Does information flow?
Managing information flow and fluidity in medical practice

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Abstract
The topic of this article is public programs and investments in IT in health care, and their emphasis on the strengthening of electronic information flow as crucial to improved health care delivery, quality and efficiency. The article engages these programs and discourses by exploring information and its uses in practice*. Drawing on literatures in the fields of STS, CSCW and Health Informatics, it explores how information flow emerges in and out of practices and material arrangements; the work involved in making and managing information flow; and the relations between electronic and other forms of information flow. It then turns to an analysis of the nature and character of information and its uses in medical practice; the notion of 'information' that informs IT plans and programmes in health care; the relations between these models and orderings of information; and consequently, how electronic flow interferes with the conditions for medical practice.*

Key words
Public IT programmes, health care services, information flow, electronic patient records, medical practice, multiple ordering, fluid and collective information

Biographical note
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Introduction: IT programmes in health care services

In Norway as in many other countries the future and modernisation of the public sector is at the top of the public and political agenda. There are strategy plans and programs to promote innovation and renewal in the public sector -- as well as programs for research into these processes, their conditions and obstacles. In these public plans and programs, IT holds a position as a particularly promising and powerful means for improving public service delivery, quality and efficiency. And health care is one sector which is marked out as particularly promising and has been made the target of huge investments into IT.

In the most recent governmental strategy document on IT in health care services in Norway, *S@mspill 2007:Electronic cooperation in the health- and social sector*, it is put like this:

> Many believe that a comprehensive programme for information technology is the most effective measure for improving quality and efficiency in the health and social welfare sector.(p. 4)

And then to support this claim, the strategy plan refers to the importance IT in healthcare is attributed internationally, and quotes an EU report which boldly states that

> eHealth is the single-most important revolution in healthcare since the advent of modern medicines, vaccines, or even public health measures like sanitation and clean water.[1]

The reason for these visionary hopes in IT in health care services relates partly to problems and challenges identified internally to medical and health care practices, and partly to problems and challenges in their administration and management. In both cases, information flow – or, more correctly, the *lack of* information flow -- is defined as a critical point and problem. Barriers to the desired development, it is said, lie in systems that don't speak the same language, and in meetings between paper based and electronic information systems. Accordingly, the national strategy plan identifies as the primary challenge and priority the strengthening of information flow by using IT, and, more ambitiously still, transition from hybrid information systems and communication to all-electronic and uninterrupted information flow.[2]

It is this idea and discourse of 'electronic flow', and the visions for health care services they are embedded in, that I wrestle with in this article. In the last few years 'electronic flow' has become a trope in IT policy not only in health care but in e-government discourses more generally. Tracing its genealogy immediately takes us back to a heterogeneous set of sources, moments and origins in organisation and management theory, in innovation studies, in work and action research and in social and cultural theory. In these discourses, flow, and particularly flow made possible and generated by the networks of IT, is conceived as a decisive characteristic and most often also as a condition and driving force in the shaping and reshaping of the social formations, collectives, organisations and identities of our time.[3] In its more rationalist and functionalist applications, IT and electronic flow is the means and tool which spurs an efficiency-enhancing re-engineering of the organisation where everything that is 'superfluous' is cut away.[4] Instead of simply supporting existing work practices, and so 'paving the cow paths', it is argued, one should instead make new, modern, streamlined and efficient 'super highways' or even 'traffic arteries'. So the metaphors abound

– and also become reified. The specificities of practices, and of different fields of practice, with different kinds and uses of knowledge and 'information', as well as the material realities and practical struggles involved, all disappear from view. And so do the specificities of the subjects and objects that are at the centre, the objective, of these practices. Does it for instance make a difference that the objects of medical practices are ill or diseased bodies, and people?

Whether it is possible and sensible to transfer business and management theory to any field of practice, such as the heterogeneous practices of public services, and what the implications of this transfer might be, is urgent. It is also addressed, for instance in social science, in the discussions and critiques of New Public Management.[5] But it is also dealt with *in practice* by all those involved in design and implementation of IT in health care and other public services, and in the research that follows such processes. They find themselves located somewhere between theory and practice – that is between grand theories of the revolutionary effects and rationalising potentials of IT in health care organisation on the one hand and medical practices and their everyday uses of information and information technologies on the other. They try to improve work-processes and information flows while at the same time taking the actors, the knowledge practices and the objects they work with seriously. My concern, when researching the implementation and uses of IT in public services, is with how my work can interfere with these powerful IT programmes and their ideas about electronic flow as a panacea for health care -- and at the same time stay committed to medical practice and its challenges.

This article on IT and electronic flow in health care services thus links up with such practical and discursive attempts to problematise the turn to a simple application of business and management theory (including theory about the potentials and uses of IT) to public sector services; it also explores the implications of such an application. And it does so in a particular way: it approaches the discourses on the uses of information technologies in health care

services and management by exploring information and its uses *in practice*. Drawing on a case study of the implementation of an electronic patient record in one of Norway's largest hospitals, and in particular on data collected through fieldwork in neurosurgery and a medical outpatient clinic, it analyses different instances of information generation, use, and sharing in order to consider the role of IT and electronic flow in medical practice.[6] In this approach I draw on analytical tools from a material semiotic approach and literatures on the uses of IT in the field of Science and Technology Studies (STS) as well as the adjacent Computer Supported Cooperative Work (CSCW) and Health Informatics.[7]

The question that this article deals with, then, is how information is generated, shared and used in medical practice; how in this process information is made to flow, electronically and otherwise; and what the relations are between the different models, practices and orderings of information. The article starts by exploring how information flow emerges in and out of practices and material arrangements; the work involved in making and managing information flow; and the relations between electronic flow and other forms of information flow. It then turns to an analysis of the nature and character of information and its uses in medical practice; the notion of 'information' that informs IT plans and programmes in health care; the relations between these models and orderings of information; and how electronic flow interferes with the conditions for different kinds of medical practice. It ends with a commentary on the implications for prospective design and development of IT for health services.

The objective is twofold: first; to contribute to a better understanding of the character and uses of information in medical practices. And, secondly; to bring out the argument that electronic flow in health care services both rests upon and interferes with other forms of information and information flow; that it requires a lot of work and also creates new work; that this is due to the fact that it excludes large parts of medical information practice and

process; and, consequently, that the notion of 'information' informing these IT systems needs to be broadened and become both more generous and modest if it is to be able to effectively support and improve medical and health care practices.

Making information flow in health care: the role of the intake office

The intake office of the neurosurgery department is staffed with 3 secretaries. They are placed next to the general office where the department's mail comes in and the medical staff comes to fetch their mail. Every week, one of the secretaries in the intake office is responsible for sorting and distributing the mail. First of all, she sorts out the mail that goes directly into the mailboxes of the staff. This is mail that is not addressed to the department, like information leaflets, journals and conference invitations. The rest is taken to the secretary's office, opened and date-stamped, and sorted again. There are external referral letters; discharge summaries and doctors' notes from other hospitals about patients that have been or are being treated here; test results from the lab; images and descriptions from radiological examinations; requests for a second opinion; requests for expert opinions from the National Insurance; hand-written emergency forms; and signed notes and test results that have been returned from the doctors in the department and are ready to go to the archive.

