How Physicians 'Achieve Overview': A Case-based Study in a Hospital Ward

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ABSTRACT

Clinicians' work in hospitals is safety- and time-critical, and often stressful due to the number and complexity of patient cases they must attend to. Therefore, how clinicians gather information, identify problems and make decisions concerning patients is a crucial concern, a process that can be labelled 'achieving overview'. In the process, clinicians use various artefacts amongst which medical records are central. Decades of experience is embedded in the structure and use of paper-based records. However, the development of electronic patient records (EPR) will change both structure and use of medical records, including 'achieving overview'. We conducted an ethnographic study in a hospital ward using paper-based medical records in order to understand how clinicians achieve overview. Inspired by the approach of exnovation, we elicit the use of paper-based records in order to inform the design of EPRs. We propose five axes which span out the process of achieving overview and describe implications for design of EPRs.

Author Keywords

Electronic patient records, ethnography, distributed cognition, healthcare, narratives, overview, sensemaking

ACM Classification Keywords

H.5.3 Group and Organization Interfaces

General Terms

Design; Human factors; Theory

INTRODUCTION

Health care work is often safety-critical and conducted under duress. Hence, gathering information about a situation or a patient's condition, constructing a coherent assessment and deciding what to do next are crucial tasks. The risk of making decisions that impair or are fatal to people puts immense pressure on health care professionals, who often have to act based on insufficient information. They are trained to do so and will rarely be reproached for it, unless they fail to notice or understand the significance

of available information. However, gathering, presenting, and interpreting information and constructing a coherent assessment upon which to act are crucial in health care. This whole process can be labelled 'achieving overview'. As an initial working definition, achieving clinical overview is about *how health care professionals arrive at a sufficiently informed, accountable and coherent understanding of a situation, so that they are capable of acting consciously and with confidence.*

Because of the high-tension, safety-critical characteristic of health care work, health care staff are trained to work under stress, organisational routines have been established, and a variety of different artefacts have been developed to support health care professionals' information gathering, decision-making and coordination of work. As several studies within CSCW have shown, this is an inherently collaborative process, where health care staff communicate, collaborate, and move about [1; 19; 20]. Amongst the various artefacts used, the patient record is probably the most prominent [2], and it presents a well-known space within which health care professionals know how to act [32].

Patient records, paper-based or electronic, structure information in various ways: chronologically, problem-oriented, according to profession (physician and nursing patient records) and according to source (results from x-ray department, laboratory etc.). Ordering information is often based on standard terminologies for diagnoses, nursing interventions, drug identification and reimbursement (e.g. SNOMED CT, NANDA, ATC, DRG)[1]. Health care professionals are acquainted with these ordering standards, and the physical structuring of information in patient records thus resonates with mental orders that are known to health care professionals. However, in Europe and the USA hospitals are presently planning to, are in the process of, or have already implemented electronic patient records (EPR). Since the enabling capacities of paper and IT differ, the development of EPRs will entail changes in the ordering of patient records and its use in practice. Developing EPRs that present and order information in ways that facilitate

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[1]Systematized Nomenclature Of Medicine Clinical Terms; North American Nursing Diagnosis Association; Anatomical Therapeutic Chemical (Classification System); and Disease Related Groups.

clinicians' achievement of overview is hence a core challenge for present efforts to digitize health care work [27].

BACKGROUND

Our interest in and focus on 'overview' were spurred by a critical episode that took place when we did a longitudinal study into the implementation of an EPR in a regional hospital in Denmark. The EPR was cross-professional and meant to be used by various health care professions in the hospital, including physicians, nurses, physiotherapists, medical secretaries etc. It structured information in ways that partly overlapped with and partly deviated from the order and categories used in the paper-based patient record. A week into the implementation, the senior physicians demanded a meeting with the steering group responsible for implementing the EPR. Here the physicians passionately argued for significant changes to the EPR's display of information; too much information was presented to them in the EPR, some of it irrelevant, and the functionality to switch between views or scroll up and down was insufficient. They feared that they would miss available information, fail to find relevant information, and argued that the EPR did not help them generate a coherent understanding of a patient's situation. In their own words, they feared 'loosing overview'. The steering group immediately changed the display of information in the EPR to avoid a halt in the implementation process. The physicians' frustrations were somewhat lessened, and we as researchers were left with a strong impression of how an EPR might hinder rather than support achieving overview.

Digitisation of medical work is proceeding fast, and despite many setbacks and delays, there are no indications that it will stop. EPRs is one major IT infrastructure around which these efforts pivot with the hope of achieving better continuity and higher quality of patient care as well as more work and resource efficiency. The anticipated advantages of EPRs include updated data, immediately propagated across various settings and available to multiple clinicians at the same time. This is in contrast to working with paper-based patient records, where information is updated only when secretaries transcribe physicians' dictates, and information is only available to persons who can physically access the record, which is only available in one place at a time. Studies within CSCW have already shown that the shift from a paper- to IT-based media is not unproblematic. Paper is flexible and micro-mobile, which supports close collaboration in ways that IT-based documents do not [12; 13], and it allows easy and fluid annotations and juxtaposition of pages [26]. In contrast to office work, which experienced the first wave of digitisation, health care work is inherently mobile and collaborative in ways that are not supported by standard office computers [1; 9].

