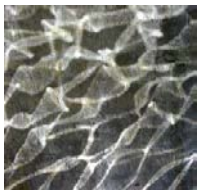

Fluids or flows? Information and qualculation in medical practice

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Abstract

Purpose – Seeks to explore the assumptions and limitations of current programmes for the creation of electronic patient records by comparing ICT programme statements with hospital uses of information.

Design/methodology/approach – Compares qualitative data from medical ICT programmes statements with data from ethnographic studies of hospital decision making. Uses actor-network theory to develop a performative definition of information as that which secures a decision or "qualculation", whether in the form of calculation or judgement.

Findings – Shows that decision making depends on a mix of formal and informal considerations that are, however, always restricted in scope and number. Shows that some of these are locally and organisationally contingent.

Research limitations/implications – The ethnographic findings illustrate the character of information rather than offering data about the character of decisions in different clinical locations.

Practical implications – Caution is needed in the face of claims about ICT programmes in health care. It is possible to anticipate neither all the uses of information nor what wi ll count as information in advance.

Originality/value – The paper develops a performative definition of information. This is whatever secures a decision in practice. Information thus reflects a situated process of simplification and bounding of relevancies. This suggests that information not only flows (which is assumed in ICT programme statements) but also is fluid, unpredictably changing its form and character. This claim is relevant both to the design and use of ICT in health care and to the theory of information.

Keywords Medical practice, Information research, Information theory, Decision making, Complexity theory

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Introduction

Health informatics is exceedingly complex. And it is also a hot topic. In most industrialised countries there are huge programmes of ICT investment in health services, and Norway and the UK, our own countries, are no exception. The starting point is that information is poorly mobilised and difficult to retrieve. This, it is said, impedes both clinical judgement and effective health care management[1]:

> Better care for patients, and improved health for everyone depend on the availability of good information, accessible, when and where it is needed.

This statement, which comes from the UK National Health Service Information Authority, echoes many others. At the same time there are dissenting voices that point to failed ICT investments (both within and beyond the health care system) and to supposed inefficiencies that occur when ICT is insufficiently flexible. Sceptics within health care practice itself also worry that clinical judgements are eroded – even undermined – by inappropriate information systems.

In this paper, we approach these debates, and the issue of complex information systems, obliquely. Our focus is on information and information flow. The large ICT programmes in health care seek to make information flow in ways that are predictable and seamless. Unpredictability or turbulence are seen as problems. But here is the rub: unpredictability cannot be banished from health care. Clinical decision making is often, perhaps almost always, unpredictable. So what does this tell us about information? Our response is that to think this well we need to move from talking about "information flow" to more complex and "fluid" understandings of the character of information.

To make this argument we start by exploring recent work in science and technology studies (STS), and especially actor-network theory (ANT). STS and ANT have always been concerned with complexity in practice. In part they have explored how organisations that are heterogeneous and dispersed come to achieve a degree of order, albeit messy or incomplete. Indeed, some of this work has attended to ICTs and their role and character in organisations, and there are well-known studies in health informatics that build upon and extend these approaches. However, over the last ten years, there has been a shift within STS towards so-called "after ANT". The latter is of particular interest to us in the present context. This is partly because in "after ANT" the attention to complexity has become even more marked. It is also because the way of thinking about complexity has changed, and become, dare we say it, even more complex. To put it briefly, much earlier ANT work is relatively functionalist and indeed, sometimes, managerialist in tone. On occasion, it has become caught up in and used within ICT programmes themselves to justify optimistic – one might say overoptimistic – technological scenarios. By contrast, in "after ANT", the extent to which it is assumed that functional coordination can or should be achieved is open to doubt. As we will show below, some of the assumptions of early ANT appear quite hubristic from this new perspective.

Though there are exemplary studies that develop this "after ANT" approach within ICT research, the extent to which it has been adopted in practice is quite limited[2]. This is the context in which we introduce the aspirations of a major Norwegian healthcare informatics programme, "S@mspill" ("Te@mwork"). We show that this implies a particular model for information, information flow, and the proper use of information. Using an "after ANT" approach, we argue that this in turn implies a particular and

unrealistic understanding of health care decision making and clinical practice. We suggest that the programme takes uncertainty to be a (perhaps unavoidable) technical matter of insufficient information. By contrast, we argue that information flow and use in many medical practices (for instance in conversations, telephone calls and meetings) does not fit this model. To do this we use Norwegian empirical materials collected in a case study of clinical decision making in the context of implementation of electronic patient records[3]. We frame the argument in two ways. First we distinguish between information flow and the fluidity of information, and suggest that it is necessary to come to terms with the latter as well as the former in work on information and ICT systems. Second, we talk of "qualculation", a term whose significance we will explain below, which allows us a way of thinking about the variable role of information in circumstances of both formal calculation and (for instance) clinical judgement. Unless information systems are able to handle both of these together with their instabilities, they will, or so we argue, fail in practice.

STS, ANT and multiplicity

As we have indicated above, STS has always been concerned with the complex and heterogeneous relations between science, technology and society. Though there are many different theoretical approaches within this field, these may for certain purposes be grouped into two. In one (SCOT, the social construction of technology and SSK, the sociology of scientific knowledge) society is seen to shape technologies and scientific knowledges[4]. In this family of approaches the search is for social factors (for instance economic or gender relations) that might shape or distort knowledges and technologies. In this way of thinking it is the social or the human that is taken to be creative and generative. Implicitly, then, for most writers in this tradition, in the first instance the social is taken for granted. It becomes a more or less stable backcloth that helps to explain technological or scientific change.

The second approach is different because it does not privilege the social in this way in the first instance. Indeed, it does not distinguish – at least in principle – between society on the one hand and technology or scientific knowledge on the other. Instead, all of these are seen as being expressions of materially and discursively heterogeneous relations. The unit of analysis is thus relations, or perhaps the heterogeneous practices which carry and produce relations. Relations are seen to be continuous. There is no clear dividing line, at least in principle, between the technological, the social, or indeed the human. If we speak of the human, or of a technology, then this is an effect of the processes that express and produce relations. Specific devices, social roles, or social relations, are expressions of what is sometimes said to be a "seamless web". This means that the second approach also differs from SCOT in its understanding of creativity. This is not located within society or people, but rather in the web of heterogeneous practices and relations that simultaneously produce the social, the technological, the material, the embodied, the cognitive and the human.