What does the secretary do with this mass of mail? External referral letters and images, either in the form of CD-roms or large envelopes with film sheets, are put on the side and treated separately. Other things are dealt with right away. A request for a discharge summary, for instance, is passed on to the central archive by internal mail. Other documents that go directly to the patient records in the archive are put in a green envelope on a particular shelf. A CD-rom with the images of a patient coming for a consultation in the outpatient clinic

in a fortnight is imported into PACS, the digital picture archive system, and then handed over to the secretary of the outpatient clinic next door. Incoming images are also registered in a notebook, the so-called ‘blue book’, as a form of back-up where the secretaries can check quickly if patients or doctors call to ask if their images have been received. Images that the department has inquired about, are also imported to PACS – given that they are digital -- and then put together with the referral letter that has been waiting in a red folder labelled ‘referral letters without images’ in a special box on one of the shelves in the intake office. The referral letter and images are then passed on to the internal mail box of the relevant doctor who makes the decision about whether the patient should be admitted or not. Test results for in-house patients are put in the head nurse’s mail box for notification and then he or she sorts them into the paper record in the (temporary) record system in the reception on the ward. Test results for patients that have an appointment and are coming in soon, are temporarily stored in a special folder in the general office or the office of the outpatient clinic because otherwise they may not get back from the central archive in time. Other test results, notes and discharge summaries from other hospitals and external doctors are distributed in the internal mail boxes and shelves of the doctors who treated the patients in question. Finally, the external referral letters are registered in PIMS, the electronic patient information system, with information about where it comes from, the preliminary diagnosis, and the name of the relevant in-house doctor. Two copies of an evaluation form are printed out on the basis of this. One goes with the referral letter to the doctor dealing with the case, is filled in by him, returned to the secretaries and then either passed on to the patient-coordinator or sent to the archive. The other copy is put in a folder on the secretaries’ shelves so they can keep track of what they have received, what has been passed on to the doctors for evaluation, whether they have dealt with it within the given time-limit, or whether the secretaries need to send a reminder.

The conditions of possibility of information flow

What this elaborate story of the elaborate system for handling information in the neurosurgery department shows is first of all that information flow is an *achievement*. It is the result of carefully invented arrangements, practices, distributions, routines and procedures that together ensure that information flows and circulates – in strictly regulated paths. Accordingly, flow must be both *made* and *managed*.

This, for instance, is expressed in the work instruction of the intake office. This explicates the tasks, division of labour and rotation between the four secretaries, and so for instance also tells who is responsible for checking the folder with the copies of the evaluation forms following external referral letters, and if necessary inquiring or sending reminders to the doctors; how often this should be done; and when. Without these arrangements and practices, information would *not* flow. Perhaps not at all, and at least not in a controlled way.

An example of the latter is a problem many departments have experienced with requests for medical attention by a specialist in another department, the so-called internal referral letters. These tend, or at least have tended, to get lost. And some departments have adopted radical measures in order to solve this problem – such as forcing all the doctors to come and register their internal referrals in one secretary's office. Indeed, in one department the doctors had to meet and discuss them in this tiny office, too: no referral letter was allowed to leave that room until it had been registered, answered, carried out, documented, and could be sent to the archive. Instituting such a regime was one way – perhaps the only way -- of getting control of and managing the flow of information.

But further, what these stories also demonstrate is that making and managing information flow *involves a lot of work and effort.* And this goes into the development of the

arrangements, routines and formal procedures – as well as their continual realisation and management. The actors that contribute here are diverse and include health professionals as well as IT people and the administrative staff. It is however a point made by several authors that the work of secretaries and administrative staff in particular tends to disappear from view and become invisible.[8] It is the kind of work that only becomes visible and palpable once it is *not* done, the argument goes, and that creates the conditions for flow that appears to be smooth and effortless.

Another term for this kind of work is 'articulation work', the kind of work that makes the conditions for and allows other forms of work to take place.[9] However, its use often seems to imply that articulation work is constituted in opposition to 'real' -- productive, generative -- work. This is not a distinction I want to make. As will become clear in what follows, these practices are involved in the generation and use of information in medical practice as well as its flow and management.

The last point that needs mention here is that the practical and material arrangements that help generate and control information flow involve many and heterogeneous technologies, including but not limited to computers, printers, digital image archive systems, patient information systems, and the electronic patient record. Other crucial technologies are for instance the telephone and the copying machine. But people and offices and shelves and boxes and notebooks and folders also go into them. And so do the practices, routines and formalised procedures that bring them together, and through which these elements all become attached to one another.[10] Indeed, as actor-network literatures in STS argue, it is this arrangement of heterogeneous elements, actors and practices into a network that holds together, and that directs and manages and controls the relations, the exchanges and circulations in them, that makes flow rather than its lack or even uncontrolled overflow.[11]

Making *electronic* information flow: the case of the scanning project

One of the activities I started following in the hospital was the scanning project. This had an ambiguous position. In the larger context of the IT-department and its strategies, the scanning project was quite small and taken to be unproblematic. It had little of the technical challenge and status attached to it of some other projects, such as the prestigious portal.[12] Also in terms of resources, the scanning project was modest. There were resources for the equipment, that is 'handy' table scanners for the departments and a few larger scanners for the central archive; the purchase of the software; the installation and handing over to the clinical departments; and two or three follow up meetings. It also had a provisional, part time project leader, some technical assistance and one person from the central archive who had been engaged to work on the mapping, sorting and categorisation of documents.

At the same time, however, the scanning project was also attributed enormous importance. On the one hand, it was supposed to (help) solve the problem of exponentially growing archives and lack of archive space. On the other hand, it was also supposed to teach and convince health professionals about the blessings of electronic information and information flow.

What became evident quite soon, however, was that simply installing and handing over the technology would not do. The established information practices in the clinical departments were so heterogeneous that the suggested formal procedure that accompanied the scanners, did not make enough sense for the departments to proceed with. The diverse routines and procedures around a supposedly simple matter such as opening mail turned out to become a big issue. Mapping these became a time-consuming activity, and the question of who could open what turned into a hot topic. In addition, scanning took time; it turned out that

it was not at all a simple matter of sending the papers through a handy table scanner -- and the new tasks did not come with extra resources. Voices of protest were raised, and departments refused to co-operate before they got extra manpower.

Observing the actual process and practice of scanning, what we learned -- and the 'we' here includes the IT department's people, the secretaries, and the observer -- was that there were so many different formats and qualities of paper documents; that they came with so many different fonts and handwritings; were written with so many colours and qualities of pencils, pens and printer ink; were printed or written on one or two sides; sometimes had curves or sketches of family trees included; sometimes were documents in process, with information that was unfinished and enfolding, or were renewed and replaced every day or on a regular basis; and so on. Not all of these documents would go through the scanners or become legible on the screen. Some would have to be scanned through larger and more specialised scanners (in the central archive) than the small ones in the departments. Some were two pages long, others twenty-five or more. The smaller scanners, although they in theory should have been able to handle all these complexities, in practice often did not. There were many error reports, and scanning one referral letter with attachments might take up to five minutes or more. There were problems with the mechanisms that fed the paper documents into the scanners; at other times the documents were fed into and through the machine, but still had not been scanned or imported into the electronic patient record. And for security reasons the secretary had to log in, specify a time for her access, and also enter a reason for it, with every entrance into the electronic patient record. The secretary also had to tidy up and organise the documents when scanned; enter date and department; classify the documents and specify which sections they should be imported to. In practice, the documents were often difficult to classify, and so also to locate in the electronic record. For instance, doctor's notes or discharge summaries were sometimes also referral letters. This was because

the author-doctor had simply added a few lines to her note saying that on this background she would ask for a specialist's evaluation of the case at hand. At other times, internal referral letters came in the form of a letter, and so formally as an external referral letter, because it was more convenient for the doctor to dictate this as a letter at the same time as dictating the note after a consultation than to open and write an internal referral letter within the electronic patient record. So where should they be put?