Ordering information in medical records in ways that support and augment clinicians' work is a central challenge. Orders based on, for example, source (e.g. x-ray department or laboratory) or transactions (e.g. admittance, ordering of medicine) provide little support for a cogent understanding of a patient's present state and problem. Problem-oriented records were proposed as early as 1969 as one answer to this, but have proven difficult to implement [4; 29]. According to a report by the National Library of Medicine, "The health care IT systems of today … squeeze all cognitive support for the clinician through the lens of health care transactions and the related raw data, without an underlying representation of a conceptual model for the patient showing how data fit together and which data are important or unimportant. There is little or no cognitive support for clinicians to reason …" [27: p40]. In this paper, we study clinicians' actual practices of achieving overview as a first step towards the goal of developing an understanding of how to order medical records. Such an investigation could start with practices based either on paper-based or on electronic patient records. The present case is inspired by the suggestion by Sellen and Harper (2002) that work practices that involve paper can be used as an analytical resource for design of IT. Electronic devices do not have to copy paper, and the affordances that paper supports should be understood in their practical and organisational context. However, more can be learned about the overall goals that paper serves, and this may inform design. Specific to health care, Berg and Toussaint (2003) call for analyses of paper-based patient records that bring forward their strengths and weaknesses in order to examine their integration with work practices and how this contributes to the performance of health care work [3]. In a broader perspective, such studies can be seen as examples of 'exnovation' [16]: a term proposed to describe how analysis of the mundane, routine practices can bring forward their invisible, taken for granted contribution to what actors try to achieve. 'Exnovation is the process of making existing strength of practices explicit by mapping the tacit resources of practitioners' [16].

In the following, we will pursue such a strategy of exnovation to bring forward how clinicians using paper-based patient records achieve overview. Paper-based work practices will provide an analytical resource for studying what 'achieving overview' means, and we will later conduct a follow-up study of clinicians working with a wholly digitised patient record. The focus will primarily be on physicians, because they are the central and ultimately responsible profession in hospitals. We are aware, as will also be evident from the empirical analysis, that medical work and achieving overview are collaborative endeavours that involve collaboration with other professions. We will continue the article in the following way. First, we present related work within CSCW on diagnosing and achieving 'overview'. Second, we describe the methods and setting of our case, and, third, continue to present the results of our analysis of the empirical data. Fourth, we discuss the implications of our case analysis for understanding overview and how this may inform the design of health care

IT in general and EPRs in particular. Fifth, we end the article by summarising the case and our conclusions.

WHAT IS 'OVERVIEW'? CONCEPTS AND THEORIES

Webster's Encyclopedic Unabridged Dictionary defines overview as 'a general outline of a subject or situation; survey or summary' (Webster's 1996: p1386), whereas the Oxford English Dictionary mentions 'Inspection; overseeing, supervision' and provides a more elaborate definition: 'A general survey; a comprehensive review of facts or ideas; a concise statement or outline of a subject. Also: a broad or overall view of a subject' (Oxford English Dictionary. Accessed online 30.1.2013). In the context of medical work, 'general outline', 'comprehensive review of facts' and 'concise statement of a subject' are all applicable and make sense. For example, clinicians construct a general outline of a patient case based on the temporal unfolding of their illness trajectories [28]; they make comprehensive reviews of facts when they go through a patient record and sum up cases, for example 'discharge summaries'; and they make concise statements of a subject when they make a diagnosis based on test results and the patient's account of his or her problem.

However, the process of *arriving at* the state of overview is less easily described as the definition of that state or noun. Within CSCW, a processual approach is represented by 'information seeking', which investigates the gathering and retrieval of information and stresses the temporal and collaborative characteristics of these activities [19] [21]. It tends though to focus on what triggers and facilitates information seeking rather than the establishment of a comprehensive understanding of and decision-making upon a situation or patient case. A collection of articles investigating 'diagnostic work' also adopts a processual approach. Diagnostic is "...the work of determining and categorizing … trouble, and scoping for what to do about it (if anything) "[6: p110]. This includes not only medical work, but also that of web designers, ground control operators, engineers, and users of travel management systems. Diagnostic work is seen as cooperative, distributed, and technologically mediated and framed. The papers do not amount to a common theoretical framework, but argue for the need to conduct empirical research into the interactional processes of 'diagnostic work' [6]. Related to the issue of 'achieving overview' is the issue of 'awareness': actors' perception of their interactional space. 'Achieving overview' could be seen as a special instance of awareness: an actively pursued, reflective understanding of one or more patients' situation. Though central to CSCW and subdivided into situated, peripheral, temporal, etc., awareness, the term remains only loosely defined ([25]. For an overview, see [8]). .

While the above approaches are relevant, neither pinpoints 'achieving overview' precisely. However, in our search for broad, sensitising concepts and frameworks that may inform our investigation, we have come across three approaches that seem especially relevant: sensemaking, narrative theory and distributed cognition.

Sensemaking is the approach proposed by Weick [30], and focuses on how actors organise equivocal inputs in ways that make sense. Sensemaking can be described as a reciprocal, ongoing interaction between the search for information, meaning ascription and action. It is often instrumental, subtle, swift, social and easily taken for granted, but may become explicit when the environment conducts itself in unusual ways, or when actors cannot immediately engage with it. Sensemaking is a collaborative process to which communication is central. Analysing a hospital, Weick suggests that sensemaking is distributed across organisations and people:

> *… if knowledge about the correctness of treatment unfolds gradually, then knowledge of this unfolding sense is not located just inside the head of the nurses or physicians. Instead, the locus is system wide and is realised in stronger or weaker coordination and information distribution among interdependent healthcare workers.* [31: p412]

A central concept in sensemaking is 'functional deployment': imposing labels on interdependent events in ways that suggest plausible acts of management, coordination and distribution. For example, diagnosing a condition and thereby also suggesting future action.