Since it is about both material and discursive relations, it is convenient to follow feminist technoscience writer Donna Haraway, and describe the approach as a form of "material semiotics". This is because it is concerned with logics, rationales, discourses or strategies that are taken to underpin, be carried in, and reproduced by materially heterogeneous networks, organisations, structures or practices. It is also because it

insists that these are contingent and continuing processes. “Ordering” is never finished. It is a verb (or a gerund), rather than a noun.

At this point it becomes useful to distinguish between two major variants of this material semiotics. First, there is ANT, which is well known for its “network” analyses of relational materiality and its concern with “ordering”, and treats power as productive. Second, there are feminist technoscience studies, where the explorations of ordering are usually more explicitly concerned with domination and the situated character of knowledge production, including their own[5].

Our approach to ICTs in health care is informed by the material semiotics of both ANT and feminism. Our focus is on how relations get done in particular locations, and the heterogeneous effects of those relations, including information, organisational structures, and human decision making. What clues does ANT offer us? As we suggested in the introduction, in its early versions ANT is sometimes misleading: it is too easily read as, and indeed worryingly close to, a materially heterogeneous version of managerialism. In this early work relations are often taken to be centred and susceptible to a single order or a single set of ordering principles[6]. Later versions of ANT have responded to feminist critiques of their apparent managerialism and their insensitivity to power, and they are much more complex[7]. Ordering is now more often seen as multiple and therefore complex. For instance, organisations are not seen as single heterogeneous networks, but rather as different sets of relations that are local, contingent, and endlessly variable. A range of modes of ordering are enacted, and they interact together to make complexities that are themselves contingent, local, and in some cases downright messy[8].

The move to multiplicity has been matched by the creation of new theoretical tools for handling complex orderings. These include metaphors of fluidity and flow. For instance, in the earlier versions of ANT it was sometimes assumed that relations were ordered in part through the circulation and flow of “immutable mobiles”. An immutable mobile is something that moves around and also holds its shape. Orders, machines, ships, charts, money, texts, or information – these are examples of possible immutable mobiles that circulate. They help to hold networks in place but they also depend upon those networks. In later versions of ANT the focus has changed. Objects and texts still circulate. But (this is the crucial difference) they also change their shape as they move. Indeed, it has been argued, more strongly, that such shape-shifting is necessary to movement: that even the most rigid-seeming objects need to adapt themselves to local circumstances[9]. In short, they are at least often better understood as mutable mobiles. The relevance of this for information is obvious. Does the latter hold its shape as it flows through an organisation, or does it change its shape? Does it simply flow, or is it fluid in form as well? The “after ANT” intuition is clear: that which flows also is also likely to be fluid. It is likely to change its shape. In short, information needs to change its shape and re-form itself as it moves around.

It is possible to develop this point by thinking about the supposed difference between calculation on the one hand and judgement on the other. Conventionally, these are often distinguished from one another and said to be different in kind. Calculation is taken to be mechanical and algorithmic in form. The implication is that it demands information that is relatively clear and codified, information that holds its shape, and information that flows like an immutable mobile. In this respect, then, calculation is distinguished from judgment. The latter is seen in part as an art form. It uses

information that is partly tacit and context-sensitive – information that is therefore variable or fluid in form. Such is the conventional distinction, and no doubt it catches something important. But against this, we want to argue that judgement and calculation also have much in common. This is because each makes relations between elements that are materially heterogeneous and different in kind. Each needs to simplify those heterogeneities and order – perhaps homogenise – them. Each, therefore, works by setting limits to what will count as "information". Each does this by setting boundaries to what is taken to be important and what is not. In short, we are arguing that judgement and calculation both work by arraying and manipulating entities within a single spatio-temporal frame. In this way they achieve what we will call qualculability[10]. But notice what we have done in bringing these together. We have implied that even in calculation, the frame and its boundary-making are variable. In short, we are arguing that even in calculation information does not simply flow but is also fluid. And this is the take-home point of our paper.

What does this tell us about ICT programmes? To put it no higher, it suggests that we need to maintain a healthy degree of scepticism when we stumble across extravagant programme claims by ICT protagonists. Like a number of other writers, we therefore argue that it is quite impossible to create ICT systems that will work in all contexts. It is hubris to imagine that it is possible to anticipate all information needs and information uses[11]. In other words, what we are calling qualculation, whether in the form of calculation or judgement, demands not just information flow but also information fluidity. This is the claim that we seek to substantiate in what follows.

Information and information use in/according to ICT policy

The following quotation comes from the Norwegian programme plan for ICT in healthcare:

> We wish for a society in which good health and social security are ensured for the whole population. The health and social sector continually face new challenges in ensuring that these values are met. Examples of such challenges are ensuring a comprehensive supply of services in a period with increasing specialization, and maintenance of adequate welfare services when state and municipal budgets are tight.
>
> How can the challenges be met? A comprehensive focus on the priority areas of information and computing technology (ICT) is regarded by many as the most effective measure for improving quality and effectiveness in the health and social sector.

The document goes on to cite what it describes as "the strong political emphasis given to this area internationally" by citing the view of the ministers of health in the EU countries:

> eHealth is the single most important revolution in health care since the advent of modern medicines, vaccines, or even public health measures like sanitation and clean water[12].

No elaborate commentary is needed here. We simply cite this as an example of the way in which the importance of ICT is emphasised in, indeed treated as crucial to, the future of health care (and other related state functions). To a surprising degree, it appears that ICT is being treated as the key to future health care. Similarly programmatic claims are to be found in the ICT initiatives in other countries, for instance, the UK:

> 1.1 [ ] Better care for patients, and improved health for everyone depend on the availability of good information, accessible, when and where it is needed.
> 1.2 The purpose of this information strategy is to ensure that information is used to help patients receive the best possible care. The strategy will enable NHS professionals to have the information they need both to provide that care and to play their part in improving the public's health. The strategy also aims to ensure that patients, carers and the public have the information necessary to make decisions about their own treatment and care, and to influence the shape of health services generally.
> 1.3 To achieve these objectives, the strategy commits to:
> - lifelong electronic health records for every person in the country
> - round-the-clock on-line access to patient records and information about best clinical practice, for all NHS clinicians
> - genuinely seamless care for patients through GPs, hospitals and community services sharing information across the NHS information highway
> - fast and convenient public access to information and care through on-line information services and telemedicine
> - the effective use of NHS resources by providing health planners and managers with the information they need[13].

