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PhD Dissertation
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Diagnosing the Uncertain

A CSCW perspective on initial diagnostic work

Academic advisor: Associate Prof. Pernille Bjørn
Submitted: April 2013

Cover photo In the foreground, plastic trays in the medical department secretariat at Køge Sygehus for distribution of referrals to the different medical sub-sections. In the background, the secretary is interpreting the information stated on the symptoms of disease while distributing the referrals.

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“If you are not sure what a given disease should typically look like,
how do you tell if someone has it? If symptoms are highly variable,
or hard to identify, how do you create a typical picture?”
(Susan Leigh Star 1985: 399)

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RELEVANCE FOR PRACTICE

Diagnosing the Uncertain

A CSCW perspective on initial diagnostic work

Copenhagen, 2013

Before the general introduction of the dissertation, a brief summary of how the dissertation findings can be directly relevant for practice is provided.

This dissertation is based upon a 3-year PhD research project conducted by Naja L. Holten Møller in the *Technologies in Practice* research group at the IT University of Copenhagen. Findings of the dissertation have been published internationally in research papers authored by Naja L. Holten Møller, professor Paul Dourish (University of California, Irvine), associate professor Pernille Bjørn (The IT University of Copenhagen), and associate professor Signe Vikkelsø (Copenhagen Business School).

"Initial cancer diagnosis should be subjected to fundamental reflection"

- This dissertation from the IT University of Copenhagen analyzes the diagnostic work that precedes the occurrence of the suspicion that a person has cancer and raises questions about **how we re-think diagnostic work to better support initial cancer diagnosis**.

- The dissertation suggests that the dynamic relationship that evolve between work practices and technology during the process of initial diagnosis affects how potential cancer patients are diagnosed.

"Issues arising from the case of uncertain diagnostic trajectories"

The case of "uncertainty" is important and raises issues addressed in this research project. The diagnostic centers that are currently emerging in Denmark is one reason why this PhD research project is important: **Organizations and technology evolve together, and altering one affects the other and vice-versa.** To fully understand the complexity of diagnostic work requires that researchers are considering the continuously changing premises for collaboration in order to support the diagnostic work that precedes a cancer suspicion – and that designers of practice observe carefully how their work is dynamically interlinked. This dissertation explores the following research questions:

1) What characterizes the diagnostic work that precedes a suspicion of cancer?

2) How are patients sorted in the process of deciding if cancer should be suspected or not?

3) How are the diagnostic steps coordinated across collaborating specialties, hospitals, and sectors?

4) What are the challenges within the work practices of achieving continuity of care in diagnostic work across different contexts?

“Nature and type of diagnostic work matters: Bringing things together or keeping them apart”

Based on in-depth ethnographic studies of collaborative work practices in a Danish GP’s office, a Danish hospital, and a US hospital over a period of 13 months, the dissertation develops an argument about diagnosing the uncertain. The dissertation uses this particular example to understand the complexity of the situated practices of diagnosis and the whole that they form in terms of the overall work setup. The dissertation indicates that **the diagnostic work that precedes a suspicion of cancer is embedded within the routine diagnostic work.** Therefore, measures to support this type of diagnostic work where the course of diagnosis is uncertain have to address the broader group of providers involved in diagnosing patients with general symptoms of disease.

“Naming of diagnosis: Categorization before and categorization after”

In terms of the categorization of patients with potential cancer, this dissertation suggests that a simple “before” and “after” distinction is not practically feasible when the course of diagnosis is uncertain. When symptoms of disease are unclear, disease categories emerge in the process of diagnosis. In order to handle such uncertainty, professionals rely on subtle categorizing (e.g., “patient lost 20 kg.”) rather than formal disease categories (e.g., “obs cancer”). Findings of the dissertation indicate that **the wrong use of formal categories has consequences for the individual patient but also might increase the waiting times of potentially higher-risk patients**. To minimize this risk, practitioners in situations of uncertainty rely on subtle categories rather than formal categories.

“New ways of thinking about the diagnostic work in the area of cancer”

A fundamental principle in diagnostic work in Denmark as well as in other countries is continuity of care. Comparing data from a US workplace study and a Danish workplace study of how practitioners appropriate technologies, we may begin to discern challenges to continuity of care that cut across these different contexts. In both the US workplace study and the Danish workplace study **linking of clinical work is challenged across lines of responsibilities of care (personalized or collectivized) and the constitution of roles (persisting or changing)**, which become available in the appropriation of collaborative information technologies. Concrete lessons can be learned from how technologies are appropriated to accomplish continuity of care across different contexts, especially in cases where the goal is new, improved practices.

Summary

In this dissertation I explore the diagnostic work, which precedes the occurrence of the suspicion that a patient has cancer. I do so from the point of view of Computer Supported Cooperative Work (CSCW). From this research perspective I explore encounters between practitioners, organizations, practices, protocols and more in the initial diagnostic work. I unpack initial diagnostic work as a collaborative practice, and focus exactly on issues related to collaboration. Three aspects of collaborative work are essential to understand this initial diagnostic work; the "invisible" aspects of diagnostic work, the "coordinative" aspects, and the aspects of "inclination". Each of these aspects are crucial for understanding the initial diagnostic work in situations where it is uncertain what is the matter with a patient.

The key findings are *first* that diagnostic work that precedes a suspicion of cancer is characterized by the open-ended process in which disease categories are worked on while getting applied: As the patient´s state and course of disease is not straightforward the categorization is subtle and emerge in the context while being applied. The practice of categorizing patients and related practices central to the initial diagnostic work are not solely carried out by clinicians. Non-clinicians such as secretaries also carry out diagnostic work. This reflects how certain activities in initial diagnostic work are practically enmeshed, even if formally separated.

Second, I find that the sorting practices preceding a suspicion of cancer is a practice used to achieve the particular goal of prioritizing a patient in relation to other patients and available resources. This sorting is handled by formal sorting mechanisms but is guided by informal sorting mechanisms: one such informal sorting mechanism is subtle categorizing characterized by a subtle use of categories (e.g., "patient lost 20 kg") that communicates the level of urgency rather than mutually exclusive categories (e.g., "obs cancer") in the initial diagnosis. Another informal sorting mechanism is collective remembering whereby actors interpret the accuracy by which categories have been applied.

Third, I find that the coordination of diagnostic steps across specialties, hospitals and sectors is formed by the essential role of coordination mechanisms embedded within

artefacts such as the electronic referral template. Coordination through these artefacts and coordination mechanisms, I find, implies both bringing together some things but also keeping others apart depending on the specific nature of the work. Avoidance in this way may help practitioners in some situations make sure responsibility stays clear and coordinated at all times as part and parcel of the initial diagnostic work.

Finally, I find that the conditions for achieving continuity of care throughout initial diagnostic work are interdependent with the organization of work. Comparing data from a US workplace study and a Danish workplace study of how practitioners appropriate technologies I find that challenges to continuity of care cut across these different contexts. In both these studies linking of clinical work is challenged across lines of responsibility for care (personalized or collectivized) and the constitution of roles (persisting or changing) interdependent with how patients circulate between care providers.

The dissertation consists of two parts: In the first Part I introduce the workplace studies on which this dissertation relies, I present the research strategy, and I discuss how the findings of the dissertation extents and compliments existing knowledge of diagnostic work. Part II is also the empirical contribution of the dissertation and consists of 4 research papers each exploring a different topic related to the overall research questions of the dissertation.

Sammenfatning

I denne PhD-afhandling undersøger jeg det tidlige diagnostiske arbejde, som går forud for en mistanke om, at en person har kræft. Dette undersøger jeg ud fra et CSCW-forskningsperspektiv, som beskæftiger sig med computer-understøttede samarbejdspraksisser. Specifikt undersøger jeg i afhandlingen ”mødet mellem” praktikere, organisationer, praksisser og protokoller m.fl. i det tidlige diagnostiske arbejde. Således udfolder jeg det tidlige diagnostiske arbejde som en samarbejdspraksis og fokuserer i afhandlingen særligt på problemstillinger relateret til samarbejde. Tre aspekter af samarbejdspraksisser er afgørende i forhold til at forstå det tidlige diagnostiske arbejde; “usynlige” aspekter af diagnostisk arbejde, “koordineringsaspekter”, og “kursskifteaspekter”. Hvert af disse aspekter er centrale i det tidlige diagnostiske arbejde, hvor der er usikkerhed om, hvad patientens diagnose er.

I PhD-afhandlingen peger jeg *for det første* på, at diagnostisk arbejde, der går forud for en egentlig kræftmistanke, hvor diagnostiske kategorier appliceres, er en åben proces. Når retningen af en patients sygdomsforløb endnu ikke er klart, fremkommer disse kategorier over tid i den kontekst, hvor de appliceres gennem brugen af subtile kategorier. Denne praksis med at kategorisere patienter og øvrige relaterede praksisser er ikke blot kendetegnende for klinikeres arbejde. Ikke-klinikere, for eksempel sekretærer, er også involveret i det diagnostiske arbejde. Denne involvering af bl.a. sekretærerne afspejler, hvordan aktiviteter i det diagnostiske arbejde er formelt adskilte, men er vanskelige at adskille i praksis.

For det andet peger jeg på, at den visitation, som sorterer patienter forud for en kræftmistanke, er afgørende for at prioritere en patient i forhold til øvrige patienter og de tilgængelige ressourcer. Denne sortering af patienter er håndteret via formelle sorteringsmekanismer, men håndteres i praksis guidet af uformelle sorteringsmekanismer. Subtil kategorisering (fx ”patient har tabt 20 kg”) er et eksempel på en sådan sorteringsmekanisme, som anvendes til at kommunikere, hvor akut en patient er gennem et spektrum af kategorier snarere end gennem gensidigt ekskluderende kategorier (fx ”obs cancer”) i diagnostik. En anden uformel

sorteringsmekanisme er gensidig erindring, hvorved praktikere fortolker præcisionen af andre praktikeres applicering af kategorier.

For det tredje peger jeg i PhD-afhandlingen på, hvorledes koordinationen af diagnostiske tiltag er formet af koordinationsmekanismers essentielle rolle i diagnostisk arbejde, såsom den elektroniske henvisning. Jeg peger på, at koordinationen gennem sådanne artefakter og koordinationsmekanismer både indebærer, at ting bringes sammen, men også at de holdes adskilt afhængigt af naturen af arbejdet, der skal koordineres. Praktikere kan således i nogle situationer, via adskillelse af arbejdet sikre, at ansvaret holdes klart som en integreret del af det tidlige diagnostiske arbejde.

Endelig peger jeg på, at betingelserne for at sikre sammenhæng i forløbet af det tidlige diagnostiske arbejde er gensidigt afhængige af organiseringen af dette arbejde. Jeg peger i PhD-afhandlingen på, at udfordringer i forhold til at skabe sammenhæng går på tværs af kontekst ved at sammenligne data fra et amerikansk og et dansk arbejdspladsstudie af, hvordan praktikere tilpasser og anvender teknologi. I begge disse studier er sammenhæng udfordret i relation til ansvaret for behandlingen (personligt eller delt) og anvendelsen af roller (permanente eller skiftende), som hænger sammen med, hvordan patienten cirkulerer mellem aktører i sundhedsvæsenet.

Denne afhandling består af to dele: I første del introducerer jeg de arbejdspladsstudier, som denne PhD-afhandling bygger på, jeg præsenterer forskningsstrategien, og jeg diskuterer, hvordan resultaterne af afhandlingen bidrager til eksisterende forskning og bringer ny viden ind om tidligt diagnostisk arbejde. Afhandlingens anden del, som også er afhandlingens empiriske bidrag, består af 4 forskningsartikler, der hver især udgør en selvstændig del af studiet i undersøgelsen af de forskningsspørgsmål, som afhandlingen undersøger.

PART I: INTRODUCTION COVER

PART II: RESEARCH PAPERS

Paper no. 1 99

Møller, N.H., Dourish, P. (2010) Coordination by avoidance: Bringing things together and keeping them apart across hospital departments. Proceedings of the 16th ACM international conference on supporting group work (GROUP '10), ACM, pp. 65-74.

Paper no. 2 111

Møller, N.H., Bjørn, P. (2011) Layers in sorting practices: Sorting out patients with potential cancer. Computer Supported Cooperative Work (20), Springer, p. 123-153.

Paper no. 3 145

Møller, N.H., Vikkelsø, S. (2012) The clinical work of secretaries: Exploring the intersection of administrative and clinical work in the diagnosing process. Proceedings of the 10th international conference on the design of cooperative systems (COOP '12), pp. 33-47.

Paper no. 4 163

Møller, N.H. (submitted) Achieving continuity of care: A study of the challenges in a Danish and a US hospital department. Submitted to the 2013 European Conference on Computer Supported Cooperative Work.

Figures

Tables

Appendices

PART I

1 Introduction

“Coordination and collaboration, like consultation, are authoritative concepts in and of themselves, operating as unarguable tropes that can be safely deployed in summative policy writing as words capturing the allure of deeds (action), and fixability (solution), with the added attribute of being generically inoffensive” (Tess Lea 2008: 66).

This dissertation explores the diagnostic work that precedes the occurrence of the suspicion that a person has cancer from the perspective of Computer Supported Cooperative Work (CSCW). Previous research on cancer diagnosis, for example, includes social and cultural studies (Stacey 1997; Zuiderent-Jerak, Bal et al. 2012) and a considerable number of clinical studies of, for example, delay (Jiwa and Saunders 2007; Tørring 2011; Tørring, Frydenberg et al. 2013). These other perspectives are all important to gaining an overall picture of cancer diagnosis; however, to understand the situated practice we need to explore the diagnosing process from the perspective of CSCW. What I explore in this dissertation is the encounters in diagnostic work in order to ascertain how diagnosis before a suspicion of cancer occurs. The CSCW perspective is characterized by in-depth studies of the situated accomplishment of work as it is carried out in a certain context. In contrast, other research perspectives, particularly in the clinical tradition, have often taken a decontextualized approach to understanding initial cancer diagnosis, focusing more on determining the causations and extent of the challenges in the area of cancer diagnosis. In this way, the focus on situated work is possibly the most important affordance of the CSCW perspective in terms of extending and contributing to the broader research on diagnostic work that precedes a cancer diagnosis. As I initiated my research I was interested in precisely that after years of engaging with the field of cancer policy in my training as a political scientist and later through my position in the Danish National Board of Health (NBoH). Here I actively took part in the process of defining and writing Danish policy around standardized cancer pathways; however, I wanted to see things not just from the point of view of Danish practitioners, but also from that of US practitioners.

The Danish standardized cancer pathways prescribe sequences and steps in the cancer trajectory from the point in time where a patient is suspected to have cancer (Sundhedsstyrelsen 2008). Shaping or defining the cancer trajectory in this way reduces complexity because the larger number of patients where unclear symptoms may or may not point to cancer are not included in the standardized cancer pathways directed at specific types of cancer diagnoses (lung cancer, colon cancer, etc.). According to the NBoH, in order to avoid dropping these other patients with unspecific symptoms entirely, initiatives to strengthen collaboration and coordination had to include the larger number of patients (Sundhedsstyrelsen 2008). This emphasis on collaboration and coordination has repeatedly been brought up in all Danish national cancer plans (Sundhedsstyrelsen 2000; Sundhedsstyrelsen 2005; Sundhedsstyrelsen 2010). In the introductory quote Tess Lea points out how collaboration and coordination, in addition to consultation, fix complex issues in policy. The quote describes precisely some of the concerns of the studies reported in this dissertation, which are related to the complexity of collaborative work in practice. The overall purpose of this dissertation is to unpack the complexity of the diagnostic work that precedes a suspicion of cancer. This breaks down to a number of research questions related to initial diagnostic work. The general topic of diagnostic work has received considerable attention in CSCW and related fields of research (Star 1985; Strauss, Fagerhaugh et al. 1985; Orr 1986; Mol and Elsman 1996; Büscher, O'Neill et al. 2009; Kane and Luz 2009; Büscher, Goodwin et al. 2010; Jutel 2011). From this perspective, diagnostic work is expected to detect and grade the disease while informing treatment (Mol and Elsman 1996), and diagnosing and treating are thus enmeshed practices. Previous research has investigated the definitive cancer diagnosis where the diagnostic work is characterized by the closing of ends (Kane and Luz 2009). The question is, what characterizes the preceding diagnostic work where it is not even certain what the course of the disease is? The first research question investigated in this dissertation is:

RQ1. What characterizes the diagnostic work that precedes a suspicion of cancer?

While at the NBoH I began to contemplate the complexity of diagnosis in terms of how a suspicion of cancer gets rendered in practice. The main purpose of the Danish standardized cancer pathways was to prescribe steps and sequences in the cancer trajectory so that patients could feel confident that guidelines were being followed. The story with the standardized cancer pathways dates back to 1998 when the public and politicians learned that survival rates of cancer patients in Denmark were relatively poor compared with other Nordic countries (Nordisk Ministerråd 1995). To deal with this problem, the first national cancer plan was introduced in 2000, mapping survival rates for particular cancer diagnoses (Sundhedsstyrelsen 2000); the second national cancer plan in 2005 pointed to problems with coordination and collaboration that seemed to be interlinked with the survival rates (Sundhedsstyrelsen 2005). Though a large amount of money was invested in the area of cancer following the first two cancer plans, there were still reports of patients in limbo when collaboration had failed. The issues in the cancer area continued to build up. Then, in 2007 the standardized cancer pathways were introduced. The idea of standardized cancer pathways was not unique to Denmark and had already been implemented in other countries at the time they were initiated in Denmark. However, a 2007 study of standardized cancer pathways, or what is referred to in the UK as "fast tracks," reported that breast cancer was diagnosed at a later stage after the implementation of fast tracks (Jiwa and Saunders 2007). The reason for this, the UK study reported, was in part that patients assigned to a UK fast track turned out not to have breast cancer – causing other patients with breast cancer outside the fast tracks to wait even longer than before. The UK study informed the standardized cancer pathways in Denmark: To guide sorting practices, the Danish standardized cancer pathways were designed as formal resources for the practical sorting of patients. For a patient to be considered a candidate for a standardized cancer pathway there had to be a reasonable suspicion of cancer (Sundhedsstyrelsen 2008). The issue of sorting is a classic interest for CSCW (Bowker and Star 2000), and previous research illustrates how sorting practices form complex, collaborative multiplicities of work practices, people, and processes simultaneously working together (Bjørn and Rødje 2008). From this perspective, the sorting of patients relies on both formal and informal resources for action. Yet, there is a tendency to make only the formal resources visible to the outside, thereby rendering invisible the informal resources that are key to the success of formal sorting work in practice (Star and Strauss 1999; Bowker and Star 2000; Martin, O'Neill et al. 2007; Randall, Sharrock et al. 2007). Figure 1 illustrates the steps and sequences in the Danish version standardized cancer pathway for lung cancer patients just released as I initiated my research in 2009. All standardized cancer pathways are represented by a diagram combined with prescriptions for how to apply the pathway and the associated timelines. A second research question is:

RQ2. How are patients sorted in the process of deciding if cancer should be suspected or not?

The policy around the standardized cancer pathways specifies that pre-booking across specialties, hospitals, and sectors is crucial for the practical success of standardized cancer pathways (Sundhedsstyrelsen 2008). Thus, a patient should always be pre-booked for the sequences and steps in the cancer trajectory that are expected to become necessary for the diagnosis of that patient (Sundhedsstyrelsen 2008). Pre-booking of patients is presumed to be supported by the hospitals' existing electronic information systems in the same way as booking of any other patients. Consequently, the pre-booking of patients suspected to have cancer had to be integrated with practices that already support booking of all sorts of patients across specialties, hospitals, and sectors. The pre-booking of patients is made difficult by the inherent paradox of cancer: it can take time to diagnose cancer, yet most types of cancer will progress during this period (Hamilton 2009; Tørring 2011). The right diagnostic tests have to be conducted before deciding if it is appropriate to pre-book a patient for a standardized cancer pathway. The formal articulation of a suspicion of cancer influences the booking of a patient, while there is, by law, a particular set of timelines that must be adhered to if a patient is suspected to have cancer (Indenrigs-og Sundhedsministeriet 2006). In terms of booking, this set of timelines will place other

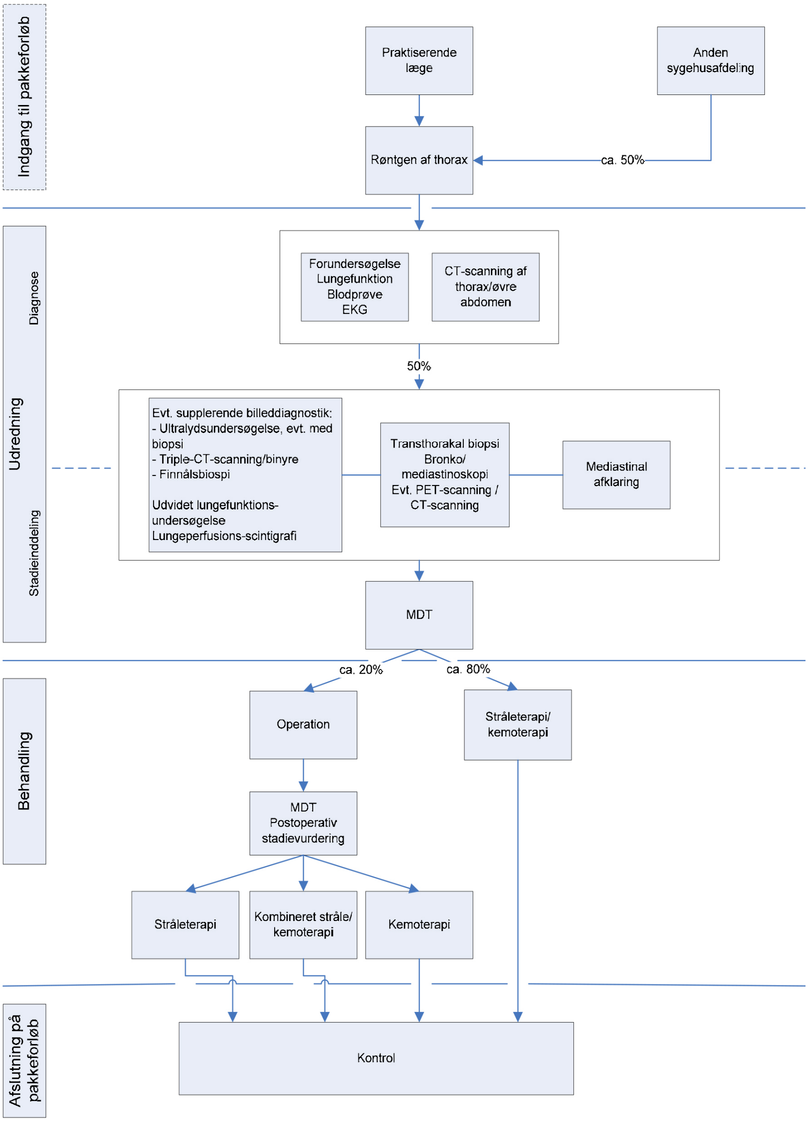

Figure 1. Danish standardized cancer pathway (Sundhedsstyrelsen 2009)

possibly more ill patients later in the queue if it is not quite certain that a patient will probably turn out to have cancer. To deal with this issue, the NBoH in 2011 eventually introduced the idea of a standardized pathway for patients with unspecific symptoms that could potentially point to cancer yet could not fit into a standardized cancer pathway (Sundhedsstyrelsen 2011). The health regions later started to introduce diagnostic centers to simplify how to handle these patients with unspecific symptoms in terms of, for example, electronic referral and booking (Region Hovedstaden 2012). That probability is relative to other patients makes the practice of electronic booking highly interlinked with other practices in the diagnostic work across specialties, hospitals, and sectors. To coordinate their complex, collaborative work actors rely on articulation work (Strauss, Fagerhaugh et al. 1985; Gerson and Star 1986; Schmidt and Bannon 1992). Thus, actors will articulate their work in the sense that they divide, schedule, and structure it to make clear who will do what, when, and where (Strauss, Fagerhaugh et al. 1985; Gerson and Star 1986). Electronic booking is an example of a practice by which diagnostic work is articulated to make clear who will do what, when, and where in the diagnosing process. Then, when pre-booking of potential cancer patients is integrated into existing practices of coordination that also support booking of various other patients, it becomes important how specialties, hospitals, and sectors collaborate around the practices of electronic referral and booking in the routine diagnostic work. The occurrence of "uncertainty" has to be enacted though before a patient can be handled as such by, for example, a diagnostic center. A third research question investigated in the dissertation is:

RQ3. How are the diagnostic steps coordinated across collaborating specialties, hospitals, and sectors?

Given that this dissertation investigates the complexity of the diagnostic work that precedes a suspicion of cancer; how patients are sorted in the process of deciding if cancer should be suspected or not; and how the diagnostic steps are coordinated and supported in terms of collaboration across specialties, hospitals, and sectors, then a final research question concerns the understanding of challenges within the work practices of achieving continuity of care in diagnostic work across different contexts – and the use of collaborative technologies. A huge challenge in healthcare, in Denmark as well as internationally, is how to achieve continuity of care (Danish Board of Technology 2006; US Office of the National Coordinator for Health Information Technology 2010). Since the basic nature of continuity of care is that several clinical specialties are involved in a distributed collaborative process, collaborative technology-use is central to investigate in the perspective of continuity if care. To understand how exactly technologies and artefacts are appropriated within various contexts we need to understand the particularities in how they are used. Previous research has illustrated how it is relevant to also have a wider perspective in the analysis of specific work practices (Strauss 1993). To see more clearly the issues of achieving continuity of care in diagnostic work that are particular to the Danish setting it has been important also to study initial diagnostic work in a completely different setting. Therefore, although the research questions of this dissertation emerged in a Danish context, the study of diagnostic work was conducted across the US and Denmark. The fourth and last research question investigated in the dissertation is:

RQ4: What are the challenges within the work practices of achieving continuity of care in diagnostic work across different contexts?

