation from all of the professions during the stay of the patients (the rehabilitation plan is also available for the patients). This is an obvious distinction from the ordinary disciplinary reports as practised in more traditional departments. When the patient leaves the hospital the physician writes a discharge letter to the general practitioner. In addition an interdisciplinary report is produced that is sent to the municipal health service. Everybody in the team (except for the physician) participates in the production of this report.

The interdisciplinary meetings, the rehabilitation plan and the disciplinary report are all organised in accordance with International Classification of Functioning, Disability and Health (ICF), a classification system developed by World Health Organisation (WHO). The main parts of their use of ICF are:

- Environmental factors
- Participation
- Body Functions and structure
- Activity

5 The cases

5.1 The interdisciplinary surveyor meeting

Today it is Friday and the end of the first week of a four week stay for the group of patients with chronic pains. During this week the different professions have conducted observations, examinations and evaluations. The pain-team (team 2) meets to agree on treatment- and rehabilitation objectives for the patients. The first part of the meeting is without patients because as one of the physicians puts it, “to establish a common ground before the patient participates in the meeting”.

Six persons are present, a physiotherapist, two occupational therapists, a physician, a nurse and a social worker. Everybody is female except for the nurse who is a short-notice stand-in for the team's regular nurse. They all seem to be in their late thirties or early forties.

What is special for them (and me) is that in the corner of the room I have prepared a tripod with a film camera. The room is rather small and therefore it is difficult to keep the whole group in the zoom. As this is my first film recording ever as a researcher I am a bit nervous. I have not decided whether I should handheld the camera when I film them or just place the camera on the tripod as I fear that the use of the large tripod in the small room will promote a certain formality. To my surprise and relief the atmosphere appears relaxed as people enter the room in turn. The social worker glances at me and says "Oh yes ...here we have Mr Spielberg". The physiotherapist for her part jokes and complains that she has not prepared her makeup and asks whether I can do anything afterwards by mixing colours on the film. The physician appears confident and places herself in such a way that when she looks up she looks directly into the camera. I relax and realise that using the tripod is quite all right. However one of the occupational therapists is sitting with her back towards the video camera. As a result, I fail to film the expression of her face when she talks. After about 15 minutes, in a suitable pause, I ask her whether it would be all right for her to change her chair. Quite willingly, she does so.

The context appears rather informal and relaxed. They make jokes and laugh. It is not the typical "reporting" context where each professional worker in turn informs what she has performed as regards the patient. It appears rather like an informal conversation. Somebody drinks coffee and between each case that is discussed there is a couple of minutes of informal talk that circles around the patients.

The informality in this meeting may be a reflection of that they also have daily lunch breaks together (in which I have joined). Lunch breaks at this hospital are normally between 11:30 and 12:00. It is very common to find groups of physicians sitting together, groups of nurses, groups of therapists etc. However at the Department of Rehabilitation, they take their lunch break at 12:00 o'clock in order to get their usual table in the hospital cantina.

On the table, there are several ring leaf books (rehabilitation plans), one for each

patient. After the meeting the patient's contact person writes down the agreed upon objectives in these books. During the stay, they also serve as a common place to document things across the disciplines. These books are also easy available for the patients as they are located either in a box next to the department's reception or in the patient rooms. On the table, there is also a small pile of paper based patient records. Each of the participants also brings her own personal notebook that is used during the meeting.

First of all they discuss how they shall organise the rest of the meeting because recently they have tried some new work approaches. The discussion circles around how ICF should be used as a means to organise the current meeting. An extract of the discussions is presented below:

PHYSICIAN: Now, we have two systems we can adhere to ...we have our usual meeting system (she points to the standardised ICF template which she holds in her hand) or this one (pointing to a sheet on the table). For instance ...I suggest that I inform you about the reason for referral and then Sissi (while turning to physiotherapist Sissi) and I can tell what we found.

OCCUPATIONAL THERAPIST-1: But then we start completely wrong (she picks the red-coloured ICF-template from the wall), we should start with "Environmental factors".

PHYSICIAN: Yes, if we shall follow that one then we start in the wrong end (pointing at the template the occupational therapist is holding), but we can start here ...or ...but we can as far as it goes follow it, but we must narrow in the problem ...

SOCIAL WORKER: I feel that it is important to include what you (all) have talked about with the patient and what we have talked about with the patient

PHYSICIAN: Yes, everything must be on the table.

PHYSIOTHERAPIST: (while turning to the physician). I suggest that you tell about the problem then gradually we can tell about Environmental factors and Body Functions and structure (some of the others nods) ...I feel that this is the most correct thing to do.

PHYSICIAN: That is by the way the method we ...

OCCUPATIONAL THERAPIST-1: Yes ...it is in a way how we have agreed to do things (the others are nodding)

They agree and the physician starts presenting the problem. The patient has suffered chronic injuries in her head and her neck as a result of a car accident. The physician looks in the patient's patient record. She informs everyone about the medical history of the case. She alternately reads and talks to the others translating from the medical context to the rehabilitation context. Sometimes the others write in their personal notebooks.

After 2-3 minutes the physician is finished and the other members of the group become active and start to discuss the case. In fact, it appears that the medical things now are put a bit behind and focus is more directed at what to do. An expression of this is that the patient record is put aside; the therapists have conducted their own hands-on examinations and evaluations that serve as a foundation for when they continue to discuss which treatment strategies to follow. Everybody speaks freely. The next sequence may in more detail illustrate the mode of the discussions:

PHYSICIAN: Then the question becomes, do we need to do anything more right now as regards objectives and such things ...can't we just wait to do it until we have the patient present ...