If we take these claims seriously, then we are being told that ICT is the solution that will combine expertise with the efficiency that is needed in an era of limited resources and exploding health-care budgets. So what should we make of these claims?

First, though they sound very general, we need to hold on to the fact that they come from somewhere specific. They are the product, or the expression, of political, technological, and policy circumstances. It is (or so it seems) necessary to sound Utopian in these circumstances, to sound rather general. This means that it is tempting to dismiss them as a form of extravagance. But even if we do this (and perhaps we should) this is also a little too simple. And this is because these rhetorics are performative: that is, they have real consequences. In particular, they help to bring (possibly unrealistic) ICT futures into being in health care. And they are associated (let us not forget) with the expenditure of vast sums of public money.

So, such rhetorics matter even if they are situated and local. But how do they matter? What, in these visions, will ICT actually do? The answer is that it will foster the flow of high quality information. Here we are, back in Norway:

> An increasing proportion of elderly people in the population, increased specialization, distribution of functions and free choice of hospitals, increase the need for cooperation between specialist health services and municipal health services. Because of the developments, it is important and necessary to exploit the potential provided by ICT in order to ensure free flow of information and good interaction in the health and social sector[14].

But what counts as information in these plans? The Norwegian document continues:

> Cooperation within the health and social sector today is hampered by a flow of information that is far from satisfactory. Information is often not available where it is needed, when it is needed and in the right form. Information is exchanged in ways that are time-consuming and/or insecure. Information goes along channels that are not continuous, some of them paper-based, others electronic, often using different electronic applications. This means that information may accumulate along the way, for example if it needs to be printed out on paper

> and put in an envelope. In addition, the quality of information is often not good enough. It can be imprecise, incomplete and irrelevant and can lie around in different organizations or within an organization.
> Efforts need to be made to improve the flow of information in the health and social sector. Well-defined and appropriate information must be the basis. It must be possible to send information along secure and speedy channels that have sufficient capacity. Generally, information must be handled in a sound way at all stages. Within large organizations such as hospitals, collecting information from patient records in one place, in a format that makes it easy to find, update and send further, presents a challenge. Electronic patient records (EPR) must be developed to solve these problems[15].

So what is information? There is a vision here. This will be "well-defined","appropriate" moving "along secure and speedy channels". It won't be "imprecise", or"incomplete". Neither will it "lie around" inefficiently, but it will appear instead "whereit is needed", "when it is needed" and in the "right form". Such is the aspiration, thehope, or perhaps the dream. There will be precise information, integrated circuitswithout noise.

This image of information is scarcely new. It fits the imaginary of undistortedcommunication – information that moves without being corrupted. As we notedearlier, in ANT this possibility is sometimes called the "immutable mobile": the objector the signal that holds its shape as it moves through a network designed precisely tohelp it to hold its shape[16]. But if this is achieved, the STS literatures add, then thistakes work, and especially invisible work. Immutability depends on effort that tends toget deleted[17]. So this is our interest: in the invisible work implied in seeminglyeffortless information flow.

More data from Norway:

> The patient record is the core in the flow of information in the health service. It is here that all information is gathered from those who have an obligation to provide documentation. When production and dispatch of information from patient records becomes digitalized, this core will need to be well integrated. The immediate gains of introducing electronic patient records (EPR) are clear and perhaps particularly visible in general practitioner services so far. Routine work, such as writing prescriptions and issuing medical certificates, is done more quickly, the record is more easily readable and complete, and last but not least, physicians find the patient record when they need it[18].

We cite this for the further light that it sheds on the character of information in thisparticular Utopian vision. Information is imagined as textual and symbolic. Doctorsuse records. How exactly those records are used, though important, tends to become asecondary matter. And the possibility that information might come in other materialforms has disappeared.

Similarly, information is, or at least can be made, context-independent. Thus theNorwegian document proposes:

> The main objective for further coordinated development will be that:
>
> - EPR shall represent the whole continuity of patient care
> - EPR shall support interaction through exchange of electronic messages and sharing of information
> - It shall be possible to retrieve and adapt EPR information for planning, leadership, research and quality improvement

- It shall be possible for EPR to aid decision-making for health personnel through quality control of procedures, integration of clinical guidelines and access to current legislation[19].

Again we see the aspiration to immutable mobility. Information may, or at least shouldbe, moved between contexts and still hold its shape. It should be possible to use it, too,in all those different contexts.

The picture, here, is clear. In this way of thinking the problems of the health caresystem can be substantially addressed if only information can be persuaded to flowproperly. Information needs to be clear, definite, specified and defined. This impliesthat it needs to be textual and symbolic. Information flow needs to be seamless andintegrated. The implication is that information needs to be context-independent. Itneeds to be usable and re-usable, putatively staying the same and holding steady in arange of different contexts that include patient care, planning, research, and financialmanagement.

So much for the aspirations. But what of information in practice? We turn now toour ethnographic stories.

Information use and decision making in clinical practice

> One morning I was sitting with the secretaries in the neurosurgery admissions office. There was anxiety and some agitation about a request that had come late in the afternoon the day before, and again early in the morning. The question was how to handle it. Formally, it wasn't an emergency case: there was no referral in the form of an official letter, fax or telephone call. And then again it might indeed be an emergency. There had been repeated phone calls from a desperate husband asking whether they had received a referral letter about his wife. She had been examined for a suspected brain tumour, but the local hospital could find no signs of it. However, the symptoms had persisted, so they had gone to a private radiological centre. And the images made there suggested the possibility of a tumour. Now they wanted a specialist hospital to admit her. Would it do so?
>
> So here was the problem for the secretaries. How to help these distressed people? How to get the case evaluated and a decision about it made? How to decide whether she should be admitted? What priority should her case have?
>
> They started by asking for the images. Without these the doctors could not make any evaluation. And they needed the referral letter too. Both arrived in the course of the morning. But how to get them evaluated? The secretaries had been discussing this over the coffee, in the corridors and with passers-by in their offices. The problem was that half of the doctors were away at a meeting, and the relevant surgeon was also away. So who could they ask to step in and make a decision? Who was in the same field, or at least close to it? And who was on duty, or expected to come on the next shift? And who was busy operating, and not? And then there were "personal" questions too: they were worried that when the surgeon returned he would pick a fight about what had happened. Who would be willing to stand up to him?