These research questions reflect a pragmatic hope that the dissertation may provide insight to both CSCW and the wider research on diagnostic work, but also to practice. Though what I explore in the dissertation is the diagnostic work on certain days and in certain settings, this type of study has a wider relevance (Clarke, Hughes et al. 2006). Diagnostic work is thus a common practice across contexts. The study provides valuable insight on the practical accomplishment of the initial diagnostic work. There are many other questions that could be investigated in this dissertation, but only a few questions could be included to privilege in-depth studies of the situated accomplishment of the initial diagnostic work. Obviously, the concepts developed on the basis of these studies are not stable but can only help us continue work on how to better support diagnostic work by technology and in terms of policy.

1.1 Research questions

The research questions of this dissertation summarize to:

RQ1

What characterizes the diagnostic work that precedes a suspicion of cancer?

RQ2

How are patients sorted in the process of deciding if cancer should be suspected or not?

RQ3

How are the diagnostic steps coordinated across collaborating specialties, hospitals, and sectors?

RQ4

What are the challenges within the work practices of achieving continuity of care in diagnostic work across different contexts?

1.2 Reader's guide

The following provides a guide for the reader and an overview of the dissertation. The dissertation starts by presenting in Part I the positioning of the dissertation before turning to discussions across the research papers. Then, in Part II, the research papers, which form a key part of the research findings, are presented. The dissertation reads as follows:

In *chapter two* the theoretical positioning of the dissertation is outlined in the context of CSCW and three general aspects of collaborative work; invisible work, coordination, and inclination work, each of them central when studying initial diagnosis.

In *chapter three* the method of the dissertation is presented. It is best characterized as workplace studies by which I have ethnographically investigated the situated diagnostic work that precedes a suspicion of cancer.

In *chapter four* the findings of the research papers are summarized in relation to the overall research questions of the dissertation, and answers are presented across the different papers.

In *chapter five* the dissertation is concluded before turning to the research papers, each presenting their own part of the overall research project and investigating the research questions of the dissertation.

2 Diagnostic work

I now turn to the theoretical positioning of the dissertation. In the following sections three aspects of collaborative work, each of them relevant for initial diagnosis, set the scene for the dissertation. I refer to these as, respectively, the "invisible" aspects of diagnostic work, the "coordinative" aspects, and the aspects of "inclination". Subsequently, I argue that these aspects are characteristic of the collaborative work in diagnosis that precedes the occurrence of the suspicion that a patient has cancer. Each aspect adds to what is already known about the diagnosing process while also telling us something new about the characteristics of the initial diagnostic work. Diagnostic work is the work involved in identifying and categorizing emerging problems while scoping for possible ways to deal with the issue (Büscher, O'Neill et al. 2009). Previous research on the process of diagnosing cancer has illustrated how the work of reaching a definitive diagnosis is characterized by the closing of ends (Kane and Luz 2009). However, the closing of ends by the temporary elimination of uncertainty suggests a desire for certainty that can easily be overestimated in studies of how effective action is achieved in diagnostic work (Street 2011). Closure, it is argued, is not necessarily the basis for effective action (Ibid p. 817). Diagnostic work is a collaborative activity. Yet, in the broader public, diagnostic work is often perceived as an individual work practice (Schmidt, Wagner et al. 2007; Büscher, O'Neill et al. 2009; Kane and Luz 2009; Büscher, Goodwin et al. 2010, Street 2011). Thus, diagnostic work does not rely only on the skills of an individual; it is the result of routinely applied skills by a collectivity of actors (Slack, Procter et al. 2010).

From this perspective we need to investigate diagnostic work as a collaborative activity where multiple actors are interdependent in their individual work by which they influence their common area of work – diagnosis. Thus, collaborative work, also referred to as cooperative work, is defined by the interdependence of multiple actors in their individual work by which they influence their common area of work (Schmidt and Simone 1996). The analysis of diagnostic work in this dissertation is closely related to (but not restricted to) concepts developed in relation to this notion of collaborative work. Taking CSCW as a point of departure for the study of initial diagnostic work, the dissertation is positioned within a broader group of studies interested in how practical, collaborative work in general is carried out. Previous CSCW-research illustrates how diagnostic work is a social phenomenon (Alby and Zucchermaglio 2009) that includes actions for developing a shared understanding of a particular situation or problem (Nevile 2009). Actors involved in diagnosis are highly dependent on how other practitioners interpret their individual yet interdependent actions. Actors' interpretations are thus part of the routine diagnostic work (Strauss, Fagerhaugh et al. 1985; Schmidt, Wagner et al. 2007). Despite the importance of interpretation, the activity of interpreting the actions of other practitioners while searching for possible ways to deal with a problem is often invisible and has generally been under-theorized in previous research (Mesman 2010). This type of invisible work makes up one part of diagnostic work: it is the subtleties of collaboration that escape formal models for work (Star and Strauss 1999). For example, the invisible work in diagnosis is characterized by practices such as re-collecting the accuracy by which categories have been applied by other practitioners. Yet, not all routine diagnostic work is invisible work, and diagnosis also consists of the coordination of actors dividing, structuring, and scheduling their interdependent activities so that it is clear how work is carried out (Strauss, Fagerhaugh et al. 1985; Gerson and Star 1986). To coordinate diagnosis from this perspective is thus an important effort for handling the interdependencies of the various interlinked activities (Lundberg and Tellioglu 1999).

Finally, an important part of the initial diagnostic work in the area of cancer relates to the shifting urgency of patients causing a shift in the diagnosing – and yet we may talk about this work as following a plan. I refer to the activities required to manage these shifts in urgency as *inclination work*. The inclination work in cancer diagnosis is the work involved in defining the right level of specialization in time and place when the seriousness and direction of a patient's symptoms of disease is not clear. A long-lasting cough may be just that – or it may be a first symptom of lung cancer. This inclination work of considering sending the patient to a place with a higher level of expertise is interesting for the area of cancer precisely because it is related to the overall plan for work: It is characterized by actors realizing alternative routes of action or when to bring the routine to a temporary halt. The focus of the dissertation is the diagnostic work that precedes a suspicion of cancer. This particular type of work is embedded within routine diagnostic work; however, due to the contingencies and complexities of diagnostic work, exceptions may always occur. Routines constitute a set of possible courses or patterns rather than a single course (Feldman 2000). That cancer is perceived as the more “rare” case from the perspective of, for example, a GP, does not make cancer an “exception” in terms of how patients are handled within the overall plan for work. Diagnostic work in general is characterized by the huge diversity in patients’ course of disease (Strauss, Fagerhaugh et al. 1985; Jutel 2009; Jutel 2011). However, at some point for some patients it becomes necessary to step up the level of specialization to ensure effective action. To address this slightly more systemic change in the overall plan for work, we need to examine the inclination work of the initial diagnosing process.

Beginning with the concept of invisible work, I will show how it is crucial to understand this aspect of diagnostic work in relation to the diagnosis of what may turn out to be cancer. I will then turn to the concept of coordination in diagnosis and demonstrate how inclination work is crucial for the practical accomplishment of diagnostic work.

2.1 Invisible work in diagnosis

As noted, an important part of diagnostic work is rendered invisible from the perspective of formal representations or resources for action – or what is sometimes referred to in CSCW as plans (Suchman 1987; Schmidt 1997; Star and Strauss 1999). This happens for different reasons that we need to understand. In some cases invisible work is rendered invisible because it simply does not count as work or because its legitimacy can be questioned (Star and Strauss 1999). In other cases, it is so much a routine or part of the regular work that it is taken for granted, which again renders it invisible in, for example, formal resources (Star and Strauss 1999). Consequently, invisible work is crucial for understanding how diagnosis is carried out in practice. Invisible work is traditionally a matter for the feminist strand of CSCW-research, and in relation to medical work gender is certainly an issue (Markussen 1996; Timmermans, Bowker et al. 1998; Forsythe 2001). In the area of cancer, part of the diagnostic work is also rendered invisible, but I will argue here that it has less to do with gender and more to do with the discretionary nature of this diagnostic work. Previous research defines discretionary work as the practices that get things back on course (Schmidt and Bannon 1992; Star and Strauss 1999). Nevertheless, in relation to diagnostic work this definition fails to address much of the discretionary work of, for example, secretaries and physicians involved in diagnosing patients. The type of discretionary work that is important for diagnosing cancer implies practices of interpreting other practitioners' categorizations of a patient in a certain way to determine the course of events. What we can learn from the feminist strand of the CSCW-literature is that categories have politics: When a perspective is made visible another is silenced (Suchman 1994; Symon, Long et al. 1996; Bowker and Star 2000; Bjørn and Balka 2007). Specifically, in the area of cancer, whether a patient is categorized as "obs cancer" or not makes a difference in terms of how the diagnosis is carried out. Staying with the metaphor of Star and Strauss, the silent layers of interpretive practices involved in diagnosing patients in due time is embedded in the arenas of voice under the general rubric of categorization. The invisible layers of interpreting practices are constantly negotiated against the visible arenas of categorization that are taken for granted into practices of shuffling and re-shuffling queues of patients. This negotiation of patients queuing for diagnostic examinations is a crucial part of making the context and what counts in the process of categorizing patients (Star and Strauss 1999).

Diagnosis is a classification tool of medicine used in diagnostic work (Bowker and Star 2000; Martin, O'Neill et al. 2007; Randall, Sharrock et al. 2007). And, diagnostic work involves a pre-existing set of categories (i.e., diagnoses) that have been agreed upon by the medical profession to recognize a particular condition in combination with the actual process by which such categories are applied (Blaxter 1978; Jutel 2009). The diagnostic categories are applied so as to help actors close ends in the definitive part of the diagnosing process (Kane and Luz 2009). There are several criteria at play when such categories are applied; for example, it was found in a study of radiology services that actors in collaborating departments would classify all examinations as (at least) urgent; the non-urgent category was believed to postpone the examination of a patient (Symon, Long et al. 1996). This in turn led the radiologists to make their own interpretation of the categorization of patients, and the re-categorization was rarely fed back to the referring physician (Symon, Long et al. 1996). Although categorization influences the course of diagnosis in a certain direction, there needs to be reasonable grounds to believe there is enough resemblance of elements to categorize a patient in a certain way (Jutel 2009). The process that precedes the application of a formal category is not all about negotiating medical symptoms; as one study of the investigation of potential suicides suggests, it includes moral concerns as well (Timmermans 2007). In the case of cancer it is essential that a patient is categorized in due time to get the potential disease under control, although there are complex, moral issues at stake, such as the prioritizing between patients. Classification schemes to categorize patients are spatial, temporal, and spatial-temporal segmentations of the world (Bowker and Star 2000). To decide where a patient fits in the various different queues for diagnostic examinations, we rely on classification schemes that help us divide, structure, and schedule work, for example, according to the level of specialization in medicine. In this way, categorization and invisible work in the area of cancer are closely interlinked by the discretionary nature of the work involved in making categories work in practice.

The invisible work in the initial process of diagnosing patients thus characterizes the discretionary activities involved in interpreting the accuracy by which categories have been applied so as to avoid preliminary courses of action or postpone actions, because this can, in both cases, be harmful to the patient – and other patients as well.

2.2 Coordination in diagnosis

The performance of diagnostic work typically relies on different types of specialties (servicing and clinical specialties) and is thus essentially collaborative. To diagnose cancer in due time sometimes takes time – time during which the disease will typically progress (Hamilton 2009; Tørring 2011). Accordingly, the actors involved in diagnosis are profoundly affected by temporal images; the actors run faster when they perceive that a patient needs acute care (Strauss, Fagerhaugh et al. 1985; Ellingsen 2003). In this way, coordinating the diagnosis of cancer is not simply a matter of coordinating the "clock time" work across the collaborating actors; the individual course of disease makes it necessary also to coordinate what counts as "in time" work, or what I refer to here as *due time*. Clock time may be contrasted with due time through the understanding that in due time, "the past, the present and the future are not situated on a line, that is to say, linearly spatialised" (Michael 2000: 21). The passing of time in diagnosis is structured by clock time to effectively coordinate an activity with its other related activities (Bardram 2000). However, it is also structured by the socially ordered time of, for example, work rhythms – similar to the way we understand "seasons of the year" and "stages of life" – when activities have to be connected in a certain way (Reddy, Dourish et al. 2006). The concept of due time, however, has no general definition (in contrast to clock time) – it is an after-the-fact category that can only be defined in the particular situation. This lack of general definition means it is not possible to know a priori what constitutes due time for a given course of disease and therefore what the perfect timing of diagnosis would have been. Even so, the concept of due time is essential to diagnosing patients while it is still possible to treat the disease. Thus, when diagnostic work is coordinated it is a matter of actors getting a mutual understanding of, on the one hand, the clock time course of work, and, on the other hand, due time in relation to the disease's perceived course of development.

To illustrate the complexity of coordinating due time, we may consider the diagnosis of prostate cancer. In the specific case of prostate cancer, if a patient is not sick from the cancer, diagnosis may cause more harm to a patient than the disease itself (Borre and Iversen 2007; Iversen and Røder 2010). Thus, in the case of prostate cancer, the diagnostic test itself can be quite damaging to the prostate tissue. The continuous reconciliation to the course of disease is crucial, the example illustrates, to making decisions about the next medical step that is appropriate given the risk for the particular patient. Prostate cancer, in contrast with most other types of cancer, is often not fatal (Borre and Iversen 2007; Iversen and Røder 2010). However, this example is useful to illustrate the complexity of cancer diagnosis related to decisions about risk. The coordination of due time, in terms of the slower progression of this particular type of cancer, emphasizes the role of what is referred to in CSCW as due process – that is, the continuous reconciliation of work to the situated contingencies (Gerson and Star 1986). This reconciliation also depends on the situated options for treating the disease (even when the diagnosis is somewhat uncertain) while the practices of diagnosing and treating are enmeshed (Mol and Elsman 1996). The coordination of due time by, for example, actors' descriptions of their assessment of timely action makes room for the disorderly elements of diagnosis that are not entirely compatible with categories of disease embedded in, for example, booking systems. However, in general, time tends only to be handled explicitly when the focus is, for example, the booking and turnover of particular importance to actors' coordination of work (Strauss, Fagerhaugh et al. 1985).

To coordinate due time, actors rely on what is referred to in CSCW as articulation work (Blumer 1969; Bannon and Schmidt 1989; Clement and Wagner 1995; Schmidt and Simone 1996). Articulation work helps actors to mediate and manage their interlinked activities (Gerson and Star 1986; Schmidt and Bannon 1992). Articulation work thus defines activities in which actors achieve coordination that makes their collective efforts add up to more than bits of accomplished work (Strauss, Fagerhaugh et al. 1985; Symon, Long et al. 1996). Accordingly, the coordination of due time relies on articulation work in which actors depend on getting a mutual understanding of the course of disease, including any disorder (symptoms when there are no other indications of disease) that is relevant, to make sure the diagnosis eventually arrives at an orderly whole. This disorder of diagnosis is in some cases the "clue" that eventually leads practitioners to consider serious diagnoses such as cancer. Though, the importance of articulation work also causes a tension between cooperation and conflict embedded in the collaborative work (Symon, Long et al. 1996; Ellingsen and Obstfelder 2007). Indeed, conflict is somewhat commonplace in medical work (Moser 2010). In relation to the initial diagnostic work, the coordination across specialties, hospitals, and sectors will necessarily imply conflict and not just cooperation when negotiating what constitutes due time so that a patient does not jump queues ahead of other potentially more ill patients. However, it is not the difference in the presentation of the diagnosis that causes controversies – these types of controversies are rare in clinical work; rather, it is argued, controversies arise around the enabling actions and not the diagnosis as a fact (Street 2011 citing Mol 2002: 818). Thus, the essence of coordination by due time is how to coordinate action when practitioners suspect that the regular tests and practices are not sufficient to guide the diagnosis of a patient.

Coordination of the initial diagnosis is thus a state of work achieved by the collective of actors to handle the interdependencies of the various activities that are necessary for arriving at a diagnosis in time to treat the patient. Coordination, in this way, implies coordination both by due time and by clock time.

2.3 Inclination work in diagnosis

Diagnostic work is organized around the different "shapes" of medical specialties that make up the overall model for work in healthcare organizations (Strauss, Fagerhaugh et al. 1985; Symon, Long et al. 1996, Lundberg and Tellioglu 1999). In Denmark diagnostic work is also organized around different levels of specialization (local, regional, national). Thus, a crucial activity involved in diagnosis is the inclination work of actors to decide on the appropriate level of specialization within this overall organization of work. To ensure a high level of specialization, the Danish National Board of Health (NBoH) has defined requirements for the different medical specialties (infection medicine, immunology, oncology, etc.). These requirements are defined, for example, by the number of patients with a particular diagnosis per specialist that it takes to uphold the different levels of specialization. Although inclination work is closely tied to the coordination of the patient's course of disease, it is slightly more systemic than the regular distribution of work. Inclination work focuses on the overall organization of work, or what I refer to here as levels of specialization in clinical work. The inclination work is thus about a patient's shift in urgency causing a shift in the diagnosis at a merely systemic level; it involves decisions about what level of specialization is appropriate when practitioners are not able to find a solution to a problem – and not simply what specialties to involve in the diagnosing process.

Not being able to find the solution to a problem straight away is widely referred to as normal, natural trouble; thus, normal, natural trouble is part and parcel of the practical accomplishment of work in accord with rules of practice (Clarke, Hughes et al. 2006 citing Garfinkel: 24). Diagnosis usually follows a certain routine or course because actors have had much experience with dividing and structuring their work in that way, reflecting the characteristic "shape" of the medical specialties (Strauss, Fagerhaugh et al. 1985). The inclination work where a patient's course of disease, while being without clear direction, does not fit the shape of the medical specialties can easily be thwarted by the normal, natural trouble category. Thus, inclination work, as I define it here, starts precisely where actors realize they are not dealing with normal, natural trouble. These are the situations where actors realize that a higher level of specialization is required to diagnose a patient. In contrast, normal, natural trouble is related to workarounds that primarily solve problems locally and temporarily (Gerson and Star 1986). Normal, natural trouble defines situations where rules or routines are not considered broken, just compromised (Clarke, Hughes et al. 2006). Routines are important because (as with diagnosis) most of the work is performed routinely (Strauss, Fagerhaugh et al. 1985; Feldman 2000; Schmidt, Wagner et al. 2007). Routines are sets of possible courses of action, rather than a single course, which are effortful and emergent through actors' practice (Feldman 2000). Inclination work is thus part of the routine diagnostic work. Nevertheless, the important question is not when something is routine work but rather whether the practitioners are able to recognize alternative routes of action or when to bring the routine to a temporary halt (Feldman 2000). The normal, natural trouble stops where the balance tips over to be slightly more systemic.

To be able to realize alternative routes for action rather than dealing with a problem as normal, natural trouble, actors may rely on formal resources – or what has also been referred to as plans (Suchman 1987; Schmidt 1997; Suchman 2007). Plans are abstract constructions to be applied under particular circumstances, and plans involve more activities than can be specified by a literal interpretation to work in accordance with the plan (Randall, Harper et al. 2007). The plans involved in diagnosis guide practice, but there are also more precise scripts of particular steps of work that will always have to be conducted in the same order (Schmidt 1997). The routine by which patients are signed up for diagnostic examinations in Denmark follows the principle that patients are seen first by a GP or a specialist of general symptoms of disease. Therefore, in terms of cancer, it is an important part of the diagnostic work that actors are able to realize when to change the routine by which diagnostic examinations are applied. For example, when a patient is suspected to have cancer it may be necessary to discard the course of diagnostic examinations that apply to patients that are not acutely ill. The formal resources for action in the area of cancer in this case may help actors shift the course of routine by defining the patient as being acutely ill. From this perspective, plans support the inclination work involved in diagnosis by legitimizing alternative routes for action that otherwise only apply to, for example, the acute patients handled by acute care departments (e.g., how long it can take before a patient is scanned). Plans can thus help actors handle the complexity when work becomes distributed and involves various actors, thereby making the articulation work extremely complex and demanding (Schmidt and Bannon 1992). However, the plan itself does not change the state of affairs, but it will have to be enacted.

Inclination work in the initial diagnosing process thus defines actors realizing alternatives to the routine or bringing the routine to a temporary halt at a slightly more systemic level than when diagnosis is straightforward. To do so, actors may rely on formal resources to help them shift the course of action and coordinate this with collaborating actors.

2.4 Summary

In this chapter, I have introduced the theoretical positioning of the dissertation: Three aspects of collaborative work are particularly relevant for understanding the diagnostic work that precedes the occurrence of the suspicion that a patient has cancer, respectively, the "invisible" aspects of diagnostic work, the "coordinative" aspects, and the aspects of "inclination". The invisible work involved in initial diagnosis is characterized by the discretionary activities involved, for example, in interpreting the accuracy by which categories have been applied so as to avoid preliminary courses of action or postpone actions. In this way, categorization and invisible work in the area of cancer are closely interlinked by the discretionary nature of the work involved in making categories work in practice, which often disappears in formal plans for work. In initial diagnosis, coordination is the state of work achieved by the collective of actors to handle the interdependencies of the various activities that are necessary for arriving at a diagnosis in time to treat the patient. This coordination of initial diagnosis relies on actors' mutual understanding of both clock time and due time. Coordination of due time thus characterizes actors' reconciliation to the situated options and what is seen as the appropriate thing to do. In relation to the routine diagnostic work, the shifts that occur in the course of actions reflect the inclination work in initial diagnosis. The inclination work begins where the balance of dealing with trouble in diagnosis tips over and becomes slightly more systemic. To change the course of actions, actors may rely on plans; thus, plans from this perspective may support the inclination work involved in initial diagnosis by legitimizing alternative routes for action that otherwise apply to patients that need to be seen as acute.

In the following chapter I reflect on the research method of the dissertation and what this means for how I have studied the initial diagnostic work. I draw upon workplace studies in the tradition of CSCW.

3 Workplace studies

In this dissertation I explore, through in-depth ethnographic studies, the diagnostic work that precedes a suspicion of cancer. The perspective is best characterized as workplace studies in the tradition of CSCW (Luff, Hindmarsh et al. 2000). In the CSCW tradition, workplace studies have been particularly concerned with the type of work characterized as collaborative work or cooperative work. This dissertation positions itself within the line of CSCW workplace studies that draw in particular from symbolic interactionism (e.g., Blumer 1969). Broadly, the dissertation contributes to research about the complexities of collaborative work practices (e.g., Star and Griesemer 1989; Symon, Long et al. 1996; Star and Strauss 1999; Forsythe 2001). Scholars in the area of symbolic interactionism such as George Herbert Mead (1863-1931), Herbert Blumer (1900-1987), and Anselm L. Strauss (1916-1996) began to conduct studies of particular forms of work during the mid 1950s (Dourish 2004). These studies drew our attention to the ways in which actors make sense of the world as they interact with one another using symbols, for example, rules, roles, or documents (Blumer 1969). As workplace studies moved into more interdisciplinary strands of research, including CSCW, their purpose also became somewhat broader than producing empirical descriptions of work (Luff, Hindmarsh et al. 2000). The particular interest of workplace studies in the tradition of CSCW became to understand the nature of collaboration and to develop concepts on this basis to provide better technology support to the people that would be carrying out the work (Schmidt and Bannon 1992). Early CSCW workplace studies emphasized how, for example, actors handled particular types of work collaboratively, often where the collaborative nature of this work was not obvious (e.g., Strauss, Fagerhaugh et al. 1985; Symon, Long et al. 1996; Star and Strauss 1999; Forsythe 2001).

These workplace studies that came out of research around symbolic interactionism helped me understand issues that I previously engaged with as a political scientist and in the NBoH from a new perspective. I discovered that my previous training as a political scientist and engagement with policy linked with my interest in understanding practice within the perspective of CSCW workplace studies that draw on symbolic interactionism. To illustrate this link, I will consider an example provided by Strauss. With this example of diagnostic practice Strauss demonstrates how the wider context including policy is crucial to understand the complexity of such practice (Strauss 1993). Thus, what the following example shows is the interdependence of everyday practice and wider societal and political conditions in relation to which this practice (diagnosis) unfolds. The example highlights the importance of also having an understanding of the wider context in the analysis of specific work practices. And, it illustrates how I see my previous experience link with practice studies. In Strauss' example, diagnosis of a patient was delayed because latex gloves were out of stock at the retailer, and the latex gloves were out of stock at the retailer because the national guidelines on the prevention of AIDS had just been released, prescribing use of latex gloves for more types of diagnostic examinations. Thus, what Strauss argues is that understanding what conditions were operating in a particular situation where a practice was carried out may help us understand the depth of that practice and how it connects to other practices and phenomena (Ibid: 62).

In the following section, I elaborate on how workplace studies rely on ethnography in the tradition of CSCW.

3.1 Ethnography in workplace studies

Ethnography is often considered a specific perspective on the world when studies of work are conducted from the point of view of CSCW (Randall, Harper et al. 2007). Thus, ethnography is not only a tool or a technique, but also a way of engaging with the world. Ethnography has played a central role to understand work as situated and socially embedded (Symon, Long et al. 1996; Forsythe 2001; Schmidt 2000; Suchman 2000; Slack, Procter et al. 2010). The social organization of work thus includes what is being worked on, the assemblage of tasks, and the interrelations among workers (Strauss, Fagerhaugh et al. 1985). The strength of ethnography, compared with other research strategies (e.g., surveys), is that it produces an understanding of everyday work as it is accomplished (Emerson, Fretz et al. 1995). The ethnographic study allows the researcher to use the "situated" observation of, for example, a work practice to understand the complexity of the "whole" or overall work setup (Eisenhardt 1989). The value of ethnography to CSCW is closely related to the continuous development of concepts through various workplace studies and the deeper understanding of certain work practices brought about by these studies (Plowman, Rogers et al. 1995; Schmidt 2000; Schmidt 2011). This way of building concepts is clearly demonstrated in a recent special issue on diagnostic work that contains studies that emphasize the variety of physicians', mechanics', technicians', operators', and others' diagnostic work (Büscher, O'Neill et al. 2009). Here it is illustrated, for example, how diagnostic work is generally a social practice of identifying problems while scoping for solutions to these problems (ibid).