Arranging for and enabling electronic flow

Perhaps it is trivial to note that information flow has to be made and involves work and effort, or even to specify *how* information flow is generated in the linking of material arrangements and practices. No doubt the people who are in the business of implementing the new information technologies know this: the flow charts they produce in their mapping exercises and analyses of work processes make this quite obvious. But what they have still had to learn is that even the new *electronic* information flows require a lot of work and effort, and that this goes far beyond the introductory familiarisation with and naturalisation of new technologies.[13] As my story about the scanning project shows, this was not foreseen.

So what I want to argue here is that contrary to what many -- including the IT-department, the hospital management, and the grand theories of the potentials of IT in health care and other public services -- seem to assume, *electronic information flow involves lots of work, too*. And this, I want to argue, is not a remnant of 'the old way' of handling information with paper documents, folders, shelves, boxes and archive cupboards that simply disappears or at least *can* be cut away with the introduction of computer technologies. Neither can it be blamed on the intermediate situation with what is called 'hybrid solutions'. Electronic

information flow is preconditioned upon the same kind of carefully developed arrangements of material elements, technologies, human actors, practices, divisions of labour, routines and procedures as pre- or non-electronic flow.

Information in practice: A day in the medical outpatient clinic

Many of the patients in the medical outpatient clinic are in-house patients in other departments who come for medical attention by a specialist in one of the sub-disciplines within the field of internal medicine. They are referred to the outpatient clinic through the internal referral letter. Most departments now use the new electronic version, and so does the medical outpatient clinic.

But there are also external patients coming in for regular consultations, and even patients who come in for tests and controls on a daily basis, such as patients who have undergone kidney transplants. The outpatient clinic also gets emergency cases, mostly from within the hospital, who need these specialists' attention right away or at least the same day. Co-ordinating and juggling the clinic's work programme, the work books of the individual doctors, nurses, available rooms and different special labs or equipment is therefore something of an art.

Sitting with and following the secretaries in this outpatient clinic, observing the use of the new electronic version of the internal referral letter and how it interferes with other information practices and tasks such as mail routines, the transcription of doctors' notes, and the management of the department's daily programme, it was obvious that the electronic internal referral letter is one technology and channel of information, but not the only one. In

the situations and practices that I observed, a more critical technology seemed to be the telephone – followed, and assisted, by the pager.

For a patient to get medical attention by one of the specialists in the medical outpatient clinic thus involves a lot more than sending, receiving and answering a request by way of an electronic internal referral letter. Many patients do not turn up for their appointments, and many arrive late. For the secretary, this means that she has to find out whether patients are on their way, why they are delayed, if they might be walking around in the corridors having got lost, if they need assistance or transport has to be organised, if the transport has been delayed, if they have fallen ill, if they have arrived and registered in the hospital hotel the evening before, and so on. This is all done by telephone. Emergencies are usually also announced first by telephone, or perhaps by phone *and* by electronic means, because one cannot know when the box for incoming internal referrals will be checked. With emergencies, the secretary also has to displace other appointments, reorganise the plan for the use of rooms and nurses, and call for doctors. And she does so either by looking them up in their offices, labs or consultation rooms, leaving notes and especially small post-it notes, and by telephone and pager.

The heterogeneity of information, information technologies and information flows

In the discourses on IT in health, and the discussions of the problems with information flow in particular, but also much of the research literature in health informatics, there is quite a narrow focus on paper documents versus electronic ones. The idea is that one should replace paper by electronic documents and get what in the policy discourses and scenarios are celebrated as the future ‘paperless hospitals’. One reason for this is that the focus in IT system

design in health care has been on information archives, the repositories, and so the possibilities for storage, access and retrieval, rather than on the actual information practices in different medical practices, including those of hospitals.[14]

But if instead one starts out from information practices more generally, and traces how information is shared and communicated, the picture becomes very different. A typical day with the secretaries showed that information came in and was handled and passed on in all kinds of formats. There were people coming in person to give oral messages; but also post-it notes or hand-written messages on a sheet of paper; handwritten comments on test results from the lab; a whole line of communications in a series of post-it-notes in different colours, with commentaries from different actors, attached to a referral letter; radiological images in the form of CD-roms or film sheets; entries in books (like the blue book); photocopied paper documents in folders; faxes; e-mails; pagers; people running after someone in the corridor, passing on verbal messages or notes on a piece of paper, perhaps even going up or down the stairs to look for someone in a meeting or office; -- and not least, there were so many telephone calls! There were moments when I contemplated the idea of writing about the central but neglected role of telephony for medical practice instead of about computer technologies… And all of this came in addition to the strictly defined patient record contents like the doctor's notes and discharge summaries, laboratory results, radiological descriptions, referral letters and so on that also contained and carried information across locations, actors and use situations.

So what I want to argue here is that there is a *neglected heterogeneity*, which is also a *material heterogeneity*, to the information, information technologies and information flows in health care practices that cannot be reduced to a simple question of either paper or electronic form. And, further, that acknowledging the heterogeneity of information practices is

significant to understanding why the transition to electronic records is slow, difficult, painstaking and sometimes even characterised as unsuccessful.

If this is right, then the idea that the current information systems are and should be only provisionally hybrid appears in a very different light -- as unrealistic or even naïve.[15] This is even more so because it turns out that the relation between electronic information flow and other kinds of information flow is not simply one of harmonious co-existence. Yes, there is a plurality of forms and materialities of information and information technologies existing side by side as different and equally possible options. But there is also *dependency*. This is obvious from the above story about the uses of the electronic internal referral letter in the medical outpatient clinic. Indeed, my main argument here is that electronic information and flow is often insufficient in itself and so it *not only co-exists with, but also rests upon other flows*. And accordingly it also rests upon the work and effort, as well as material arrangements and practices that enable and carry these other information flows.

More work for mother…[16]

In the medical outpatient clinic, the task of dealing with the new electronic version of the internal referral letters had been delegated to one secretary, or more precisely even, to one secretarial function. Incoming referrals to the department were all collected at this one desk and computer, where the box and work lists were checked two or three times a day and then registered and inserted into the departments' and its individual doctors' work programmes. Notwithstanding the art and skill it took to juggle the daily programme and activity in this medical outpatient clinic, handling the internal referral letters was a rather simple matter.

In neurosurgery, it was a different matter altogether. The administration's proposal for a new procedure for internal referral letters was five pages long and provoked laughter as well as protests and resignation.

For instance, when a doctor in neurosurgery sends a request for medical attention by an eye specialist or a specialist in genetics for a patient who is supposed to come for a consultation in the department's outpatient clinic, she either dictates or fills in an internal referral letter in the electronic patient record and leaves the document in a draft status. It is then taken over by the patient coordinator who sets a date and time for the appointment and coordinates the planned examinations and attentions by specialists with this appointment, and returns it to the doctor in time for the examinations to be ordered. Then the doctor signs and sends the internal referral letter. When the referral returns with an answer from the other department, the doctor who required the examination has to check and sign for it in order for it to disappear from her work lists. But many doctors don't, and so the departments often have unfinished work that is many months old accumulating in their work lists.