So what does this tell us about information? The Utopian stories about ICT and its usesseem somewhat beside the point here. Yes, there is a referral letter and there are someimages. But these form only a small part of the relevant "information". This, as isobvious, is heterogeneous. It also includes organisational exigencies, the peculiaritiesof a day when half the doctors were absent, informal knowledge about individuals andworking practices, together with a sense both of the distress and the urgency for thepatient and her husband. This is heterogeneity at work. What is important here iscontext-sensitive, if not context-dependent. What counts as information is a function of

a particular set of circumstances, and those circumstances are particular, possibly even quite unusual. To put it another way, what counts as information is variable: it shifts from situation to situation. Indeed, it shifts from situation to situation within what might be thought to be stable contexts – the operating theatre, or the general practitioner's surgery. But if this is right, then it poses the question: how would one know beforehand, and outside the particular unfolding circumstances, what would count as the appropriate information?:

> When the referral letter and the images arrived, the secretaries consulted the working lists and rang up possible surgeons. Two said they wouldn't take the case on. A third agreed. One of the secretaries ran down the stairs with the documents. But still the patient's husband was ringing in. The secretaries were sympathetic, but they couldn't give him substantive information. This had to go through the GP. The desperate husband contacted the patient ombudsman. The secretaries had his office on the line too, and found themselves defending the hospital's policy of not giving medical information over the phone.

This continues the story, and it can be used to make the same argument: relevant information is context-dependent, and that context is heterogeneous. But note, too, that it is materially heterogeneous. Images, letters, conversations, phone calls, physical movements through the hospital, all of these carry information relevant to the story, and relevant to the clinical decision-making. The question is obvious: how might such information be related to, or included in, an electronic patient record?:

> Later the same afternoon, the surgeon came to the secretaries' office to collect his mail. He said that he had looked at the GP's notes and the images, but now he wanted to discuss the case with a colleague. He wanted a second opinion, but he couldn't get this yet: his colleague was still operating. The outcome? Next morning they decided that it was not an emergency and the patient should not be admitted. Instead, she should be called to the outpatient clinic for more tests. Then depending on the results and discussion at the daily meeting of radiologists, neurosurgeons and anaesthetists, they would come to a final decision.

This is a third episode in this story that lets us make a further crucial point: information in medical decision making is distributed and collective in a wide sense of the word. It is, of course, distributed across time and space. This is precisely one of the issues that the ICT visions are intended to address: decisions take place in different places and different times, and often involve many different kinds of people. The vision is that the information to support those decisions can be collected and centralised in the EPR, but our sequence of stories raises questions about this aspiration[20]. It is clear that parts of what we have been describing could, and no doubt should, form part of an EPR. But others that appear to be equally important seem to resist this hope. This is because, and here we follow a line of argument that has been well articulated within ICT research on health, information is distributed between different kinds of actors, elements, arrangements and contexts[21].

The ICT visions we are talking about appreciate that decisions are made in different places by different people. Indeed, it is the difficulties that follow from this distribution across time and space that they are intended to solve. But the manner in which decision making is distributed across different kinds of actors and elements is more difficult to fit with the ICT vision, because it tends to delete many aspects of the social and material processes involved in contributing to and using information:

> Another incident from the same department. A neurosurgeon had seen a patient in the outpatient 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 looked up the results on his computer by logging onto the radiology information system (RIS – this stores textual reports from radiological examinations) and searching out the results from the tests he had requested. Luckily, it was good news: there were no traces and no signs of recurring or new developments of tumours. The patient was sent home. Weeks later, however, the patient was readmitted to the local hospital and notice was also given to our surgeon. He was baffled. As it happened, he got the news, or read the letter, in the secretaries' office, and he told one of the secretaries about it. She surprised him even more with her comment: "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. "But I didn't know, and I wasn't told!" the doctor exclaimed. It turned out that he had been looking at a provisional test result in the radiology information system (RIS). But the radiologist in charge had taken a second look and had had second thoughts. He'd changed his mind before signing and closing the case. He had concluded that there was indeed suspicion of a recurrent tumour. But when the paper version of the test result finally came to the department, it was dealt with and signed by another doctor in our doctor's absence.

This story is also about immutable mobiles. But are things that move around immutable if there is enough invisible work? As we hinted in the Introduction, the answer from "after ANT" is no, not necessarily. Things that move may also change. Sometimes this is a problem because the code, the information is being corrupted or degraded. But sometimes the STS stories suggest that this is not the case. Instead it is the capacity or the propensity to change shape that makes movement possible in the first place: the possibility of mutable mobiles[22]. Our story illustrates this only partially. It can be argued that if the results had been confirmed then the mistake would not have occurred. This is right but it also disguises what we think is the larger or more fundamental problem. Information is always incomplete. It is always in process. It is always dependent on what has preceded it, and what is about to come. And what precedes it, and what is about to happen is always changing too, in principle. Mutability is the order of things. Or, to put it in another register, that of ethnomethodology, it is indexical (context-dependent), and that indexicality is "repaired" – that is, coped with and resolved for the moment – reflexively, that is, in relation to a changing context which includes what has just happened and what might be about to unfold. "Good organisational reasons for bad clinical records", the title of Harold Garfinkel's paper, caught the logic here more than 40 years ago[23].

Medical decision making as qualculation

We've made a contrast here, between the utopics of the large-scale ICT plans on the one hand, and the rather complex and situated realities of medical decision making and practice on the other. We have also chosen our stories because they index what we take to be common features of such practices. But now we want to turn to the specifics of "decision making" and the ways in which information is used in such decision making. Once again we work through illustrative examples. The first has to do with heart transplantation.