Although debated, in CSCW there is general agreement that ethnography goes on for a prolonged period of time in order to be able to answer questions on how practices are socially embedded (Randall, Harper et al. 2007). The research strategy of ethnography very much depends on the researcher, as she is her own research instrument, seeking to immerse herself in data (Glaser and Strauss 1967). Thus, ethnography allows the researcher to become sensitive to the matter studied relying also on her disciplinary origins and interdisciplinary interests (Randall, Harper et al. 2007). An iterative process where one shifts between collecting and contesting data is one strategy for the researcher to obtain this sensitivity (Klein and Myers 1999). To elaborate, the iterative process is a matter of writing up data on several levels through several rounds of challenging those data (e.g., observations of avoidance in coordination activities → concepts on active coordination? → concepts on avoidance? → coordination by avoidance?). In this process of writing up data, the categories may be articulated in various ways; and in practice, the process is also not as straightforward and includes the contesting of data against various other concepts.

However, often what is reported in research papers on the process of writing up data is only the result of the process of how data was coded or categorized (Emerson, Fretz et al. 1995). The researcher is typically the only one who knows just how many “iterations” took place to craft the research paper. These iterations forms a process of getting to the point where only marginal change is required to come to a conceptual understanding that is robust enough also to describe a work practice or phenomenon in different but similar situations. The process of writing up data is thus constituted by reaching a point where the researcher finds the account is adequate and there is no need to articulate categories differently – while the ethnographic research strategy can never provide a full account of reality (Emerson, Fretz et al. 1995). Part of the iterative process involves contesting the interpretations and categorizations by considering, for example, if the researcher and practitioners have different interpretations (Klein and Myers 1999). To describe this process of how we as researchers develop analytical concepts that may help us to support a particular type of work by better understanding this work is complex; therefore, it is crucial that it is clear to peers how the research process proceeded, making it possible for peers to evaluate one’s studies (Klein and Myers 1999).

3.2 Workplace studies in this dissertation

While my overall interest in this dissertation is studying the diagnostic work that precedes a suspicion of cancer, I was quite aware from the beginning of my research that I was not looking for sites of cancer specialists. The challenges that I had observed during my employment with the NBoH did not pertain to the definitive part of the diagnostic work; rather, the important challenges were concerning the initial diagnostic work. This insight guided me to particular field sites early on in the study. To anticipate whether the focus on the initial diagnostic work preceding a suspicion of cancer would, in fact, allow me to investigate the challenges I encountered in the NBoH, I contacted a radiology department to conduct a small preliminary study. Altogether, the preliminary study involved 14 hours of observations. The work unfolding in a radiology department is quite important for the diagnosis of cancer – whether it is already suspected or detected by coincidence. The radiology department, I assumed, would have patients referred to it who did not fulfill the criteria prescribed by the NBoH Danish standardized cancer pathways. I was interested in the practices of collaboration and coordination that subjected these patients to further diagnosis. The observations in the radiology department took me to the secretaries' office, where referrals of patients were received. Handling referrals of patients included sorting. This sorting was based on the referrals stating, for example, the reason a scan was needed and how fast it was needed. During my previous work with the Danish standardized cancer pathways, I had not considered yet these settings. For example, I had to reconsider my assumptions about the nature of diagnostic work and where it takes place (Klein and Myers 1999). Notably, the cancer pathways of the NBoH do not explicitly mention secretaries' work. However, during my observations I found out that diagnostic work was taking place in the offices of secretaries and by the plastic trays used for administrative purposes (see cover photo) because this is where important practices such as sorting of patients are also carried out.

In my preliminary study, the radiology department secretary explained how the sorting of patients relied on the particular GP's referral pattern. They used this pattern to interpret the information stated on the referral of a patient. The secretary explained to me that they got information about the GP's referral pattern from a database. This example immediately captured my interest because it implied a dimension to sorting patients that was not based on interpretation. After further conversations about this database, it became clear that there was, in fact, no database in a technical sense. However, the practitioners in the radiology department still remembered the referral patterns of the GPs, the secretary insisted. The preliminary study changed my focus to one aimed at the sorting of patients and how this specific practice is socially embedded. Secretaries in the radiology department receive the referrals of patients electronically, and in this way they are involved in sorting patients, as I describe in more detail in Chapter 4. Thus, I decided to initiate my observations in both a GP's office (often the senders of referrals) and in the secretaries' office in the radiology department (the receivers of referrals), in addition to observations in radiologists' office space at Køge Sygehus, which became the primary site of my studies. I shall go into details on the site of the studies in the following section. Moreover, I decided to include an outpatient clinic in the medical department at Køge Sygehus as well as the section that receives patients before sending them on to one of the other sub-specialized sections of the medical department. During my studies in the medical department at Køge Sygehus I also conducted observations in the secretaries' office spaces. The medical department has patients referred by the GP's office on a regular basis. Figure 2 illustrates the formal distribution of responsibility in the diagnosis process when a patient is referred to the medical department. Although it is the radiology department that conducts the radiology work (MR-scan, CT-scan, etc.) and the lab that conducts the sample work (blood tests, urine tests, etc.), the medical department is formally responsible for the follow-up, as Figure 2 illustrates. I decided to focus on the radiology department and the medical department because these two departments are often involved when patients have unclear symptoms of disease. The medical department specializes in diagnosing general symptoms of disease, including, for example, a patient whose symptoms may point to pneumonia but who has also lost weight and for this reason is referred to the medical department for a more thorough diagnosis. The radiology department gets involved in the initial diagnostic work when a suspicion, which is, for example, located to a particular organ or part of the body, needs to be further addressed.

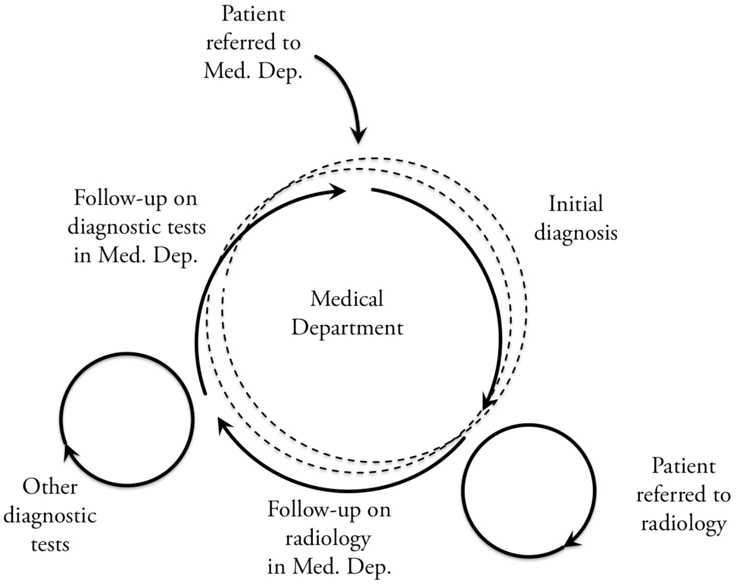

Figure 2. Distribution of responsibilities in the initial diagnosis process

A number of patients are diagnosed with cancer every year, although this is not a specialty of Køge Sygehus. The formal responsibility for patients, when the result of the assessment is a reasonable suspicion of cancer, is allocated to the sister hospital, Roskilde Sygehus. Therefore, I assumed that I would be able to observe the patients without clear symptoms of cancer at Køge Sygehus. This assumption turned out to be right; thus, in various situations patients were referred to Køge Sygehus because of a slight suspicion of cancer. These patients had been particularly difficult to include in the Danish standardized cancer pathways during my time at the NBoH. In the secretaries' office I became interested in the intersection between physicians' and secretaries' work. Physicians regularly stopped by the secretaries' office. They did so to assess referrals or to discuss with the secretaries the handling of a patient, among other things. Physicians' diagnostic work is at the core of the NBoH cancer pathways (Figure 1). However, the collaboration that I observed between secretaries and physicians focused my attention more on the intersections of clinical and administrative work. This work seemed crucial for the diagnosis of patients across specialties, hospitals, and sectors. Technologies, such as the electronic information systems supporting the diagnostic work, were the focus of interest wherever it influenced the diagnostic work. In total, I conducted 118 hours of observation at the medical department and the radiology department at Køge Sygehus, including the GP's office that was collaborating with Køge Sygehus. Per week, I spent 2–3 days at these sites, during which I produced field notes, which I later transcribed. The data collection was conducted over a period of 13 months. Observations typically lasted for most of the day to get a feel for the rhythm of the diagnostic work.

The study in the US was conducted at a medical department also specializing in patients with general symptoms of disease that sometimes turn out to be a first sign of cancer. Thus, the US medical department diagnoses a number of cancer patients every year, much like the Danish medical department. The US case was crucial for me being able to see more clearly issues in diagnostic work particular to the Danish case. Diagnostic work in the US case and the Danish case rely on similar practices, but the organization of work and the use of technology are different. Per week, I spent 2–3 days at this site, as with the Danish study, during which I produced field notes, which I later transcribed. The data collection was conducted over a period of 2 months. In the US case, as with the Danish case, the observations typically lasted for most of a day. Altogether, the US study consisted of 40 hours of observations and is thus similar in length to the study of the Danish medical department. Yet, as mentioned in Chapter 1, the organization of diagnostic work and the use of technology in the US case were quite different from the Danish case. The conditions for carrying out diagnostic work were obviously not the same, I soon realized, when I observed how in the US case mundane collaborative technologies were used in a different way to what I had previously observed in the Danish case. The US case therefore provided a different and quite important opportunity to understand diagnostic work in the Danish case in more depth. For instance, I compared the US case and the Danish case, and this comparison resulted in the research paper on how continuity of care is achieved differently in these two cases, which is included in Part II of this dissertation. The following section presents in more detail the research sites looked at in this dissertation: A GP's office located in the local area of Køge Sygehus in Denmark, the Danish hospital (Køge Sygehus), and the US hospital, which has to remain anonymous due to regulations about these matters in the US.

3.3 The sites in the workplace studies

GP's office: The GP's office where I conducted observations has five GPs associated with it and one GP in training, three secretaries, three nurses, and one laboratory technician. When a GP encountered a potential cancer-related complaint, the GP might refer the patient to a hospital for further examination. This was often Køge Sygehus. Depending on the patient's symptoms, the GP might also refer the patient to a private specialist. If there was a reasonable suspicion that the patient had cancer, the GP could refer the patient directly to a hospital specializing in cancer treatment (Roskilde Sygehus). In Denmark, a patient cannot be admitted to a Danish hospital without being referred by either a GP, a private working specialist, or directly by the hospital's acute care section.

Danish hospital: The teaching hospital where I conducted my studies in Denmark specializes in patients with general symptoms of disease that sometimes turn out to be a first sign of cancer. The hospital, Køge Sygehus, which is in the process of becoming a university hospital, employs more than 1,300 personnel serving more than 110,000 outpatient visits to the hospital and more than 39,000 inpatient visits per year. The medical department is organized into 5 wards and 5 outpatient clinics. The wards are sub-specialized in, for example, initiating diagnosis of medical patients (AVA), or specialized diagnosis of patients with symptoms of diabetes, heart disease, etc. The radiology department is just one ward, though, and it is divided into sub-specialties, for example, CT-scans (CAT), MR-scans (MRI), ultrasound, etc.

US hospital: The university hospital where I conducted my studies in the US specializes in patients presenting both general symptoms of disease and more specific symptoms of disease, such as cancer-related symptoms. The hospital employs more than 3,500 personnel serving more than 300,000 outpatient visits to the hospital and nearly 17,000 inpatient visits per year. The medical department, which I focused on, is organized into six teams (not sub-specialized). Each team admits up to 20 patients. While the team is located on a particular floor of the hospital, patients are spread out on different floors.

3.3.1 Data collection

The following section provides an overview of the data collected, which serves as the foundation for the research papers presented in Part II of this dissertation. Throughout my studies it has been important for me to trace the standardized cancer pathways and how they are enacted in practice before the essential decision to assign a patient to a standardized cancer pathway or not. Thus, an important motivation for this dissertation has been to understand the relationship between the formal resources guiding work and the practical work.

Observation studies: I first observed a version of the cancer pathways in the GP's office as a one-page version of the NBoH standardized cancer pathways, which had been provided by the local health region and printed by the GP herself (Appendix A). The next time I observed a version of the cancer pathways was in the secretaries' office in the radiology department at Køge Sygehus, as a memo on booking practices when patients are suspected to have cancer (Appendix B). These different versions of the Danish standardized cancer pathways helped me understand connections between practices across specialties, hospitals, and sectors. Other artefacts collected in the studies were, for example, physicians' work schedules, pre-defined schemes for sorting patients, or copies of patient records when the patient turned out to have cancer. The standardized cancer pathways and various other artefacts in general were a central data source in the observational studies. Besides helping me understand the relationship between formal and informal practices, the collection of artefacts was important for me to gain insight into the conditions of how initial diagnostic work was accomplished. Artefacts repeatedly pointed me toward certain places as essential sites for observing coordination practices. Table 3.3.1.1 gives an overview of the observational studies and how observations proceeded over time. The table presents an overview of the variety of practices that are involved in the initial diagnostic work; however, even this apparently comprehensive list of practices is simplified and should not in any way be seen as complete. For example, the discretionary practices of diagnostic work have been difficult to represent in the table. Also, the table gives an impression of how my studies progressed, from the preliminary study of a radiology department to the more in-depth studies. The table also reveals a range of practices that could have been further explored in the dissertation; one example would be practices involved in “clustering” or re-configuring “codes” for making the booking of patients more effective. The secretaries, I found, “cluster” or re-configure these “codes” embedded in the electronic booking system to make the booking of patients’ smoother. These practices emphasize the importance of making electronic healthcare information systems configurable to users. However, this was not my focus in this dissertation.

Table 3.3.1.1: Observation studies

Preliminary studies			
Study	**Length**	**Location**	**Observations**
Feb. 2009	10 h	Radiology department at hospital (DK)	Observations of the work of secretaries and a radiographer responsible for the electronic information system for booking: assessing referrals; coordinating diagnostic examinations with patients; communicating responses to GPs and other referring physicians; coordinating places, people, equipment, and patients; adjusting the balance of "slots" for different types of diagnostic examinations.
Feb. 2009	4 h	GP's office separate from hospital (DK)	Observations of the work of a GP focusing in particular on the handling of patient data in the electronic information systems: assessing patients' symptoms; requesting diagnostic examinations; checking mail box; seeking the right codes for referring patients to certain places; reading formal guidelines; coordinating patients with secretaries, calling other physicians to coordinate further diagnosis.
March 2010	4 h	GP's office at hospital (US)	Observations of the work of a GP focusing in particular on the handling of patient data in the electronic information systems: assessing patients; symptoms; requesting diagnostic examinations; printing information for patients and communicating plans; searching for the right codes; coordinating patients with physician's assistant; calling other physicians to coordinate further diagnosis.

Danish study			
Study	**Length**	**Location**	**Observations**
July 2009	27 h	GP's office separate from hospital (DK)	Observations of the work of 3 different GPs, secretaries, and patients focusing in particular on the consultations with patients and communicating and coordinating with external actors: checking mail box; consulting with patients by phone; consulting with patients; reading secretaries' registrations of patients' complaints in electronic calendar; reading patients' records; assessing patients' symptoms; physically examining patients; researching possible courses in the healthcare system; reading guidelines; searching for the right "codes" for referral of patients and places; requesting diagnostic examinations; communicating activities, assessment, and plans to patients; filling in forms (records, referrals, medication, request from municipalities, employers, employee, etc.); assessing results of diagnostic examinations; registering activities, assessments, and plans; coordinating patients with secretaries; calling other physicians and/or secretaries to coordinate diagnostic examinations, researching particular symptoms of disease by various sources (handbooks, Internet, information from medical institutions, etc.); receiving consults/training from other physicians.

Study	Length	Location	Observations
Aug. – Dec. 2009 Nov. 2010	40 h	Radiology department at hospital (DK)	Observations of the work of secretaries, radiographers, radiologists, and porters handling patients and communicating and coordinating with collaborating actors: managing incoming referrals of patients; assessing urgency of referrals; registering the status of referrals and scheduling of patients electronically; attending conferences with collaborating departments (medical department, surgical department, etc.); coordinating distribution of the daily work by the whiteboard; answering phones of patients and physicians calling in; starting and adjusting scanners for particular types of diagnostic examinations; adjusting settings for scanners and radiology equipment; assuring safety procedures; requesting images from prior diagnostic examinations; coordinating patients waiting for diagnostic examinations with collaborating departments; attending internal meetings in the radiology department; retrieving images and describing them; comparing images; reading patients' records; coordinating equipment, patients, physicians, and places; conferencing with other physicians, secretaries, radiographers regarding the result of scans; re-scheduling patients; moving patients; reading guidelines; adjusting slots and codes for scheduling.

Study	Length	Location	Observations
Aug. – Nov. 2009 Dec. 2010	51 h	Medical department at hospital (DK)	Observations of the work of secretaries, specialists of internal medicine, and nurses handling patients and communicating and coordinating with collaborating actors: Managing incoming referrals of patients; assessing urgency of referrals; coordinating responsibility for patients, status, and priority on whiteboard; attending conferences with collaborating departments (radiology department, cross-disciplinary conferences); providing curb-side consults in other departments; responding to pagers when on-call; answering phones; coordinating patients waiting for diagnostic examinations with collaborating departments; attending internal meetings in the medical department; retrieving results of diagnostic examinations; adjusting medicine and measuring vitals; reading patients' records; registering activities; filling in electronic forms (medication, requests for test, records, etc.); conducting rounds by patients' bedsides in the medical department; conferencing status of patients with new shift of physicians and nurses; communicating with GPs and other relevant collaborating actors; moving patients; reading guidelines; receiving consultations/training from other secretaries, physicians, nurses; dictating assessment of patients status; discharging patients to collaborating hospital departments or GP; requesting paper records; filing printed continuation, etc., in paper version of patient record; calling collaborating actors to find way through the healthcare system when patient needs to be handled at a higher level of specialization.

US study			
Study	**Length**	**Location**	**Observations**
Mar. – Apr. 2010	40 h	Medical department at hospital (US)	Observations of the work of 3 different medical teams in the hospital medical department focusing in particular on the handling of patients and the communication and coordination with collaborating actors: admitting patients (when on-call); assessing urgency of patients' symptoms; coordinating responsibility for patients, status, and priority on the team whiteboard; providing curb-side consults in other departments; providing family consults with the team's patients; responding to text messages on pagers and calls; requesting consults from specialists in other hospital departments; requesting diagnostic examinations; consulting patients and family; consulting social worker and case manager and in some cases the patient's insurance company/provider; providing collective curb-side consults/rounds at patients' bed sides in the team; retrieving results of diagnostic examinations; adjusting medicine and measuring vitals; reading patients' records; registering activities; filling in electronic and paper forms (medication, requests for tests, records, administrative papers, etc.); conferencing status of patients with new team at the end of the teams rotation; conferencing status of patients with the new shift of nurses and nursing assistants; discharging patients; reading guidelines; receiving consultations/training from other physicians; sending samples by the hospital tube systems; calling private facilities (e.g., skilled nursing facility) when patient cannot be discharged to home.
Total	**176 h**		

Interviews: Interviews were another important data source and an integrated part of the observation studies. GPs may see a patient many times before they even suspect cancer. To be able to study patients that later turned out to have cancer, it was therefore important to conduct semi-structured interviews with GPs in addition to in situ interviews during observations. Three GPs were interviewed about the process of diagnosing cancer. The semi-structured interviews were based on quite open questions. The strategy was to interview the GPs about one of their most recent patients where they suspected cancer. The GPs were interviewed in between their consultations with patients, and the interviews lasted for around 20 minutes at a time. All GPs were interviewed next to their computers. This meant that they had access to electronic patient records to help them remember details. In the hospital departments, in situ interviews were conducted, especially when secretaries' and physicians' work took place on a computer. The point of these in situ interviews was to have the interviewees speak out loud as they conduct their work (Strauss, Fagerhaugh et al. 1985). Throughout the collection of data I also had various informal conversations, with, for example, former colleagues or people I collaborated with in the NBoH. I used these conversations both to contest my interpretations and to make interventions while the NBoH standardized cancer pathways are continuously being developed when they are updated every 2–3 years. In particular, I tried to raise the issue of secretaries' work. Table 3.3.1.2 provides an overview of the interviews that were conducted throughout the research project and how the focus on different groups of practitioners progressed. It is particularly obvious from this overview how other practitioners such as nurses were, to a large extent, rendered invisible from the perspective I have applied to understand the initial diagnostic work that precedes a suspicion of cancer. This is not surprising: Rendering a certain part of the diagnostic work visible will mean that other parts are rendered invisible, which in this case obviously means the subject position of nurses. However, what is also obvious from the overview provided by the table is the difference between the groups of practitioners that I have interviewed in the Danish and the US case: secretaries and residents, respectively. Although in both of these cases my aim was to get a better understanding of the initial diagnostic work, I was guided to different settings in the

Danish case and the US case. In the US case the electronic referral and booking is handled by the acute care section – or if the patient is seen in the outpatient clinic, it is handled by a call center located separately from the hospital departments. In the Danish case the electronic booking and referral is handled by secretaries' offices located in each of the clinical departments. The table also shows that in the US case the group of practitioners that I encountered in my studies of diagnostic work were known as "nursing assistants." Last, the table shows that my access to residents in the Danish case was limited in numbers compared to the US case. Although I did make an effort also to interview and have informal conversations with residents in the Danish case, they seemed to be less available than in the US case, where an attending physician had a team of 5 senior residents, residents, and students to carry out the daily tasks.

Table 3.3.1.2 Interviews and informal conversations

	Preliminary studies	
Interview date	**Location**	**Interviewee**
11/02/2009	Radiology department (B)	Radiographer responsible for electronic booking system (n=1)
17/02/2009	Oncology department	Specialist of cancer and lung disease involved in policy making (n=1)
20/02/2009	GP's office	GP1 (under training) and GP2 (experienced) (n=2)
25/03/2009	Radiology department (B)	Secretary with special training in the area of booking (n=1)
26/08/2009	Radiology department (A)	Chief physicians in the radiology dep. and the medical dep. (n=2)
04/11/2009	Cancer conference	Administrators on regional and national level (n=2)
02/03/2010	GP's office (US)	GPs using electronic healthcare information systems (n=2)

Danish study		
Interview date	Location	Interviewee
01/07/2009	GP's office	GP1 (n=1)
02/07/2009	GP's office	GP2 (n=1)
10/07/2009	GP’s office	GP1 and GP3 (n=2)
05/10/2009	Radiology department (A)	Radiologist (n=1), secretary (n=1)
06/10/2009	Radiology department (A)	Secretary (n=1), radiologist (n=1)
12/10/2009	Medical department	Secretary in medical secretariat (n=1)
13/10/2009	Medical department	Medical specialist (n=1)
15/10/2009	Medical department	Secretaries in outpatient clinic (n=2)
26/10/2010	Radiology department (A)	Secretary and front-desk secretary (n=1)
27/10/2009	Radiology department (A)	Radiographers in drop-in (n=1)
28/10/2009	Radiology department (A)	Radiographer (n=1), radiologist (n=1)
02/11/2009	Medical department	Medical specialist (n=1), nurse (n=1)
05/11/2009	Medical department	Secretary in AVA (n=1) surgeon (n=1)
27/10/2010	Medical department	Secretary in outpatient clinic (n=1)
28/10/2010	Medical department	Secretary in AVA (n=1)
19/11/2010	Radiology department (A)	Secretary and front-desk secretary (n=2)
15/12/2010	Radiology department (A)	Chief physician on protocols (n=1)

	US study	
Interview date	**Location**	**Interviewee**
20/03/2010	Medical department	Medical specialist (resident) (n=1)
21/03/2010	Medical department	Medical specialist (attending phys.) (n=1)
30/03/2010	Medical department	Medical specialist (resident) (n=2)
31/03/2010	Medical department	Nurse (n=1) and nursing ass. (n=1)
05/04/2010	Medical department	Medical specialist (resident) (n=1)
09/04/2010	Medical department	Medical specialist (attending phys.) (n=1)
12/04/2010	Medical department	Medical specialist (resident) (n=1)
Total		**46**

3.3.2 Data analysis

Overall, the data analysis followed an iterative process (as already mentioned; see Klein and Myers 1999). Therefore, the identification of interesting findings started during the data collection and continued throughout analytical write-ups of the empirical cases (Emerson, Fretz et al. 1995). To analyze data, I started experimenting with Clark's situational analysis at quite an early point in my studies (Clark 2005). Applying situated analysis I, for example, "mapped" secretaries' work in relation to exploring the complexity of booking practices and the material and social conditions for this practice. A different mode of analysis was derived from the literature as I tried to make use of a concept of expertise laid out by, for example, Wynne (1992) and Collins and Evans (2002) to understand secretaries' role in the diagnostic work as "experts" of coordination. Still, this concept was not sufficient, I found, to understand my observations of secretaries' work; something else was at stake, and it was only when I turned to the concept of clinical work that I realized how important the secretaries' role was in the initial diagnosis of patients with potential cancer. In this way, analytical writing (and by this I mean the in-process writing of analysis working through data again and again Emerson, Fretz et al. 1995) has been key throughout researching initial diagnostic work. Moreover, to contest my own analysis, I circulated my research papers in various drafts and discussed them in various settings, some academic. Also, on various occasions, and during observation studies in particular, I attempted to contest my analysis by presenting my findings to practitioners. Involving practitioners, to also validate my analysis, turned out to be challenging because even though research papers are focused on a certain issue and constrained to a limited number of pages, reading these papers is still a considerable extra task for busy practitioners. However, I did find that both physicians and secretaries appreciated that someone (me) had taken the time to study and describe their work with, for example, electronic booking and referrals. Secretaries and physicians encounter electronic booking and referral differently, and thus it was an obvious connection point to study encounters in the initial diagnostic work. I was interested not so much in the practice of booking or referring patients but in the encounters around these work practices, both formal and informal. To contest data and discuss these with practitioners is also part of obtaining sensitivity toward different interpretations (Klein and Myers 1999). I spent considerable time discussing my observations with practitioners (when I could not get them to read draft versions of papers) and communicating the essential points in meetings and through e-mail correspondence. Table 3.3.2.1 gives an overview of the processes that have taken place throughout the research project.