PHYSIOTHERAPIST: I think we should summarise what the main conclusion is ...as I see it, it is the job ...

PHYSICIAN: The job, yes ...

PHYSIOTHERAPIST: He certainly has a clear and delimited problem in the neck and shoulder ...it becomes a question what we can do ... at any rate as regards physiotherapy ...whether we can do anything particular (...) then I think that what is related to the job becomes the major question.

PHYSICIAN: He is fully examined and it is quite clear that what is wrong with him ...in that way it certainly...

SOCIAL WORKER: (breaks in) Are there no more x-ray pictures or anything like that to be performed? ...(some noise – several are speaking)

OCCUPATIONAL THERAPIST-1: And there is no such strange things? ...everything is ...?

PHYSIOTHERAPIST: (nodding) it is very much ...like this (she illustrates by lifting and moving her hands in a special way that the problem is clear cut) ...together with (...)

OCCUPATIONAL THERAPIST-2: Is there anything to achieve by surveying exactly what he is doing?

PHYSIOTHERAPIST: I believe it rather gives meaning to examine things more related to driving a car ...what are the factors that cause ...(...) if it is possible to correct those two operations then ...

OCCUPATIONAL THERAPIST-1: Certainly, it must be quite all right to go through all his work tasks and consider 'what he feels is all right' and 'what he finds difficult' ...then ...related to some other ... and does he see any other solutions ...whether there are other things he can do instead.

SOCIAL WORKER: (breaks in) But is it anything to do with it?

PHYSIOTHERAPIST: Well ...no ...it is an open question ...It becomes a question to what degree we can influence this thing

PHYSICIAN: He has a small prolaps ...sometimes those things dry up

SOCIAL WORKER: (nodding) But does it help for ...(she places her hand on her shoulder)?

PHYSICIAN: Yes, it helps for the shoulder ...the pain in the shoulder. It is caused by the nerve that transfers the impulse to the arm (she explains some more) (...) but the problem is located in the neck

PHYSIOTHERAPIST: And together with the other thing ...

PHYSICIAN: Yes, the wrist ...the left wrist.

SOCIAL WORKER: Because it is this he wants us to say something about ...whether he can take up his job again.

Physician: Yes...

PHYSIOTHERAPIST: (breaks in) but I think perhaps we can do that

SOCIAL WORKER: Already now?

PHYSIOTHERAPIST: No ...I mean ...when we have tried out a conservative strategy to see whether ...

SOCIAL WORKER: (nodding) yes

PHYSIOTHERAPIST: He also is placed in a work situation where he is 6 hours at work and 6 hours off (some murmur and nodding from the others) ...and he cannot work half time and not reduced so it is ...

OCCUPATIONAL THERAPIST-2: And when he is there he has to handle the work whatever the tasks are.

5.2 Producing the final interdisciplinary report

We are in physiotherapist Sissi's office. Sissi, shares the office with four others from her team (the social worker and two occupational therapists). She is about to start producing the final interdisciplinary report for a patient. The patient has been at the Dept. of Rehabilitation for two weeks and will remain here for another two weeks. However as the contact person for the patient, Sissi already now starts producing parts of the report. Gradually the other members of Sissi's team will participate in the writing. Actually, she is a bit late in this process as they often start to produce it just after the surveyor meeting. Then they include the patient's medical history and the agreed upon treatment objectives from the surveyor meeting.

As the physiotherapist logs on to the computer, she has the letter of referral at hand, the daily rehabilitation plan for the patient, her own physiotherapy notes and the paper based patient record. The framework for the report is the ICF word-template. She finds it on the computer, creates a new document, and continues to write the reason for the referral as she reads it from the patient record. In addition she writes the medical history. Parts of this are quite similar to the content in the patient record, but an important exception is that she translates Latin medical expressions (like cervical column and stenosis) into common Norwegian in order to make it understandable and useful for the patient. She copies the social background from the rehabilitation plan. She also reads her own personal notes that she started to write when she and the physician together examined the patient the very first time. These notes are also used during the interdisciplinary meetings both as a basis for informing the others, as well as a place to write her own personal notes. The department has made a fundamental choice not to

formalise the use of the disciplinary personal notes as one occupational therapist puts it, “Then we would undermine the interdisciplinarity work. Then everybody would place their loyalty into their disciplinary documentation”.

Nevertheless, she will also use these personal notes if she has to write a physiotherapist appendix to the interdisciplinary report. If she chooses to produce a disciplinary appendix then it will aim at the physiotherapist examination and will explain what has happened and what has functioned properly. The appendix is thus aimed at other physiotherapists and not the patient. Sissi also tells that she seldom reads the appendixes that are produced by the other professions, but as they work together she roughly speaking knows what they are doing. However the number of these appendixes has decreased significantly after they a year ago started to produce a common interdisciplinary report.

Sissi comes to a point where she writes dot, dot, dot. She explains: “This point, I must check out further. There is insufficient information in the rehabilitation plan and I have to check this with the others in the team or the patient”. She further tells: “many times you don’t know, so you have to write those dots in the report, or ‘Audhild, check this out! Is this correct?’ or ‘you have to write here!’, I write those things in cursive or in brackets and as the contact person for this case I have a special responsibility to glue it all together and if somebody writes too much I edit it and I am fairly careful with the choice of words. We all do it!”