What is the information that goes into the process of matching potential recipients and donor organs for transplantation? Miria Grisot, who did fieldwork and interviews for a study of co-ordination and information-sharing in the interdisciplinary and distributed team responsible for heart transplants, says that when decisions are being made, they are made on the basis of very limited information. In fact, this can be – it is – fitted into four lines in the waiting list for heart transplants. It seems that this is all that is needed[24]:

> When the surgeon on call checks to find which patient is a possible recipient for an available heart, and if they should proceed with the process of harvesting and transplanting it, it is usually only the waiting list that is consulted. This consists of a paper printout containing all the necessary data on patients. It is updated on a weekly basis as patients need to be closely monitored during the waiting period. The first part lists "active patients" and the second lists patients that have been temporarily withdrawn from the active list, for instance because of an infection or a general deterioration of their condition. Furthermore, the information content is also structured in a way that can be consulted quickly. The data for each patient is coded and displayed on only four lines, which contain information on five areas including patient ID; cardiological clinical information (including diagnosis, Pulmonary Vascular Resistance, earlier thoracic or transplantation surgery, height and weight); immunology information (including ABO blood type, antibodies, virology, previous transfusions, pregnancies, screenings, last serum); location of the patient; and the patient's contact data (telephone numbers, beeper, and the date the patient was put on the waiting list). The procedure for matching organ and recipient does not take geographical location and distance into account, but considers only clinical values, and in the following hierarchical order: blood type, body size, urgency, waiting time, CMV and HLA matches (immunological values).
>
> Usually this is enough, and it is all there is time to look at. When the surgeon on duty has found a match for an organ in the list, he contacts the patient and asks her or him to follow the pre-set travelling plan and come to the hospital as soon as possible. The maximum time from explantation to implantation for hearts is only four hours, and so the transplant team needs to go to the hospital where the donor is located to harvest the organ, get back, and implant it in the new patient within that time.

Comments. First, note that the information that is needed, or at least used, in these life-and-death circumstances is limited in scope: four lines only. Second, note that this appears to be sufficient. Are the decisions being made poor ones? Would additional information help? Of course we cannot be sure. There might be better ways of deciding whether to implant or not, but in the real circumstances no-one is complaining. It seems to work. Indeed, it ought to work, since the practitioners have been refining how they handle this information for ten years. Three, note that it offers a quick overview. What appears on the list has been prioritised: only the most important factors appear on the list. Everything else is deleted (more on deletion shortly). Four, of course, yes, the circumstances are dramatic: time is of the essence. The decision has to be made in minutes or it will not be made at all. Other decisions may be made under less time-pressure and demand more input. But many less dramatic medical decisions are also made against the clock, and very few can be indefinitely postponed. But these four points are preliminary to our fifth and main point. This is that the story suggests that it is useful to think of information as performative. So what does this mean?

We have already touched upon this above. In analytical philosophy, a word is performative if it is not simply a word but also an action[25]. The classic example is taken from the English marriage ceremony. If a person says "I do" at the appropriate

moment, this utterance performs the act of marriage. It is an act. How might this apply in health care? Our suggestion is that to think of information as performative would be to say that information is what enters into a decision and makes it possible. Something, a set of symbols, a radiograph, a conversation, a pulse rate, comes to count as information because, in one way or another, it acts, is allowed to act, as a factor entering into a decision. "In one way or another", because how it acts, how it "informs" is indeed context-specific. And, to be sure, if it does not count, then in that context, it is not information at all but simply (we might perhaps say) data.

To put it in the language that we introduced at the beginning of this paper, information is material that secures the possibility of qualculability. As we noted earlier, qualculation is a term that both describes what we usually call calculation on the one hand, and the exercise of judgement on the other. It is a way of drawing attention to the fact that the two (which are habitually treated as being different in kind) both become possible – indeed they are only possible – because they array and manipulate appropriate elements within a single relevant frame in order to achieve an outcome or a conclusion[26]. But this implies the performative understanding of "information": in this way of thinking, information is what is present and relevant. This suggestion bears only a partial relation to the definition of information developed in information theory[27], and has little in common with the implicit empiricism that underpins the Utopian discourses found in the programme statements about health informatics: the idea that it is possible to design systems that can exhaustively gather in all possible relevant information and transmit it to every relevant site[28].

The difference between what we are proposing and more standard notions of information may be clearer if we reflect on the commonplace that all decisions are made on the basis of imperfect information. So what does this mean, "imperfect information"? What would "perfect information" look like? No doubt there are various responses to these questions that might lead us, following Herbert Simon, to think about satisficing rather than optimising[29]. Or different versions of satisficing because information might have been better, perhaps more complete. But matters are complicated in other ways too:

> The waiting list draws together, compresses and codes information from a set of sources, actors, departments and labs which is brought together from a pre-transplant evaluation (a very diversified set of examinations and tests) in a particular meeting in the cardiology department called the "heart meeting". This discusses and evaluates the candidate patients for transplantation – after which they are either accepted onto the waiting list or not. The information that is collected and made use of in this meeting includes both paper and electronic patient record, the radiology information system (RIS), the picture archive system (PACS), as well as EchoPac and CardiaCat, the laboratory information system (EROS), information from immunology and pathology, reports from psychological evaluations, and the (illness) history of the patient. But from the moment the patient is placed on the waiting list, this list (almost) replaces the EPR as well as the other sources of information as support for decision making. Further data from control consultations during the waiting period are however fed into the various other sources of data, including the EPR and EROS.

Compare and contrast this story with the four lines of information on each patient on the waiting list. Almost everything that goes into the former has disappeared from those four lines. Perhaps it has been filtered, but something else also has happened. Information has also been brought into being as it has been contracted to those four

lines. Why is this? Again the argument is an old one in STS: when things are "drawn together" (to use Bruno Latour's felicitous phrase) they are simplified[30]. But, and this is the crucial point that we want to make here, they are also juxtaposed in ways that are generative and produce novelty. They are made, and, at the same time, and as part of the same process, they are thrust into a new context. Something is being made that was not there before. To put it differently, what counts as information is (and necessarily) being bounded in a new way. And it this bounding, this simplification, this practical setting of limits, that renders qualculation possible. The decisions of qualculation determine what will perform as information and what will not. And this limit-setting is indeed practical: how the limits are done depends on the task at hand. What is included and excluded, likewise. That is what the bounding is about.