Table. 3.3.2.1 Contesting/communicating analysis by mail and/or meetings

Date	*Subject of dialogue*
10/07/2009	GP's office: Reflections on observation studies of consultations with patients with potential symptoms of cancer.
02/11/2009	Chief physician in the medical department: Reflections on observation studies of patients with potential symptoms of cancer.
05/11/2009	Medical specialist: Reflections on observation studies of patients with potential symptoms of cancer.
26/11/2009	Chief physician in the medical department: Reflections on electronic information system functionality.
18/12/2009	Chief physician in the radiology department: Presentation of findings and first draft of paper on *sorting practices*.
28/01/2010	Regional and national administrators/clinicians at the Copenhagen Conference on Cancer Services: Reflections on sorting practices and standardized cancer pathways.
17/03/2010	GP's office: Presentation of findings and first draft of paper on *sorting practices*.
29/03/2010	US medical specialist: Reflections on observation studies of diagnosis in DK and US.
04/04/2010	US medical specialist (under training): Reflections on observation studies of diagnosis in DK and US.
18/05/2010	National administrators/clinicians at the National Board of Health: Presentation of findings and first draft of paper on *sorting practices.*
30/07/2010	National administrator/clinician at the National Board of Health: Discussion of technicalities.
09/09/2010	Chief physician in the radiology department and medical department: Discussion of findings and draft paper on *coordination by avoidance*.

Date	*Subject of dialogue*
18/10/2010	Chief physician in the medical department and the radiology department: Presentation of findings and second draft of paper on *sorting practices*.
27/10/2010	Secretaries in the medical department: Presentation of first draft of findings that were turned into paper on *secretaries' clinical work*.
28/10/2010	Secretaries in the radiology department: Presentation of first draft of findings that were turned into paper on *secretaries' clinical work*.
24/11/2010	Chief physician in the radiology department: Reflections on whiteboard functionality in the department.
26/08/2011	Administrator of Regional IT (central office): Presentation of paper on *coordination by avoidance* and *sorting practices*.
19/12/2011	Clinician in the Danish Cancer Society: Reflections on the role of technology in sorting practices.
13/02/2012	Administrator of Regional IT (call center): Presentation of paper on *secretaries' clinical work*.
22/02/2012	Central administration at Køge Sygehus: Presentation of findings and papers on *coordination by avoidance*, *sorting practices*, and *secretaries' clinical work*.
05/02/2013	Chief physician in the medical department: Presentation of findings and second draft of paper on *continuity of care*.
19/02/2013	National administrator/clinician at the National Board of Health: Discussion of findings and second draft of paper on *continuity of care*.
11/03/2013	Chief physician in the radiology department: Presentation of the overall findings of the dissertation.

3.4 My role as a researcher

The aim of this last section is to describe my transition from being a part of the team at the NBoH, which defined the Danish standardized cancer pathways, to becoming a researcher. This transition implies a change in whose perspective I represented. At the NBoH, I was responsible for answering questions posed by the parliamentary representatives or the press regarding issues on, for example, the formal initiatives to prevent waiting times in the area of cancer. This included, for example, precluding uncertainty of the legal responsibilities for patients' waiting time by answering questions about how these matters were to be interpreted. My new role as a researcher changed my perspective. In this new role, I could be the one asking the questions. However, I carefully considered the perspective I would take. I already had a clear idea about the challenges in the area of cancer diagnosis. The difficult task was not to decide on what issues I wanted to immerse myself in. Rather, the challenge was to be conscious of my transition from one role to the other. My new role as a researcher allowed me to embrace the complexity of practice, which is often reduced in politics for valid reasons, such as leaving it to practitioners to decide the details of how work is to be carried out. Yet, politics and the practical work in the area of cancer are, in my perspective, impossible to separate. Research, it has previously been described, "effectively intervenes [e.g., in politics] by accepting, challenging or diversifying problem definitions of the actors we study" (Mesman 2007: 281). Many of these actors I had already encountered during my time at the NBoH. But at that time I did not take the practitioners perspective.

I have been confronted in my studies by practitioners (including both administrators and physicians) who interpreted the findings of my studies as disturbing in the sense that they found them to be diverging from what they perceived as "ideal practice." I have myself wondered if what I sometimes observed was disturbing. I have come to use this feeling of disquiet or disturbance as a guide through complex issues in the initial diagnostic work. The "responsible way to study a world not of objects, but of action and interpretation … is the responsible work … by members of our disciplines for members of the society as a whole," Addelson states (1991: 122). On the one hand, Addelson continues, "it is a question of honesty in our vocations; on the other, it is a question of responsible service" (Addelson 1991: 123). The point is that researchers enact "authority" despite their discipline, and their formal position thus makes it crucial to serve the society (ibid). In the field of health care, it is not in any way unusual to investigate sensitive issues (Mesman 2007). For example, in my studies of sorting, I found that the consequences of sorting can, for a patient, make a difference of months of waiting. To be responsible in the sense of Addelson and others, I have carefully and thoroughly researched situations that I found to be of general importance to Danish and US patients. The careful investigations of a situation in which sorting practices were carried out helped me realize how a situation is interdependent in several ways with context (Klein and Myers 1999). Also, this experience of thoroughly investigating a situation was maybe the most important part of my becoming a researcher.

The concrete situation referred to above in which sorting was carried out played out a few months into my research project. The chief physician in the radiology department had informed me about some adverse events where secretaries, by accident, had caused two patients (who later turned out to have cancer) to wait for their diagnostic examinations. As I sat in the secretaries' office that afternoon observing the booking of patients according to a specialist assessment, I felt quite disturbed when a referral prescribed that the patient should not wait longer than 2–3 weeks. The patient, however, was booked into a slot 2 months later. This was not a case of exception handling (Schmidt, Wagner et al. 2007). The secretary did not even bat an eyelid when I asked about the booking of this patient. When I got home that day I felt uneasy about the situation. I had carefully written down notes while the situation unfolded. This was in principle a potential cancer patient, as the referral stated "little obs pro," meaning there was a slight suspicion of serious disease, potentially cancer. Over the following period of time I carefully took notice of exactly how electronic booking was carried out, how it was discussed in secretaries' weekly meetings, and what the larger perspectives on electronic booking were. In my notes, I have written: "It is everyday practice that patients are referred with unclear symptoms of disease, and despite the use of wording such as little obs malignancy [which might indicate cancer], the referral is handled routinely when the secretary looks up the first available time to schedule this patient" (Secretaries' office, Radiology Department, October 28th, 2010).

In the secretaries' office, the legal rules for how to handle patients with potential cancer were translated into local rules. The local rules were then translated into a paraphrase in the standard letter sent to patients when the required time-to-diagnoses could not be met by the radiology department: the paraphrase described to the patient how the department could help the patient get an appointment at a private hospital if the patient did not want to wait for this diagnostic examination. In the electronic booking system the slots distributed between the different types of diagnostic examinations had been decided by a committee of specialists, I found out, to make sure that scanners were being deployed in the most effective way. This decision made by the committee was evaluated on a regular basis, and changes were entered into the electronic booking system by the chief radiologist responsible for this particular task. The secretaries knew the legal rules in the area of cancer quite well. In my notes I have described how the chief secretary explores in the weekly secretary meeting "if there are still problems with oncologists that do not write the exact dates and times for pre-booked examinations in the referrals" (Chief secretary, Secretaries' weekly meeting, October 27th, 2010). The chief secretary made sure that changes were being communicated to the secretaries booking patients, but in addition to this practice and the weekly meetings the secretaries also rotated between tasks. The rotation was important because the secretary doing the booking obtained some sense of the rhythm of the collective work of the radiology department. But to maintain the sense of rhythm required that the same secretary be responsible for the routine booking of patients for a minimum of a couple of weeks.

The particular situation that I had observed played out within these carefully made decisions on how to effectively provide health care for the extremely variegated group of patients handled by the radiology department. When I realized the complexity of this situation I also realized my own transition to representing the perspective of the practitioners (e.g., secretaries) that carry out the electronic booking of patients. The secretaries, one may argue, are vulnerable to agendas of rationalization, and in practice, I found, office automation was often articulated as the end of secretaries as we know them – the issue of "caring for records" is a case in point. Although analysis of secretaries' work is only one of the contributions of this dissertation, it illustrates in important ways how I see myself as conducting responsible research. Ignoring the work of, for example, secretaries, which is also rendered invisible in contexts other than health care, may prove expensive in the long run, it has been argued (Star and Strauss 1985). For example, Star and Strauss refer to the cost of not using electronic information systems in the way they are intended (although one may argue this is also an illusion). In my investigations patients who are not receiving proper diagnoses pay the price of such misuse. Secretaries' work is often considered problematic in so far as it interferes with the clinical work, I realized from reports of adverse events in my studies, but IT such as electronic information systems is a condition for distributed collaboration today. The work of secretaries is thus crucial to initial diagnosis.

The aim of this section was to describe my transition to becoming a researcher. The following chapter presents in more detail the findings based on the research project.

4.1 What characterizes the diagnostic work that precedes a suspicion of cancer?

Photo Secretary booking patients in the electronic information system in the medical department (outpatient clinic) while simultaneously handling incoming calls from patients, physicians and others. Different sizes and colors of notes are used by the secretary to remember details of tasks (e.g. request of information and referrals) that have to be handled at a later time.

4 Presentation of findings in the research papers

This chapter brings together the findings of the research papers that comprise Part II of the dissertation and address each of its research questions. A common thread among the four research papers is that they all revolve around invisible work, coordination, and inclination work in diagnosis, all previously outlined in the theoretical chapter of the dissertation. The overall focus of the four papers is the encounters involved in the diagnostic work that precedes a suspicion of cancer; this makes the definition of diagnostic work central and will therefore be the starting point of the presentation of my findings. The following sub-sections focus on each of the respective research questions of the dissertation.

4.1 What characterizes the diagnostic work that precedes a suspicion of cancer?

Specifically, the literature on classification and categorization has been brought up in previous research as a conceptual framework for understanding what characterizes diagnostic work (Blaxter 1978; Bowker and Star 2000; Jutel 2009; Jutel 2011). According to this literature it is crucial to understand the discretionary activities involved in interpreting the accuracy by which categories have been applied in diagnostic work. Diagnostic work involves a pre-existing set of categories (i.e., ICD10) that have been agreed upon by the medical profession to recognize a particular condition in combination with the actual process by which such categories are applied (Blaxter 1978; Jutel 2009; Jutel 2011). While I agree that diagnostic work is critical, my research adds to the understanding of diagnostic work by pointing to a crucial activity that is often neglected – namely initial or pre-diagnostic work characterized by the discretionary activities involved in interpreting the subtleties of clinical work before a category of disease has been applied. In my research I have thus focused on diagnostic work at the point where it is still uncertain whether a patient should even be suspected to have cancer and hence what the relevant categories to apply would be. This part of the diagnostic process is often rendered invisible in formal resources guiding action, such as the Danish standardized cancer pathways.

What is revealed from the perspective of invisible work is that uncertainty in terms of contradicting or vague symptoms of disease play an important role in the initial diagnostic work, which is distinct from later diagnostic work (Møller and Bjørn 2011). Contradicting or vague symptoms of disease may be a first sign of cancer – or something completely different. The Danish standardized cancer pathways address this issue but do not handle it as part of the cancer pathways. Clinical practice involves exercising collective responsibility for understanding the consequences if alternatives are chosen (Wennberg 1984). Variations due to, for example, uncertainty in the diagnosis process are typically perceived as unwanted by physicians, as something we need to reduce through standardization (Raghupathi 1997; Bates 2002). The later diagnostic work, it has been argued, is about closing ends by applying categories (Kane and Luz 2009). The diagnostic work is divided into two different processes of practitioners: 1) agreeing on the categories and 2) applying the categories of diagnosis (Blaxter 1978; Jutel 2009). However, in my investigations I found that in the initial diagnostic work the categories are not predetermined but instead emerge in the situation (Møller and Bjørn 2011). Practitioners thus apply practices of subtle categorizing when a patient's course of disease is not straightforward, and this strategy is critical for the initial diagnostic work. For example, when the observations of a patient (fit, healthy patient) do not fit the results of a test (increasing infection levels), the practitioners need to communicate about the urgency without assigning a distinct category. It is impossible for the GP to assign the pancreatic cancer diagnosis to the patient on the first visit because the symptoms by themselves could be interpreted in various ways (Møller and Bjørn 2011). The practitioners therefore apply subtle categories, such as "patient lost 20 kg," to communicate the urgency in different ways that they presume other practitioners will understand.

However, the diagnostic work does not rely simply on the skill of physicians; it is the result of the routinely applied skills of the collectivity of actors (Slack, Procter et al. 2010). In my investigation of diagnostic work this notion became evident in the roles secretaries play in the diagnostic work. Secretaries do clinical work (Møller and

Vikkelsø 2012). Although, in general, a considerable part of secretaries' work is to support the articulation work and administrative work necessary for the diagnosis of patients, not all of this work can be understood simply as administration and support of others' articulation work (Møller and Vikkelsø 2012). That secretaries do clinical work is often considered somewhat controversial: Secretaries are not concerned with diagnoses, a recent study claims (Bossen, Jensen et al. 2012: 9). Secretaries are concerned with whether diagnoses have been entered in the computer, are properly coded, and checking that the record is complete (Bossen, Jensen et al. 2012). The diagnostic work from this perspective is a particular type of collaborative work that is "clinical" or "medical" at its core (Büscher, O'Neill et al. 2009). Thus, it is the work of clinicians, ranging from physicians assessing patients, to technicians running tests, and nurses tending to patients while taking note of their condition.

Secretaries' work is well described in CSCW and related fields (Bardram 1997; Müller 1999, Schmidt and Wagner 2007; Reddy and Jansen 2008; Reddy and Spence 2008; Bossen 2012). However, as illustrated by the example suggesting that secretaries are uninterested in diagnoses (Bossen 2012), it tends to be conceptualized in relation to diagnostic work using the limited terminology of secretaries as administrators, or as supporting clinicians' articulation work to manage the intersection of administrative and clinical work. In addition to these supportive and administrative functions, secretaries also play an important role in the diagnosis of patients, but the clinical work of secretaries is easily rendered as invisible. For example, when secretaries distribute referrals of patients for diagnostic examinations to the sub-sections of the hospital medical department, they are involved in activities crucial to diagnostic work (Møller and Vikkelsø 2012). To distribute the referrals is formally the secretary's job; however, while doing this job she simultaneously becomes aware that the patient is at risk of not receiving the sufficient treatment and therefore takes action and re-categorizes the referral (Møller and Vikkelsø 2012). The secretary thus carries out diagnostic work in the same way as the physician, re-interpreting the categorization of the patient while formally handling the referral of a patient.

The direct partaking of the secretary in, for example, the re-interpreting of the categorization of a patient should not be understood as coincidental practice; rather, this partaking follows from the positioning of the secretary at the “intersection” of formally separate but practically enmeshed practices, namely the administrative and clinical work involved in diagnosis (Møller and Vikkelsø 2012). Diagnostic work is thus the total work done over the course of disease (Strauss, Fagerhaugh et al. 1985). However, in this dissertation I emphasize secretaries’ work in order to draw attention to the fact that formal and common-sense definitions of activities and job responsibilities do not always, and in fact seldom, mirror exactly the reality of work. This is by no means a new observation (Strauss, Fagerhaugh et al. 1985; Svenningsen 2004). But, as illustrated in my investigations of how secretaries become involved in diagnostic work, previous research has stayed relatively true to such common-sense and formal distinctions of secretaries as, for example, directing assistants, even though organizational practice can be empirically shown to be different (Møller and Vikkelsø 2012).

This dissertation investigated initial diagnosis from the perspective of invisible work to understand the work that goes into initial diagnosis when symptoms of disease are uncertain. What become particularly pertinent from this perspective in the characterization of the initial diagnostic work is the subtleties in collaboration around diagnosis. The subtleties of diagnostic work illustrate how actors often seesaw between activities in a fashion that makes it hard to distinguish where one type of work ends and another begins (Møller and Vikkelsø 2012). This observation adds to what we already know from previous research on what characterizes diagnostic work. Diagnostic work is the work involved in identifying and categorizing problems while scoping for possible solutions (Büscher, O’Neill et al. 2009). It is characterized by the closing of ends (Kane and Luz 2009). While almost always a collaborative practice, diagnostic work is the result of the applied skills of the collective of actors (Slack, Procter et al. 2010). What is added to what we already know is how initial diagnostic work relies on collaboration that occurs before practitioners can apply categories of disease that formally close ends.

Thus, in this dissertation I argue that the diagnostic work that precedes a suspicion of cancer is characterized by the open-ended process by which categories are applied: The categories emerge in the context while being applied through the use of subtle categorizing when the patient's course of disease is not straightforward. To get the work done, and when diagnostic tests do not reveal obvious signs of cancer, diagnosing patients involves substantial articulation work to mediate and manage the relationships between actors. This practice of categorizing patients and related practices is not simply the job of clinicians; non-clinicians, for example, secretaries, also carry out diagnostic work, reflecting how activities of diagnostic work are formally separate but practically enmeshed practices.

4.2 How are patients sorted in the process of deciding if cancer should be suspected or not?

Photo Plastic trays containing the paper record and other clinical information of each of the patients admitted to the ward AVA (Akut Visitations Afsnit). AVA initiates the diagnosis of patients with unclear symptoms of disease admitted to the medical department at Køge Sygehus.

4.2 How are patients sorted in the process of deciding if cancer should be suspected or not?

While categorizing is central in diagnostic work, the interpretive work of actors involved in deciding if a patient should be suspected to have cancer is not simply a process of deciding the accuracy by which categories have been applied. In this process of categorizing patients, I argue, actors' sorting of patients is *guided* by formal sorting mechanisms but is *handled* by informal sorting mechanisms (Møller and Bjørn 2011). The shared understanding of a common area of work is highly dependent on how actors interpret each other's actions. In a Danish context, arriving at this shared understanding also implies the interpretation of practitioners operating at different levels of specialization. With this perspective, I foreground practices of actors realizing alternatives to routine or when to bring the routine to a temporary halt – rather than working around the routine. Previous research characterizes sorting as complex, collaborative multiplicities of work practices, people, and processes simultaneously working together (Bjørn and Rødje 2008). Exploring the diagnostic work that precedes a suspicion of cancer, I found that a sorting mechanism is a practice used to achieve the particular goal of prioritizing a patient in relation to other patients and available resources while reducing the effort involved in the articulation work required to sort patients in a distributed work setting (Møller and Bjørn 2011). Sorting mechanisms involve interpretation work where the interpretation of the classification scheme is the essential decision of the diagnostic work that precedes a suspicion of cancer.

The interpretation of other healthcare practitioners' actions is typically based on written information in diagnosis: "Reading" the actions of others provides a perspective for how to interpret previous actors' actions based on the personal experience (i.e., senior rank, specialty, etc.) of these other actors (Hartswood et al. 2003). Interpretation in the diagnostic work that precedes a suspicion of cancer is framed by participants' perspectives (on patients, examinations, colleagues, resources, etc.) based on their existing knowledge and experiences with the sorting of patients and people involved (Møller and Bjørn 2011). In the previous section I argued that actors rely on subtle categorizing when it is not clear whether a patient should even be suspected to have cancer. Subtle categorizing, from this perspective, forms one sorting mechanism in the diagnostic work that precedes a suspicion of cancer (Møller and Bjørn 2011). By saying that interpretation work is involved and that it is framed by actors' prior experiences, interpretation work is linked to the act of remembering (Orr 1986, Bannon and Kuutti 1996). In my investigations of diagnostic work, another informal sorting mechanism is thus collective remembering.

Collective remembering is process where multiple actors develop a shared understanding of a particular event or action. Remembering is closely related to story telling, and previous research found that diagnostic work has a strong component of story telling that helps both to inform others, but also to demonstrate to others a competent practice (Orr 1996). By remembering, actors develop a shared meaning (Bannon and Kuutti 1996), and thus actors' perspectives can become part of the practices. This involvement of perspectives increases the complexity of interpretation, interaction, and coordination significantly (Møller and Bjørn 2011). It might appear odd that GPs and hospitals communicate the urgency of diagnosis through these subtle ways instead of simply stating the facts. However, a crucial aspect of this way of communicating originated in the widespread concept of remembering. Collective remembering characterizes practices where both the GPs and the hospital staff "keep track" of each other's collaborative actions and remember the interaction patterns between each party (Møller and Bjørn 2011). The GP interprets the hospital (how long do the GP's patients have to wait), and the hospital staff interprets the GP's referral patterns (how many patients does the GP refer with a suspicion of cancer where it turns out to be another diagnosis). A crucial element of this mechanism of collective remembering is thus to not cry wolf if trust is to be built or maintained.

According to a Danish study on GPs' handling of patients that could potentially have a diagnosis of lung cancer, a significant proportion of Danish GPs reported that they hesitate to use the term "cancer" to avoid worrying patients (28 pct.) and to avoid losing credibility among peers in hospitals (40 pct.) (Bjerager, Palshof et al. 2006). The issue is further complicated by the lack of consensus among GPs and hospital physicians on the exact use of the term cancer (Sundhedsstyrelsen 2009). Collective remembering influences the hospital's perspective on the local GPs, which is not directly visible in the electronic information system used for referral of patients. However, this does not reduce the effect of collective remembering as a sorting mechanism that silently guides the practices of sorting patients (Møller and Bjørn 2011). In this way, the interpretation of actors involved in diagnosis is linked to collective remembering: The silent layers of interpretive practices involved in diagnosing patients in due time are embedded in the arenas of voice under the general rubric of categorization. Figure 3 below illustrates how the result of each of these examinations affects the decision to formally suspect cancer or not for a given patient. The figure illustrates the sorting of three potential cancer patients (marked with red) and how they are waiting in several queues for diagnostic examinations with various other patients (black) whose conditions may be of an entirely different nature even though they are waiting in the same lines. When a test result from the lab (B) increases the overall suspicion of cancer, this affects the GP's assessment of how long that patient should wait in other queues where he/she has been signed up (A, C, D). Or, if Radiology (C) suddenly reveals a suspicious finding, the GP will also move the patient up in the other queues (A, B, D), including making sure she sees the patient sooner herself.

The course of diagnosis is not necessarily linearly spatialized, Figure 3 illustrates, but may involve some going back and forth between places, depending on the timing. Thus, getting a "hit" in one of the diagnostic tests may also depend on how much the disease has progressed. Therefore, to diagnose a patient in due time sometimes takes time – and if the timing is not right in terms of the course of the disease, the tests might not provide the required hit before several rounds of testing (A, B, A, A, C, B, D). At the same time, diagnostic steps are decided on for other patients as well, which affects the clock time coordination of the diagnostic work. This recursive relationship between the queuing for and the results of the diagnostic examinations is illustrated by the +/÷ above the potential cancer patients in the figure, which will affect whether a particular patient is handled as "acute," "semi-acute," or "planned" relative to other patients. In practice, however, the semi-acute category resembles a subtle category and status that is not formally embedded in the electronic information system functionality. Yet, the semi-acute category is applied regularly, I

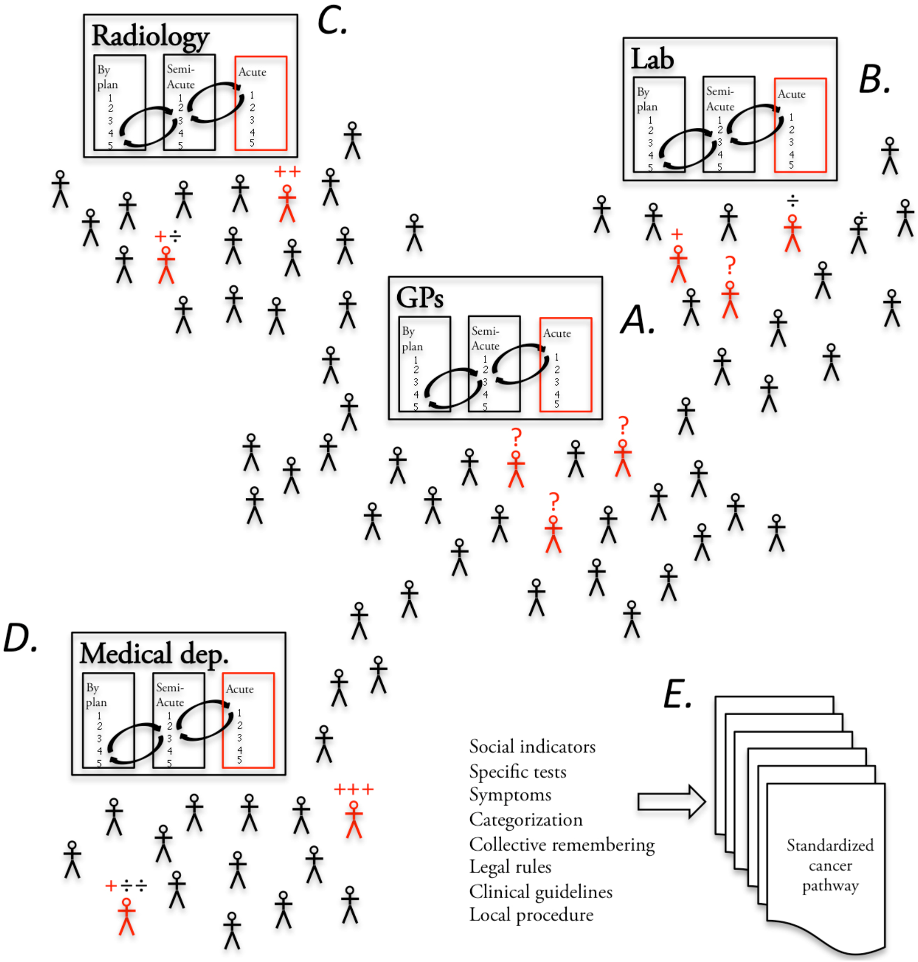

Figure 3. Layers in sorting practices: Shuffling and re-shuffling the patient with uncertain symptoms in various queues as a suspicion of cancer emerges. Each +/÷ represents a change towards a stronger or weaker suspicion of cancer through visible and invisible sorting that precedes the essential decision of whether or not to assign a standardized cancer pathway to the particular patient.

found, to communicate the urgency of a patient in the free-text fields that are available in the electronic information system used for communication across specialties, hospitals, and sectors. Figure 3 illustrates how, if the indications of cancer (social indicators, specific tests, categorization, etc.) provides support (+) for a suspicion of cancer, the patient will be prioritized in the queue for additional diagnostic examinations and move up from planned to semi-acute or acute, depending on how strong the suspicion is articulated to be. On the other hand, if the results reject a reasonable suspicion (÷), the patient will be placed at the end of the queue for future diagnostic examinations as "planned" according to the waiting list. Thus, the figure illustrates three red patients turning into two as the suspicion of cancer grows stronger or weaker and, for one of the red patients, is entirely rejected. Consequently, the latter red patient is no longer in the queue at D, the hospital medical department that makes the essential decision of whether or not to refer the red patients to E (the standardized cancer pathway). In this way, the three potential cancer patients move through A, B, C, and D as part of a larger group of patients (black) suspected to have various other diagnoses.