After a while she writes down the patient’s objectives. The patients are responsible for stating their objectives for the stay, whereupon these objectives are discussed in a meeting with the whole team. In such a way they all have agreed on what the objectives are. As a final thing she writes the goals related to body functions and structure and adds: “I do know what I have done, but yet I don’t know so much what the others have done”.

She tells that the ICF-classification makes the work with the report a bit hard as it cuts across disciplines along the presented dimensions and they have to adhere to these dimensions at each step in their writing. The others in the team will fill in information in each of these ICF-categories.

ICF- dimensions	resources	problems	patient goals	measures	procedure	evaluations	goal evaluations
Body function and structure							
Activity							
Participation							
Environmental factors							

Figure 1 ICF-dimensions

The physician explains that now she will instruct the others in the team to check this document and to write those things that are necessary. This is accomplished both by use of email, notes or that she tell them to do so. This means that this document is a “working document”. It is not finished until the patient has left and this will not happen until two weeks from now. In this period, the health care workers in the team will write regularly in the document. And as Sissi puts it, “We don’t know whether we (including the patient) have achieved the goals until the last interdisciplinary meeting. In this meeting, the results will be evaluated in relationship with both the short- and the long-term goals. In addition, we must take into account the patient’s motivation”.

Before the report is sent to the municipality health service (some time after the patient has left), each and everyone must sign out in the document that they are finished.

The team’s physician does not participate in the process of producing the interdisciplinary report as she writes her own physician’s report, the discharge letter to the general practitioner. Nevertheless the physician also considers the common goals. As one of the physician puts it, “It is very important to have the written goals from the others in order to do things properly”. Accordingly the content of those two reports reflects each other. Consider the physician describing the practice of producing discharge letters:

“When I dictate the discharge letter and the interdisciplinary report is finished, I often take a look at it (...) Sometimes I can copy some good statements from it. I also know that if I finish my discharge letter before them, they look at it when they write their report”.

6 Analysis

6.1 Maintaining the negotiating climate in daily work

As several different professionals work together, negotiations are necessary in order to agree on a common understanding and further work strategy (Bucciarelli, 1994; Fujimura, 1996; Law, 1987). Consider for instance, the second discussion from the interdisciplinary surveyor meeting how the participants establish a common basis through negotiations. They agree on the status of the case and define what are the most important things to sort out: “how can the patient manage work, will he be able to drive, the cause and location of the pain”. The heterogeneous and compound aspect of the case is also emphasised as it involves the patient’s everyday context, his current situation and his own expectations. Everything must be evaluated as a whole.

Negotiations between professionals may be hampered as the profession itself defines the content and the organisation of work (Freidson, 1970; Gieryn, 1999). In addition, the participants possess different negotiation powers as they represent different professions carrying with them various degrees of credibility (Fujimura, 1996:145). This is something the Dept. of Rehabilitation wants to curb as one therapist describes their choice of organisation:

“We wanted to put the focus on the patient rather than the profession. Consequently we wanted to avoid that the physician spoke first, then the psychologist, then the physiotherapist (...) and then lastly, the nurse”.

The shift towards more “sliding boundaries” between the professions implies that the profession itself to a lesser degree defines and organises work. Instead the classification system ICF is used as a mechanism to ensure the boundaries for interdisciplinary work. ICF cuts across the disciplines and reinforces interdisciplinarity. ICF defines how to organise meetings, how to structure documents according to interdisciplinary guidelines and ensures that all the participants can contribute in the discussions, evaluate each others judgements and agree on how to conduct the common work. A poignant example was when occupational therapist-1 at the interdisciplinary surveyor meeting picked the red-coloured ICF-template from the wall, while strongly arguing that their meetings still must be organised in accordance with ICF. Later on she also argued that their use of

ICF ensured that:

You avoid that it becomes a kind of display of ‘what I have done and what I have surveyed and I have found this and that’. It becomes a kind of display of disciplinary capacity (...) a kind of competition or active position taking, which is a very bad foundation for the negotiations (occupational therapist)

Organising work completely different, as generally practised in the hospital, is not without costs as new boundaries must be maintained. It conforms with Gieryn’s (1999) notion of boundary work that underscores that it takes an effort to negotiate the boundaries. An example is when the physiotherapist, Sissi, struggles with the interdisciplinary report. She says:

“The work with the report is a bit hard as it cuts across disciplines along ICF dimensions and we have to adhere to these dimensions at each step when we write.”

This additional (and often invisible) work is also illustrated by a therapist comparing the traditionally way of producing reports with how they do it in this department:

“In traditional departments, the reports are based on a previous referral, a case, and a produced report, done! In our department, on the other hand, we must continuously coordinate with each other and evaluate our contributions up against what the others got. And really, it is demanding if you come from a place where you are used to working more limited with your own things”

Another mechanism that promotes interdisciplinarity is the actual organisation in the department. The different professionals are located together in the department under one leadership. Knorr-Cetina (1999:97) use the notion of ‘acting body’ as a way to increase understanding and illustrate this as ‘a person insisting on meeting a phenomenon face-to-face in order to understand its properties and procedural implications’. One of the therapists emphasised this point:

Our usual neuro-psychologist is on a leave of absence and therefore we have a psychologist in a part time position. However, it is not possible to work in an interdisciplinary way with him. Rather it becomes in accordance with the traditional way of doing things in hospitals, that is, we refer the patients to him by using a referral form. This is a culture that we are not used to. We don’t do

this with our regular psychologist. He knows the department and participates from the moment the patient is admitted to the department.

The organisation in the department also results in different professionals sharing offices as is the case when Sissi writes the final interdisciplinary report. The formal organisation is also reflected in informal common lunch breaks as the teams wait to go to the hospital cantina until their table is free.