Closely related, narrative theory focuses on how actors interpret and construct coherence when making sense of the world in which they act [14; 15]. For example, interpretations may take the form of stories based on a chronology of events or a narrative whose unifying structure is that of the plot. Such 'emplotment' is similar to functional deployment in sensemaking. It involves making a configuration in time, creating a whole or a story out of a succession of events. Actions, events and information take their meaning by belonging and contributing to the overall narrative. The narrative approach has been effectively used within health care as a way of understanding medical reasoning, such as physicians' ability to extract relevant elements from the history of illness and form a meaningful narrative which establishes causal relations. For example, Mønsted et al. [17] analyse physician-patient consultations and describe how physicians before meeting patients construct a proto-narrative based on the information available in patient records. Physicians then re-emplot this narrative when talking to and hearing patients' narratives. Mønsted et al. argue that the process in their case is not optimally supported technologically, because patient information is distributed over multiple systems and documents. Gaining an overview is hence a complex and cumbersome task [17].

Finally, the approach of 'distributed cognition' proposed by Hutchins and colleagues is relevant. Distributed cognition explicitly strives to get beyond a focus on the individual

mind when analysing work settings. Instead, the distributed socio-technical system is the primary analytical unit, since most kinds of work are conducted by several people collaborating and using various artefacts. The approach sees itself as cognitive, because its focus is upon how people think, solve problems, predict and make decisions. It is distributive, because its concern is how information is represented and how representations are transformed and propagated during work activities, involving various people and artefacts [10; 11; 23].

> *Cognition is embodied. ... Minds are not passive representational engines, whose primary function is to create internal models of the external world. The relations between internal processes and external ones are far more complex, involving coordination at many different time scales between internal resources – memory, attention, executive function – and external resources – the objects, artefacts, and at-hand materials constantly surrounding.* [10: p177]

As information is propagated through minds, instruments, maps etc., it is transformed and the states of these entities are changed. The socio-technical system is 'computational' in transforming and changing information. As information is propagated across representational media – which can be internal as well as external to the mind – the various distributed entities are coordinated and work together. 'Overview', in this framework, can be seen as the result of computations by the use of various media. Distributed cognition shares with sensemaking and narrative theory the collaborative, communicative and distributed characteristic of acting and extends them by explicit incorporation of technologies and media. It has been applied in health care by, for example, Palen and Aaløkke (2006), who show that people at home make use of daily routines, inventory and materiality to remember to take their medication [18]. Likewise, Sarcevic et al. analyse interdisciplinary teamwork in trauma resuscitation based on distributed cognition [24].

In the following, we adopt the stance that the process of achieving overview is collaborative, communicative, distributed, and 'computational' by using various media. 'Functional deployment' and 'emplotment' are terms that propose initial understandings of the process of achieving overview. At the same time, we will argue that it is possible to go into more detail on how overview is achieved in practice. We will do this based on an ethnographic study, combining observation of and interviews with physicians in a university hospital. In the analysis we will propose that achieving overview can be described through five conceptual pairs spanning out five axes.

RESEARCH SETTING AND METHODS

The study was conducted by the second author in a ward for the treatment of liver and bowel diseases. The ward employs 135 clinical staff including 24 physicians, and has 22 beds and an outpatient clinic with approximately 14,000 appointments a year. The average length of patient stay is

four days and covers a great diversity in length of stay. A considerable amount of the patients are admitted several times, because of different chronic conditions. The ward is part of a university hospital in Denmark, which has approximately 10,000 employees and 1,150 beds divided between 26 wards. On a yearly basis the hospital has approximately 82,000 discharges. An EPR had not yet been implemented in the ward. This ward was chosen for this study of overview, because of the complexity and long patient histories of the patients affiliated with the ward.

The ward routines included a morning conference attended by all present physicians, usually around 15. They subsequently split into two teams each covering one half of the ward and did pre-ward round conferences together with the nurses. On specific weekdays the physicians attended a diagnostic imagining or a pathology conference before the pre-ward round conference. After this, three or four physicians went to the outpatient clinic, one or two had on-call duties, and the remaining physicians did ward rounds, which lasted until late lunch. In the afternoon conference the physicians would follow up on new results and information generated during the day.

The physicians and the other professions in the ward used a mix of paper-based and digital artefacts. The most important and frequently used by the physicians were the following: the entirely *paper-based patient record* consisting of a paper sleeve containing loose sheets of paper organised by means of different tabs, which divided the record into various sections for very diverse information, ranking from insurance papers, x-ray descriptions and physicians' progress notes. The latter was the most used section by the physicians. The progress notes themselves were structured in different ways, using typography to mark selected parts. Progress notes were placed in the record by the nurses once they had been transcribed by a secretary. *Stationary computers* displaying *laboratory results* and *medication* in two different software programmes were found in both team offices. Laboratory results were displayed like a spreadsheet, enabling different views (e.g. numeric values or as a graph) and showing different time spans. Medication was displayed as an electronic list, one for each patient.

The medical ward divided its staff into two teams; each team was responsible for a group of patients and had its own team office used by physicians, nurses as well as health care assistants. A central artefact in these offices was a *whiteboard* displaying a chart containing information about the team's patients. The chart featured a row for each patient and was divided into columns for diagnosis, treatment plan, expected discharge, urgent problems etc. Information was updated several times a day by erasing text with a cloth and entering new information with a pen. The whiteboards functioned as a meeting point and as a central resource when the staff discussed patients.

Finally, two different *printed lists* used by physicians and nurses were important. One listed all the patients admitted to the ward and featured only a very limited amount of information. The other listed only a team's patients and featured a considerable amount of information in comparison with the other list. The physicians almost always carried these lists with them and frequently entered notes related to specific patients or to other things they needed to remember.

Data collection

Data were generated through ethnographic fieldwork. Around 60 hours of observation, distributed over 12 days and five months, was conducted by the same researcher, who followed the physicians around observing their work. All observations were conducted in the morning or in the afternoon. Initially, appointments were made in advance with a particular physician, but as the physicians became acquainted with the researcher, contact was made ad hoc with a diversity of physicians' tasks and experience in mind. Typically, observations started at the morning conference or the afternoon conference, which both were mandatory for the physicians.