In practice many more specialties may get involved in the diagnosis of patients suspected with cancer, and therefore the clinical specialties represented in Figure 3 are only a simplified illustration of how patients move through specialties, hospitals, and sectors. I refer to this work of up- or down-scaling patients in relation to queue management as inclination work. Previous research states that in medical practices with high variation, professional discretion becomes very important (Wennberg 1984). I do not claim high variation exists in the area of cancer, but that in the diagnostic work that precedes a suspicion of cancer, where the end result is still open-ended, variations are evident. Because the result is still open-ended the interpretations of actions by previously involved actors becomes crucial. Thus, I found that a critical part of diagnostic work that is often neglected in previous research on diagnosis of patients is the handling of queue management. Queue management is part of the crucial interpretive work required to sort patients. The issue of sorting is a classic interest for CSCW (Bowker and Star 2000). The practical sorting of patients relies on both formal and informal resources for action (Bjørn and

Rødje 2008). Yet, there is a tendency that the informal resources that are key to making the formal sorting work in practice disappear from, for example, plans guiding work (Star and Strauss 1999; Bowker and Star 2000; Martin, O'Neill et al. 2007; Randall, Sharrock et al. 2007). Therefore, what is added by the investigation of diagnostic work that precedes a suspicion of cancer is how sorting is also a process of queue management.

Thus, in this dissertation I argue that the sorting that precedes a suspicion of cancer is a practice used to achieve the particular goal of prioritizing a patient in relation to other patients and available resources while reducing the effort involved in the articulation work required to sort patients in a distributed work setting. The sorting involves interpretation work. This interpretation is handled by formal sorting mechanisms but is guided by informal sorting mechanisms: One such informal sorting mechanism is subtle categorizing that communicates the level of urgency through a spectrum of categories (rather than mutually exclusive categories) in diagnosis. Another informal sorting mechanism is collective remembering whereby actors interpret the accuracy by which categories have been applied. Because of the general uncertainty in the diagnostic work where symptoms point to various diagnoses, professional discretion becomes crucial.

4.3 How are the diagnostic steps coordinated across specialties, hospitals and sectors?

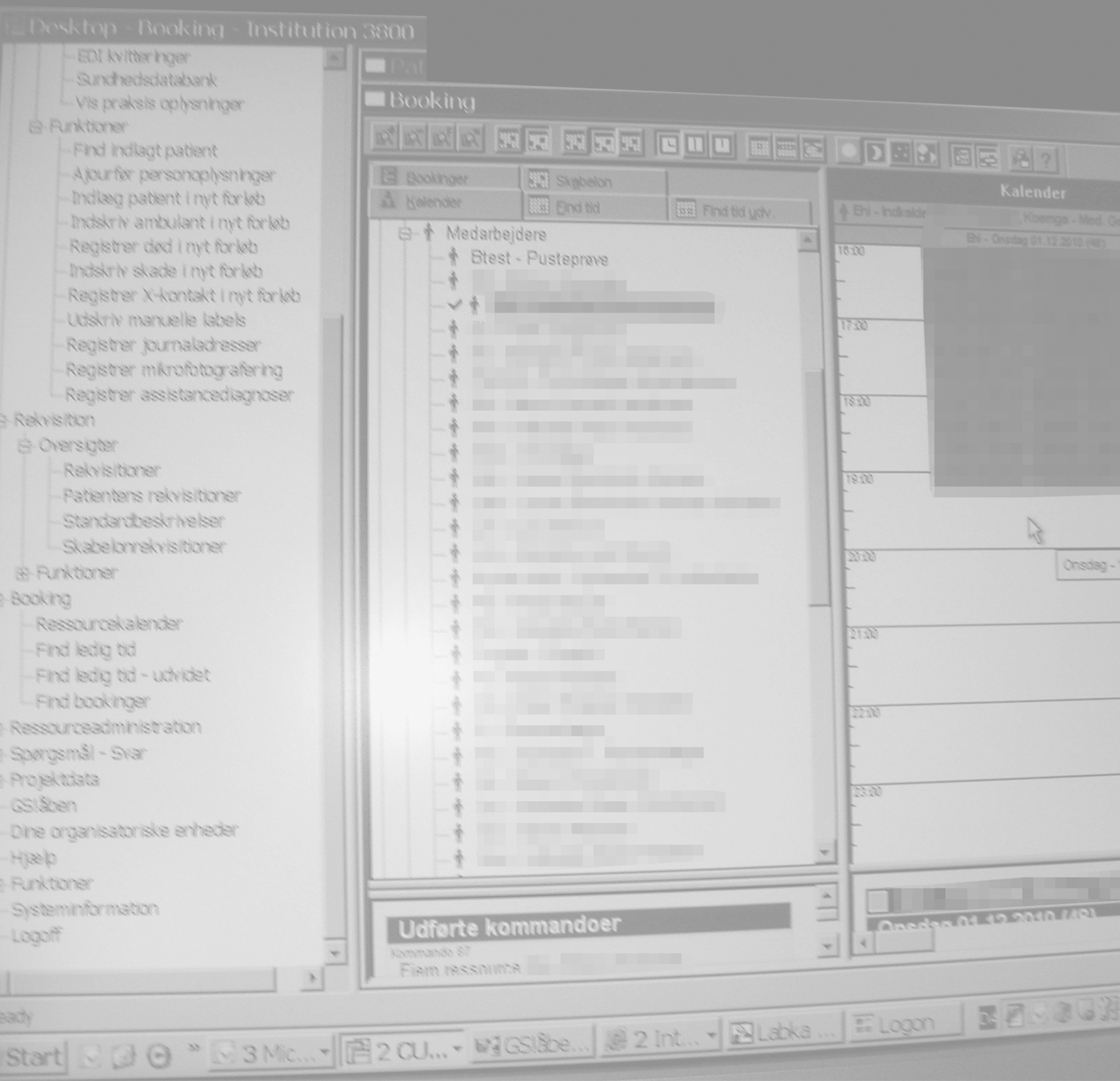

Photo The electronic information system used by the different clinical departments at Køge Sygehus for administrative and clinical purposes. To the left possible actions are listed including, e.g., an overview of the planned diagnostic examinations for a certain patient.

4.3 How are the diagnostic steps coordinated across specialties, hospitals, and sectors?

To manage their interlinked work, actors rely on articulation work (Strauss, Fagerhaugh et al. 1985; Gerson and Star 1986; Schmidt and Bannon 1992), and in the case of diagnostic work, this articulation work is handled through the use of various coordinative artefacts (Møller and Bjørn 2011). The electronic referral template is one such artefact used as a communication and coordination medium across specialties, hospitals, and sectors, displaying important information that guides the sorting of patients in the receiving hospital (Møller and Bjørn 2011). It resembles what is referred to in previous literature as a coordination mechanism (Schmidt and Bannon 1992; Clement and Wagner 1995; Schmidt and Simone 1996). The artefact and agreed-to procedures that form the coordination mechanism (e.g., the electronic referral template, the electronic overview of future examinations, or the electronic information on the current location of the EPR) are stipulating the work of actors collaborating to diagnose a patient (Møller and Dourish 2010). The coordination mechanism brings different people and different processes together in the initial diagnostic work; however, it may keep them apart, too (Møller and Dourish 2010).

Thus, I found that actors also coordinate diagnostic work in crucial ways by using avoidance as a way of keeping responsibility clear (Møller and Dourish 2010). This is evident, for example, in how a patient's diagnosis is coordinated across specialties where tasks are intersecting. The distribution of responsibility between the clinical specialties is something that is often not described in detail in formal protocols or procedures. A debate I observed between two surgeons highlighted the importance of avoidance in coordination when the nature of the clinical work is discretionary and relies in important ways on interpretation. A patient had come in with a boil, and the two surgeons were deciding whether they would be the right sub-section in the surgical department to handle this patient – or if it would be the orthopedic surgeons. The debate concerned whether the patient's boil was in fact located inside or outside of what they referred to as the "swimsuit" demarcating a certain area of the patient's body. Depending on where the boil was located, they would avoid coordinating in an explicit manner with the orthopedic surgeons. Coordination by avoidance thus describes a mechanism whereby actors avoid moving into other actors' legitimate fields of interest. In this sense coordination by avoidance helps actors coordinate responsibility of distributed tasks by realizing alternatives or bringing routines to a halt in order to coordinate practices in a way that is appropriate to the particular situation.

Taking a closer look at this definition of coordination by avoidance, it can be divided into two parts: First, coordination by avoidance is defined by a mechanism used to pursue coordination by avoiding the actions that may collide with other actors' performance of routines or routes of action. Avoidance implies that coordination is two-sided and is not only achieved by bringing things together, but also by keeping them apart. Second, coordination by avoidance is defined by the coordination of responsibility when it would otherwise be unclear. Coordination of responsibility is ongoing at all times, and this activity therefore implies that coordination also comprises decisions to coordinate by avoidance – and not simply active coordination. By suggesting this definition I also suggest that coordination by avoidance occurs as part and parcel of organizational work in relation to the diagnosis of patients. An overall characteristic of coordination mechanisms is that they help reduce the complexity of articulation work by rationalizing it (Schmidt and Bannon 1992; Gerson 2008), and this is also characteristic when actors coordinate by avoidance (Møller and Dourish 2010).

Through the concept of coordination by avoidance I attend not only to the actions taken by the actors involved in diagnosis but also to the actions they avoid, as appropriate to the particular patient's situation (Møller and Dourish 2010). Coordination by avoidance, I found, is a mechanism whereby actors coordinate by, for example, delegating, procrastinating, and demarcating tasks to make sure responsibility stays clear (Møller and Dourish 2010). Avoidance is also evident in how another group of staff coordinate the diagnostic work, namely the secretaries. The secretaries, I found, avoid requesting a patient record before the collaborating department is done with their diagnostic tests. The paper record thus works as a "depeche," indicating to other departments the process of relay and how to time their own preparing of clinical documents. To accomplish work actors rely on coordination mechanisms that help them realize alternatives or temporarily halt routines to accomplish work in a way that is appropriate (Møller and Dourish 2010). The actors in this way are supported by the electronic information system when it helps them realize the appropriate thing to do (Møller and Dourish 2010).

Avoidance comes in various forms and shapes in secretaries' and physicians' coordination of diagnostic work. Coordination mechanisms help actors in these situations realize when responsibility is shared and when it shifts (Møller and Dourish 2010). Avoidance makes coordination less time demanding when, for example, secretaries in the radiology department do not have to call the clinical departments to re-schedule a patient but delegate this activity by avoidance (Møller and Dourish 2010). Delegating the responsibility to the clinical department is a way to ensure that other activities are rescheduled accordingly. Thus, coordination by *avoidance* is different from *active* coordination, the latter of which is associated with timely coordination (Bardram 2000). The shared understanding of responsibilities permits actors to coordinate by avoidance, although it presumes some understanding of the responsibilities of other departments. Though, this presumption raises questions about the actors' competencies and attentiveness to the broader organizational process (Møller and Dourish 2010). There are thus some aspects of diagnostic work for which the coordination of diagnostic steps across specialties, hospitals, and sectors cannot rely on avoidance in the experience of practice (Møller and Vikkelsø 2012).

The particular example of how secretaries follow up on the scan results of patients who have been discharged from the medical department illustrates this complexity when diagnosis is distributed across specialties, hospitals, and sectors (Møller and Vikkelsø 2012). To ensure the lines of responsibility stay clear, particularly in the case where a scan result may point to cancer, the secretary actively coordinates with other actors (Møller and Vikkelsø 2012). And so what the overall perspective of coordination work in diagnosis also draws attention to is the importance of the nature and type of work that has to be coordinated. Previous research shows how actors rely on articulation work to coordinate their work (Strauss, Fagerhaugh et al. 1985; Gerson and Star 1986; Schmidt and Bannon 1992). Articulation work may be supported by coordination mechanisms defined by an artefact and agreed-to procedures (Schmidt and Simone 1996). An overall characteristic of coordination mechanisms is that they help reduce the complexity of articulation work by rationalizing it (Schmidt and Bannon 1992; Gerson 2008). However, in terms of avoidance, this particular mode of coordination mechanism is easily overlooked. This dissertation contributes to previous research by pointing to a coordination mechanism that is essential in diagnostic work but different from previous descriptions of coordination mechanisms and the practice of avoidance. The extent to which avoidance in coordination mechanisms always takes on a material form can be debated, as illustrated in the example of the swimsuit. Despite the imagined materiality, avoidance still forms a coordination mechanism.

In this dissertation I argue that coordination of diagnostic steps across specialties, hospitals, and sectors is characterized by the essential role of coordination mechanisms embedded within artefacts, for example, the electronic referral template. However, coordination by these artefacts implies both the bringing together of things but also keeping them apart to ensure the diagnostic work stays coordinated. Coordination mechanisms are useful for supporting diagnostic work that may rely on the shared understanding of responsibilities relative to the total organization of work. And, coordination mechanisms may even allow actors to coordinate work using the different strategies, including coordination by avoidance (keeping things apart) and active coordination (bringing things together). The appropriate strategy for coordination will depend on the nature of the work that has to be coordinated, as some tasks are not suitable for coordination by avoidance, for example, the coordination of responsibility following a test result that may change the entire course of the diagnosing process.

4.4 What are the challenges within the work practices of achieving continuity of care in diagnostic work across different contexts?

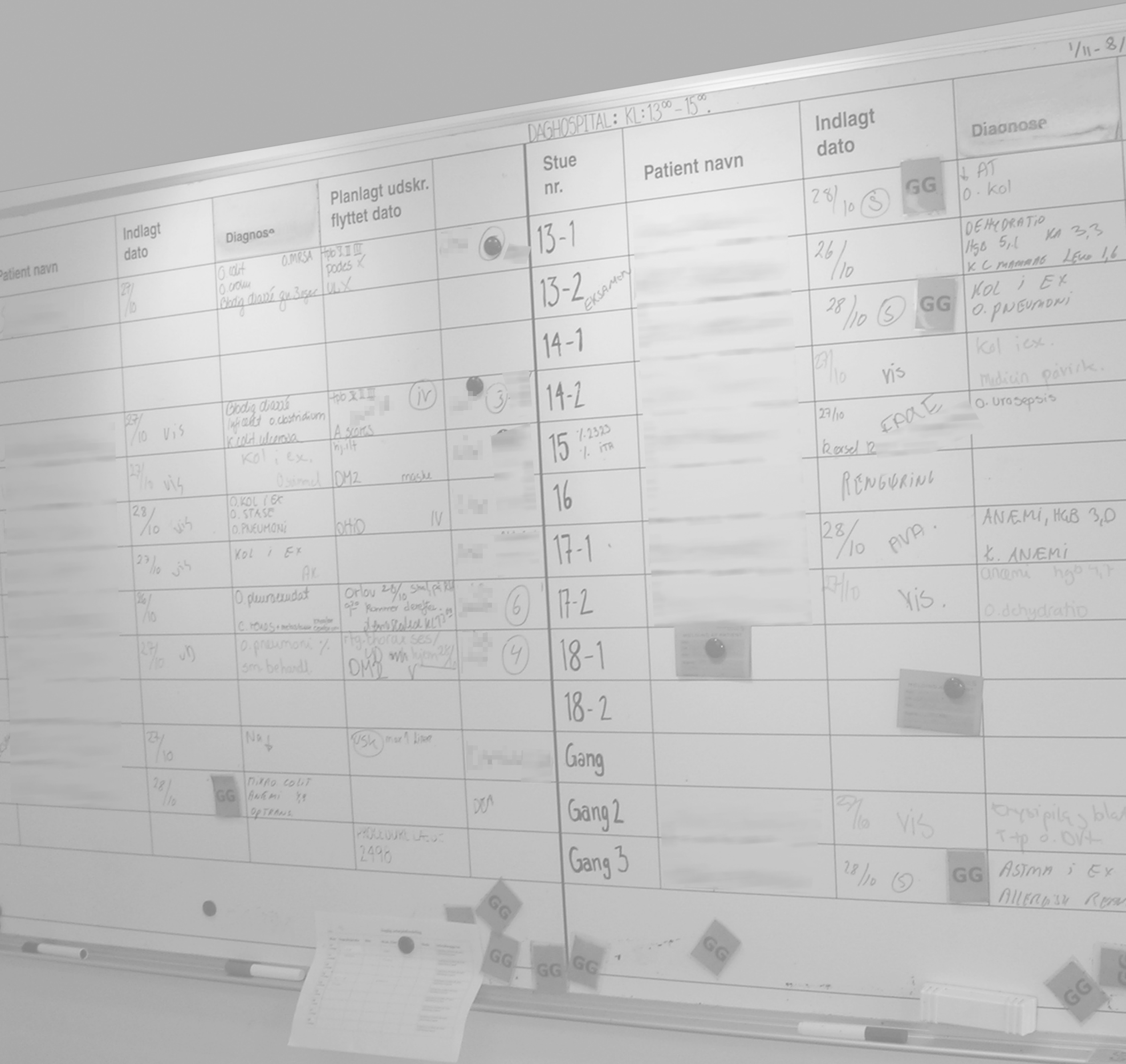

Photo Whiteboard in the medical department (AVA – Akut Visitations Afsnit) at Køge Sygehus used for organizing work including; the timeline of the admittance of patients in AVA, the diagnosis of patients, the plan for when patients may be discharged and the name of the physician responsible for seeing the patient on that particular day.

4.4 What are the challenges within the work practices of achieving continuity of care in diagnostic work across different contexts?

Informed by the previous research questions exploring the complexity of the diagnostic work that precedes a suspicion of cancer; how patients are sorted in the process of deciding if cancer should be suspected or not; and how the diagnostic steps are coordinated and supported in terms of collaboration across specialties, hospitals, and sectors, the final research question concerns the challenges within the work practices of achieving continuity of care in diagnostic work across different contexts. A huge challenge in Denmark as well as internationally is how to achieve continuity of care (Danish Board of Technology 2006; US Office of the National Coordinator for Health Information Technology 2010). Specifically, continuity of care becomes important when various specialties get involved because a patient is suspected to have a serious disease, for example, cancer (US Institute of Medicine 2001). Continuity of care forms a practice of linking across the clinical information and the clinical specialties that collaborate to diagnose a patient (Møller *submitted*). This linking practice is related to but different from practices of translating described in previous research as a way of making clinical information relevant in a particular context (Winthereik and Vikkelsø 2005). Whereas the practice of translation makes the clinical information useful in the context of, for example, a certain specialty, the practice of linking concerns how the organization of work and politics challenges and creates certain conditions for practitioners coordination and communication of information (Møller *submitted*). For example, the practical linking of care across specialties depends on the organization of work and the wider context of politics when practitioners communicate about the diagnosis of a patient (Møller *submitted*).

Since the basic nature of continuity of care is that several clinical specialties are involved in a distributed collaborative process, collaborative technology use is a central focus of investigation from the continuity of care perspective. To understand exactly how technologies and artefacts are appropriated within various contexts, we need to understand the particularities in how they are used. For example, we need to understand what characterizes the staffing and the relationships with external services related to continuity of care in diagnostic work (Balka, Bjørn et al. 2008). Thus, when continuity of care has to be enacted in practice, the challenges of context-dependent discontinuity become available in how technology is appropriated. Discontinuity, as with patients who wait too long for reasons other than clinical ones, is a common challenge and a central reason why the Danish standardized cancer pathways were initiated (Sundhedsstyrelsen 2008). Discontinuity has typically been addressed in the broader field of studies on cancer diagnosis in relation to, for example, “delay” (e.g., Jiwa and Saunders 2007; Tørring 2011; Tørring, Frydenberg et al. 2013). However, these studies tend to neglect the complexity of practice and technologies involved in diagnostic work. To support continuity of care is a matter of ensuring coordination and effective communication so that tasks are not disintegrated in the complex organization of clinical work (Strauss, Fagerhaugh et al. 1985).

Studying the initial diagnostic work across different contexts, findings suggest that the challenges to continuity of care can be detected by studying practitioners’ appropriation of technologies (Møller *submitted*). By comparing cases in Denmark and the US, I found that actors in the two cases address similar concerns of providing the best possible care for patients under the particular circumstances, but at the same time they appropriate the same types of mundane technologies differently (Møller *submitted*). The nature of work involved in achieving continuity of care in the Danish case and the US case is similar and is guided by an acceptance that the direction of a patient’s disease can be uncertain. The appropriation of technologies, however, pointed to the difference in handling the responsibility for care and how roles are constituted. The challenge to achieving continuity of care in the US case was that patients had discontinuous admittances dependent on their healthcare coverage. This means that the entries into electronic patient records about patients’ admissions are often incomplete, which puts practitioners at risk of overlooking relations between admissions over time and therefore of overlooking aspects of clinical work. In contrast, the challenges in the Danish case were that the entries across patients’ admissions are continuously added within the health region’s collaborating hospitals, increasing the length of the electronic patient record with the consequence of different challenges to be handled by the appropriation of technologies supporting the work (Møller *submitted*).

In both the Danish case and the US case, the practitioners manage to overcome the local challenges specific to their context, achieving continuity of care. However, only by comparing this appropriation of technologies as part of the everyday clinical work do the broader challenges across different contexts become clear. The challenges in the US case and the Danish case are characterized in essential ways by the patients' circulation between providers. In the US case, to accommodate challenges posed by a lack of documented care over time due to the wider context of private healthcare, the relative continuity between the patient and the practitioner becomes central to supporting clinical work, I found (Møller *submitted*). In contrast, to accommodate the challenges posed by the wider context of public healthcare in the Danish case, the practitioners rely on continuous documentation. Thus, in both the Danish case and the US case valuable lessons can be learned if the goal is new, improved practices. To return to the final research question of the dissertation regarding the challenges to continuity of care across different contexts, two important points can be learned from the US and Danish cases: First, the appropriation of technologies and the organization of work and politics all affect how practitioners achieve continuity of care. Second, challenges to continuity are characterized in essential ways by how the responsibility for care and the constitution of roles are handled within the particular context (Møller *submitted*). The responsibility for care and the constitution of roles might be organized differently and provide certain conditions and challenges for continuity of care in diagnostic work. The risk is that patients and their clinical information will not circulate easily between providers, causing delays in getting any closer to a diagnosis that can detect and grade their disease.

Thus, in this dissertation I argue that the conditions for accomplishing continuity of care are interdependent with how the work is organized and politics in terms of the responsibility for care and the constitution of roles. This organization around the responsibility for care and the constitution of roles becomes visible in the enactment of technologies. The responsibility for care and the constitution of roles is characterized in essential ways by the patients' circulation between providers, which makes practices of linking part and parcel of clinicians' everyday practice. In the US case, to accommodate challenges related to a lack of documented care over time, the relative continuity between the patient and the practitioner becomes central to supporting clinical work. In the Danish case, the continuity of documented care is central to how clinicians accommodate challenges of discontinuity between the practitioner and the patient.

5 Conclusion

In this dissertation I explored the encounters in initial diagnostic work in order to ascertain how diagnosis before a suspicion of cancer occurs. This I explored from a CSCW perspective through in-depth ethnographic studies of the situated accomplishment of work in a Danish GP's office, a Danish hospital, and a US hospital over a period of 13 months. Three aspects of collaborative work were essential to understand this initial diagnostic work; the "invisible" aspects of diagnostic work, the "coordinative" aspects, and the aspects of "inclination". Exploring these different aspects of the initial diagnostic work empirically, I observed how the suspicion of cancer emerges in the process of categorizing a patient.

Thus, findings of this dissertation suggest that it is difficult, when the course of disease is uncertain, to conceive of a potential cancer diagnosis as before and after categorization. Diagnostic work is not always a straightforward process, and to ensure that closing ends by applying categories does not become the only way to move diagnosis forward, it is crucial to support dimensions of work that may help actors legitimize other ways of collaboration. From a support-by-technology perspective, this means that electronic information systems cannot be conceptualized in terms of "calendar time" alone to support collaboration. To coordinate with others what I have referred to in this dissertation as *due time* is crucial in situations where formal categories do not support the shifting of urgency or movement to a higher level of specialization despite indications that something is wrong with the patient.