Earlier we talked of a single spatial-temporal frame. Now it becomes clear that the spaces and times involved may be subtle and complex. They shift and unfold as the process of decision making moves on. How they are bounded is also materially heterogeneous. As Garfinkel showed, it is provisional, context-dependent, and reflexive[31]. In a performative theory, information is therefore a materially heterogeneous and iterative achievement. It is partly located in formal records, electronic and otherwise. However, and crucially, it also arises out of informal practices and organisational contingencies of the kind we have discussed above[32].

Discussion

We have argued in this paper that information relevant to health care decision making (but no doubt elsewhere too) is a moveable feast. It shifts and it is context sensitive, even context dependent. We have also argued that in practice it is distributed through a range of different material forms and organisational arrangements – and that in an important sense it is an effect of collective work: it arises out of, and it belongs to a collectivity. It makes little sense to think about information outside these practicalities. In particular, it makes little sense to talk about information except as part of a process. It is done, it enters decisions, and it is redone.

This claim illustrates, and hopefully supports, our further contention that information needs to be understood performatively. Information, we have suggested, is what it is that makes decision making possible. To use the language that we introduced earlier, it is what works to afford the possibility of qualculability. But to say this is to say two things. On the one hand it is to point to what is mobilised and made relevant in the context of a decision. It is also, however, to indicate that the qualculations of decision-making are impossible in the absence of boundaries. Almost everything has to be made irrelevant if the action is to go on. So information (and the design of information systems) is all about boundary-making too. The problem is that the relevant boundaries are always on the move. They are dependent on circumstances, shifting, materially heterogeneous, and all the rest.

This is the context that is needed for our point, and one that we take to be important, about "information flow". This term, and its close analogues, are constantly in circulation in the world of ICTs. We learn from the discourses of informatisation that information is only good if it flows:

> Electronic interaction is decisive in order to ensure the free flow of information that is necessary to achieve this goal [of continuity of care] [33].

But what does it mean "to flow"? And is this the metaphor that we really need? This is what we have argued. We need to talk of fluidity as well as flow. To talk of flow is to evoke an image of a conduit, for instance a highway, a pipeline, or an electronic cable. First you design the conduit. Then, once you have built it, it is available to carry traffic. It transmits vehicles, water, or bytes, which move in one end, and flow out the other. And (this is crucial) in this image their passage does not change them. Flow fails if what is being carried gets corrupted on the journey. Flow, then, is all about the circumstances for generating immutable mobiles: in health care, the immutable mobiles that are needed for medical decision making or "continuity of care".

We have contrasted this with the closely related metaphor of fluidity. Thus in STS, to talk of fluidity is also to talk about change. It is to talk about changes in what it is that is flowing. Understood in this way fluidity is about flow plus change. Or, as we suggested above, it is about mutable rather than immutable mobility[34]. So here is our suggestion. In the materially, organisationally, and socially heterogeneous qualculations that are so important to health care, information does not simply flow. It does not stay stable. It is also, and always, fluid too. Which means that it is open, uncertain, in process, both complete and incomplete in ways that are themselves open and uncertain.

As we have noted above, electronic information of all kinds is essential to good medical decision making. Our argument is not that health services should avoid this and return to paper records. Neither is it that formal tools are inferior to those that are informal and human. Information indeed needs to move around and much of it will do so in electronic form. But having said this we have been arguing that the metaphors for thinking about informatisation need to be shifted. The models of information too. They need to talk of fluidity as well as flow.

This is a proposal with implications for the new ICT programmes. One, a definition of information as perfect flow will never be satisfactory because it excludes too much. Two, electronic information will always intersect with information in other material forms in ways that are complex and heterogeneous. Three, what will count as information in a particular context will always be open and uncertain. So, four, we need to beware of the hubris that informs Utopian programme statements of the kind we quoted in the opening sections of this paper. Information as fluidity is about practice, about tinkering, and it is about designing ICT systems that know that they cannot know it all or anticipate every possible use. If information is understood as fluidity as well as flow, then its definitions will not try to set fixed boundaries, to delineate what is to count as information and what does not. It will not try to anticipate the kinds of qualculations that make up decision making in health care. Utopianism is not what is needed here. It is too ambitious, too rigid. What is needed are permissive strategies for informatisation.

Of course much of this is recognised in the existing critical literatures on health informatics. But it is important to understand that successful informatisation will always tolerate – and indeed afford – multiple modes of qualculation. It will coexist with other forms of fluid flow. Importantly, it will recognise that ICT innovations have implications, possibly damaging, for other forms of information flow.

Notes

1. For a brief account of the current UK programme for developing ICT in the National Health Service, and creating electronic patient records, see Department of Health (2003). The rationale for the UK programme is laid out in the Wanless Report (Wanless, 2002). At the beginning of 2005, as we are drafting this article, the ICT programme is being investigated by the UK National Audit Office.
2. The exceptions include Berg (1997a), Berg and Timmermans (2000), Winthereik and Jensen (2002), Hanseth et al. (2004, 2006), and the other papers of the special issue on ANT and information systems in Information Technology & People, Jensen (2004, 2005), Ellingsen and Monteiro (2005) and Grisot (2005).
3. This is based on data collected by Ingunn Moser between November 2003 and November 2004 in connection with a study of the implementation of an EPR in one of Norway's largest and most specialized university hospitals. The hospital 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 what is called "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. All data have been disguised to protect confidentiality. The approach to methods and sources of data is multiple, and includes fieldwork, interviewing and documentary sources. We do not claim that our data constitute a representative sample either of clinical decision making or of the use of ICT resources in that decision making. Our concern, rather, is to highlight a range of different patterns for information use, in order to illustrate the variability and specificity of medical uses of information.
4. See, for instance, Bijker et al. (1987).
5. On feminist technoscience studies, see especially Haraway (1991a, b, 1997). On ANT see, inter alia, Callon (1986), Latour (1987, 1998), and Law and Hassard (1999).
6. For critical commentary on early versions of ANT, see Star (1991) and Lee and Brown (1994).
7. See, for instance, Mol (2002) and Singleton (1998).
8. See Law (1994, 2002, 2004).
9. See de Laet and Mol (2000) and Law and Mol (2001).
10. See Callon and Law (2005).
11. On health informatics, see Berg (1997b), Timmermans and Berg (1997), Timmermans et al. (1998), Berg and Timmermans (2000), Østerlund (2002), Ellingsen and Monteiro (2005), and Hanseth et al. (2006). On ethnomethodology, see Heath and Luff (2000), and Garfinkel's seminal "Good organizational reasons for 'bad' clinical records" (Garfinkel, 1967a). For anthropologically influenced work, see Suchman (1987) and Hutchins (1995).
12. Ministry of Health and Ministry of Social Affairs (2004, p. 4). This is the English version of the Norwegian S@mspill.
13. This is from the web pages of the UK NHS Information Authority (2001).
14. Ministry of Health and Ministry of Social Affairs (2004, p. 9).
15. Ministry of Health and Ministry of Social Affairs (2004, p. 12).
16. The term comes from Latour (1990).
17. See, for instance, Star (1991) and Fujimura (1992).
18. Ministry of Health and Ministry of Social Affairs (2004, p. 15).