No judgement about which situations to study was made in advance, but emerged in a grounded way; observations focused on physicians' actions and interactions with other staff and artefacts with a view to identifying situations in which overview was important, how overview was achieved, and which factors hindered or supported this process. When necessary and appropriate, clarifying questions were posed, and small informal interviews were conducted during observations. Field notes were taken, including both text and sketches, to capture actions, vocal and non-vocal. The notion of thick description guided the way data were recorded [5; 7]. Field notes were transcribed and extended as soon as possible after the observation.

Interviews with seven physicians were made to supplement observational data. The semi-structured interviews focused on physicians' accounts of what overview is and how they achieve it. The inclusion criteria for interviewees were diversity of physician experience. The interviewees consisted of six males and one female with experience in the ward ranging from six months to 20 years. All interviews lasted around one hour, were recorded and subsequently transcribed verbatim.

Analyses of the data were initially guided by the sensitising theoretical concepts and framework presented above, but with the intentional strategy to let other relevant issues and codes emerge from the data. During analyses transcribed field notes from observations and transcripts of interviews were looked through, with the purpose of finding thematic codes, capturing different aspects of 'achieving overview'. The preliminary set of codes was then discussed by the authors. After these discussions, additional codes were proposed, and a second round of coding was conducted. This resulted in codes like 'The physicians definition of overview', 'complete overview', 'sufficient overview', 'chronological overview', 'here&now status', 'different ways of conduction ward rounds' etc. As we went through the codes and their content we saw that some of them were clustered around the same underlying aspect, but representing opposite dimensions of the aspect. The different codes were then combined into five conceptual pairs structuring the presentation of findings. These codes are not based on quantified measurements, but were chosen because they were the ones most often found in the empirical material across multiple interviews and observations.

FINDINGS

A preliminary indication of what overview is about is provided by the physicians' own explanations and understandings during the interviews. This will provide some provisional clues about overview, but it will also show that its achievement can be difficult to conceptualise, because is it embedded in situated practices.

The physicians' understanding of overview

In the beginning of each interview the physicians were asked how they perceived overview and what overview looked like in their daily clinical practice. Generally they answered the question by explaining what kind of information they need in order to establish an overview. One physician explained it this way:

> *Well, it means to have everything available, that's what I would say. I think it means that I can be seated and read exactly what had happened yesterday. What did the blood samples say? What did the x-ray that I ordered this morning show? And what about the cultivation of blood? That I have everything right at my fingertips. Together with a nurse, who can tell me about the patient's conditions today. This clearly creates the optimal overview in my opinion.* (Female physician, one year of experience in the ward)

There are several significant clues in this statement. The ideal situation is to have all the information in one place ('be seated and read'), rather than, we surmise, to have to move around and search for information; to have exact information on different issues ('what happened yesterday'; what are the results of various test); to have unmediated access to information ('right at my fingertips'); and to collaborate with other actors ('together with a nurse').

However, most often the physicians found it somewhat difficult to talk about the process of establishing overview. When they talked about a process related to overview, it was in a generalised form like the following: Overview is to gather information, to know the patient history, to know the results of the test samples and to be aware of the treatment plan. Focus was on the process in patient history and not so much on the physicians' work process of establishing overview. They did not talk about how they gathered

information or how they got to know the patient history. As one physician said:

It's important. As much information as possible. Both concerning what has been and how matters look like right now. Then you are able to make decisions on a better basis. Both concerning what to do right now and in general. ... The cool thing about being a physician is that you have some symptoms, and then you have some possible diseases, and then some tests to confirm or dismiss it. This is a connection you make all the time. (Male physician, six months of experience in the ward)

Making a 'connection' between information and a problem, which can be seen as 'functional deployment' or construction of a narrative, is of course central to the process. However, the quote also points to central aspects of the process of achieving overview; 'as much as possible' expresses a wish for comprehensiveness, and 'has been' and 'right now' reveal a historical and a here&now aspect.

All the physicians had an opinion about what kind of information they needed in order to feel confident in the established overview, but it was difficult to establish in the interviews how they got this information or how they wanted to get this information. Hence, one of the purposes of the analysis below is to provide a conceptual frame through which it is possible to talk about what overview is about and how it is achieved.

Aspects of 'achieving overview'

Our empirical material and analysis reveal the existence of many 'different' aspects involved in the achievement of overview. In the following we present five conceptual pairs which outline different dimensions of overview. Examples from both interviews and observations will be inserted as the conceptual pairs are presented. The pairs are not to be seen as dichotomous concepts, but rather as poles which in practice may be intertwined and difficult to separate. Nor are they necessarily mutually exclusive. The achievement of overview is affected by different needs, contexts, situations etc. and often requires combination of poles.

Historical and here&now aspects

Historical overview refers to a chronological understanding of the patients' history going back as far as deemed relevant by the physician and the problem at hand. On the other hand, here&now overview is concerned with the present status of the patient – what is the situation right now?

The here&now aspect comes to the fore with stable patients, at first examinations of patients, or when a physician is under time pressure and needs to know whether a patient's condition is stable enough to justify the postponement of a thorough examination. Here&now is also relevant when a patient's condition is critical and action has to be taken immediately. The historical overview is relevant whenever a physician wants to understand symptoms, developments and the present state in a richer context of information. Often, the historical and the

here&now aspects are entangled and achieved in parallel processes. Frequently, the information gathered in the process of establishing here&now overview is only meaningful if the physician has at least a minimal historical overview. A patient's weight, for example, is useless if you only have this one value, and the same is often truth for the value of a blood sample. On the other hand, information from the historical overview is often less meaningful and has little value as an indicator for action, if the physician is not aware of the current status of the patient.