Initially, I asked what characterizes the diagnostic work that precedes a suspicion of cancer. Diagnostic work is the result of the collective work of actors where administrative and clinical practices are in some respects enmeshed practices, this dissertation suggests. In order not to render essential activities invisible, it is important to re-think the concept of diagnostic work from a support-by-technology perspective in relation to access and the groups of actors that get involved in the initial practical diagnostic work, both clinicians and non-clinicians. Danish policy writing in the area of cancer care identifies support of collaboration and coordination as a key objective. But the work of non-clinicians, for example, secretaries'work, is rendered invisible in these plans that are supposed to guide work in practice.

Next, I asked in the dissertation how patients are sorted in the process of deciding if cancer should be suspected or not. The diagnostic work is layered, findings of this dissertation suggest, in the sense that it is structured by actors' interrelated, iterative practices. These are practices where actors construct, organize, re-organize, and merge queues within which each patient is simultaneously situated. To re-think how we may support the initial diagnostic work that precedes a suspicion of cancer, information on the multiple queues that a patient is waiting in is essential for the collective of actors, including, for example, both secretaries and physicians. From a support-by-technology perspective, this means that electronic information systems need to support multiple, interlinked queues rather than simply the practice of scheduling.

I then asked how diagnostic steps are coordinated across specialties, hospitals, and sectors. Diagnostic work, the dissertation suggests, may be actively coordinated, but it may also be coordinated by avoidance, rationalizing work at the same time as it prevents ambiguity. And so this finding draws attention to the importance of the legitimacy of different aspects of coordination. To support coordination by technologies, the dissertation suggests, it is crucial to understand the nature and type of work that needs to be coordinated. Coordination mechanisms can reduce articulation work significantly by embedding support for avoidance and, in this way, keep responsibility clear, but they also need to prevent patients from falling through the "cracks." Coordinating the results of diagnostic tests that may change the course of work is an example of the limitations of coordination by avoidance.

The research questions of this dissertation emerged in a Danish context, but the investigations of diagnostic work were conducted across a US and a Danish setting. To see more clearly the challenges that revolve around issues of continuity of care – that is, the linking practices in the diagnostic work that are particular for the Danish context –it has been important also to investigate diagnostic work in a completely different context, namely, the US. Thus, the final question I asked in the dissertation is what the challenges are within the work practices of achieving continuity of care across different contexts. Studying the initial diagnostic work, findings of this dissertation suggest that continuity of care can be detected by studying practitioners' appropriation of technologies. When continuity of care has to be enacted in practice, the challenges of context-dependent discontinuity thus become available in how technology is appropriated. The responsibility for care and the constitution of roles might be organized differently, and these different organizational approaches may provide certain conditions and challenges for continuity of care in diagnostic work. However, a risk is that clinical information and the patients will not circulate easily between providers, causing delay in getting any closer to a diagnosis that can detect and grade their disease

In this dissertation I have unpacked initial diagnostic work in the area of cancer as a collaborative practice, and in doing so I have suggested particular areas for consideration to continue re-thinking diagnostic work from a CSCW perspective. At the time this study was conducted, the Danish standardized cancer pathways primarily supported the diagnostic work after a suspicion of cancer had been formally articulated. Later, in 2011, the Danish NBoH introduced a standardized pathway directed at patients with unspecific symptoms that can potentially be cancer related to address some of the challenges related to uncertainty in diagnosis (Sundhedsstyrelsen 2011). The diagnostic centers that are currently emerging in Denmark are one reason why further research should be undertaken in continuation of this dissertation: Organizations and technology evolve together, and changing one affects the other, and vice-versa.

To fully understand the complexity of the initial diagnostic work requires that researchers consider the continuously changing premises for collaboration to support the diagnostic work that precedes a suspicion of cancer – and that designers of practice observe carefully how their work is dynamically interlinked.

6 References

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PART II

Paper no. 1: Møller, N.H., Dourish, P. (2010) Coordination by avoidance: Bringing things together and keeping them apart across hospital departments. Proceedings of the 16th ACM international conference on supporting group work (GROUP '10), ACM, pp. 65-74.

Coordination by Avoidance: Bringing Things Together and Keeping Them Apart Across Hospital Departments

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ABSTRACT

Coordination is central in CSCW systems design, where it is often considered as a process of bringing artifacts and activities together and making them part of a larger system. In this paper, we argue that existing conceptualizations of coordination in CSCW can be successfully extended with the notion of *coordination by avoidance.* We introduce this notion to describe particular coordination mechanisms whereby actors avoid routines or routes of actions when it conflicts with those of other actors. In a study of pre-diagnostic work, we found that actors coordinate by avoidance when they realize alternative routes of action or that a routine has to be set to a halt to ensure that practices stay coordinated. Routines in diagnostic work are for instance the rescheduling of patients and requesting of relevant patient records that are mundane practices, however, necessary when responsibility is shared or shifts between various actors collaborating to diagnose a patient. Thus, the contribution of this paper lies in empirically identifying practices of avoidance and extending dominant conceptualizations of coordination through the notion of avoidance. We identify four ways that actors coordinate their practices by avoidance; by *demarcating, procrastinating, delegating and accommodating* routines or routes of action. Furthermore, we conceptualize coordination by avoidance as a distinct type of coordination mechanism to be taken into consideration in CSCW information systems design.

Categories and Subject Descriptors

J.3 [**Computer Applications**]: Life and Medical Science – *Medical Information Systems*

General Terms

Management, Design.

Keywords

Medical information systems, coordination mechanisms.

1. INTRODUCTION

In writings on healthcare policy, as in other areas of collaboration, "coordination" emerges as a central concern. Where multiple actors come together to collaborate in complex work settings, we are generally concerned with how their actions can be coordinated. Continuous and smoother collaboration is generally argued to result from more frequent and more careful coordination, i.e. in cancer diagnostics [12], [18], [29]. Unsurprisingly, then, when information systems are incorporated into healthcare settings, they are often called upon to solve what is described as the "problem of missing coordination" [22], [30]. For serious illnesses like cancer diagnosis, which is the focus of the study we report here, these problems are especially acute as patients move between different healthcare providers and different sectors of the healthcare system [9].

To support coordination practices, we need to understand the different aspects of coordination. Coordination is often thought of as *bringing things together* and making sure that they come together effectively; however, our investigations of coordination practice suggest that coordination is also often about *keeping things apart*. Hence, the aim of this paper is to investigate coordination in its own right and to extend ways to think through practice with the notion of coordination in CSCW systems design.

Coordination is central in CSCW where it has been discussed in terms of coordination mechanisms [26], [27], informal coordination [7], temporal coordination [2], [21] and coordination of reach [11]. Previous studies have explored how coordination mechanisms stipulate the activities that are linked through them [4]. This way coordination mechanisms bring artifacts and activities together and make them a part of a larger system, although, they may keep them apart too [8], [11], [31].

Taking this latter perspective, we argue in this paper that existing conceptualizations in CSCW can successfully be extended with the notion of *coordination by avoidance* to describe the type of coordination mechanisms where activities are avoided or brought to a temporarily halt. With this approach, we foreground practices of avoidance that often remain in the background in healthcare policy writing, and instead suggest that they actually play an important role in achieving effective collaboration.

Coordination by avoidance involves actors' recognition of alternatives to a given routine or route of action. In figuring out when to avoid certain routines and routes of actions, the actors make sure that their specific actions are adequate to the particular patients' situation. The research question is: What forms does avoidance take in coordination practices and what role does it play

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for the overall coordination across the organization? Exploring this question empirically the paper points to how coordination by avoidance can take on different forms, including practices of *demarcating*, *procrastinating*, *delegating* and *accommodating* to ensure coordination.

The paper is structured as follows. First, we begin by sketching an outline of existing conceptualizations of coordination in the CSCW literature. We contrast the prior work with the analytically distinct conceptualization of coordination by avoidance. Second, we present the research method and then go on to present examples from our empirical data of mundane coordination practices from an ethnographic study in a mid-size Danish radiology department and clinical departments in so far their collaboration. In particular we focus on avoidance in coordination practices and what role it plays in these four examples. Third, the discussion section investigates the way coordination by avoidance can help us to understand coordination practices in extension of the existing concepts of coordination in CSCW. Finally the paper concludes by conceptualizing coordination by avoidance in relation to healthcare and more broadly in relation to CSCW systems design.

2. The Concept of Coordination

Coordination, as a general topic, has received considerable attention in prior research, not only in CSCW but also in related fields such as organizational studies as well as in the particular domain of healthcare. Similarly, the concept of avoidance is comparable to, but distinct from, ideas that have been employed by previous researchers. We will discuss several of these here.

2.1 Concepts of Coordination in CSCW

The literature on coordination in CSCW draws attention to the way that coordination mechanisms not only structure actors' collaborative activities, but also support actors' articulation of those activities for them to come together [5], [8], [24], [25], [26], [27], [28]. Articulation – both in the sense of the breaking down activities, and in the sense of the formulating or expressing them – can itself be conducted as a collaborative activity. Therefore, articulation conducted as a collaborative activity and making sure that things come together in turn also needs to be articulated [26]. Blumer and others have pointed to how social components influence actors' articulation of collaborative activities [5]. Shaping articulation social components gives it a shared meaning within a certain context or community and it is suggested that social components should be taken into account when we think through collaborative technologies [21].

One strand of research has focused on the way in which coordination mechanisms take on material form and how those material objects in turn shape coordination practice [4], [6], [26], [27]. The artifacts and procedures that form a coordination mechanism might be analytically distinct, though in practice they are seamlessly interwoven. Agreed-to procedures make sense to actors within a certain context or community, where they have a shared meaning. They are shaped by social components. This way, coordinative mechanisms shape the decisions and arguments of actors as they go about their work [4]. And therefore while activities that unfold in real-time cannot be undone or replayed [21], the incorporation of social components in coordination mechanisms becomes even more important to support shared meaning in the particular context or community.

Other strands of research have sought to understand coordination practice by paying attention to the way that spatial and temporal scope shapes the articulation of collaborative activities [2], [11], [19], [21]. For instance, Bardram's concept of timely coordination is defined as "an activity with the objective to ensure that the distributed actions realizing a collaborative activity takes place at an appropriate time, both in relation to the activity's others actions and in relation to other relevant sets of neighbour activities" [2 p. 163]. Gerson, relatedly, addresses articulation work from the perspective of "reach" that draws attention to the scope of the activities that bring things together [11]. Both of these conceptualizations point to the articulation of coordination as a collaborative activity, which in turn may also need to be articulated to carry out any particular activity. Informal ways of articulating or organizing activities forms an alternative to the merely formal articulation whenever time pressure requires this [7], though, scope influences the premises of actors' coordination of these activities too [11].

An overall characteristic of a coordination mechanism is therefore that it helps to reduce the complexity of articulation work by rationalizing it through segregation, standardization or coordination [11], [25]. The focus on the *material artifacts* that structure coordination tends emphasize the ways that different people and different processes come together – around objects, records, reports, information structures, places, etc. However, a focus on coordination in action reveals that coordination mechanisms may also be concerned with segregation and separation as a strategy to reduce the complexity of articulation work. Separation and segregation may be features of formal processes and standards; our empirical investigations focus on actor's practices of avoidance in healthcare.

2.2 Related Concepts of Actors' Coordination by Avoidance

A distinctive feature of coordination by avoidance is that actors' recognition of potential alternative courses of action takes place *in advance* rather than *after* a problem has occurred. Avoidance in this respect is different from repair work, which takes place after a problem has occurred [10], [28]. The question here is not what qualifies as routine (or repair work), but whether actors are able to realize alternatives to routines in advance and thereby adjust or temporarily avoid them. Thus, Feldman and others point out that what counts as routine and what count as alternatives to routine or adjustments are not clear-cut [10], [20]. Accordingly, "routines" are sets of possible patterns, rather than a single pattern, which are effortful and emergent through actors' practice [10].

An important consideration in healthcare is that routines should always be performed in ways that are appropriate to the particular patient's situation [9]. Clearly, this will vary from one patient to another depending on whether the patient has other diagnosis to give an example of complicating factors and therefore requires adjustments one way or the other. Berg points to the ad hoc and messy nature of medical work [3] that makes actors' reflections on how to adjust or avoid some routines temporarily even more pertinent in the case of patients with complicated diagnosis.

Thus, when looking at how people employ information systems designed to support organizational work in these sorts of settings, we need to attend not only to the actions that they take but also to the actions that they avoid, as adequate to the situations in which they find themselves.

The type of coordination where actors rely on avoidance has been conceptualized in institutional theory as the act of "negative coordination" [17], [23]. Negative coordination denotes a strategy where actors, in choosing their own courses of action, avoid inflicting damages to the protected interests of other actors. Negative coordination is one strategy that actors may legitimately deploy to achieve coordination by searching for solutions that do not collide with other actors' interests. In contrast, positive coordination describes a strategy whereby actors coordinate actively to search for new ways of moving forward even though it may challenge the interests of the involved actors.

Negative coordination may result from a need to escape what Lea refers to as the "paradox of coordination" [14]. The paradox arises where a perceived lack of coordination structures gives rise to an organizational response – the circulation of a newsletter, the institution of a new meeting, or the development of a new process – which itself functions as "ever-renewing points of connection" that in turn also need to be coordinated. To the actors involved, this means that there are new points of connections to be taken into consideration that extends the effort it takes to coordinate. This cycle or paradox draws attention to the legitimacy of coordination by avoidance. We argue that avoidance is not a problem, but rather just part and parcel of organizational work; our goal here is to bring it within the scope of CSCW analysis as a distinct coordination mechanism.

2.3 Extending Conceptualizations in CSCW

In terms of CSCW, an effective coordination mechanism helps to rationalize articulation work where segregation, standardization and coordination are different strategies that actors might employ [11], [25]. Gerson writes of this: "One kind of rationalization is segregation. This makes things independent of one another, removing the connections or contingencies among them wherever possible. Complex tasks are broken into multiple independent tasks. Similar things are grouped, and dissimilar things are segregated" [11 p. 198]. Similarly, negative coordination is a strategy that implies some form of segregation. Taking seriously that coordination mechanisms imply *both* bringing things together *and* keeping them apart, we propose a definition of an analytically distinct type of coordination mechanism that we describe here as coordination by avoidance:

> *Coordination by avoidance* describes a mechanism whereby actors avoid moving into other actors' legitimate field of interest. In this sense coordination by avoidance helps actors to coordinate responsibility of distributed tasks realizing alternatives or setting routines to a halt in order to coordinate practices in a way that is adequate with the particular situation.

Taking a closer look at the definition, coordination by avoidance is divided into two parts.

First, coordination by avoidance is defined by a mechanism used to pursue coordination by avoiding the actions that may collide with other actors performance of routines or routes of action. Avoidance implies that coordination is two-sided and is not only achieved by bringing things together, but also by keeping them apart.

Second, coordination by avoidance is defined by the coordination of responsibility when it would otherwise be unclear. Coordination of responsibility is ongoing at all times, and this implies that it also comprises decisions to coordinate by avoidance. By suggesting this definition we also suggest that coordination by avoidance occurs as a just part and parcel of organizational work.

Our research question here, then, is: What forms does avoidance take in coordination practices and what role does it play for the overall coordination across the organization?

3. RESEARCH METHOD

The research question is investigated in the paper focusing on aspects of coordination in four cases of everyday work in a radiology department and in clinical departments in so far their collaboration. These four examples are part of an overall study of the pre-diagnostic process when patients have potential symptoms of cancer where coordination is one particular concern of many.

The study was designed as an exploratory, ethnographically-inspired study [15], [16] guided by the research sites to point out those aspects of the practices that are profound in this diagnostic work. The investigations later became more focused on the particular aspects that had emerged from the first part of the study and led us to focus on the aspect of coordination by avoidance amongst others.

Empirical data reported here focus especially on the radiology department that takes on a central role in much diagnostic work. Data was collected over a period of 11 month in 2009 where the first author visited and re-visited the various sites that also included clinical departments and general practitioners – all central actors in diagnostic work. In total, the first author spent 100 hours observing practices and conducting in situ and semi-structured interviews at the main sites. Prior to this 14 hours of preliminary studies were conducted in sites that are similar to the ones studied (amongst these a smaller radiology department), to get some idea of the setting.

Throughout observations, field notes were constructed, in situ interviews were transcribed, and semi-structured interviews were both tape recorded and transcribed and guided later analysis. Moreover, various documents were collected throughout the study period, as were various images (pictures, prints, video, etc.) of the observed practices. In situ interviews were prioritized where secretaries, radiologists and radiographers were asked to think-out loud during ongoing work practice.

This method allowed the healthcare professionals to talk about their work practices while they emerged. On the other hand, the method to some extent restricts the results too. This is especially evident in situations where there is a tight schedule, i.e. in the situation where a patient has to be taken care of in an acute manner that limits the time there is to talk about ongoing activities. However, the in situ interview, we found, all in all useful to study practices that sometimes come across as silent like avoidance.

3.1 The Site: Mid-Size Radiology Department

The radiology department where observations were conducted is located in a Danish mid-size hospital. It plays a central role in diagnostics of patients in its region. It has been modernized over the last couple of years; a new information system has been implemented and a technological upgrade with a new MR-scanner (also called an MRI-scanner) and CT-scanner (or CAT-scanner) allow the department to process an increased number of diagnostic examinations and provide the department with new ways of diagnosing. In addition to these changes, the workflow of the department was analyzed and routines adjusted.

Approximately 60.000 diagnostic examinations are performed in the radiology department every year where the larger part of diagnostic examinations is X-rays (47.000) in addition to CT-scans (5.000), MR-scans (2.000) and ultrasound-scans (6.000). The healthcare professionals in the radiology department consist of secretaries, radiologists and radiographers who are organized in a hierarchy where they rank under the responsibility of a chief secretary, chief physician and chief radiographer. At the same time, this hierarchy reflects a set of shared responsibility for tasks that all feed into each other.

The secretaries manage incoming referrals and makes sure that they are sorted according to the referral, which states whether a patient is to be examined as an acute, sub-acute or as a planned case. A radiologist re-sorts referrals into acute, sub-acute and planned when assessing whether it is in fact the right diagnostic examinations that were ordered and describe the results of them (CT, MR, ultrasound etc.) after the scans have been performed. Radiographers are responsible for performing the examinations and assess whether slides and sequences are appropriate while the patient is being scanned. This is to some extent dependent on the scheduling of the secretary, too, grouping the patients to ensure that the slides and sequences will not have to be changed whenever there is a new patient in the scanner. Thus, representatives of all three groups (secretaries, radiographers, radiologists) are important actors in the diagnostic work and depend on each other.

The radiology department collaborates with a range of clinical departments that are both located at the hospital and at other hospitals in the region – as well as general practitioners and private practicing specialists that can also refer patients there. In particular the observations focused on collaboration with the medical department located at the same hospital as the radiology department. The Medical department is particular interesting here, being one of the departments with a formal agreement with the radiology department on scans. Thus, the medical department is one of three departments at the hospital with special access to scans if patients are suspected with cancer. Compared to other illnesses, cancer is considered to be particularly urgent and various initiatives have been taken to support better diagnosis for cancer patients.

A shared information system (OPUS) has recently been implemented across the various hospital departments that generally supports the registering, scheduling, communicating, coordinating, and managing of patients. In addition to this, the radiology department uses a radiology information system (RIS) and archive system (PACS) that other hospital departments may also enter to some extend to refer patients, retrieve images etc.

4. COORDINATION PRACTICES FROM THE PERSPECTIVE OF THE RADIOLOGY DEPARTMENT

In the following section the issue of coordination is explored in four different examples of everyday work practices observed in the radiology department and the clinical departments it collaborates with. The examples explore situations where more than one department is involved in diagnostic examinations at a time and how avoidance is profound in their coordination practices. It is in these situations where more departments are involved that coordination is put at risk.

In this way, realizing when the practical responsibility of a patient is shared between hospital departments or when it shifts becomes an important part of the diagnostic work. This is a somewhat broader understanding of diagnostic work than what would typically count as work that contributes to the production of diagnosis in the eyes of healthcare professionals. However, whenever departments interpret their responsibility, this is deeply intertwined with the way that diagnostic examinations are performed.

In our perspective, diagnostic work is an organizational consideration, not purely the decision of physicians, as it is often seen. Thus, other healthcare professionals like secretaries are increasingly important with the growing coordination of patient trajectories within information systems (i.e. secretaries coordinate responsibility of patients while scheduling them) We will discuss the emergence of coordination by avoidance in our fieldwork setting through four forms of avoidance that arose in our fieldwork: demarcating, delegating, procrastinating and accommodating.

4.1 Demarcating Through Pre-booked Times for Particular Departments

We found work by secretaries to be particularly important for coordination of responsibility between hospital departments. In the radiology department, secretaries perform the scheduling of patients in the radiology information system (RIS) where time-slots are pre-booked for CT-scans, MR-scans, ultrasound scans and X-rays. The time-slots are organized after the urgency of patients' illnesses within two formal categories 'acute' or 'planned'.

The organization of scans is furthermore based on the part of the body that is being scanned (i.e. the brain). The secretary can then book scans by simply asking the information system to find the first available time for i.e. a MR-scan and preferably within a time-slot pre-booked for 'MR brain-scans' if this is the scan that is ordered. Organizing the scans in time-slot means that there are fewer adjustments to be done between each patient. Scheduling the scans this way: 'brains' with 'brains' and 'backs' with 'backs', allows the radiology department to scan more patients than if there was no demarcation.

To schedule a patient in RIS, the secretary asks the information system to find the first available times for a particular type of scan, *i.e.* MR brain scan. Secretaries' identification of available times for scans within the time-slots is fairly automated for the vast amount of scans. Though, there are a few departments (the medical department, the surgical department and head-and-neck surgical department) that have pre-booked times every week for their disposal that may not be booked for other departments. These times are pre-booked for the purpose of patients suspected with cancer and are for the disposal of the departments up till 36-hours before the scan is due.

The cancer times have to be annulled by the clinical department if not used and no later than 36 hours before the particular scan is due so that it can be booked for other groups of patients. This is stated in a formal letter from the management of the radiology department with regard to national recommendations on cancer patient pathways. The national recommendations prescribe the pre-booking of times in the information system for patients suspected with cancer as one strategy to reduce wait time. To cancer patients it is crucial to be diagnosed and treated as quickly as possible to improve the prognosis.

Scheduling of cancer times is complicated by several factors, however. Secretaries and the other staff at the radiology department take very seriously a concern to reduce factors that might be slowing down the diagnostic process of clinical departments. At the same time, cancer times may be booked for other patient groups when released by the clinical department no later than 36 hours before the scan is due. As such, secretaries in the radiology department are under a lot of pressure whenever it seems that there is an available cancer time, though they also want to make sure that patients suspected with cancer can always be scheduled for a scan with short notice.

This means that not only staff at the radiology department (secretaries, radiologists, radiographers) are required to continuously coordinate to make sure that cancer times are scheduled accordingly, but the clinical departments that have cancer times for their disposal also have to be coordinated to make sure that they themselves request the times within the 36 hours if they want to be sure to have them for their disposal. The issue came up at the secretaries' weekly meeting, where they discussed how to handle the distribution of cancer times. The distribution of cancer times had been an issue since the secretaries had denied a cancer time for a clinical department that was located at another hospital in the region. Consequently, the hospital department filed a complaint to the management of the radiology department. At the weekly meeting, it was a relief for the secretaries when it was stated that the management found that the secretaries had been right in denying the other department the cancer time at that particular time.

The discussion picked up again when it was brought up that also some of the local departments at the hospital were asking to have some time-slots that would only be for their disposal. One secretary commented that the clinical departments might get fewer patients scanned if they were responsible for scheduling patients themselves instead of the secretaries of the radiology department. A huge difference of the times booked within the regular time-slots and the cancer times is that cancer times 'belongs' to the clinical department if not released 36 hours prior to the scan. Thus, 36 hours before the scan is due the secretaries at the radiology department actually have the possibility to book the cancer times for other patient groups. However, scheduling times for other patient groups is done with the risk of delaying the diagnostic process if a potential cancer patient suddenly needs a time for a scan after the 36-hour are due. Delay of the diagnostic process is something that all staff in the department try hard to avoid.

While the 36-hour rule gives the secretaries the authority to book cancer times for other patient groups, they agreed that they would continue to avoid scheduling cancer times at least if the requesting department was located off the hospital. This decision to some extend contradicted the secretaries' belief that the most effective way to book patients for scans is not to have the clinical departments book patients themselves but instead to pool the scans independent of the department.

To avoid a break-down of cancer times the secretaries preferred to attain some buffer by only releasing cancer times after 36 hours to departments that are located at the hospital. The secretaries felt that the radiology department would be held accountable if they were not able to provide scans for patients suspected with cancer – even if in principle the pre-booked time could be released for other patient groups. Here, demarcation helped the secretaries to avoid scheduling times in the information system that are pre-booked as a buffer for patients suspected with cancer. Rather than forcing secretaries to book all of their buffer, demarcation becomes a mechanism for secretaries to avoid certain times and search for others in the radiology information system as long as it did not concern the group of patients with potential symptoms of cancer.

4.2 Delegating the Re-scheduling of Orders From Other Departments

Avoidance is not always explicit as in the example above. Like the scheduling or booking of scans, re-scheduling or change of bookings is carried out within the radiology information system (RIS). At most, the times are organized in RIS in time-slots of 'brains', 'stomachs', 'backs' etc. that are not reserved for any particular departments. The clinical departments are responsible for the order of scans regardless of whether a patient is referred to them as an inpatient or outpatient. This also means that if a patient wants to change the date of a scheduled appointment the radiology department will not re-schedule it if the patient calls the radiology department to do this.