Equally, when the department receives internal referral letters from other departments, and either the doctor on duty or the team routes them out to the relevant doctors, these also have to be answered and completed. Even if, as in emergency cases (and sometimes also in other cases), the request comes by telephone whereas the electronic version only comes afterwards -- and sometimes much later too. So seeing the patient in question, and in practice dealing with the request, even dictating the conclusion and note to the patient record, is not enough. The internal referral letter requires that it be answered, documented, signed and completed in the electronic system. In addition, the doctor has to print it out and pass it on to the secretaries for it to become registered as part of the activities of the department that they get paid for.

This is where the secretaries come in. The secretaries in the department are appointed to follow up, check and send reminders to a handful of doctors about their uncompleted work; to make sure that all the requests for medical attention are properly registered; and in some cases to take over and finish it so that the department's work lists are manageable and the department gets paid for its activities.

Electronic information flow generates entirely new tasks and work loads

Now what the stories about the electronic internal referral letter show, and what the scanning project also demonstrated, is first that new technologies for making information flow create a set of entirely new tasks, work loads, and distributions of these new tasks. Secondly, they also often involve more actors and elements in the arrangements that are required to make them work, and to make information flow, than before. In the case of internal referral letters, for instance, the secretaries in neurosurgery earlier had virtually nothing to do with these requests. The introduction of the electronic version for them simply added new work. More work. And as for the other actors involved, the doctors, it didn't make less work either. Instead it tended to interrupt other, for them more efficient, information flows, such as requests and agreements communicated orally in more or less accidental meetings in a corridor or the canteen. And where such requests could earlier be adequately dealt with by dictating a note or report to the patient record that documented what had taken place, there is now a set of new additional tasks that need to be attended to: checking, ticking off, signing, answering and documenting in a special section of the electronic patient record. And in addition it has to be photocopied and communicated to the secretaries in order to be registered.

True enough, the complaints of health professionals have been heard: in order to allow for more flexibility, better work flow, and also safety and quality -- especially in emergency cases -- the procedure does not require that there is an electronic referral letter before one can take action. Again this demonstrates that electronic flow rests upon other information technologies and flows: in cases of emergency you cannot count on electronic messaging or referrals because you don't know when they will be read and handled. The medium for

communicating requests for medical attention is therefore not specified – but it is still required that all requests *also* be communicated, dealt with and completed electronically. And this makes new and additional work.

"An exclusively medical meeting": Medicine versus technology and administration?

The very first day I came as an ethnographer to observe how information is used and shared in the neurosurgery ward, I was thrown out. I had been told that the pre-round meeting was crucial and The Location for me to start with. Access had been granted and I had been instructed about where and when to show up and whom to ask for. I sat on a stool in the duty room watching the hectic preparations of the secretaries while we waited for the entry of the doctors. The office director was stressed because one of the patient records was missing and there was no note about who had taken it, when and for what purposes. But then the doctors filed in and the meeting was about to start. The doctors each carried some folded paper sheets with today's work programmes and patient lists in their hands or pockets. The office director carried the bunch of patient records and placed them on the table. We were seated in a circle around a long oval table. There were three or four workstations with computers at a bench along one of the walls, but most of the doctors were seated with their backs at these computers. The office director briefly introduced me and asked me to present myself. I had only just started when I was interrupted by a doctor who objected. There were several agendas in his objection to my presence, but to my mind, the important argument was that this was an exclusively medical meeting. It had nothing whatsoever to do with scanners and scanning -- or any other modules and projects to do with the electronic patient record for that matter.

Information in health care: the order of IT versus medical practice?

The reason for rehearsing this incident is that I am interested in what was performed in it – namely a boundary, and a conflict, between medical practice and the uses of information therein on the one hand, and IT discourse, IT systems and administration on the other. But I am also interested in how we might think about this boundary performance, and what we might learn from it about the role of electronic information flow and its relations to medical practices and their uses of information. So what are the various possibilities?

First, as a social scientist it is very easy to frame – and blame! -- such problems and conflicts as having to do with professional interests, power games, hierarchies and culture in health care practices. And so to assume that the boundary made in the situation related above first and foremost distinguished between groups of people and professions, such as health professionals versus what is indeed sometimes quite disparagingly called 'mercantile personnel'. This is however not where I want to end. Instead, I want to bracket these processes for a moment and explore the possibility that there is something *more* to it that cannot be explained away by simple reference to power, interests and 'the social'.

Second, then, in IT discourse and management the response is usually that situations such as the above show that one has failed in the attempt to make the necessary organisational changes, or, in the jargon of the day, in 'process (re)modelling'.[17] In a partially related tribe, namely the branch of organisational studies and IT research that mobilises actor-network-theory as a resource, it is all a matter of getting the sociotechnical network in place: aligning people, physical facilities, technical infrastructures, equipment, practices and routines; configuring and fixing in place their relations and interactions; and so making sure things

(such as information) flow and circulate through this network in a functional and efficient way.

So these are two possibilities. But I want to explore a third and different alternative that draws on related work by John Law, Annemarie Mol and also Marc Berg and Stefan Timmermans. These contributions follow the same semiotic approach of tracing how paths and so order are built in material practices and arrangements, but also rework it as they break away from the functionalism and managerialism in actor-network studies on the one hand, and its embedded notion of social order and space as singular on the other.[18] Instead they investigate the different orders, or better 'modes of ordering', at work in particular practices, settings and locations, and how these co-exist and interfere with one another in complex ways.[19] Against this background, then, I want to revisit the incident described above one more time. And I want to suggest that the boundary performed in that meeting did not so much distinguish between people, professions and their interests as between different -- and clashing -- modes of ordering knowledge-practices. Thus what I make of the above commentary, is that in medical practice, IT systems and the discourse that surrounds them (and are co-constitutive of them!) are – at least sometimes -- experienced as belonging to a different world and ordering. This then is seen as intruding into the world and ordering of medicine. And, implicitly, that medical practice, and 'information' in medical practice, is different in kind and nature.[20] But what is its nature? And what is the relation between these different practices and their models of information?

I will tell another small story. A related incident took place in a similar situation some months later when I was sitting in to observe in the pre-round meeting of the intensive care unit of the same department. A nurse whom I had never met before asked what my research was about. While I tried to explain it very briefly, without disturbing the rest of the meeting,

one of the doctors mumbled: “information does not flow!” There was no space for me to respond at that moment -- but I wish I had had the chance to inquire into what he meant.

Since then I have been wrestling with this set of questions: What *is* information in medical practice, and how is it used? Does it flow, or, otherwise, how is it shared? How does it relate to the model of information and the visions of information flow in IT plans for health care? And can this relationship perhaps also help explain why the introduction of electronic patient records is painstaking and slow, and why IT systems and electronic information flow tend to produce more rather than less work? And what might the further implications be?

In the remainder of this article I therefore turn from the concern with how information flow is made possible and achieved, and the relations between electronic and other forms of information flow, to the concerns I have just introduced about the nature and ordering of information in medical practice, how this relates to the model of information in IT systems and plans, and what the implications might be for medical practice as well as for IT design and development.

Information in the clinical consultation: The neurosurgery outpatient clinic

I am sitting in to observe with a neurosurgeon in her day in the outpatient clinic. The doctor is seated in front of a table with computer and two screens, a standard screen and a special one for viewing digital radiological images. This is in order for the doctor to be able to read the patient record and look at radiological images, check laboratory results or read radiological descriptions and evaluations at the same time. Or, alternatively, for her to be able to compare images on two screens. Next to her are two chairs. These are placed so that the patient and her companion can look at the screens with the doctor if relevant. On the other side there is a shelf

on wheels with the paper records of today's patients. Many of the patients in this department have a long history here, and so their paper records are sometimes the size of several telephone directives stapled together. In addition there are large film-sheets with radiological images from before the introduction of digital imaging technologies and archives.