19. Ministry of Health and Ministry of Social Affairs (2004, p. 16)
20. This difference between information as collective versus collected is also explored more thoroughly in Moser (2005).
21. This is a commonplace both in STS and CSCW and academic work on health informatics. Cognitive activities have been removed from the mind of the individual, and relocated in a series of material and practical arrangements in a range of different STS literatures. How this has been done varies from literature to literature, but the focus on the mind has been criticised in many. See, for instance, Hutchins (1995).
22. For discussion of mutable mobiles see de Laet and Mol (2000), Law and Mol (2001) and Mol and Law (1994).
23. See Garfinkel (1967a).
24. This is drawn from Miria Grisot's work (Department of Informatics, University of Oslo). We are deeply grateful to her for having shared her data, and letting us use this story. For a discussion of it in the context of her work, see Grisot (2004).
25. See Austin (1965).
26. See Callon and Law (2005).
27. For a classic statement of information theory, see MacKay (1969), and a similar classic statement of performativity, see Austin (1965). The performativity of social practices is widely stressed and explored in contemporary social science. In different versions, see, for instance, Butler (1993), Osborne and Rose (1999), and Law (2004).
28. It should perhaps be noted that the waiting list is usually enough, but not always. For instance, it cannot be right kept up to date all the time, and so in between updates, if there are important changes or variations, the transplant coordinator will register these in the patient record and communicate them to the cardiologist in charge either orally or by telephone. This means that while the waiting list is constructed as a set of defnite bits of information, it is still understood that there may be need for other more fluid forms of information. This is a practical question of bounding.
29. See, for instance, Simon (1955).
30. See Latour (1990).
31. This is because they depend on a web of constantly unfolding retrospective-prospective relations. See Garfnkel (1967b), and for the argument developed in STS, Lynch (1990).
32. On the complex character of spatiality, see Law and Mol (2001).
33. Ministry of Health and Ministry of Social Affairs (2004, p. 5).
34. See Law and Mol (2001).

References

Austin, J.L. (1965), in Urmston, J.O. (Ed.), *How to Do Things with Words*, Oxford University Press, Oxford.

Berg, M. (1997a), "Of forms, containers, and the electronic medical record: some tools for a sociology of the formal", *Science, Technology & Human Values*, Vol. 22 No. 4, pp. 403-33.

Berg, M. (1997b), Rationalizing Medical Work: Decision-Support Techniques and Medical Practices, MIT Press, Cambridge, MA and London.

Berg, M. and Timmermans, S. (2000), "Orders and their others: on the constitution of universalities in medical work", *Configurations*, Vol. 8, pp. 31-61.

Bijker, W.E., Hughes, T.P. and Pinch, T. (Eds) (1987), The Social Construction of Technical Systems: New Directions in the Sociology and History of Technology, MIT Press, Cambridge, MA.

Butler, J. (1993), Bodies that Matter: On the Discursive Limits of "Sex", Routledge, New York, NY and London.

Callon, M. (1986), "Some elements of a sociology of translation: domestication of the scallops and the fishermen of Saint Brieuc Bay", in Law, J. (Ed.), Power, Action and Belief: A New Sociology of Knowledge?, Sociological Review Monograph, No. 32, Routledge & Kegan Paul, London, pp. 196-233.

Callon, M. and Law, J. (2005), "On qualculation, agency and otherness", Environment and Planning D: Society and Space, available at: www.comp.lancs.ac.uk/sociology/papers/callon-lawqualculation-agency-otherness.pdf

de Laet, M. and Mol, A. (2000), "The Zimbabwe bush pump: mechanics of a fluid technology", Social Studies of Science, Vol. 30 No. 2, pp. 225-63.

Department of Health (2003), "Every patient to get electronic patient record", available at: www.dh.gov.uk/PublicationsAndStatistics/PressReleases/PressReleasesNotices/fs/en? CONTENT_ID = 4062888&chk = SRDjWX (accessed 10 December 2004).

Ellingsen, G. and Monteiro, E. (2005), "The slight surprise of integration", in Sorensen, C., Yoo, Y., Lyytinen, K. and Degross, J.I. (Eds), Designing Ubiquitous Information Environments: Socio-Technical Issues and Challenges, Springer, New York, NY, pp. 261-74.

Fujimura, J. (1992), "Crafting science: standardized packages, boundary objects, and translation", in Pickering, A. (Ed.), Science as Practice and Culture, Chicago University Press, Chicago, IL, pp. 168-214.

Garfinkel, H. (1967a), "Good organizational reasons for bad clinical records", Studies in Ethnomethodology, Prentice-Hall, Englewood Cliffs, NJ, pp. 186-207.

Garfinkel, H. (1967b), Studies in Ethnomethodology, Prentice-Hall, Englewood Cliffs, NJ.

Grisot, M. (2004), "Integrating knowledge across disciplines: a case study from heart transplantation", paper presented at the 5th European Conference on Organizational Knowledge, Learning and Capabilities, Innsbruck.

Grisot, M. (2005), "Ordering fluidity and information and infrastructures: a case study of heart transplantation", PhD thesis, University of Oslo, Oslo.