Instead re-scheduling is delegated to the department that ordered the scan in the first place that will also have to order the re-scheduling of it. Although it may seem like a lot of bureaucracy that the secretaries at the radiology department do not just do this on the spot, the reason becomes obvious when taking a closer look at the activities involved in re-scheduling of patients.

At the radiology department a secretary answers the phone daily between 09:00-12:00, where patients, general practitioners and others may phone in. Also on one particular morning when we were observing, a few patients called the secretary to reschedule their appointment. A patient had an appointment for a scan; however, he wanted to reschedule because the scan collided with his vacation that has already been planned. The secretary looked up the patient in the system. Here she can see all scheduled appointments for the patient at the hospital. The clinical department had already scheduled a follow-up appointment for him. The secretary checked the information in the system, then explained to the patient that he had to contact the clinical department to have them reschedule the scan.

The reason for this is that the appointment following the scan is typically scheduled a few days after the day of the scan. Here the clinical department gives the patient the result and they will agree on the next step depending on the results of the scan. The clinical departments have a limited access to the radiology information system, where they may order diagnostic examinations and later retrieve images and the results described by the radiologist. They cannot schedule the scans in the radiology system themselves – only order them – or they can cancel the scans that were already ordered. The secretary in the radiology department can tell from the information that she is guided to that the patient had already been scheduled in the clinical department for a follow-up appointment. And rather than rescheduling the appointment if ordered in-house the secretary asks the patient to contact the clinical department to change his appointment. This is not to make things more complicated for the patient, but to ensure that another appointment that has been booked for the patients in the day clinic in his case will be moved accordingly. At the follow-up appointment the clinical department will communicate the results of the scan to the patient.

This is not explained to the patient in the phone, but if the secretary in the radiology department had simply rescheduled him before it was clear whether it was possible to reschedule the appointment in the day clinic accordingly, it would have complicated things risking the patient to fall between stools. The responsibility of coordinating the re-schedule of appointments is delegated to the clinical department by avoiding doing this from the radiology department. Thus, delegation helps the secretaries make sure that responsibility is clear rather than taking responsibility for part of the rescheduling that could actually be performed in the radiology department – and this would have complicated the coordination.

Through delegation of responsibility for coordination of the appointment of the scan and the following appointment for the result from the scan the delegation helps to keep responsibility clear when more than one department collaborate to diagnose the patient. The secretary at the radiology department at the same time accepts some slack in the real-time scheduling. This is to make sure that the rescheduling will be coordinated in both the radiology department and the clinical department. The avoidance through delegation in other words becomes a mechanism that helps the secretary in the radiology department, though, it means that she have to slack on the rescheduling in real-time in the radiology information system.

4.3 Procrastinating on Requests of Patient Records In Use in Other Departments

In diagnostic work, there is often more than one department involved at a time providing different types of diagnostic examinations. Delaying procedures like the request of paper records becomes important when in use in other departments collaborating to diagnose a patient. In the diagnostic process, several departments share the paper record, which is typically used alongside the electronic patient record. Like the paper record, it contains the patient's history, but the paper record is often a fast alternative close to hand compared to the electronic record and the departments therefore argue that they prefer to have both. In the medical day-clinic located at the hospital the shifts in responsibility of patients is realized in various ways. One way is the location of the paper record of the particular patient. Other ways include the patient's appointments registered in the information system that forms an electronic overview.

The paper records are kept in the hospitals archive when not in use in any of the hospitals departments or day clinics. While in use the patient record follows the patient meaning that the medical department, the radiology department etc. collaborating to diagnose the patient will typically only have the paper record while performing a certain procedure. The paper record helps the various departments and day clinics realize when the responsibility of the patient is shared or shifting, while remaining a fast alternative to hand. A concrete example of this is the secretaries' use of paper records in the medical day clinic.

The paper record helps the secretaries realize what will be the adequate routines or routes of action when preparing the records of patients where their appointment are coming up. An important part of the preparations of a patient's appointment is to make sure that the patient record is updated with the latest lab results for the use of the physician that will see the patient. The day clinic sometimes has a wait list up to 2 months depending on whether or not the patient needs to be seen by the specialist acute. And to keep track of the upcoming appointment the update of the patient record in advance is an important task. The secretaries use the paper records to keep track of appointments that are coming up and therefore require that specific things be brought together for the use of the appointment. Colorful post-its at the front page of the paper record are used to remind secretaries of things that they should make sure are updated – not only in the paper record but also in the electronic record. Whereas the paper record only has one front page where post-its can be placed (that is at the same time hard to miss), there are various "front pages" in the information system.

A week in advance of the patient's appointment in the day clinic the secretary requests the patient record to make sure that it is updated. However, before requesting the paper record, the secretary looks up the location of it in the hospitals information system OPUS where it is registered if the patient record is in use elsewhere. If not in use, the paper record is requested electronically and prepared both in terms of the routine update with the newest lab-results etc. and in terms of post-its that secretaries and physicians use to remind themselves if there are particular things that needs to be taken care of. However, the paper record is only requested if the secretary can tell from the information in OPUS that the patient has no other appointments in any of the other departments. This, she explains, is to avoid requesting the paper record if another department is still doing examinations assuming that it interfere if they not have the paper record at hand.

Instead, the secretary delays the request of the paper record a few days. At the time where the paper record is eventually requested, it is delivered in the postal routine where it goes directly to the secretaries' office space. The postal worker delivers paper records routinely every morning where the records are delivered in big brown envelopes. In case the patient record is needed urgently, the secretary may phone the postal workers and have the record sent up express, though it is underlined by the secretary that this is something that is kept count of. If possible, the paper record should always be requested at least a few days before an appointment if it is not required urgently. The secretary then registers the patient record in the information system so that it is clear to others that look it up that the record is now located in the medical day clinic. The day before the appointment the secretary again checks all the paper records that were prepared to make sure that last-minute results are included. The paper records are placed in order at the physician's desk and a copy of the electronic calendar put on top.

As such, the paper record serves as more than a fast alternative to hand for the physicians that are the ones to see the patient; it also serves as a way for secretaries to keep track of patients' appointment coming up. Secretaries at the same time are responsible for updating the record with the newest results that are crucial for the physician to be able to decide on the next medical step together with the patient. Therefore, request of a patient record from another department before the diagnostic examination has been performed will not only interfere with their procedures, but, most likely the patient record will also not be updated. To the secretary, the avoidance when procrastinating on the request of a patient records if in use in another department makes sense as a mechanism to ensure coordination.

4.4 Accommodating Difference at Inter-departmental Conferences

To coordinate their findings with other departments, the radiology department every week hosts morning conferences according to a fixed schedule for the collaborating departments. The schedule is displayed on a whiteboard in the corridor with the names of radiologists responsible for morning conferences that week. A secretary in the radiology department updates the whiteboard on Fridays with information on physicians' responsibility for the following week as well as information on the radiologists that will be responsible for MR-scans, CT-scans etc.

The number of morning conferences listed on the whiteboard differ from one clinical department to another: the morning conferences with the surgical department are held every day where all patients that were examined by the radiology department the previous day(s) are run-through by a radiologist. The morning conferences with the medical department on the other hand are only held twice a week. Another difference is that the medical department will choose a number patients that they would like the radiologist to run-through rather than go over all patients.

As such, the number of conferences not just reflects the differences of the patients that are selected for presentation; it also reflects the type of information that is presented at the morning conferences. A radiologist who runs morning conferences on a regular basis explains that his presentations of the results of scans will differ from department to department ranging from a lot of short presentations to a few longer presentations. Short facts are presented for the many surgeons that will attend the morning conference whether they are surgeons or training to become surgeons, while more detailed descriptions are provided for the medical specialists.

At the morning conference the surgeons enter the room in a rush and leave the room the same way the minute that the morning conference is over and sometimes even before the radiologist has answered the last question. Approximately 1-2 minutes is used to run-through each patient. To some point the surgeons could just as well get the information from reading the description of the scan in the information system, the radiologist comments. In contrast it varies how many of the medical specialists that will attend their morning conferences and they will typically only attend when a patient of theirs is presented.

After the morning conference the radiologist usually has a smaller or larger stack of notes of things (re-examinations etc.) that came up at the morning conferences and has to be followed up. A few things are added to the descriptions of the scans as well. Only when the radiologist has released the description of the scan the clinical departments can retrieve the descriptions that they use to guide decisions on what will be the appropriate next step. Images, in contrast, can be retrieved by the clinical departments immediately after the scan.

Thus, the radiologist will to some extend avoid some information revealed from the scans on the morning conferences with the surgical department if he interpret it as non-important for the surgical procedure. The scans may reveal a lot of information that is on the other hand relevant to the medical department that has a broader interest in the way that the body works. The surgeons have an interest in fixing the parts of the body that is the focus of surgery and here it does not always matter whether the milt seems slightly bigger than what is considered normal to give a concrete example.

This way avoidance of some information becomes a mechanism that accommodates the different interests of clinical departments. The surgical department performs surgical procedures every day where they will use the 'fresh' scans of patients to guide the surgery. The medical department uses the scan to get a picture of patients' state of health as a supplement to other measures. And to present the same type of information at the different morning conferences would confuse the picture rather than accommodate the important differences in perspective. Thus, avoiding some information helps the radiologist accommodate the specialization of the clinical departments.

5. DISCUSSION: COORDINATION BY AVOIDANCE

Coordination by avoidance appears in a number of important ways to coordinate trajectories when departments collaborate to diagnose patients. The radiology department is one of the key actors in the diagnostic process. In turn, it is a huge concern to the radiology department not to slow down diagnostic examinations that are performed simultaneously in the collaborating, clinical departments. For this reason, the radiology department is an interesting starting point for investigations of coordination when more than one department collaborate to diagnose patients.

Coordination practices played out in the four examples of the radiology department and the clinical departments in so far their collaboration points to the legitimacy of avoidance. Here avoidance is a legitimate response when responsibility shifts or is shared across hospital departments. From Lea's perspective [14], coordination achieves its legitimacy by avoiding ever-multiplying points of coordination (with their associated overhead). In our perspective, though, it is more importantly about avoiding that points of coordination are ambiguous.

Avoidance helps actors to make good on their responsibility even though medical work may be messy and marked by ad hoc decisions [3]. Based on these findings, we argue that coordination by avoidance can in fact be conceptualized as a distinct coordination mechanism. As the examples illustrate demarcation, procrastination, delegation and accommodation all make legitimate ways for actors to make sure that responsibility is clear across hospital departments. Avoidance in these examples is a pertinent, just and parcel part of diagnostic work. Although avoidance is often not the first thing that comes to mind when setting healthcare policy, it comes across in our analysis as important to keep responsibility clear.

Actively coordinating [2], departments call the secretaries in the radiology department, to ensure that the departments' acute referrals are being handled as they should be. A shared understanding of how acute referrals should be handled means that secretaries all know that they have to prioritize acute referrals before other referrals. This way articulation of shared or shifting responsibility of patients is conducted as a collaborative activity that in turn also needs to be articulated as pointed out by Schmidt and Simone [26]. However, the articulation of collaborative activities may also be performed by simply avoiding routines or setting routines to a temporarily halt as the examples illustrate.

Thus, actors demarcate, procrastinate, delegate and accommodate activities to make sure that others do not confuse the shared or shifting responsibility. The coordination mechanisms (i.e. information systems) are crucial in these situations to help actors realize when responsibility is shared and when it shifts. Here the information system helps the secretaries avoid the re-scheduling of patients that also has to be re-scheduled in another department to ensure that activities of the hospital departments remain coordinated. Leaving the re-scheduling to one department therefore is the effective way to make sure that it is coordinated in both hospital departments.

The coordination mechanisms in the examples of this paper play a different role than what Ash and others describe when they describe how workarounds [1], [13] becomes necessary for actors to get their work done. Where Ash et al. examine workarounds as "clever methods for getting done what the system does not let you do easily" [1 p. 195], we found with the perspective of avoidance that the opposite may also be true: The information system *helps actors* to get done what the routine otherwise not let them do easily when it helps actors realize in advance what may be the alternatives to routines or routes of action.

However, a question that remains is what makes the legitimacy of avoidance. The counterpart to *coordination by avoidance* is to actively coordinate as pointed to by Bardram's concept of timely coordination [2]. Supported by the articulation that is in itself conducted as a collaborative activity between actors, timely coordination is concerned with the actively bringing together of things. Thus, the objective of timely coordination is to ensure that distributed actions realizing a collaborative activity take place at the appropriate time. Avoidance, then, gives a different focus where actors coordinate by demarcating, procrastinating, delegating and accommodating actions to make sure that activities take place at the appropriate time. This raises questions about the actors' competencies with it requires especial skill and attentiveness to the broader organizational process.

In the examples we presented, avoidance make coordination less time demanding when the secretaries in the radiology department do not have to call the clinical departments to coordinate how to re-schedule a patients appointment, for instance, or when the secretaries do not have to coordinate with the clinical departments that have cancer times for their disposal when deciding whether they can give these to other patients, or when the radiologists do not have to work to align the needs of different clinical departments for their presentations.

Instead, the shared understanding of responsibilities permit and make it possible for these actors to make decisions, though, it presumes some understanding of the responsibilities of other departments. Actors' competences may be stretched a little further than what would be the formal interpretation of these. However, the shared understanding of the distribution of responsibility in the organization means that these actors do not feel that it is stretching it too far when demarcating, procrastinating, delegating and accommodating actions.

While the actors could actively coordinate these things with each other, this would in some cases cause a slip in responsibility rather than ensuring that responsibility is always clear. In the same way, actors will adjust routines when realizing that the routines will otherwise not produce the intended outcome or that replacing the routine will produce new outcomes [10]. The actors' demarcation, procrastination, delegation and accommodation allow the collaborating departments to maintain some form of stability or formal stringency. Thus, procrastinating on the request of the patient record the secretary to some extend knows the routines in the radiology department that makes her confident that the patient record can instead be requested a few days later. Routines are reified through their recurrent use in everyday life [20]. While avoidance of routines may be temporary, avoidance is important to ensure the effective coordination of responsibility when it shifts or is shared.

It is not least the way that coordination mechanisms take on a material form that is important in a double sense when actors coordinate by avoidance. The presence or the absence of the paper record guides the secretary's actions. And, here avoidance not only plays an important role for the secretary to realize how far the performance of routines is other departments. It also plays an important role for the secretary to realize how far the performance of the department's own routines is and to make sure that routines are performed adequate with the patient's trajectory. The activities that unfold in real-time cannot be undone or replayed [21], but the coordination mechanism may help the secretary avoid routines in advance when realizing that it will conflict with other actors' legitimate interests. Taking on a material form, the coordination mechanism reminds the secretary that she needs to request the paper record a few days later.

Though the purpose is slightly different, avoidance was also observed in physician's coordination practices where avoidance is one way to accommodate the differences between the clinical departments. And, thus, to accommodate some difference this way supports the specializations of the clinical departments. The radiologist to some extend decides on what will be the relevant level of information to the different clinical departments. Like in the case of the secretaries the radiologist does not feel that this is stretching it too far due to the actors shared understanding of the distribution of responsibility. How the responsibility is distributed across the hospital departments at a day-to-day level in the overall organization is something that is sometimes difficult to trace - whether secretaries or physicians. In the examples of coordination practices, secretaries and physicians all rely on a shared understanding of how responsibility is distributed to coordinate their activities.

Thus, the distribution of responsibility is something that is typically not described in detail in formal protocols or procedures. The following remark from a surgeon in the co-located surgical department illustrates this. Here a patient came in with a boil. Two surgeons were deciding whether they would be the surgical department to perform surgery on this patient discussing whether the boil was in fact located inside or outside of what they talked of as the "swimsuit" (demarking an area of the patient's body). The swimsuit became their way to make decisions on the distribution of responsibility within these surgical sub-departments is not described in any protocols or procedures. As such, depending on whether the boil was located inside the swimsuit, this was the responsibility of the surgeons and they would avoid coordinating with the orthopedic surgeons and perform the surgery themselves. In the opposite case they would have asked the orthopedic surgeons remove the boil. Avoidance is a just part and parcel of coordination practices, although, it can be discussed to what extend it always take on a material form as an actual coordination mechanism (or like in the example above where the surgeons coordinate by the imagined swimsuit that does not take on a material form as such, but still forms a coordination mechanism).

A last remark that remains clear throughout the discussion here is that in all of the examples coordination by avoidance depends on actors' understanding of the distribution of responsibility in the overall organization. Understanding this is time saving and can even strengthen the integration of practices and the information system. Acknowledging the existence of coordination by avoidance then draw attention to the importance of not only bringing things together, but also to keep them apart and can help us think through coordination practices.

6. CONCLUSION

Coordination is often thought of as *bringing things together*; however, our investigations of coordination practice suggest that coordination is also often about *keeping things apart*. And, thus arguing that avoidance is not a problem, but rather just part and parcel of organizational work; our goal with this paper has been to bring avoidance within the scope of CSCW analysis as a distinct coordination mechanism. Thus, we asked in the paper: "What forms does avoidance take in coordination practices and what role does it play for the overall coordination across the organization?

The question we explored in the analysis of the various forms that avoidance takes on in everyday practices in a radiology department and clinical departments in so far their collaboration. The radiology department was chosen as an outset for investigations as one of the hospital departments most frequently involved in diagnostic work. Exploring the question empirically, we analyzed how coordination by avoidance takes on different forms, including practices of *demarcating*, *procrastinating*, *delegating* and *accommodating* that help actors ensure the effective coordination of the overall organization whenever responsibility shifts or is shared. These forms of avoidance helped actors to legitimately avoid routines or routes of action when colliding with those of other actors and thereby ensure the effective coordination across hospital departments.

In related studies, Feldman and others have found that actors will find ways to adjust routines when realizing that the routines will otherwise not produce the intended outcomes or that replacing the routine will produce new outcomes. Our study suggests that coordination by avoidance can take on the material form of a coordination mechanism that helps actors realize alternatives to routines in advance rather than after a problem has occurred. Furthermore, based on the examples of coordination mechanisms in the empirical examples, our study suggests that coordination by avoidance is a just part and parcel of diagnostic work. Coordination by avoidance can help us think through coordination practices to fully comprehend these.

We suggest a conceptualization of coordination by avoidance as a distinct type of coordination mechanism. Thus, coordination by avoidance describes a mechanism whereby actors avoid moving into other actors' legitimate field of interest. In this sense coordination by avoidance helps actors to coordinate responsibility of collaborative tasks realizing alternatives or setting routines to a halt in order to coordinate practices in a way that is adequate with the particular situation.

The observation that avoidance often remains in the background in healthcare policy writing, as in other areas of collaboration, where coordination emerges as a central concern, was originally the motivation for this paper. Avoiding certain activities or setting them to a temporarily halt is not the same as *not coordinating* activities. Drawing attention to the legitimacy of avoidance is, therefore, important when we think through the information systems that are requested in policy writing. Acknowledging that avoidance may also be desirable in some situations, the question to be addressed is how we also incorporate avoidance when we think through information systems.

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Layers in Sorting Practices: Sorting out Patients with Potential Cancer

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Abstract. In the last couple of years, widespread use of standardized cancer pathways has been seen across a range of countries, including Denmark, to improve prognosis of cancer patients. In Denmark, standardized cancer pathways take the form of guidelines prescribing well-defined sequences where steps are planned and pre-booked in order to manage patient trajectories. They are different from typical medical guidelines because they combine both administrative and clinical prescriptions. A key issue related to the enactment of a standardized cancer pathway concerns the decision to initiate a pathway for a particular patient. Due to the limited resources within the Danish healthcare system, initiating cancer pathways for all patients with a remote suspicion of cancer would crash the system, as it would be impossible for healthcare professionals to commit to the prescribed schedules and times defined by the standardized pathways. Thus, sorting patients with symptoms of potential cancer becomes an essential activity. In this paper, we investigate the pre-diagnostic work of sorting patients with symptoms that may potentially be cancer. We identify and conceptualize the sorting practices for potential cancer patients in the pre-diagnostic work as being structured in layers of the interrelated, iterative practices of constructing, organizing, re-organizing, and merging the multiple queues within which each patient is simultaneously situated. We find that the ordering of patients in queues is *guided* by the formal sorting mechanism, but is *handled* by informal sorting mechanisms. We identify two informal sorting mechanisms with large impact on the sorting practices, namely subtle categorizing and collective remembering. These informal sorting mechanisms have implications for the design of electronic booking systems because they show that sorting patients before initiating a standardized cancer pathway is not a simple process of deciding on a predefined category that will stipulate particular dates and times. Instead, these informal sorting mechanisms show that the process of sorting patients prior to diagnosis is a collaborative process of merging multiple queues while continuously deciding whether or not a patient's symptoms point to potential cancer.

Key words: pre-diagnostic work, cancer, sorting, collaboration

1. Introduction

Awareness of waiting times for diagnosis and treatment has increased in various medical areas (Bjørn and Balka 2007; Ryan et al. 2000; Siciliani and Hurst 2004). In Denmark, politicians and the public share a particular concern for waiting times related to cancer diagnosis and treatment because the survival rates reported for different types of cancer are lower in the Danish population compared with neighbouring countries (Sundhedsstyrelsen 2005). To improve cancer survival rates, Danish hospitals have invested a significant proportion of their resources to eliminate waiting times in cancer diagnosis and treatment (Jensen et al. 2002). The Danish healthcare system is publicly funded under the responsibility of Denmark's five regions that formally own the hospitals. The National Board of Health and the Ministry of Health and Prevention are the national public authorities. In October 2007, the government introduced standardized cancer pathways as a strategy to reduce waiting times for patients with a reasonable suspicion of cancer (Sundhedsstyrelsen 2008a).

A key issue related to standardized cancer pathways concerns the decision to initiate a pathway for a particular patient. Standardized cancer pathways prescribe well-defined sequences where steps are planned and pre-booked in order to manage patient diagnosis and treatment. The decision to initiate a cancer pathway then commits the healthcare professionals to performing diagnostic examinations and treatments in a precisely defined, timely manner. Due to the limited resources within the healthcare system, initiating cancer pathways for all patients with a remote suspicion of cancer would crash the system—it would be impossible for healthcare professionals to commit to the prescribed schedules and times defined by the standardized pathways with the limited resources available. Thus, sorting patients *before* initiating standardized pathways becomes an essential activity in enacting standardized cancer pathways.

Sorting patients with potential cancer may seem to be a straightforward, individual activity, and deciding to initiate a cancer pathway may appear to be a simple activity based on applying the standardized classification scheme embedded in the standardized cancer pathway for the particular cancer type (i.e., lung, breast, pancreatic) (Sundhedsstyrelsen 2009a, c, d). However, studies of how patients are sorted in an emergency department found that sorting practices form complex, collaborative multiplicities of work practices, people, and processes simultaneously working together to accomplish successful sorting of incoming patients with respect to the limited resources available (Bjørn and Rødje 2008). Therefore, in this paper we embrace the sorting of patients as a collaborative activity. We investigate the process that precedes the decision to initiate or not to initiate a standardized cancer pathway. The research question is: How is the sorting of patients with symptoms of potential cancer handled in practice in the pre—diagnostic work? We identify two informal sorting mechanisms embedded within the collective sorting practices, namely subtle categorizing and collective remembering. Both mechanisms are crucial to understanding how healthcare professionals sort potential cancer patients, ensuring that high-risk patients are diagnosed and treated as quickly as possible under the resource-limited circumstances of the healthcare system.

The paper serves as an investigation of patient sorting practices in the pre-diagnostic work, and our findings suggest the need to re-think the conceptualization of patient sorting to include how various queues for diagnostic examinations are interlinked. We found that sorting practices are structured in layers of the collaborative, interrelated, iterative practices of constructing, organizing, re-organizing, and merging the multiple queues within which each patient is simultaneously situated. We further found that these practices are *guided* by the formal sorting mechanism of standardized cancer pathways but are *handled* by the informal sorting mechanisms of subtle categorizing and collective remembering.

The paper is structured as follows. First, we introduce our empirical case and method (Section 2). Then we present our theoretical framework (Section 3), which is based on previous work on classification, diagnostic work, and sorting. In Section 4, we present the standardized cancer pathways as formal guidelines for sorting patients with potential cancer. In Section 5, we present our analysis, identifying the two informal sorting mechanisms, subtle categorizing and collective remembering, which are used to handle the sorting. We then discuss our empirical findings by linking these to the theoretical framework (Section 6). Finally, we conclude (Section 7) by conceptualizing the sorting practices as layered, collaborative, diagnostic sorting practices of constructing, organizing, re-organizing, and merging the multiple queues of patients with potential cancer.

2. Research method

This paper reports on an empirical study investigating the practices of sorting patients with symptoms of potential cancer. The study is an ethnographically informed workplace study (Forsythe 1999; Luff et al. 2000; Randall et al. 2007a) and builds on qualitative studies of work practices where multiple research sites were visited and re-visited over a period of 13 months. The study was inspired by Star and Strauss (Star and Strauss 1999) in our attempt to understand sorting practices within the healthcare system. We investigated both what constitutes the formal guidelines for handling the sorting of patients with potential cancer as they appear in the standardized cancer pathways and, in this way, comprise the *arena of voice* (Ibid) as well as the actual practices—the *layers of silence* (Ibid)—by which the healthcare practitioners construct, organize, re-organize, and merge multiple queues for diagnostic examinations that are invisible to the standardized cancer pathways. These practices are highly interlinked, and, in practice, no clear-cut distinction exists between them. This distinction is more of an analytical manner.

The study was first initiated as an exploratory study where we were guided by the research sites to point out essential aspects of the sorting practices. Later, the study focused on the particular aspects of queuing, which had emerged as an essential part of the sorting practices. To investigate sorting practices in the pre-diagnostic work, it is essential to investigate a context where patients are not yet suspected of having cancer. In Denmark, patients with a reasonable suspicion of cancer are referred straight to a hospital responsible for standardized cancer pathways. However, patients with unclear symptoms (that may later turn out to be cancer) are referred to hospitals focusing on general symptoms. Therefore, one of the focused observation locations was a hospital responsible for general symptoms. Patients are often referred to the hospital by their general practitioners (GPs). The GPs are the gatekeepers of the Danish healthcare system. As such, we also conducted observations within a GP's office. This approach gave us the opportunity to investigate how patients are sorted in the pre-diagnostic work before a suspicion of cancer is established, creating a clear link between the context of study and the empirical site (Klein and Myers 1999).