Before the patient comes, the doctor searches for the patient in the patient information system (PIMS) and looks at the overview of her latest contacts with the hospital. The patient in question is an eight year old girl who was born with a spinal chord hernia, has been operated on several occasions in her back and legs and has been followed up by the neurosurgery department on a yearly basis since birth. The doctor wants to have a quick look at the three-year old MR images (nuclear magnetic resonance imaging technique) and some more recent images examining a developing scoliosis – which means that the girl's spine is taking on a s-shape because one leg is growing faster than the other. However, the images are stored in a digital archive and retrieving them takes some time. While waiting, she reads the note following the images from a doctor in the orthopaedic department. When she finishes this, the images are still not accessible. The doctor picks up the paper record, reads in it, and makes some notes on a sheet of paper. She sighs and gives up on the images and goes to look for the patient in the waiting room.

The patient comes in with her mother. One of the things they want to discuss is the girl's level of activity and the risks they involve. The doctor addresses the girl and asks how things go for instance in school. "I do everything", the girl proudly declares. "I swim, bike, play football and do skating and snowboard in winter." But then she also tells of a recent incident in school where she was hit in the back, wet herself, but also, and more worrying, became numb, felt a prickling in her legs and also temporarily lost the sense of touch and feeling. They had consulted a specialist the same evening. The mother refers what he said and how they had reasoned, and our doctor listens, adds some questions -- some directed at the

girl, some at the mother – and suggests some actions that can be taken to prevent or limit the possible risks involved in the girl's activities without stopping them. The doctor examines her back, hips and legs with hands and eyes. She asks her to walk a line, to walk on heels and toes respectively, to jump and to hop on one leg.

The variable and context-dependent character of information in medical practice

Going about it empirically and sociologically, what is striking in the above story from a clinical consultation is, first, how *variable* and also *materially heterogeneous* information is. What makes information here is not only a paper record on the one hand and an electronic one on the other. Rather, there are paper notes and letters, electronic notes, digital images, film sheets with images, the girl's verbal description of her situation and important incidents, her bodily exercises and performances, the mother's verbal account, telephone calls, and the doctor's questions and knowing hands. Further, if we trace the sources of information in the clinical situation and interaction related above, we see that information arises in and comes together from a range of actors and locations that are distributed in time as well as in space. These actors and elements all contribute to a collective formation of information.[21] And third, what these sources and elements of information are, and which of them turn out to be important, is not only variable but also *unpredictable*. Again this can also be shown from the story above. In neurosurgical practices, the images are often attributed great importance. Without images, the secretaries always repeated, the doctors won't even look at a referral letter. But in the above outpatient clinic consultation, the images played a minor role. This was not because the doctor didn't look for them: she did. The reason was rather that it was so difficult and longwinded to retrieve the images from the digital archive; and that she was

pressed for time because someone had double-booked two patients in an already tight schedule that day. So what became important sources of information here were the concerns that the patient and mother wanted to discuss, and the girl's account of her activities and especially the incident at school. And the only way for the doctor to learn about *this* was through listening to the girl and her mother's accounts, and the clinical examination.

This is not to deny that at the end of the consultation, the various sources and pieces of information are drawn together and translated into the record by the doctor. She is the one in the position where all of this comes together and needs to be juxtaposed, related, juggled, and if not reconciled then at least provisionally summed up and accounted for.[22] But the focus on the record, that is the textual or symbolic and so abstracted documentation, still seems to draw the attention away from and so to exclude large parts of the actual process. The record is an element, and an important element, but not the only source of relevant and necessary information for the clinical situation and practice.

It is my argument that this is not the exception that confirms the rule, but is rather the rule itself. The consequence, then, is that it is difficult if not impossible to legislate in advance and make a complete map and specification of what makes or will come to make the relevant information in a given clinical situation.[23] To be sure, in certain contexts and circumstances it is fairly easy to legislate about what makes information – but in others it is not. Sometimes, as for instance in emergency cases, the indicators taken into account are very few, because time is limited and one has to act to save life. But then again, operating theatres have to be free, with doctors on duty who have the right kind of competence, who are not already exhausted or have to pick up children. At other times, an unexpected or so far undetected infection can stop a planned treatment or operation programme. And so can a new piece of information like the fact that the patient's condition has deteriorated, or that she suffers from diabetes. In which case there is often a need for further tests before proceeding with the planned

programme. And then the need for the assistance of nurses in anaesthesia in order to do a specialised blood test can also postpone or influence the decisions and actions taken. All of which are examples of what can make relevant and crucial information in certain circumstances, and of the varying forms in which it comes. Sometimes it is the clinical measurement of a patient's pulse, sometimes the patient's jumping performance, sometimes a piece of paper showing the result of a lab test, sometimes a telephone call to the head nurse in anaesthesia, sometimes the verbal account of a patient and sometimes the duty roster or operation programme.

So anything can be or become information. The implicit definition or model of information in these medical practices, I want to suggest, is that information simply is what allows one to arrive at a conclusion and a decision about what to do next and how to act.[24] The argument I draw from this is that this shows that knowing, explicating and predicting what is or will be important information is almost impossible outside of that given, unfolding context. As pointed out by other authors as well: information in clinical practices is essentially context-dependent.[25] The further implication of this, in relation to the role of electronic information flow, is that at least parts of what makes or may come to make information in the clinical practice cannot be foreseen, planned for and taken into account in the design of the electronic record either. Except by acknowledging that there are limits to what the electronic record can do.

Indefinite realities and information: The tumour that wasn't - and then was

Another incident. A neurosurgeon had seen a patient in the outpatient's clinic for a post-operative consultation. The patient had been operated for a cancerous tumour in the brain. It

was a nervous moment for the patient since he was about to learn about the results from the first tests after the operation. The doctor had looked up the results on his computer by logging onto the radiology information system (RIS – this stores textual reports from radiological examinations) and searched out the results from the tests he had requested. It was, luckily, good news: there were neither signs of new nor recurring developments of tumours. The patient went home. Weeks later, however, the patient was readmitted to the local hospital and our surgeon was notified. He was baffled. It happened that he got the news, or read his letter, while in the secretaries' office, and that he told one of the secretaries about it. She surprised him even more with her comment that "but that was what the test result said, wasn't it, that there was suspicion of a recurring or spreading of the tumour". She happened to remember the case, and she also happened to have been the one who dealt with the test results from the laboratory and radiology department when this result came in, on paper. "But I didn't know, and haven't been told," the doctor exclaimed. What then turned out was that the radiologist in charge had had a second look and second thoughts, come back to the case and changed his conclusion. S/he concluded that there was indeed suspicion of a – recurring, further -- tumour. When the final paper version of the test result came to the department, however, it was assumed that our doctor had seen the electronic version and that it could be signed by an assistant doctor in our doctor's absence.

The emergent, processual and fluid character of information in medical practice

I want to use the story about the tumour to argue that medical information is or at least can be indefinite and processual. It cannot always be pinned down. It isn't necessarily definite or precise. Whether there is something there, a trace, a sign, or not, is not easy to decide. At least

not right away. It may need a second look, a second thought, and perhaps also a second opinion. Perhaps even a third and a fourth one! And so it is emergent and processual, and may change over time.