This entanglement is seen in the following quote where a physician was asked: What does it mean for you to obtain overview in your daily clinical work? He answered:

Often it is like this – we go and see the patient and talk to them and talk about their problem. Often this one problem is, in quotes, a trivial problem. But almost all of them have something in the load. Things that are not insignificant for the current problem. In that case, if I meet unprepared, only focusing on the current problem, not aware of its background – then I will be set straight. (Male physician, 10 years of experiences in the ward)

The following observation snippet also shows the entanglement of the historical and here&now aspects of achieving overview, and additionally displays the entangled use of different artefacts and actors in this establishment.

Observing one physician as he prepares for ward round. The physician looks at the computer to find test results from ordered samples. He expresses that he finds the results 'peculiar'. He then starts to discuss the results with another physician sitting next to him in the office. While they are discussing the results, they go further back in time on the computer to see test results from samples previously completed on the patient. (Male physician, six months of experience in the ward)

The physician starts by looking on the computer in order to find the latest test results. He sits by himself and opens a spreadsheet displaying the results. He is puzzled and turns to another physician sitting next to him and they discuss the case. No evident explanation is found and they both turn to the computer and type a new interval into the spreadsheet, so test results are displayed further back in time, while they continue to discuss and try to find an explanation for the latest test results.

In order to pursue the here&now aspect, physicians use various artefacts and interaction processes. The most commonly used artefacts and interaction processes are the patient record with emphasis on physicians' notes, test results from, for example, blood samples, diagnostic imaging, urine samples etc.; conversations with patients, nurses and other physicians; physical examinations of the patients; and different kinds of conferences, like morning conferences in the ward, and cross-disciplinary conferences on e.g. pathology. Indeed, it is a very collaborative and interactional process. Pursuing the historical aspect,

physicians often use the same artefacts as described above, but the most used artefact is the patient record, with special focus on physicians' notes and test results as described above. To a lesser extent, they use conferences, conversations with patients, nurses and other physicians and physical examinations to pursue the historical aspect.

Shared overview and individual overview
This conceptual pair illustrates an axis from the entire ward, trying to assess all of the patients, to the individual physician preparing for a patient during ward round or in the outpatient clinic.

Shared overview is established jointly among the clinicians and is concerned with a group of patients. The central situations through which shared overview is achieved, are the different kinds of joint conferences of physicians or of physicians and nurses. Individual overview is concerned with one patient at a time and requires more detailed information about this one patient. Individual overview is usually established concerning the patients that a physician is responsible for when he or she is on call. Individual overview is rarely an individual process, since other actors and artefacts contribute to this process. Overall, however, with respect to the individual overview, other actors do not have the same amount of information or the same overview as this one physician has of a particular patient. Indeed, shared overview informs the establishment of individual overview by providing information about patients in the ward for the physicians to build on. Also, individual overview helps clarify and enhance the shared overview.

During the day in the ward there is a tendency to go from establishing shared overview to establishing more individual overview, of course with exceptions and deviations. The day starts at half past eight with a morning conference. All the attending physicians meet at this conference. They are seated around two tables in the lunch room, often with the most experienced physicians gathered around one table and medical students and new physicians around the other table. Often present also is a nurse, whose task it is to contribute with updated information and function as a link between nurses and physicians. The physician who has been on night shift takes a book with a handwritten list of patients admitted during night shift. The physicians briefly audit all the patients admitted in the ward, with special focus on new patients. The central activity at the morning conference is information sharing and talk; furthermore, the physicians take notes on the printed lists. One physician described the benefit of the morning conference this way:

> *Well, it's sort of a broad briefing, these morning conferences. It's just a briefing on what we have in the house. What's new and what has happened, which we all ought to know about. Even if you do not participate in the actual work with the patient. If you encounter the patient during the day in one way or another. Or on call the following day, then you have some kind of overview,*

you know who the patient is. (Male physician, five years of experience in the ward)

Some days the morning conference is followed by a more subject-specific conference, for example diagnostic imaging or pathology. The physicians have to move to another building to attend these conferences, and they often carry with them the printed lists and make annotations. On a large screen in the front of the room x-ray or MR images are presented and examined and discussed by the physicians, concerning their implications for the patients.

After these conferences, the physicians split into two teams, each responsible for a group of patients. The teams engage in separate pre-ward conferences, discussing their patients in more detail, now with the active participation of the nurses. Here, the most commonly used artefact is the whiteboard.

Afterwards, physicians prepare for ward round or other duties by establishing a more individual overview of the patients they are responsible for. Here the patient record and various test results are extensively drawn upon when establishing the individual overview.

At half past twelve all the attending physicians meet again and discuss almost all of the patients in the ward, now in the light of new knowledge generated during ward rounds or outpatient consultations. During this noon conference the physicians are seated around one table with a computer connected to a widescreen at the end of the table. On the widescreen they often display various test results concerning the patients they are discussing. In addition, almost all of the physicians bring the printed team lists and other artefacts like personal notes, and patient records are used in varying degrees. The physicians take turns and go through the patients they are responsible for. Either they ask the other physicians specific questions about a patient or they start a more general conversation about a patient – Are we on the right track with this patient? What do we do next? The physicians often use the printed team list when they go through their patients and add new notes to the list following the conversation. In this way they make plots and re-emplotments to the patient history, adding yet another layer of information, contributing to the on-going process of extending, change or modify the clinical overview.

An example of the achievement of individual overview is provided in the vignette below of a physician preparing for a ward round together with a nurse.