Hanseth, O., Aanestad, M. and Berg, M. (2004), "Actor-network theory and information systems: what's so special?", Information Technology & People, Vol. 17 No. 2, pp. 116-23.

Hanseth, O. et al. (2006), "Reflexive standardization. Side-effects and complexity in standard-making", MIS Quarterly, Vol. 30, forthcoming.

Haraway, D. (1991a), "A cyborg manifesto: science, technology and socialist feminism in the late twentieth century", in Haraway, D. (Ed.), Simians, Cyborgs and Women: The Reinvention of Nature, Free Association Books, London, pp. 149-81, available at: www.stanford.edu/dept/HPS/Haraway/CyborgManifesto.html

Haraway, D. (1991b), "Situated knowledges: the science question in feminism and the privilege of partial perspective", in Haraway, D. (Ed.), Simians, Cyborgs and Women: The Reinvention of Nature, Free Association Books, London, pp. 183-201, available at: www.hsph.harvard.edu/rt21/concepts/HARAWAY.html

Haraway, D.J. (1997), Modest_Witness@Second_Millennium.Female_Manq_Meets_ Oncomouse¯: Feminism and Technoscience, Routledge, New York, NY and London.

Heath, C. and Luff, P. (2000), Technology in Action, Cambridge University Press, Cambridge.

Hutchins, E. (1995), Cognition in the Wild, MIT Press, Cambridge, MA and London

Jensen, C.B. (2004). “Experimental devices: studies in STS and electronic patient records” PhD thesis, Arhus University, Å rhus.
Jensen, C.B. (2005), “An experiment in performative history: electronic patient records as a future-generating device”, Social Studies of Science, Vol. 35 No. 2, pp. 241-67.
Latour, B. (1987), Science in Action: How to Follow Scientists and Engineers through Society, Open University Press, Buckingham.
Latour, B. (1990), “Drawing things together”, in Lynch, M. and Woolgar, S. (Eds), Representation in Scientific Practice, MIT Press, Cambridge, MA, pp. 19-68.
Latour, B. (1998), Pandora’s Hope: Essays on the Reality of Science Studies, Harvard University Press, Cambridge, MA.
Law, J. (1994), Organizing Modernity, Blackwell, Oxford.
Law, J. (2002), Aircraft Stories: Decentering the Object in Technoscience, Duke University Press, Durham, NC.
Law, J. (2004), After Method: Mess in Social Science Research, Routledge, London.
Law, J. and Hassard, J. (Eds) (1999), Actor Network Theory and After, Blackwell/The Sociological Review, Oxford/Keele.
Law, J. and Mol, A. (2001), “Situating technoscience: an inquiry into spatialities”, Society and Space, Vol. 19, pp. 609-21.
Lee, N. and Brown, S. (1994), “Otherness and the actor network: the undiscovered continent”, American Behavioral Scientist, Vol. 36, pp. 772-90.
Lynch, M. (1990), “The externalized retina: selection and mathematization in the visual documentation of objects in the life sciences”, in Lynch, M. and Woolgar, S. (Eds), Representation in Scientific Practice, MIT Press, Cambridge, MA and London.
MacKay, D.M. (1969), Information, Mechanism and Meaning, MIT Press, Cambridge, MA.
Ministry of Health and Ministry of Social Affairs (2004), “Te@mwork 2007: electronic interaction in the health and social sector”, available at: www.shdir.no/assets/13163/ Te@mwork%202007.pdf (accessed 11 December 2004).
Mol, A. (2002), The Body Multiple: Ontology in Medical Practice, Duke University Press, Durham, NC and London.
Mol, A. and Law, J. (1994), “Regions, networks and fluids: anaemia and social topology”, Social Studies of Science, Vol. 24, pp. 641-71.
Moser, I. (2005), “Information and its uses in medical practice: a critical interrogation of IT plans and visions in health care”, International Journal of Action Research, Vol. 1 No. 3, pp. 339-73.
NHS Information Authority (2001), “Information for health –1. An information strategy for the modern NHS”, available at: www.nhsia.nhs.uk/def/pages/info4health/1.asp (accessed 10 December 2004).
Osborne, T. and Rose, N. (1999), “Do the social sciences create phenomena? The example of public opinion research”, British Journal of Sociology, Vol. 50, pp. 367-96.
Østerlund, C.S. (2002), “Documenting dreams: patient-centred records versus practice-centred records”, PhD thesis, Massachusetts Institute of Technology, Cambridge, MA.
Simon, H.A. (1955), “A behavioral model of rational choice”, The Quarterly Journal of Economics, Vol. 68, pp. 99-118.
Singleton, V. (1998), “Stabilizing instabilities: the role of the laboratory in the United Kingdom cervical screening programme”, in Berg, M. and Mol, A. (Eds), Differences in Medicine:

Unravelling Practices, Techniques and Bodies, Duke University Press, Durham, NC, pp. 86-104.

Star, S.L. (1991), "Power, technologies and the phenomenology of conventions: on being allergic to onions", in Law, J. (Ed.), A Sociology of Monsters? Essays on Power, Technology and Domination, Sociological Review Monograph, No. 38, pp. 26-56.

Suchman, L. (1987), Plans and Situated Actions: The Problem of Human-Machine Communication, Cambridge University Press, Cambridge.

Timmermans, S. and Berg, M. (1997), "Standardization in action: achieving local universality through medical protocols", Social Studies of Science, Vol. 27, pp. 273-305.

Timmermans, S., Bowker, G.C. and Star, S.L. (1998), "The architecture of difference: visibility, control, and comparability in building a nursing interventions classification", in Berg, M. and Mol, A. (Eds), Differences in Medicine: Unraveling Practices, Techniques and Bodies, Duke University Press, Durham, NC and London, pp. 202-25.

Wanless, D. (2002), Wanless Report: Final Report 2002, HM Treasury, London, available at: www.hm-treasury.gov.uk/Consultations_and_Legislation/wanless/consult_wanless_ final.cfm

Winthereik, B.R. and Jensen, C.B. (2002), "Political and moralising moments: documents as material agents in Danish visions of IT in health care", Information Technology & People, Vol. 15 No. 3, pp. 127-41.