There are many forms of information in medical practice that make this point even more clearly than the above story, such as parts of nursing documentation, the many curves in intensive care or obstetrics, or EEGs. They also create problems for IT people, systems and plans because they evolve over time and may change and take a different course at any time. They are difficult to replicate and replace by electronic versions, and so either have to be regularly updated or simply left out. And to my knowledge they are often treated as special cases and left out ('for the time being, until later').

But the case with the tumour related above isn't and cannot be treated as such a special case. The radiological examination was supposed to yield a definite and finished result. But it couldn't. My argument is that this is not a failure, or a sign of bad clinical practice – but rather a symptom of the character of information in medical practice. Knowing what something – a piece of information that may come in the form of a symptom, a concern, even a test result in the form of a figure – *means*, what the implications might be, and what actions should be taken, is not always straightforward. The way one works at this in medical practices is often negatively by excluding things, and then positively by trying things out. This then enacts or builds a process which may or may not be long-lasting, depending on the specifics of the case, such as whether one is dealing with an emergency or not.[26] But usually the set of sources and elements of information included expands, and in this process their relative meaning and significance changes as they are brought in relation with each other, juxtaposed, compared, contrasted, and, ideally, reconciled.[27] However, it should be added that the body that makes the object of knowledge in this process is often also unstable and changing. And so altogether this contributes to the emergent, processual and rather *fluid* character of information in

medical practice. And this is an important point. Medical information does not simply flow, but is fluid too: It changes as it moves and is moved between locations, situations and moments – and it changes because its context, and the boundaries to that context, and so to what is taken into account, changes, too.

But why, then, do such forms of information make problems for IT systems, electronic flow, not to speak of the IT visions? Or the other way around; how is the nature and character of information in medical practice involved in the problems medical practitioners experience with IT systems and electronic information flow?

I will explore this question by considering the model of information that underlies IT visions and plans, and is possibly also built into IT systems for health care. So what counts as information in these plans? Here is an example.

Information according to IT plans and programmes

In the Norwegian strategic plan for IT in health care, *S@mspill 2007*, it says:

> Cooperation within the health sector currently suffers from information flow that is far from satisfactory. Often information is not in the right place at the right time or in the right form. It is exchanged in ways that may be both time consuming and insecure. It often flows along channels that are poorly integrated, are partly paper-based and partly electronic, and is located in incompatible technological systems. This means that it accumulates in inefficient ways, as for example when it is printed out and put in an envelope. In addition, the quality of information is often poor. It may have

gaps, be imprecise and irrelevant, and may be located in different places even within a single organisation.

A major effort is required to improve information flow in health care. This must be based on well-defined and appropriate information which can be easily transmitted along secure, high-capacity electronic highways. Generally, information must be handled securely in all links. Within large organisations such as hospitals the challenge to collect patient record information in one place; in a format that makes it easy to retrieve, update and forward. Electronic patient records have to be developed to achieve this. (p. 12)

The formatting of information for electronic flow -- and its exclusionary effects

So according to the IT plan for health care, it is not only the information flow but also the quality of the information that is far from satisfactory. And the quality and format of the information, it is recognised, is crucial for its flow. But how is the problem framed and defined? Medical information, it says, is often imprecise, lacking and irrelevant.[28] The vision is that information can and should and will become 'well-defined', 'appropriate' and 'easily transmittable'. In other words, that information -- with the introduction of IT -- can and will become definite and precise, and specified and defined, textual and symbolic, clear and stable, and retrievable and reusable for other purposes in other contexts.

But this implies that information needs to take on a particular shape in order to be suited for this kind of electronic flow. And the format in question is what in STS literatures and vocabularies is called an immutable mobile. An 'immutable mobile', according to Bruno Latour, is an entity, an object, such as a code, that keeps its shape and remains stable as it is

moved across locations – because it moves through a network that is designed especially to hold its shape. A network where all relations, interactions, elements, categories and identities are fixed in place in a way that contributes to the stabilisation of what circulates in and through it.[29]

If this is what information *is*, or at least what *counts* as information in IT plans and systems, and the format that any information is assumed to achieve given that it is generated and documented in a disciplined way, then it also follows that the question is simply one of making it flow. Simply a question of building the networks that make flow possible, regulating and fixing the paths through which information is supposed to pass, and which also contribute to stabilise the shape of information. And so making smooth flow.

But if there is any substance in what I have demonstrated above, much information in medical practice is of a different nature and character. Indeed, as has been argued, it is both variable, materially heterogeneous, and context-dependent, as well as emergent, processual, and fluid. This means, then, that it is not easy or perhaps even possible to map out and pass judgements in advance about what will be relevant or not from a medical point of view; what is lacking and makes a gap or not; make information fit into precise and definite categories; or hold it stable. Further, it also means that given the strategy of collecting and centralising all information in the electronic record, and formatting and disciplining it for smooth electronic flow, a large part of medical practice, process and information will be under pressure by and become excluded from the IT systems and the flows they make for.

What might the implications be? According to IT research medical practitioners try to adapt and conform to the format, categories and practice of information required by the tool. Medical practice becomes disciplined to a formalism, is the argument (Berg 1997). My own study suggests that alongside this there is also a continuity, and perhaps even strengthening,

of alternative information channels and media of communication. This may help explain why the new IT systems and the electronic flow tend to create more rather than less work.

This is however not a necessary effect and implication of IT. It is *not* the point here that IT and electronic information flow in medical practice is necessarily flawed. Information in medical practice certainly needs to flow, become shared and also retrieved and reused in other moments, locations and contexts than that of its production. And IT certainly makes that a lot easier, and so also interferes with established information practices and other information flows in ways that are positive. But the visionary hopes invested in IT in health care, and in electronic flow in particular, not to speak of the easiness or smoothness with which information is assumed to move in these visions, are still far removed from practice -- if not simply 'idealist' and unrealistic.

Another possibility for IT in medical practice is for instance that design, development and implementation of IT become concerned also with what is being othered and excluded, and not only with how the new order and its flows and circulations can be made smooth and efficient. And, further, that design, development and implementation of IT turn from information *flow* to *fluidity,* or more precisely still, *fluid flow,* as their guiding metaphor. And so allow for changes in what it is that is made to flow.

But how to handle, enable and support the *fluidity of information*? In the field of STS it has been argued against Bruno Latour that contrary to what he assumes in his early works -- that in order to transport objects and facts across distances you have to make immutable mobiles and stable/stabilising networks – transformation and so a certain kind of fluidity is a precondition for flow – and for networks, too.[30] This brings us back to the invisible work, the articulation work, all the extra work that is needed to make the impression of self-contained networks and flows. But further it has also been argued that transport, or flow, can even be more efficient and successful if it is based upon fluidity, or what Mol and de Laet call

'mutable mobiles' – flexible and responsive objects that become modified and adjusted as they are moved into new contexts and configurations -- rather than upon fixed, stable and so immutable mobiles.[31]

There are however also already examples of how fluidity and fluid flow can be taken into account *in practice*. One such example is the attempt in the hospital where I did my case study to develop a system module for messaging intended to replace for instance all the yellow and pink post-it-notes, and so to enable and support an information *process*, with knowing-in-process as well as decision-making-in-process. Another example is the suggestion that the medical doctor should be notified, electronically, when the report from an examination is changed.