6.2 Redistributing control and transformation of work

The Dept. of Rehabilitation has decided to twist more fundamentally at the well-established traditional division of labour in hospitals (Blume, 1991:17; Atkinson, 1995:7; Reiser, 1984:303; Lærum, Ellingsen and Faxvaag, 2001). The circumstances of course enable such a choice. The patients in this department require an interdisciplinary approach. This calls for more collaboration between the professions per se. As efficiency or usefulness now are defined in terms of the contribution the work has made to the overall solution of transdisciplinary problems (Gibbons et al., 1994:33), and not in terms of disciplinary guidelines, this shapes how the actual work is conducted. An example is when one of the occupational therapists reflects on her own role in collaboration with the other professionals:

“In our department, on the other hand, we must continuously coordinate with each other and evaluate our contributions up against what the others got. And really, it is demanding if you come from a place where you are used to working more limited with your own things”

Although traditionally there is a hierarchy in hospitals each profession possess some autonomy, which is considered their domains (Gieryn, 1999) or “what is essential is control over the determination and evaluation of the technical knowledge used in the work” (Freidson, 1970, 185-186). In other words, the professions are involved with the patient at different stages and doing their work in accordance with their professions norms and values. Committing oneself strongly to an interdisciplinary approach, however, influence this control and possibly redistribute it. By regarding both discussions in the interdisciplinary surveyor meeting, it is obvious that the traditional hierarchy and the authoritative physician’s role are replaced by a more equal partnership where no one really dominates the conversation. The key problems and further

treatment strategies are defined together. Consider also the Method section where I describe my first entrance at the department wearing a physician's white coat. Very soon it became clear to me that the white coat and the physician played a different role in this department than elsewhere. The new physician's role was underscored by one of the physicians when she describes how it was to start working at this department:

“The work practice was new, the physician's role was both different from what I was used to as well as different from how I had learnt it should be (...) it takes some time to learn it, especially the work practice with a high degree of interdisciplinarity and the interdisciplinary meetings with the patient at centre”.

This has of course to do with how the professionals have decided to approach the patient, but it also has the implication that it feeds directly into the relationship between the professionals. A physician explained:

“The traditional doctor role and the expectations within the medical system are directed at examinations and treatment (...) and here we do little of that.”

Or as the occupational therapist expressed it:

“The physicians have a relatively small role in the interdisciplinary team because they are not the leader in such a group as they are used to in a traditional department. They become one member of a team and perhaps it is rather narrow to work with 6-7 different professions in a very special way.”

This does not only have implications for how physicians see themselves, but also has implications for what they decide to do. Consider the physician examining a patient together with the physiotherapist for the first time. Her routine work was replaced with something else:

“Now I have broken completely with the traditional physicians role in admitting the patient. My intention was to do other things than I actually did. I believed that I had to do the traditional screening examinations: blood pressure, pulse, heart, lung and all those things. Instead I focused directly on the actual problem”
(physician)

More specifically, the transformation of work and subsequent increased control for the therapists, nurses, social workers etc. is illustrated by one of the therapists comparing her former employment with her current job:

Previously I worked in the home service and participated in building up the occupational therapy service in a district in Oslo. There I experienced that my boss (a head nurse) and the other nurses defined what I could contribute with as an occupational therapist. I felt that this was completely wrong as they did not possess the knowledge about what I really could do. In this department, on the other hand, we ourselves define what we are capable of doing as occupational therapists and define the problem together with the patient when the patient is admitted.

Another example is how the decision to use interdisciplinary reports de-emphasises the role of the disciplinary reports. Since they, a year ago, started writing reports together organised through ICF, the number of disciplinary reports has decreased. In addition, the disciplinary reports are not self-contained; they are always appendixes to an interdisciplinary report. The focus in these reports has also changed from information interchange between peers (example: hospital physiotherapist and municipal physiotherapist) towards a stronger focus on informing the patient. Consider for instance how the physiotherapist takes her time translating Latin medical expressions (like cervical column and stenosis) into words more useful for the patient.

The ICF itself is transformed through its usage in the department. ICF is intended as a classification system that is supposed to be a tool that can support the organisation of information, but it has also been transformed into a mechanism that not only organises information but also work. In addition, as the users miss things in ICF, they have made some local changes and added additional amendments to the ICF.

6.3 Gateway to the “traditional world”

As a result of completely different organisation from that usually practised in hospitals this is a network that needs careful maintenance. Thus it makes it valuable to focus on the challenges and threats the departments are up against and how they continuously manage to withstand them. At this level I focus on a macro level and consider the Dept. of Rehabilitation an actor in itself and analyse the interplay with other actors. In such a way I follow Law (1987:114) when he points out that:

“For the purposes of analysis, however, the environment within which a network is built may be treated as the association of unhelpful elements into self-sustaining networks that are, accordingly, able to resist dissociation”

The intrusion of disciplinary boundaries might be a threat for some. Especially if the clinical workers feel that their role in interdisciplinary work is a bit vague. Such a feeling might be especially strong when the professionals are newly examined from their educational establishments. As one of the therapist said it:

I believe that it must be rather tough to be a newcomer at our department without some experience since you are strongly in need of role models. You have to learn how to behave like an occupational therapist, and you need to achieve identity as an occupational therapist. And you need somebody to go to when you have attended a meeting that has turned out bad for you or if you disagree in everything that has happened

This has implied that the Dept. of Rehabilitation has aimed at recruiting experienced health care workers:

What is interesting is that we in the beginning recruited experienced nurses from the municipality health service, nursing homes, home nursing care and psychiatric institutions. Everybody was in their thirties and had worked for 10-15 years and had broad practice. It was very favourable to get people that were so confident in their roles and that were so confident in their identity because this was a completely new arena and new roles needed to be constructed.