> *The physician starts a conversation with the nurse about the patient. During the conversation he makes notes on a printed list of the team's patients. Together they look up different test results on the computer. They are trying to find out if the patient receives the nutrition he needs. They look into different printed observation forms in the patient record on nutrition intake. Again the physician makes notes on the printed list of the team's patients.* (Male physician, six months of experience in the ward)

Whereas shared overview is primarily established by means of dialogue between physicians or between physicians and nurses and by using different kinds of common lists or displays with brief information about patients, individual overview is established through dialogue with other physicians, nurses or, notably, patients and by means of artefacts such as patient records, test results, observation forms, physical examinations etc.

Comprehensive overview and minimal overview
The golden standard with regard to overview is often perceived as complete overview; patients expect physicians to have complete overview of their individual illness history, and for physicians complete overview is an ideal, like when the physician in the first citation above wanted to have everything right at her fingertips.

In spite of this conception of complete overview, almost all the physicians talked about sufficient overview, which enables them to act. The physicians believed their main service was to make decisions about future actions for the patients. They did not seek to establish complete overview for its own sake. A physician expressed it this way when asked if he ever had complete overview:

> *No, of course, you never have. But a sufficient overview is what is needed. And that's what we try to achieve. It's in order to be able to make the correct decision. And the point is that you actually need quite a lot of things to achieve this.* (Male physician, 20 years of experience in the ward).

This quotation shows that even though physicians are aware that it is almost impossible to establish complete overview, they emphasise that sufficient overview often requires quite a lot of information to be regarded as sufficient.

Since the establishment of a complete overview is not attainable, it makes sense to conceptualise this dimension as spanned out between comprehensive and minimal aspects. Several factors influence the degree of comprehensiveness needed. First, a crucial task for the physicians is to determine if the patients in front of them are 'standard' patients. If not, they need a more comprehensive overview than when it comes to standard patients, where a minimal overview over the last test results will do. Likewise, if the patients are following a course of treatment and the patient condition is stable, the physicians only need a minimal overview of the patient history. On the other hand, to recapitulate or summarise a complicated treatment history requires a comprehensive overview.

A physician expressed the need for more or less comprehensive overview in the following way:

> *Like we talked about before. Well, you need to consider if this patient is a so-called standard patient. Which is a good thing to be. If he is not, well, then you need to dig a little deeper into it. Then I would read the physicians' notes a bit more carefully. Then I would look further*

> *back in time. What can we tell from the last scans? How widespread is this tumour?* (Male physician, 15 years of experience in the ward).

What counts as a comprehensive overview is very much context dependent. In some ways comprehensive overview is similar to the historical overview, but one difference is that a historical overview does not necessarily need to be comprehensive. A historical overview may only include a few central points, scattered across different time lines. Also, the historical-her&now aspects span out a temporal axis, while the comprehensive-minimal aspects concerns the amount of information needed. In their daily clinical practice, physicians strive for a sufficient overview that enables them to act. The amount of information needed to establish this sufficient overview may be comprehensive or minimal depending on various aspects.

Collaborative and single-handed decisions
During the observations in the ward it became evident that dialogue and conversation are central factor to the establishment of clinical overview. Physicians collect information about patients in various places, in various ways and by means of various artefacts. But it is often during conversations with colleagues that this information is transformed into a meaningful collection, which enables them to make decisions about future actions. During conversations physicians pick up the information gathered, put it together in new ways and make summaries for each other. Of course, a physician can go through the process single-handedly, but more often than not a certain amount of conversation is involved in the process of establishing overview. Often the physicians have qualified hypotheses about diagnoses and treatment plans and use conversations to challenge or confirm these. Observations also demonstrated the process of employment and re-emplotment or, in the words of Weick, functional deployment, as well as how the sociotechnical system performs various computations.

Conversations can take place between physicians, between physicians and nurses and between physicians and patients. Conversations are also central in establishing overview because of their ability to pass on information from one colleague to another. Several physicians argue that conversations significantly enhance their understanding of patient information. Reading the patient record is an essential first step, but discussing the information with someone else is even better. As one physician said:

> *But as I was saying, if it was the case that there was no nurse around, when we were talking about it, then I could go and read up on it by myself. But, well you know, the dialogue is often 10 times more valuable. Then you can also talk about what the real problem is.* (Female physician, one year of experience in the ward)

The quotation shows that something happens during conversations, something different from what takes place

when physicians work on their own. Information is context dependent, and if the physicians engage in dialogue with colleagues, they can 'talk about what the real problem is'.

The process of establishing clinical overview and making decisions about future plans and actions for a patient is usually not a single-handed process. The complex and non-linear process of establishing clinical overview is a constant interplay between conversation and more single-handed processes. At the different conferences all the physicians and sometimes the nurses participate in multiple conversations and dialogues. Besides these more or less scheduled conversations, physicians participate in ad hoc conversations with other physicians, nurses and patients. In between all of this dialogue and conversation physicians work and gather information single-handedly and make decisions in the light of all the collected information. The following observation is an example of how conversation and dialogue may take place wherever there is room for it.

> *The physician is supposed to participate in a diagnostic imaging conference. We arrive in good time and stand outside the conference room, waiting for the surgeons to finish their conference. Three other physicians from the ward are also waiting outside and the four of them start to discuss some of the patients admitted in the ward. They discuss treatment plan, medication and single out what it is that makes these patients unique.* (Male physician, six months of experience in the ward)

Conversations are initiated when physicians walk from one building to another, meet in the corridor or the office, drink coffee in the lunch room etc. They range from brief exchanges to more detailed conversations about a patient.

Experienced and novice

Early in the data collection phase we sensed that experience is important for the ability to establish overview. Observing the role of experience in the process of establishing overview is rather difficult, since the differences between the physicians are within their minds. However, it is also evident from their behaviour, and observing them one can see that the more experienced physicians have slightly different working routines than the novice physicians.