The radiology meeting: the role of collective learning and knowing in medical practice

Having sat in on pre-round meetings in one of the neurosurgery wards, I learned that there was a controversy about the reorganisation of the morning meetings that was relevant to my investigation of information sharing, uses and flows in the department. Until recently, all the doctors as well as the head nurses on the three wards and from the operating section were obliged to attend the 07.05 morning meeting for the department's health personnel *and* the 07.20 radiology meeting where the doctors can have images from yesterday's examinations demonstrated and analysed, *as well as* the 07.40 pre-round meeting on the respective wards. But now this had been changed, and only the doctors on duty were obliged to attend the first two meetings. The others could simply turn up at the pre-round meeting, get the essential information there, and if necessary look up the images on their computers in their offices – or so it was assumed. Some of the doctors sarcastically ridiculed this new experiment and tried to mobilise the others to support the writing of a collective critical letter to the management of

the department. What they were worried about, was the long-term implications for competence in the department – because, as they saw it, this reorganisation meant that one of the crucial means and situations for learning was being ruined. And they were especially worried about the training of new assistant doctors: How on earth would they learn if not through participation in these meetings, and especially the radiology meetings where the concrete cases were discussed through collective attention to images?

Shortly afterwards, I followed the trail of doctors to the morning meeting and the radiology meeting. This was a Monday, and so the fresh team of doctors got a report from the team of doctors who had been on duty during the weekend: how were the patients who had been operated on at the end of last week doing; what new emergency cases had arrived; their conditions; how they had been treated; and how they fared. As it turned out, one of these emergency patients had died. Then the next thing on the agenda was the work programme – which patients were in line to be operated on, what were the priorities, in which operation theatres and by which surgeons. There were discussions (these seemed to be recurrent) about the degree to which such things as operations *can* be planned in detail when it comes to timing, how many operations one surgeon can do or be up for at once (in case the first one took longer than expected), and for how many hours. Then we all filed out and headed for the radiology demonstration room. This room was organised as a lecture room where everyone faced the screens at the front. In a few minutes, the room was filled up and almost crowded. People were standing along the side and in the back. It seemed that most doctors felt that this was something they couldn't miss – and therefore turned up even if according to the new organisation, they were not obliged to.

At one side, on a small podium, a radiologist was seated in front of a workstation with a set of screens. She selected, interpreted and explained the images using the marker on the screen, and this was then projected onto the large screen. She juxtaposed and compared

images, and measured changes and differences. There were images that patients had brought from other hospitals, the department's own images made during the weekend, pre-operation images and post-operation images, and control-images made 2, 6 or 12 hours after an operation. In this way, the doctors could follow and debate each case, and also debate the results of their own and colleagues' work -- as well as their collective reasoning in relation to particular cases. They discussed the effects of particular interventions and therapies, the success of particular operations -- and the failure of others. The case where one patient had died was for instance also demonstrated and debated. In this case, images had been made repeatedly both before and after intervention during the night that was so critical, and after which the patient then eventually died.

From information as collected to information as collective and embodied

What I want to point out and argue here, is, first, the collective character of information and information use, and the collective basis upon which other more individualised forms and situations of information use rest. The argument is that to see, and be able to understand, interpret and evaluate medical images and the conditions and surgical interventions they enact, not only has to be learned, but also relies upon the collective arrangement and institutionalisation of the setting for learning; the sustained collective gathering for this meeting; and the collective exchanges and discussions in it.

So information is collective, and distributed. This has already been demonstrated on several occasions in this paper. But it is also recognised and implicit in the plans and visions for IT in health care. Indeed, one could say that it is the collective character of medical information that electronic systems for documenting and communicating information are

meant to enhance in the first instance. And yet there is a difference. In IT plans and programmes it is treated as a matter of collecting and centralising information, and, again, making and regulating information flow, rather than as a 'truly' collective matter. One way of putting it is that the IT plans recognise the distributed and *collected* nature of information in medical practice rather than its *collective* nature and basis. The difference is that information as collected can be routed out to individuals as if it was a matter of transferring money – whereas information as collective cannot. The radiology meeting is not simply an information meeting, or even a demonstration meeting, where information elements are passed on in a unidirectional transfer from A to B. On the contrary, it is preconditioned upon a different kind of sharing and fluid flow that runs through, shapes and reshapes people's eyes and bodies: what they see, how they see it and think about it, as well as how they intervene in other bodies. As such this form of collective information and shared learning becomes embodied.[32] But it also becomes embedded in knowing and decision-making as emergent process: debating the instances and treatments of particular conditions in such a collective forum both builds a basis for and makes part of reasoning and decision-making in particular cases.[33]

Of course there are also situations where medical information is simply collected and used by individual doctors – as when the doctor prepares for the consultation in the outpatient clinic. But it can also be argued that even these situations and uses of information rest and draw upon more collective information practices, including radiology meetings, other meetings focussed on specific conditions, interdepartmental meetings on specific patients, knocking a colleague's door to seek a second opinion, and exchanges with patients in the actual clinical situation.[34]

The second point I want to make here is about the embodied, material, mediated and even fluid character of information and information use that the above story from the radiology meeting demonstrates. This certainly builds a different image of information use,

sharing and flow to the one implied in and by the trope of electronic flow. What we see here is neither uninterrupted, unimpeded, frictionless nor smooth flow. Yes, there *is* information flow, but it is inescapably embodied and material, and so much more tardy and slow-moving. And running through bodies and other materials, even becoming embodied in practices, it also becomes obvious that information does not simply pass through the medium untransformed but changes with these learning actors and bodies and the collective discussions, interpretations and practices they are involved in. What we have here is therefore also a version of fluid flow.

Arranging for and making this kind of fluid flow is a different kind of achievement to that of making pieces of textual information flow through electronic cables. For information, knowledge or knowing to become a naturalised part of bodily practice, even practices that involve many and interacting bodies and actors including machines and instruments, and for this practice to flow, a different process and set of conditions have to be in place. And this includes the participation in institutionalised settings and situations for collective learning and knowing such as the radiology meeting.

The same goes for what it takes to become able to mobilise and use collective modes of information and information use in individualised settings. This is also conditioned upon a different process and set of arrangements to that of making information flow electronically.

This also helps make sense of the incident described earlier where I was thrown out from a pre-round meeting. Whatever else was on the agenda of the doctor who objected to my presence there, he later expressed strong concerns about the reorganisation of meetings in the clinic and implications for the conditions for collective learning and sharing of knowledge. So perhaps he was picking a fight not so much with the IT researcher as with the management that imposes a new order (and this new order included IT as well as me as an IT researcher) with extensive consequences for medical practice, without consulting the medical staff or

listening to their concerns about how the IT programs and systems might interfere with the conditions for their work. Similarly, the other commentary about information that does not flow can be interpreted as a statement about the non-reducibility of information in medical practice to bits of textual information that can be passed on as a commodity, or to a resource that can be treated as simple input or output of a production process.

Conclusion

The descriptions of medical practice have shown examples of information sharing, use and flow that are quite different to how information sharing, use and flow is imagined in IT plans and visions. First they showed that electronic information flow rests upon other information technologies and flows; involve a lot of work and effort; and also creates new and additional work. Secondly, it was showed that information in medical practice is variable, materially heterogeneous, collective, context-sensitive as well as context-dependent, indefinite as well as definite, and emergent, processual and fluid. The model of information in IT plans however assumes that information can and should be precise, well-defined, without gaps, relevant, easily transportable and context-independent. When juxtaposed and compared with practice, this model turns out to be very narrow and rigid as to what should count as information; what the proper form of information is; and what paths it should take.

Based on these findings I have argued that the implementation of IT built on this model of information first excludes large parts of the information practices and processes in medical work, secondly adds to the dependence upon other forms of information, and information flow and sharing, and, third, creates extra work. This is also aptly demonstrated by the fact that in practice the morning radiology meeting proceeds as before, with just as

many doctors present, despite the fact that the reorganisation should have relieved most of them from this duty. They realise that they cannot miss it. But it has become extra work.