Accepting sliding professional boundaries thus requires professionals who are willing to blur their professional boundaries. Interdisciplinarity implicates firstly, that you increase insight into your own discipline's limitations. Secondly, it is possible to learn from other disciplines (Sørensen, 1997:27). This conforms to what one of the occupational therapists that argued:

“Firstly, you learn what the others bring to the interdisciplinary team. Secondly, your consciousness is raised about what is the core in what you are doing yourself (...) so you can focus more on the work with the patient.”

The interdisciplinary teams at the department cannot do without physicians and thus are dependent on the successful recruiting of physicians. The current status of physicians in specialist rehabilitation work in Northern Norway is an expression of this:

“The head of the department was for a very long time the only specialist in Northern Norway (...) In Bodø they have struggled for a very long time in recruiting physicians. Thus they have had a relay race from Finland. In the northernmost county they manage the service by two pensioned physicians from Sweden. One of them must be over 75 years old, but they do an outstanding job.”

This serves as an illustration that rehabilitation is not a discipline with very much prestige. It is in fact at the bottom of the prestige ladder. However it also underscores the necessity of conducting an interplay with the “traditional world” and reflects on how the department manages to do it.

One other big threat for the department is the traditional way of organising patient record documentation in hospitals that conform to the existing division of labour; one kind of documentation for physicians, one for nurses and one for each therapist group whereas each one is presupposed to write and sign individually. This makes it in fact difficult to decide how to organise documentation otherwise. Standards, practices and legislation may enforce a traditional organisation of information.

For instance, it is required that a physician is responsible for producing a discharge letter in addition to the interdisciplinary report produced by the other professionals even if the content of the discharge letter to a certain extent reflects the content of the interdisciplinary reports. The physicians and the other professionals participate in the same meetings, they relate to the agreed common goals and read each other’s reports in order to write their own reports. The ICF structuring mechanism is – as it is for the other professionals – the backbone of their reports although not explicitly structured in the discharge letters as

“We don’t actually use those words [ICF], but we employ the way of thinking when we structure and produce the discharge letters” (chief physician)

In summary, the low status of disciplinary work compared to interdisciplinary rehabilitation work, the recruiting strategies, the organisation of information in traditional patient records as well as in EPRs emphasise the decisions and the work that must be conducted in curbing the pressure from traditional actors. However it also illustrates that such a group of health personnel cannot just decide to organise work and information completely different than what is usually practised elsewhere. They have to

struggle to be different, but at the same time they must engage in a continuous interplay with the traditional actors. As a result they very carefully are maintaining a gateway role.

David and Bunn (1988:172) describes gateways like this:

“They make it technically feasible to utilise two or more components/subsystems as compatible complements or compatible substitutes in an integrated system of production. A ‘perfect’ gateway’ device would permit the attainment of perfect compatibility”

This is exactly what the Department of Rehabilitation is doing. Two different networks are linked together. And the workers in the department translate back and forth between these two different contexts.

An example is when the physiotherapist writes the medical history as she reads it from the patient record. Parts of this are quite similar to the content in the patient record, but she translates Latin medical expressions (like cervical column and stenosis) into common Norwegian in order to make it understandable and useful for the patient and for the work in the department. In this way she translates from the traditional way of documenting things to the way practised in this department – accordingly she translates from one network to another.

Yet another example, the other way around, is when some of the professionals choose to produce a disciplinary appendix to the interdisciplinary report that focuses on the physiotherapist examination and explains what has happened and what has functioned properly. The appendix is thus aimed at other physiotherapists and not the patient.

7 Conclusion and implications for design

It is not difficult to argue that information systems designers must take into account existing organisational structures in their design of information systems. However organisational structure is not locked and unchangeable. Consequently, information systems must be designed in a flexible way, supporting a changing organisation. In other words, the systems must be easy to change, or easy to add functionality to, depending on changing user requirements. Another alternative is to build in flexibility in use in order to support heterogeneous user groups as well as different ways of use.

Constructing information systems for large hospitals must take into account both disciplinary and interdisciplinary work, for instance by alternative displays on the screen. In that way they may also promote interdisciplinarity in a disciplinary context.

Since structuring mechanisms such as ICF are important for the Dept. of Rehabilitation in their interdisciplinary work, an EPR should support such a structure in its content (inside the actual documents). The key point is not ICF per se; the important thing is that the foundation for using such mechanisms must exist. Thus, depending on the users' choice, the actual structuring mechanisms can be chosen. By having defined structure in the EPR documents, it seems reasonable to require that the user can get direct access to each of the information units. For instance, based on a selection from a list the user should be able to jump directly to "Body Functions and Structure" or "Environmental factors" etc. Another reasonable requirement is to be able to view the same categories from different hospitals stays in a sequence, for instance several information units of "Body Functions and Structure". Such a view could serve as a means to get an overview how the course has been in this area and how it develops.

Secondly, although the department has focused on the interdisciplinary reports and de-emphasised the role of disciplinary reports, this does not mean that access to the interdisciplinary appendixes must be difficult. Based on the selection of an interdisciplinary report from a selection box, it seems reasonable to require that all affiliated disciplinary appendixes must be presented to the user. In addition, when producing the interdisciplinary report, it should be possible to establish pointers in the document, enabling direct access to the disciplinary appendix of interest.