One of the benefits of experience is the ability to act without spending time on profound considerations every time. The physicians ascribe this ability to the fact that with experience follows a degree of familiarity with numerous patient trajectories and courses of illness. Until something else manifests itself, they act upon this stock of experience, which makes the process of establishing overview smoother, less time-consuming and often less dependent on various artefacts. In addition, the more experienced physicians are often well-informed about theories and scientific evidence within their area of speciality. One physician expressed it this way:

> *... and the more experienced physician always has his working hypothesis in the back of his mind. Of course he*

> *tries to confirm or disconfirm it all the time, right. The more inexperienced collects information here and there and hopes for a hypothesis to manifest itself, right.* (Male physician, 20 years of experience in the ward).

This quotation once again demonstrates that the process of collecting information and ascribing meaning to this information, or as Weick would say, making sense of information, is perceived by the physicians as an important part of the establishment of overview. Virtually all the interviewed physicians had the perception that the described qualities enable the experienced physicians to sort and prioritise the extensive amount of information more easily and more quickly than the more inexperienced physicians. One physician said:

> *And I'm not able to make decisions if I'm unfamiliar with the patient history. And it is of course important to be able to single out what is important in all of these hundred pages you sometimes have. What is it, what are the important facts to be aware of? And I think experience is crucial in this process.* (Male physician, 20 years of experience in the ward)

What the physician says here is that the process of prioritising and sensemaking gets easier with experience and thereby also facilitates the establishment of overview.

Five conceptual axes

What emerges from the ethnographic fieldwork is the realisation that 'overview' is produced in various situations, settings and through the use of various artefacts.

Based on this we have tried to develop concepts which make it possible to talk about physicians' experience and practice of achieving overview. The proposed conceptual pairs and five axes are meant as analytical distinctions, which span different dimensions of what is implicated in 'overview' (Figure 1 below). In practice, physicians constantly combine and switch between the aspects in their work. However, the conceptual pairs may provide an initial analytical framework through which we can understand what overview is about and how physicians achieve it, even though they may not exhaust all dimensions of overview.
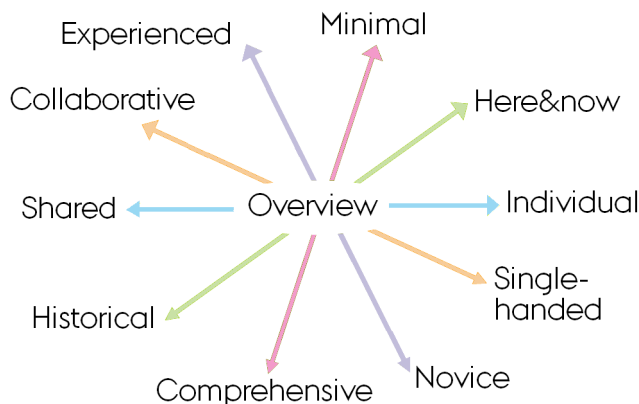

Figure 1. The five axes in which overview is spanned out.

DISCUSSION

We found the theoretical approaches of sensemaking, narratives and distributed cognition useful for framing the research into 'overview'.

Sensemaking as a process of reciprocal, ongoing interaction between the search for information, meaning ascription and action fits nicely with our empirical data. Also, it makes good sense to consider the distributed socio-technical system the primary analytical unit, as suggested by distributed cognition, and the achievement of overview a computational process across actors and artefacts. Achieving overview is not something that only takes place in the individual minds of physicians, as a process of absorbing and ordering information. The process is physical, social, technological and distributed, involving examinations of and dialogue with patients; conferences between physicians and with several professions; dialogue between physicians and with nurses; reading, looking into and carrying around artefacts such as team lists of patients, patient records, test results and laboratory tests on the computer. It becomes evident that the intertwined and complementary roles of these heterogeneous entities pass information around and transforms it. Cognition is embodied and interwoven with materiality [10].

Finally, the concepts of narrative and employment were also applicable. These are defined as pertaining not only to a level of discourse, the structure of a text or a talk, but also to action. Indeed, action is a kind of proto-emplotment where actors and materials are related to each other, so that emplotment may take place [14; 15]. In our case, we can see how physicians assemble and reassemble in different settings and groups, interact with other professions and patients, engage with different artefacts and thus construct proto-emplotments that later become actual emplotments.

However, while useful and adequate, these theoretical frameworks are not detailed enough for us to go into the specifics of the process. What emerged from our analysis of the data were the five conceptual pairs (Figure 1 above). They point out aspects that form and inform physicians' situated achievement of overview and can be said to span five dimensions: Historical and here&now concern how much of the *temporal* aspect of a patient's case should be drawn upon when producing overview; shared and individual concern the *numerical* aspect or how many patients the overview includes; collaborative and single-handed concern the *collaborative* aspect or whether an overview is produced individually or in a group; experience and novice concern *how knowledgeable* the person(s) constructing overview is(are); and comprehensive and minimal concern the *comprehensiveness of information* on a patient in the process of establishing overview.

These aspects are supported by a combination of artefacts and social techniques (dialogue, conference etc.), but not always in ideal ways; patient records are comprehensive with lots of detail, but inadequate for establishing shared overview of multiple patients, and, therefore, printed lists and whiteboards are used instead. These, on the other hand, lack the details that the records contain. Conferences are good for pooling expertise and developing shared overview, but at present they are only supported by the individually used printed lists and lack a shared artefact. Historical overview can be achieved through the details available in the patient record, but requires filtering all the information before a summary can be produced. Multiple summaries support historical overview of protracted patient cases, but are not found in one place in the record; they must be 'extracted' from the progress notes. Collaboration is supported by the micro-mobility of paper, but still requires moving around and looking from different angles and presupposes co-presence.