A set of implications for prospective design and development of IT can be drawn from this. First, one has to think of IT in health care, and electronic patient records in particular, not as replacements but additional channels for and modes of ordering information and information flow, which interfere with existing ones in complex ways (and not just in negative ways!). Secondly, the dependence on and even proliferation of alternative information flows and practices, and the extra work that is created, is one possible effect of such interactions and interferences – but it is neither necessary nor the only one that is possible. Third, design and development need to become concerned also with what is othered and excluded by the new IT tools and systems, and not only with how to order networks and enable flow. Fourth, the notion of 'information' informing IT plans and systems needs to be broadened and become both more generous and modest. What will count as information in a particular context is open, variable and unpredictable. Information is sometimes indefinite. It is emergent, in process, fluid and therefore also incomplete. Fifth, IT plans and systems accordingly need to move from information flow to fluidity, or fluid flow, as their guiding metaphors.

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Notes

[1] From a report to EUs minister conference on "The Contribution of ICT to Health", May 2003. As quoted from *S@mspill 2007: Electronic cooperation in the health- and social sector*, p. 4. The Norwegian word 'Samspill' means 'interaction' or 'interplay'.
[2] *S@mspill 2007*, p. 12.
[3] The literatures on ICT and its cultural, social and organisational effects, even in terms of creating a new social and cultural condition characterised by flow, or flux, are huge. For some recent samples, see Baudrillard (1994, 1996), Bauman (2000), Urry (2000), Castells (1996, 2000a, 2000b, 2004), Hylland Eriksen (2001) and Lundby (2003).
[4] One of the most famous proponents for Business Process Reengineering is Michael Hammer. His message of radical redesign of business processes – "don't automate, obliterate!" – has been very influential (1995). Although the wave of business process redesign left many disappointed adherents in its wake, the ideas still live on. In the somewhat modified current version, focussing on 'process (re)modelling', it is also deployed for instance within health care and, not least, IT policy in health care. See for instance Hammer and Champy (1995), but also Hammer (1996), and for a more critical evaluation of the uptake of BPR in Norway, Moltu et al (2000).
[5] This is also a fast growing body of work. But see for instance Strathern (2000), du Gay (2000), Ramsdal and Skorstad (2004), and Olsen (1989).
[6] The hospital in question has been developing and implementing clinical information systems and in particular an electronic patient record (EPR) since 1996. But even though electronic production and exchange of patient related information has been pursued for several years, it is still only partial. It has been slower than expected and one operates with 'hybrid solutions' (paper record plus electronic record), as well as a portfolio of specialised clinical IT systems e.g. for laboratory test results and radiological images. The current strategy is to develop a portal to integrate these heterogeneous systems. The data collection for this case study has been conducted over a period of one year, and is still ongoing (2004). I started out by following the implementation of the scanning project and the uses of external and internal referral letters in three departments, namely neurosurgery, the medical outpatient clinic and a lipid clinic, but have later turned to investigating information practices and uses more broadly. The approach to methods and sources of data is multiple, and includes fieldwork, interviewing and documentary sources and methods.
[7] In these bodies of work I would like to mention in particular Berg (1997a, 1997b, 1998, 2000), Bowker and Star (1999), Bratteteig and Gregory (1999), Gregory (2000), Heath and Luff (1996), Markussen and Olesen (2003), Neumann and Star (1995), Star (1991a, 1991b, 1992, 2002), Timmermans and Berg (1997), Timmermans, Bowker and Star (1998), Suchman (1987, 1999, 2000), Aanestad (2003) and Aanestad and Hanseth (2000).
[8] The reference here is to Star (1991b, 1995).
[9] The concept of 'articulation' was introduced and developed in the field of CSCW in Schmidt and Bannon (1992), and further elaborated for instance in Suchman (1996).
[10] The argument that social practices and collectives are conditioned upon and made possible by carefully ordered and ordering material arrangements, in which heterogeneous actors and elements become attached through interaction, is developed in STS by Akrich and Latour (1992), Law (1987, 1994), Callon and Law (1995, 1997), and Callon and Rabeharisoa (2004). It draws again on the work of Michel Foucault, and in particular his concept of 'dispositif' (1976, 1981).
[11] See for instance Callon, M. (1986).
[12] The portal project is a strategy to integrate existing local systems, and is built on an iterative design philosophy. See endnote 6 for more on the current situation with respect to information systems in the hospital I studied.
[13] Star (1991a, 1995) has developed the notions of 'membership' and 'naturalisation' for investigating the processes in which people become introduced to and learn to handle and use new tools and technologies.
[14] For an inspiring example of the contrary, namely an ethnomethodologically inspired study of the production and the uses of patient record information in General Practice, see Heath and Luff (1996).
[15] This is of course a lesson to be learned from the attempts to make paperless offices. But the ideas live on, despite numerous studies demonstrating that the idea that a new technology simply replaces an older one does not fit with practice. Instead, new technologies seem to enter a broader ecology of information and communication practices. See Suchman (1999), Sørensen (2002) and Moser (1998).
[16] The reference here is to Cowan (1983) and her historical work demonstrating the irony that technologies for the household, assumed to save time for women and wives or even housewives to care for their husbands and children, made more rather than less work.

[17] In *S@mspill 2007* it is put like this: "We have only to a small degree made the changes in organisation and work processes that are required to realise the possibilities IT-solutions offer." (p. 4).
[18] The references here are to Law (1994), Mol and Law (1996), Mol and Mesman (1996), Law and Moser (1999), Mol (2003), Berg (2000) and Timmermans and Berg (1997). For a parallel study in the context of disability, and of disabled people's uses of technologies, see Moser (2003).
[19] The notion of 'mode of ordering' is developed in Law (1994). It treats social ordering as a verb rather than a noun, as ongoing, precarious, recurring ordering, stresses the material heterogeneity of ordering work, as well as its multiplicity. It is also developed further in Mol (2003).
[20] This approach would also be symmetrical in that it takes the objections of health personnel, including doctors, as seriously as the positions of IT designers, and in that it does not collude with IT visions in making these actors come out as irrational and inflexible in relation to the new IT programmes.
[21] For a critical discussion of the notion of information in information systems design and developments, see Boland (1987). The argument here is that meaningful use of information implies a formation in and of the subject, that is 'in-formation'.
[22] For a discussion of the position and role of the medical doctor in hospital practice as a obligatory point of passage and a centre of calculation, in which information is collected and need to be reconciled, see Moreira (2001).
[23] For a critique of the idea of the possibility of perfect information, see Boland (1987).
[24] This is developed further in an argument about information in medical decision making in Law and Moser (2004).
[25] See Berg and Goorman (1999).
[26] Again this is developed further in Moser and Law (2004).
[27] The argument draws on Garfinkel (1967) and Heath and Luff (1996).
[28] For a counter-argument about the usefulness of the kind of information that is here labelled imprecise, lacking and irrelevant, see again Heath and Luff (1996) and Garfinkel (1967).
[29] The reference here is to Latour (1986).
[30] See Mol and Law (1996).
[31] See De Laet and Mol (2000).
[32] For the literatures on 'tacit knowledge', see for instance Knorr-Cetina (1981). For an embodied version of this argument, see Heath (2005).
[33] For a different but related version of this argument see, again, Boland (1987).
[34] The argument is, again, drawing on Heath and Luff (1996).