Thirdly, organising information from the Dept. of Rehabilitation according to interdisciplinary guidelines induces a classification challenge, as it is not obvious how to organise the department's documents in the hospital's EPR. Placing their interdisciplinary reports elsewhere than the traditional location as illustrated in Figure 1, makes it difficult for other (traditional) health care workers to locate all of the proper information or even to know whether such information exists. As they look at the physiotherapist section (H 03) they might believe that this is all there is. Consequently, the EPR must be able to present a list of all information related to, for instance, physiotherapy by knowing when a physiotherapist has contributed in the writing process. Thus the EPR should present information that exists both as part of interdisciplinary reports and disciplinary appendixes to these reports together with

traditional self-contained physiotherapy reports.

Fourthly, when organising work and related information completely different than practised elsewhere one must take into account how the interplay with more “traditional” organisations should be performed. The establishment of gateway solutions appears to be a mechanism that enables networks of people to both stay outside of other networks while at the same time being linked to them.

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Appendix A

The Questionnaire

Page 1

A. Age, gender and work position

- | | | |
|--------------------------------|---------------------------------|---|
| Age | Gender | Work position |
| <input type="checkbox"/> <35 | <input type="checkbox"/> Female | <input type="checkbox"/> Intern |
| <input type="checkbox"/> 35-50 | <input type="checkbox"/> Male | <input type="checkbox"/> Resident |
| <input type="checkbox"/> >50 | | <input type="checkbox"/> Consulting physician |

Check like this:

not like this:

B. About your experience with computers

- | | | | | | |
|---|------------------------------|--|---|--------------------------|--------------------------|
| | Yes | No | | | |
| 1 Do you own a computer? | <input type="checkbox"/> | <input type="checkbox"/> | | | |
| 2 How many fingers do you use when typing? | <input type="checkbox"/> Two | <input type="checkbox"/> Three or more | <input type="checkbox"/> All (or touch) | | |
| 3 Have you used a computer for: | Yes | No | | | |
| a Test result retrieval | <input type="checkbox"/> | <input type="checkbox"/> | | | |
| b Literature search | <input type="checkbox"/> | <input type="checkbox"/> | | | |
| c Word processing | <input type="checkbox"/> | <input type="checkbox"/> | | | |
| d Entering patient info | <input type="checkbox"/> | <input type="checkbox"/> | | | |
| e Retrieving patient info | <input type="checkbox"/> | <input type="checkbox"/> | | | |
| 4 Have you ever taken a computer course? | <input type="checkbox"/> | <input type="checkbox"/> | | | |
| 5 Can you write computer programs? | <input type="checkbox"/> | <input type="checkbox"/> | | | |
| 6 In the past, what is the most frequent you used a computer? | Never | Rarely | Monthly | Weekly | Daily |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 7 How would you rate your computer skills? | Lowest | | Average | | Highest |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

C. About the availability of computers at your working place at the hospital

- | | | |
|--|--------------------------|--------------------------|
| | Yes | No |
| 1 Do you have a computer in your office (answer no if you haven't got any office) | <input type="checkbox"/> | <input type="checkbox"/> |
| 2 Concerning other rooms you use for clinical work (e.g. ward, outpatient clinic offices, investigation rooms) | | |
| a Are there computers available for you here? | <input type="checkbox"/> | <input type="checkbox"/> |
| b <u>If yes,</u> do you use these computers? | <input type="checkbox"/> | <input type="checkbox"/> |

If you responded "no" to both questions 1 and 2a, you don't have to fill out the rest of the questionnaire

- | | | | | | |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 3 About the computers installed in the ward, at the outpatient clinic offices, investigation rooms, etc. | | | | | |
| a How often are you prevented from using them because others are using them? | Never | Rarely | Montly | Weekly | Daily |
| | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b How often are you prevented from using them due to computer errors, forgotten passwords or other machine-related problems? | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

D. About your use of personal computers for clinical tasks in the hospital



How often do you use a personal computer (PC) to assist you with the following tasks:

What computer program do you use for this task?

	Never/ almost never	Seldom	About half of the time ¹	Most of the time	Always/ almost always	EMR ²	Other than EMR
1 Review the patient's problems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2 Seek out specific information from patient records	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3 Follow the results of a particular test or investigation over time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4 Obtain the results from new tests or investigations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5 Enter daily notes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6 Obtain information on investigation or treatment procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7 Answer questions concerning general medical knowledge (e.g. concerning treatment, symptoms, complications etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8 Produce data reviews for specific patient groups, e.g. complication rate, diagnoses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9 Order clinical biochemical laboratory analyses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10 Obtain the results from clinical biochemical laboratory analyses	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11 Order X-ray, ultrasound or CT investigations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12 Obtain the results from X-ray, ultrasound or CT investigations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13 Order other supplementary investigations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14 Obtain the results from other supplementary investigations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15 Refer the patient to other departments or specialists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16 Order treatment directly (e.g. medicines, operations etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17 Write prescriptions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18 Write sick-leave notes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19 Collect patient information for various medical declarations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20 Give written individual information to patients, e.g. about medications, disease status	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21 Give written general medical information to patients	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22 Collect patient info for discharge reports	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23 Check and sign typed dictations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24 Other (specify)							

¹The time normally spent on this task
²DocuLive, DIPS or Infomedix

Remember to fill in this column, too...