Related to the discussions upon awareness within CSCW, overview can be seen as a kind of 'situation awareness' and the five axes outlined resonate with the other kinds of awareness: The historical-here&now axis shares characteristics of 'temporal awareness', and the collaborative-single axis shares characteristics of 'team awareness'. As such the axes may comprise a condensation of various sub-kinds of awareness pursued in a given situation. However, within the broad range of awareness with CSCW (e.g. passive or active, sentience or understanding), the kind of overview in focus here is actively, purposefully acquired to form an understanding of a situation. The generalisability of the axes is probably limited. However, they could possibly contribute to the approach of information seeking that focuses on what triggers and facilitates search and retrieval of information, by suggesting more specifically the kinds of information sought for. Similarly, the axes possibly could span out the space within which 'diagnostic work' unfolds. For example, in a case of website breakdown, the trouble-shooting of web administrators could be said to have pursued a minimal, here&now rather than a comprehensive overview of the situation, because the organization prioritized speed over perfection. In these ways, the five axes may contribute to CSCW as a sensitizing framework of analysis.

Implication for design

From the perspective of digitisation, the paper-based socio-technical system of the patient record and related artefacts can be criticised for providing fragmented and incoherently updated information, only available at limited locations. EPRs can be seen as the answer to such criticism by providing updated, integrated information accessible to multiple persons at any number of locations at the same time. However, from the perspective of exnovation the paper-based socio-technical system emerges as an assembly of artefacts; each of these artefacts supports the process of achieving overview in limited ways, but together they flexibly facilitate the process. The first thing one must acknowledge is thus that achievement of overview is facilitated in different situations, through different kinds of artefacts and through different presentations of

differentially filtered information. This also means that an EPR could not and probably should not be the only artefact to support the achievement of overview. Other artefacts, interactions with colleagues and patients, organisational setups etc. are equally important to consider.

This calls for artefacts that support different work situations, like working single-handedly, in groups, at patient bed, etc. Similar to the paper-based system's variety of lists, folders, records and whiteboards, the EPR should run on different platforms such as tablets, large displays, cell phones as well as on stationary computers. This also calls for supporting different ways of ordering and presenting information; summaries and views which present the most recent results and notes are necessary, but so are chronological views. Presentation and visualisation of information in EPRs is of crucial importance and have been done in many different ways so far (For a comprehensive overview, see [22]). On the basis of our analysis, one of the most important features must be the flexibility to easily move from a general overview to more detailed information and to easily shift the time span in the visualization.

One important point regarding these different artefacts and views is that they should enable the EPR to be part of the dialogues and conversations of physicians and other health professionals involved in the establishment of overview. Some essential parts of functional deployment, emplotment and computation that do not emerge when physicians work individually take place in these conversations. It is important to consider not only the artefacts, but also the processes in which the artefacts are involved.

More specific, initial requirements for EPRs arising from the above can be proposed starting with the position 'Shared overview' in figure 1 and going through the aspects clockwise. Shared overview is probably best facilitated by large displays with lists of patients and central patient information, making information about multiple patients available to groups. Individual overview, on the other hand, requires zooming in on the single patient with as much detail as appropriate. Collaborative overview requires a display that can be shared by two or more people in the many ad hoc conversations that take place, for example a display that can be carried and handed around like paper (like the printed lists), providing essential overview, but also making it possible to go into specifics. Furthermore, it should be easy to add information, so that the display can also function as an in-process working tool, not necessarily to be saved in the EPR. Experienced physicians will require a view that presents essential data to them as specialists, possibly even personalised data. While customised presentation of information might intuitively be the ideal solution for all physicians, this would in practice (apart from requiring huge customisation effort) only be suitable for highly specialised physicians, since such singular views would not support collaborative or shared overviews. Novice physicians, for example, need the EPR to present all

information in well-known, ordered ways (e.g. chronologically, source-based, summaries in a separated folder), so that they can go through all relevant information in a structured way. A minimal overview would call for situated presentations of information; this could focus on patient trajectory (e.g. admission, transfer, and discharge), problem (ordered per diagnosis) or the most recent summary, prescriptions and examination results in one view. A comprehensive overview, on the other hand, requires that all information can be accessed and presented in ordered ways, similar to the information needs of novices. The here&now overview would require the most recent progress notes, prescriptions and examination results.

This discussion on implications for design, also addresses a difficult balance when setting up EPR systems between customised presentation of information, supporting individually shortcuts and work habits, and standardized supporting tools, which is easily recognisable. To meet this variation in preferences, the EPRs must be highly flexible.

A variety of visualization methods and flexibility of customization emerges as core requirement with regards to overview, because of its complexity and contingency. Overview of single, simple tasks is easy: knowing the present medication of a patient can be facilitated by a list, and her blood pressure levels over time can be visualized through a curve. However, assessing a patient's overall situation requires an integrated combination of various visualizations customized to the specific situation.

CONCLUSION

Based on ethnographic fieldwork at a hospital ward, we have described and analysed how clinicians achieve overview. We see this process as a result of a socio-technical system, where physicians and other professions through dialogue and by the use of multiple artefacts assemble information and construct narratives: Through storytelling and emplotment, narratives are constructed that ascribe meaning to disparate events and information, and form the basis of treatment and care. Based on analysis of our data, we suggest five axes that span out the space within which the process of achieving overview takes place. Physicians' situated decision-making takes place within the poles of shared-individual; collaborative-single handed; experienced-novice; minimal-comprehensive; and here& now-historical. These axes and their conceptual pairs can inform the design of EPR. Our own next step into the study and analysis of achieving overview is to conduct new empirical study in a ward with an EPR. This will test and refine the analysis presented here.

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