E. About choice of information source

When working with diagnostics and treatment:		Never/ almost never	Seldom	About half of the time	Most of the time	Always/ almost always	
1	How often do you use other sources of information than the EMR or the paper journal/patient chart?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
2	How often is EMR ¹ <u>the first</u> you'll turn to if the paper journal is available and...	Never/ almost never	Seldom	About half of the time	Most of the time	Always/ almost always	
	a ...you know the patient?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	b ...you have never seen the patient before?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
3	<u>If you usually turn to the EMR first:</u>	Never/ almost never	Seldom	About half of the time	Most of the time	Always/ almost always	Not applicable
	a How often do you have to consult the paper journal or use other information sources?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<i>Go to section F if your response was "Never/Almost never" or "Seldom"</i>						
	b How often did you do this because you wanted to verify the content of the information?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c How often did you do this because you didn't find the information you wanted in the EMR?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

F. About your satisfaction with the EMR¹ installed in your department

		Never/ almost never	Seldom	About half of the time	Most of the time	Always/ almost always
1	Content					
	a How often does the system provide the precise information you need?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b How often does the information content meet your needs?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	c How often does the system provide reports that seem to be just about exactly what you need?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	d How often does the system provide sufficient information?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	Accuracy ²					
	a How often is the system accurate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b How often are you satisfied with the accuracy of the system?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	Format					
	a How often do you think the output is presented in a useful format?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b How often is the information clear?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	Ease of use					
	a How often is the system user-friendly?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b How often is the system easy to use?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	Timeliness					
	a How often do you get the information you need in time?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	b How often does the system provide up-to-date information?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

¹ DocuLive, DIPS or Infomedix

² E.g. right journal, right patient and right document types is located; the information (e.g. blood pressure) is labelled correctly, that the information presented is relevant; the aggregated data in overviews are correct, etc.

³ The time spent with the computer system

G. Global assessment of the EMR installed in your department

- 1 How much do you agree with the following statement about the system:
The EMR system is worth the time and effort required to use it
- | | | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Strongly disagree | Disagree | Slightly disagree | Neutral | Slightly agree | Agree | Strongly disagree |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
- 2 All considered, how would you rate your satisfaction with the EMR installed in your department?
- | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| non-existent | poor | fair | good | excellent |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
- 3 All considered, to what extent has the system changed these two aspects of your own department?
- | | | | | | | | |
|--|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | Significantly decreased | Decreased | Slightly decreased | No change | Slightly increased | Increased | Significantly increased |
| a Ease of performing our department's work | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b Quality of our department's work | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
- 4 All considered, how would you rate the success of the EMR system installed in your department?
- | | | | | |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| non-existent | poor | fair | good | excellent |
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

H. Comments

E.g. Where parts of the questionnaire unclear or ambiguous? Do you have any suggestions to improvements of the current EMR system?
Other comments?

Appendix B

Minimal requirements for functionality of electronic medical records systems for each task

The following table shows our specified minimal requirements to accept functionality for a certain clinical task as being implemented. In several cases more elaborate functionality existed, especially concerning communication within the hospital (such as "Physicians Order Entry"). Local implementations of electronic medical records systems that failed to meet the requirements of task 1 were excluded

No	Task	Minimal requirement	Comment
1	Review the patient's problems	Access to updated medical records	"Medical records" should at least include admission reports, daily notes, summaries and discharge reports written by a physician.
2	Seek out specific information from patient records	Access to updated medical records	Some structuring of the documents or notes should be present, other than simple chronology. (such as document types)
3	Follow the results of a particular test or investigation over time	A selection of results of a certain type must be displayed collectively and sorted chronologically	Presentation of textual data was accepted when it was regarded as the result of an investigation, and the electronic medical records locally was the primary receiver of such data.
4	Obtain the results from new tests or investigations	Direct or indirect access to the primary source of the data (such as communication with the lab system).	"Second-hand" information (i.e. quoted or represented by someone) was not regarded valid here. Preferably, unread information should be emphasised.
5	Enter daily notes	Access to write directly in the electronic medical records	

6	Obtain information on investigation or treatment procedures	Access to and automated query in electronic collections of local procedures for investigation and treatment of various medical conditions.	The collections could be simple text documents, but they should be accessible through the electronic medical records system and subject to continuous validation, revision and endorsement by the medical staff. Information present in the electronic medical records should be used to look up the appropriate procedure.
7	Answer questions concerning general medical knowledge	Access to and automated query in electronic medical textbooks or similar.	Information present in the electronic medical records should be used to look up the appropriate subjects.
8	Produce data reviews for specific patient groups	Presentation of some aggregated information regarding any group of patients.	Such as frequency distribution of diagnoses, complication rate, mortality, etc
9	Order clinical biochemical laboratory analyses	Ability to fill in and print out a valid form for lab analyses.	A template suitable for the local form should be present in the electronic medical records system, and the printout should be accepted as a formal request by the laboratory.
10	Obtain the results from clinical biochemical laboratory analyses	Direct or indirect access to the primary source of the data (such as communication with the lab system).	"Second-hand" information (i.e. quoted or represented by someone) was not regarded valid here.
11	Order x ray, ultrasound or CT investigations	Ability to fill in and print out a valid form for radiological investigations.	MR and scintigraphy were excluded here, because they usually are independent hospital units in Norway.
12	Obtain the results from x ray, ultrasound or CT investigations	Direct or indirect access to the primary source of the data (such as communication with the radiological information system).	Textual results entered directly into the electronic medical records system was accepted when this was the formal routine.
13	Order other supplementary investigations	Ability to fill in and print out a valid form for other investigations.	
14	Obtain the results	Direct or indirect access	Textual results entered directly into

Appendix B: Minimal requirements for functionality of electronic medical records systems for each task

	from other supplementary investigations	to the primary source of the data.	the electronic medical records system was accepted when it was formal routine.
15	Refer the patient to other departments or specialists	Ability to fill in and print out a valid form for referral within the hospital.	
16	Order treatment directly (medical, surgical or other)	The health care workers should accept the electronic request as valid.	An electronic copy of a request on paper is not valid in this context.
17	Write prescriptions	Printing of free-form text adjusted to valid forms for medical prescriptions.	
18	Write sick-leave notes	Printing of free-form text adjusted to valid forms for sick-leave notes and reports	
19	Collect patient information for various medical declarations	Access to updated medical records	
20	Give written specific information to patients (such as medication lists, status of the disease, etc)	Printing of free-form letters to the patient.	
21	Give written general information to patients about the illness	Printing of free-form letters to the patient based on templates specific for each hospital unit.	Such as information about diabetes in general, heart failure, etc
22	Collect patient information for discharge reports	Access to updated medical records.	
23	Check and sign typed dictations	Access to updated medical records and functionality for digital editing and signing.	

Appendix C

Doctors' use of electronic medical records systems in hospitals: cross sectional survey - Erratum

Hallvard Lærum
The Kvalis project (<http://kvalis.ntnu.no>)
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Trondheim, Nov 13th 2002

The Editor,
British Medical Journal

Doctors' use of electronic medical records systems in hospitals: cross sectional survey - Erratum

(Lærum H, Ellingsen G and Faxvaag A. BMJ 2001;323:1344-1348)

Dear Editor

During a recent update of the material, we once again interviewed a representative from the IT-department at the hospital where the function "Obtain results from clinical biochemical laboratory analyses" was reported implemented in the "DocuLive" EMR system.

During this interview, it became clear that this particular function only was available to users from the Neurology and Dermatology departments at the time of the study. Since none of the 11 respondents worked at these departments, our information on offered functionality for this group of respondents from 2001 is not correct. In task 10 in figure 1, the bar shown in the background should be corrected from 16 % to 0% (The background bars show percent of respondents offered functionality for each task). The results and conclusions for users of the "DocuLive" EMR system regarding task 10 in figure 2 are not correct, and ought to be withdrawn.

In our opinion, this is a significant error. We do however not believe that it influences on the principal findings and conclusion in the paper. A corrected version of figure 2 is enclosed. We suggest that the new figure is made available at www.bmj.com

Kindly regards,

Hallvard Lærum
(sign.)

Arild Faxvaag
(sign.)

Gunnar Ellingsen
(sign.)

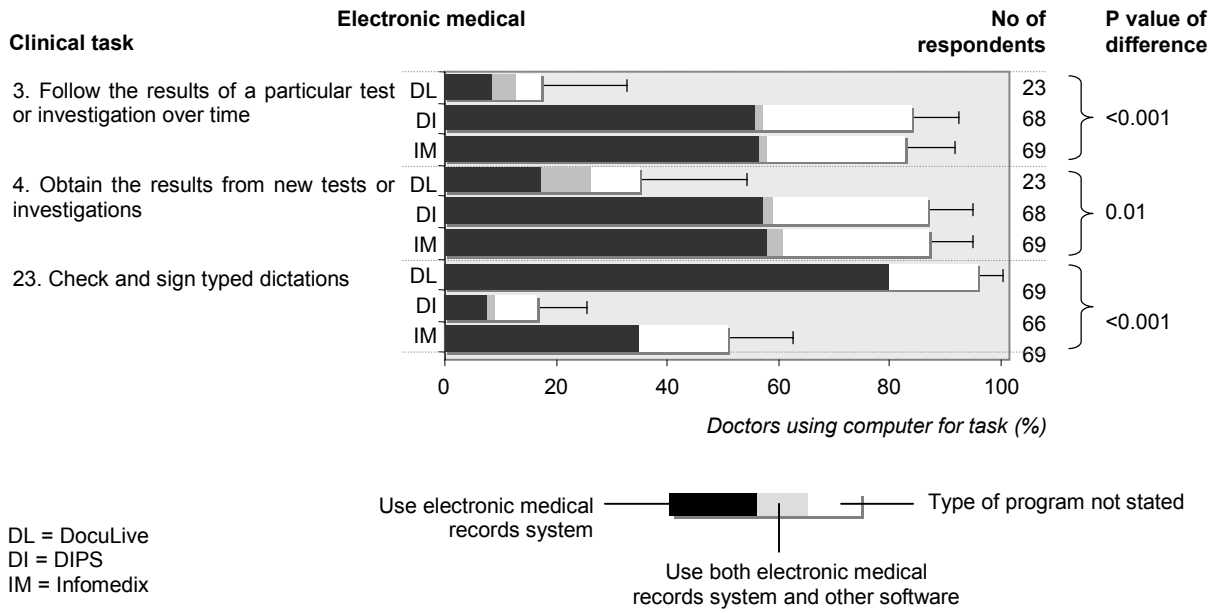


Fig 2 Clinical tasks for which significantly different percentages of doctors reported using three different electronic medical records systems that offered equivalent functionality. Bars represent percentage of doctors who reported using computers at least half of the time for performing each task (black areas show those who used only the electronic medical records system, grey areas show those who used the system and other software, and white areas show those who did not state what program they used) and error bars show the confidence interval. P values were calculated with Chi-square formula (equal P values were achieved with analysis of black areas of bars only and when grey and white areas were included).