In total, the first author spent 118 h observing practices and conducting in situ and semi-structured interviews at the two main sites: one general symptoms hospital (hospital a) and one GP's office. Prior to these observations, preliminary studies were conducted at another general symptoms hospital (hospital b) and in the GP's office, for a total of 14 h (see Figure 1). Field notes were written during all observations and in situ interviews. In addition, various documents were collected throughout the study period, as were various images (pictures, prints, video, etc.) of the observed practices. On average, a GP sees 10 patients a year that actually turn out to have cancer (Vedsted et al. 2008); thus the likelihood of observing the initial visit of a patient with potential cancer is quite small. For this reason, it was necessary to use semi-structured interviews so that the GPs could use their electronic patient records to recall the particular patients and situations where the patient turned out to have cancer. Semi-structured interviews were both tape recorded and transcribed.

The data analysis was initiated during the data-constructing process, and findings guided further observations. The initial focus of the observations was the collection of artefacts and procedures involved when various healthcare professionals sort patients. Later, observations focused on the particular themes, such as subtle categorizing, as is reflected in the main analysis of this paper. Importantly, the first author's previous profession was as part of the team responsible for designing the standardized cancer pathways in the Danish National Board of Health, which meant that she had significant insights into the formal, visible guidelines for sorting patients with potential cancer.

The first author continuously contested data (Klein and Myers 1999) by presenting them to participants at the fields sites, including one of the GPs and the chief physicians at the two hospital departments in the study. The insights from these participants provided useful interpretations for analyzing the sorting practices that emerged during the study. These informal conversations with participants served as a way for the first author to address preconceptions about the pre-diagnostic work. The informal conversations to improve understanding of data at one stage then became the preconception for the next stage in data analysis and served as a way of reasoning in analysis (Klein and Myers 1999). In addition, the study was informed by participants from the National Board of Health through informal conversations. Data were also contested through

Interviews

In situ interviews were conducted with general practitioners (3), an information systems manager (secretary with special training) in the radiology department (1), secretaries in the radiology department (3), front desk staff (2), radiologists (4), radiographers (3), secretaries in the medical outpatient clinic (2), secretaries in the medical department secretariat (2), medical specialists (3), a nurse in the medical department (1), and a surgeon (1). In addition, two semi-structured interviews were conducted with the general practitioners (2).

Informal conversations

Preliminary studies were conducted in *hospital b*, which was slightly smaller than *hospital a*, the main site of the study. The preliminary studies were meant to provide some idea of the information systems in use. The first author engaged in informal conversations with secretaries and the information systems manager while they demonstrated how to use the electronic information system. The author also engaged in informal conversations with GPs and the chief physicians in the radiology department and the medical department. Additionally, the first author attended conferences and engaged with participants from all levels of the healthcare system.

Observations

Observations were conducted at a GP's office in the catchment area of *hospital a*, where GPs regularly refer patients. At *hospital a,* observations were mainly conducted in the radiology department and the medical department (including the acute care section [AVA], the outpatient clinic for gastroenterology, and the medical department for admitted patients) as well as the surgical department, in so far as these departments' collaboration. These departments are central actors in the pre-diagnostic work when a patient's diagnosis is not clear.

Artefacts that were "followed"

Standardized cancer pathways, electronic referrals, paper referrals, patient records (paper), patient records (electronic), schedules of physicians and secretaries, "red paper notes" for urgent referrals of patients in the radiology department and "orange paper notes" for urgent referrals in the medical department, protocols for scans, post-its from morning conferences, secretaries' post-its, formal categories (i.e., formal diagnosis codes), informal categories (i.e., "lost 20 kg,"), formal letters, etc.

Coordinative meetings / conferences

Secretaries' weekly meeting on procedures for referral and booking in the radiology department, daily morning conferences of the radiology department, daily nurses' meeting on admittance of patients in the medical department, daily physicians' meeting in the medical department, physicians meetings in the outpatient clinic (gastroenterology), departments' (multi)disciplinary meetings of the surgical department and the medical department.

Pictures, prints, video etc.

Figure 1. Data sources.

conferences on cancer policy involving participants from all levels of the Danish healthcare system, which the first author attended. These conferences formed another opportunity to discuss data.

2.1. Research sites

General practitioner office. Observations were conducted in a relatively large GP office that consisted of five GPs and one GP in training, three secretaries, three nurses, and one laboratory technician. When a GP encounters a potential cancer-related complaint, the GP will refer the patient to a hospital for further examinations. Depending on the patient's symptoms, the GP can refer the patient either to a general hospital or to a private specialist. Or, if there is a reasonable suspicion that the patient has cancer, the GP may refer the patient directly to a hospital specializing in cancer. This might be the case if, for example, an ultrasound examination ordered by the GP reveals a potential malignancy; by ordering the test, the GP is the one responsible for following up on the test result. The information system supporting referrals is an Edifact-based information system (Electronic Data Interchange). Edifact is a standard for the exchange of messages that can be used across different providers of healthcare information systems. The standard is maintained by the international community.

Radiology department. Observations and interviews were conducted in a mid-sized hospital that specializes in referred patients with more or less unclear symptoms. These patients are particularly important when investigating sorting practices because they typically do not meet the formally prescribed criteria defined in the standardized cancer pathways—they represent the exception cases. The observations were focused in two departments: the radiology department and the medical department. The radiology department provides important diagnostic examinations critical for the pre-diagnostic work. It plays a central role in the region and was recently modernized. A new Radiology Information System (RIS) was implemented, allowing radiology departments at other hospitals in the region to share and exchange images and information on patients with the radiology department. Moreover, the department has new MR-scanners (MRI) and CT-scanners (CAT). The staff in the radiology department includes secretaries, radiologists, and radiographers.

Medical department. The medical department has several sub-sections specializing in different areas of medicine (such as diabetes, gastroenterology, cardiology, etc.) as well as four outpatient clinics and a medical acute care section (AVA). The medical department diagnoses a number of patients with cancer every year in conjunction with the collaborating departments, although, formally, patients must be sent to a department that specializes in cancer when the medical department realizes that a patient is in fact a cancer patient. Patients admitted to the medical department typically have no clear symptoms of cancer; thus, various healthcare professionals collaborate to diagnose these patients. Patients are first admitted to AVA before being distributed to the specialized sub-sections of the medical department. We were able to observe both acute and none-acute patients in the medical department.

The hospital has recently implemented a shared information system (OPUS) across the various departments, supporting the registering, scheduling, communicating, coordinating, and managing of patients. The OPUS system is also based on the Edifact standard, enabling it to receive electronic referrals from GPs and other hospitals.

3. Theoretical framework

3.1. Classification

Classification is a key interest to the CSCW community and has been investigated in terms of classification work in ontology-building communities (Randall et al. 2007b), classification work in call centres (Martin et al. 2007), as well as in the medical areas of disease classification (Bowker and Star 2000) and the politics of classification work (Bjørn and Balka 2007), to mention a few. Key findings from this previous work concern the nature of classification schemes, how classification schemes are constructed, and how they are enacted in practice. In the following we will link these previous studies to the case of standardized cancer pathways.

Classification schemes are, by nature, spatial, temporal, or spatial-temporal segmentations of the world that refer to a particular set of boxes in which things can be placed. The underlying assumption of every classification scheme is that consistent, unique classification principles exist and can be used to describe all cases in mutually exclusive categories (Bowker and Star 2000). Classification schemes are idealized views of a working practice often produced outside the domain of use (Martin et al. 2007). All classification schemes embody a dynamic compromise, acting as both formal and informal resources for action (Bowker and Star 2000). There is a tendency that only the formal resources are visible to the outside and embedded within the classification schemes, thus making the informal practices that are key to making the classification work in practice disappear (Bowker and Star 2000; Martin et al. 2007; Randall et al. 2007b).

The standardized cancer pathways form a classification scheme based on the National Board of Health's symptoms of different types of cancer (i.e., categories of symptoms of lung cancer, breast cancer, pancreatic cancer, etc.) *combined* with administrative prescriptions for how to apply the classification scheme. From this perspective, the classification scheme of standardized cancer pathways embeds unique prescriptions for how to administer the classification scheme in practice.

However, it is crucial to note that for potential cancer symptoms, mutually exclusive categories are seldom the case. For instance, patients may have several concurrent diagnoses besides cancer (co-morbidities) or be facing any number of other complicated circumstances that make symptoms more or less unclear, therefore rendering the standardized cancer pathways inappropriate. In these instances the patients may be labelled as potential cancer patients, but a standardized cancer pathway cannot be initiated. The National Board of Health is aware of this problem, and writes in the guidelines:

> A significant number of patients may not follow the course of a pathway from start to finish. These are, for instance, patients with other diseases or conditions that will affect the diagnosing and treatment. These also include patients where the picture of suspected or [later on] confirmed cancer is unclear. Or it may be patients with relapse after end of treatment. (The National Board of Health 2008: 4, translation by the first author)

Classification schemes often have to rely on the use of residual categories in order to render themselves complete (Bowker and Star 2000; Martin et al. 2007), and as the above quote illustrates, the residual "other" category of cancer patient is embedded within the actual standardized cancer pathway descriptions. The classification scheme here thus includes symptoms pointing to different types of cancer, as well as add-on categories such as "unidentified primary tumour" or "co-morbidity." "Unidentified primary tumour" and "co-morbidity" are therefore a formalization of essential parts of the residual "other" categories of the classification scheme. These categories can be used for patients that, for some reason, do not fit into the classification scheme of particular types of cancer.

What is particularly interesting in the case of the "unidentified primary tumour" category is that it is an example of how the classification scheme for standardized cancer pathways was extended or re-constructed due to the practical circumstances of dealing with residual categories. When the standardized cancer pathways were first released in 2008 there was no category of "unidentified primary tumour"; thus, patients were placed in the residual "other" category. However, at the end of 2010, the National Board of Health released a new standardized cancer pathway for "unidentified primary tumour."

Lung cancer	Breast cancer	...etc...	Unidentified primary tumour	Co-morbidity	"Other"
Signs, symptoms, administration	Signs, symptoms, administration	Signs, symptoms, administration	Signs, symptoms, administration	Signs, symptoms, administration	

Figure 2. The classification scheme of standardized cancer pathways.

In this way, the work behind the classification scheme of standardized cancer pathways is similar to the work on ontology building (Randall et al. 2007b). In their paper on ontology building, Randall et al., based on the work of Bowker and Star (2000), investigate classification schemes in three dimensions—comparability, visibility, and control—as a means to evaluate the usefulness of classification schemes in practice. These three dimensions were previously pointed out by Bowker and Star as the main dimensions challenging the crafting of classification schemes. The essence of Bowker and Star's argument is that "*the only good classification is a living classification*" (Bowker and Star 2000: 326).

Then, investigating classification work in the community of ontology building, Randall et al. argue that classification schemes are constructed to serve heterogeneous situations, making it possible to compare across cases. This ability inevitably makes parts of the work invisible because although the comparability allows for use across settings, it also increases the degree of inappropriateness for each local setting (Randall et al. 2007b). Bowker and Star (2000) view this dilemma as a trade-off between comparability and visibility, whereas Randall et al. (2007b) and Martin et al. (2007) suggest that it is not simply about control. Instead, they argue that all uses of classification schemes require the extra work of mediating between the scheme and practice—the extra work of translating the general classification to fit local particularities, making it useful in practice.

The nature of the classification scheme of standardized cancer pathways is a spatial and temporal compromise of mutually exclusive categories for cancer diagnosis combined with prescriptions for the administration of the classification scheme. However, the construction of this classification scheme is an evolving practice where participants (the Board of Health, cancer experts, etc.) re-negotiate residual categories and find new solutions to ensure additional categories can become part of the classification scheme, supporting both the comparability between patients and the ability to control and ensure good and timely treatment of cancer. As with all classification schemes, there is and always will be an "other" category—also in cancer treatment. In the classification scheme of standardized cancer pathways, the "other" category constitutes the cases that do not fit into a standardized pathway of diagnosis and treatment.

However, the main concern in this paper is not related to the construction and use of the classification scheme for standardized cancer pathways. Instead, our main concern is the practice of sorting patients with potential cancer that precedes the decision of whether or not patients may enter a standardized cancer pathway. In this way, the sorting investigated in this paper does not concern the use of the total classification scheme of the standardized cancer pathways (Figure 2), or even the smaller scheme consisting of "yes, there is a reasonable suspicion of cancer", or "no, there is a suspicion of cancer, but not a reasonable suspicion" (Figure 3).

Classification scheme to decide whether to initiate a standardized cancer pathway	
Yes, there is reasonable suspicion of cancer	No, there is a suspicion of cancer, but not a reasonable suspicion

Figure 3. The classification scheme that forms the essential decision of the pre-diagnostic work.

The latter classification scheme (Figure 3) forms the essential decision of the pre-diagnostic work prior to the decision of which type of cancer and thus the decision of which types of standardized cancer pathway might be appropriate. We focus on the sorting that *precedes* this classification scheme.

3.2. Diagnosing

Diagnostic work is the work involved in identifying and categorizing emerging problems while scoping for possible actions to deal with the issue (Büscher et al. 2009). Diagnostic work is a social phenomenon embedded within social organizational practices (Alby and Zucchermaglio 2009), and diagnostic work includes actions for developing a shared understanding of the particular situation (Nevile 2009). The shared understanding is highly dependent on how various healthcare professionals interpret each others' actions. The interpretation of other healthcare professionals' actions is typically based on written information. "Reading" the actions of others provides a perspective for how to interpret previous healthcare professionals' actions based on the personal experience (i.e., senior rank, specialization) of these actors (Hartswood et al. 2003). However, in diagnostic work, the ability to read or interpret the actions of other participants while identifying opportunities for actions is crucial but often invisible and has therefore been under-theorized in research literature (Mesman 2010).

Diagnosis is a classification tool of medicine used in diagnostic work (Bowker and Star 2000). Diagnostic work involves a pre-existing set of categories (i.e., diagnoses) that have been agreed upon by the medical profession to recognize a particular condition in combination with the actual process by which such categories are applied (Blaxter 1978; Jutel 2009). Diagnostic work is a collaborative activity, and prior to diagnostic work a crucial activity is pre-diagnostic work. *Pre-diagnostic work* forms the activity where formal categories (i.e., The International Classification of Diseases [ICD]) and other classification schemes are not applied so as to avoid preliminary courses of action that could possibly risk the health of the patient. Pre-diagnostic work is thus work where the decisions around examinations and treatments are open-ended. Previous research investigating how existing diagnostic categories are applied in practice (Mol and Elsman 1996; Kane and Luz 2009; Mesman 2010) found that classifications in the later diagnostic process help actors close ends by asking “what to do” rather than “what is the matter.” However, to our knowledge, no one within CSCW has been investigating the pre-diagnosis process of potential cancer patients and all of the work surrounding this process, which is the focus of this paper.

Classification schemes play a major role within diagnostic work. Various classification schemes are constructed to allow categorization of diagnoses and treatments with the aim of improving medical practice. The classification schemes represent the degree of consensus among medical professionals concerning the value of specific treatments for patient conditions, which have been critically examined for particular scientific strengths and weaknesses (Wennberg 1984). This process is highly similar to ontology building in the field of bio-informatics, where experts are involved in finding new ways to capture expertise in the knowledge domain (Randall et al. 2007b). However, whereas the building of ontologies for either medical or bio-informatics practices embraces variations as challenges that need to be incorporated within classification schemes, the actual use of classification schemes in practice forms quite a different perspective. The use of medical classification schemes is about being able to compare and control diagnosing and treatment, ensuring that best practices are enacted for all patients in a timely manner. In this perspective, variations in medical practices are typically perceived as unwanted by physicians, as something we need to reduce through standardization (Bates 2002; Raghupathi 1997); and medical practice involves exercising collective responsibility for understanding the consequences if alternative treatments are chosen (Wennberg 1984).

As shown here, diagnostic work in medical practices involves many different, interlinked practices highly connected with the underlying classification scheme relevant for the particular illness. In this paper, it is not all these practices that are in focus, but only the open-ended process of diagnosing potential cancer patients based on the sorting that precedes the classification scheme of standardized cancer pathways. So, although the standardized cancer pathways classification scheme influences the pre-diagnostic work by being the formal ordering device, this classification scheme does not take into account the sorting practices involved in the pre-diagnostic work, which are critical for the later diagnostic work and the main concern in this paper.

3.3. Sorting

To understand the sorting of patients in the pre-diagnostic work, we need to examine the heterogeneous practices through which the specific ordering devices (the standardized cancer pathways) are materialized, mobilized, and contested, at particular times and places, with varying effects (Schmidt and Wagner 2004). These formal constructs and ordering devices constitute the schemes, guidelines, and protocols for categorization of symptoms that represent the degree of professional medical consensus at a particular time. While formal constructs may constitute plans orienting actions (Suchman 2007), they may also form more precise scripts that, to some extent, prescribe specific steps—and not just orient action (Schmidt 1997). If we investigate the standardized cancer pathways from this perspective, the question is whether they form maps or scripts for diagnosis and treatment of potential cancer patients?

The standardized cancer pathways do stipulate particular times, diagnostic examinations, and treatments for particular types of patients and from this perspective have a "scripted nature." However, the "script" is not a complete list that must always be conducted in the same order, as, for example, the list of the air pilot (Schmidt 1997:142). In contrast, the formal guidelines explicitly mention in several places that all patients should be assessed on an individual basis; thus, the "script" of the standardized cancer pathways should not be followed blindly (Sundhedsstyrelsen 2009a' b' c' d). So, although standardized cancer pathways are formal constructs that, to some extent, prescribe action in a "scripted" manner, we find that the actual enactment of the formal constructs are more in terms of "maps" orienting the collective action.

While the standardized cancer pathways are designed as a formal sorting mechanism, the key interest of this paper is the informal sorting mechanisms involved prior to the essential decision of whether or not to enact a standardized cancer pathway. The essential question here is: How can we conceptualize the informal sorting mechanisms involved in the pre-diagnostic work? The informal sorting mechanisms are highly linked yet invisible to the standardized cancer pathways. To get the work done, any cooperative effort involves activities of mediating and managing these relationships in terms of articulation work (Gerson and Star 1986; Strauss et al. 1985). This goes for pre-diagnostic work as well. The important aspect of articulation work is that it is invisible to the rational models prescribing the work and is thus also invisible in the standardized cancer pathways. By being invisible, important activities for getting the work done become silent, and what counts as work in a particular context varies and is continuously negotiated (Star and Strauss 1999). Crucial invisible work involved in sorting potential cancer patients is exactly the sorting work that goes into the process that precedes the diagnosis. The practices investigated in this paper are the sorting that guides whether or not a patient's symptoms even point to potential cancer, which includes the negotiations between multiple actors involved in the pre-diagnostic work.

When we analyze our empirical case, we search for the informal sorting mechanisms. A sorting mechanism in pre-diagnostic work is a practice used to achieve the particular goal of prioritizing the patient in relation to other patients and available resources while reducing the effort involved in the articulation work required to sort patients in a distributed work setting. *Sorting mechanisms* involve interpretation work where the classification scheme (in our case "reasonable suspicion of cancer" or "suspicion of cancer") is the essential decision of pre-diagnostic work. Interpretation work is framed by participants' perspectives (on patients, examinations, colleagues, resources, etc.) based on their existing knowledge and experiences (from former work) with the subject area (sorting cancer patients) and the people (other participants, i.e., GPs) involved. By saying that interpretation work is involved and that it is framed by prior experiences, we link interpretation work to the act of remembering (Orr 1986; Bannon and Kuutti 1996). Collective remembering is a process where multiple actors develop a shared understanding of a particular event or action. Remembering is closely connected to story-telling, and prior research found that diagnostic work has a strong component of story-telling that helps both to inform others, but also to demonstrate to others a competent practice (Orr 1986). By remembering, actors develop a shared meaning (Bannon and Kuutti 1996), and thus peoples' perspectives can become part of the practices.

Then, similar to the sorting practices in emergency departments, the work of sorting potential cancer patients can be conceptualized as a collaborative sorting mechanism constituted by a complex multiplicity of work practices (Bjørn and Rødje 2008). However, in sorting patients with potential symptoms of cancer the actors involved in the decision to initiate a standardized cancer pathway are geographically and organizationally dispersed, whereas the staff involved in sorting in emergency department are organizationally and geographically co-located in this process. This increases the complexity of interpretation, interactions, and coordination significantly.

4. Formal sorting mechanisms

The objective of the standardized cancer pathways is to support acute action in cases where patients are suspected of having cancer, providing the patients with a sense of security in that they are being treated correctly and in a timely manner (Sundhedsstyrelsen 2008a). For each type of cancer—excluding the rare cancer types—the National Board of Health has defined a standardized cancer pathway, prescribing examinations, treatments, and timelines. The standardized cancer pathways were designed in collaboration with leading cancer specialists and are based on the medical guidelines for the different types of cancer. They build on the assumption that "suspicion of cancer" is a medical term that physicians generally use and understand by training. Introducing categories of "reasonable suspicion of cancer" and the residual "other" category, "suspicion of cancer," the standardized cancer pathways seek to extend this term where the reasonable suspicion categories are the ones that initiate a standardized cancer pathway. The way standardized cancer pathways are thought to work by the National Board of Health is illustrated below (Figure 4).

A reasonable suspicion of cancer should always result in the patient being assigned to a standardized cancer pathway for the particular and relevant type of cancer. Particular symptoms are described for each cancer type defining what reasonable suspicion entails. For example, if a cyst, a benign, or a malignant tumour is detected in the pancreas, there is "reasonable suspicion of cancer" in the pancreas, and therefore the patient must be assigned to the pancreatic

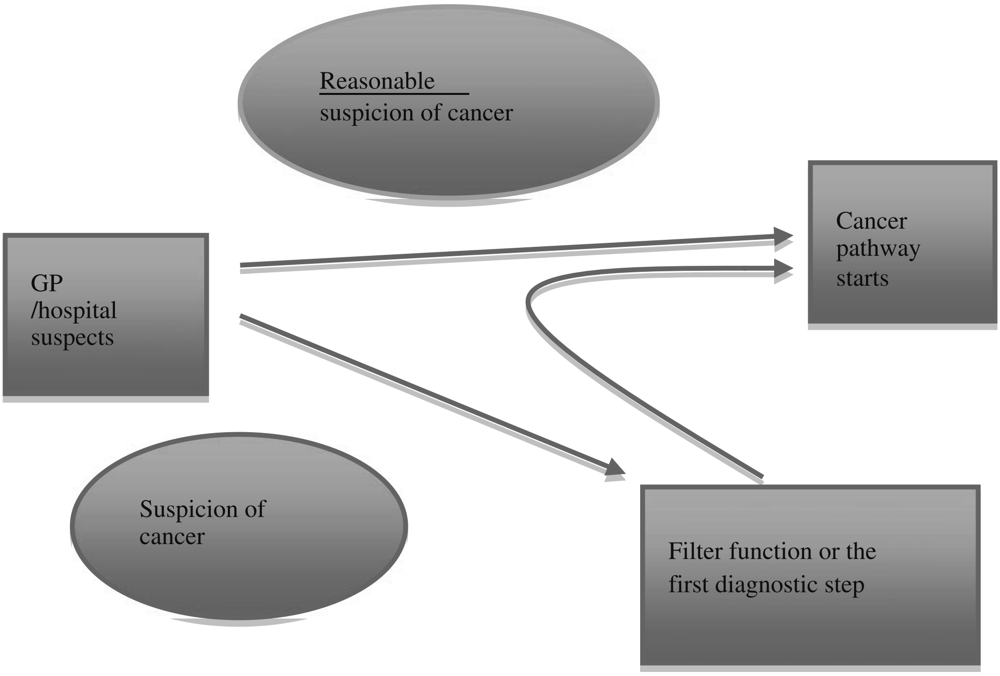

Figure 4. The entrances to standardized cancer pathways (Sundhedsstyrelsen 2008b).

standardized cancer pathway (Sundhedsstyrelsen 2009c). "Suspicion of cancer" in the pancreas entails one or more of the following five symptoms: discomfort in the pancreas, weight loss, loss of appetite, faintness, and fatigue; however, they are not sufficient to talk about a "reasonable suspicion of cancer." Instead, further examination is needed, typically a CT-scan or an ultrasound scan, to establish if there is in fact a reasonable suspicion of cancer (Sundhedsstyrelsen 2009c). As such, when symptoms are unspecific, such as fatigue, the patient must queue up for diagnostic examinations first to determine whether there is a reasonable suspicion. It is important, according to the general guidelines, that physicians react both to the specific symptoms and to the rather unspecific symptoms like loss of appetite, faintness, and fatigue (Sundhedsstyrelsen 2008b). In this way, the unspecific symptoms expand the specific symptoms of pancreatic cancer to a rather vast amount of interlinked categories. The category of symptoms for pancreatic cancer is constituted by both the specific symptoms, i.e., a suspected malignancy revealed by a scan, *and* the extended criteria. Below we will provide three examples of how the standardized cancer pathways are thought to work. The first two examples are highly complex situations, whereas the last example is straightforward.

Depression or cancer. A key activity in sorting patients is to distinguish "reasonable suspicion of cancer" from "suspicion of cancer." Signs of pancreatic cancer may be loss of appetite, faintness, and fatigue, which are rather common, unspecific chief complaints that may also be symptoms of, for example, depression. Cancer and depression are treated rather differently, and, according to the guidelines, the physician should always be aware of the possibility to overlook cancer when these symptoms appear without any other reason. The first question will then be whether the patient should have an ultrasound and/or CT scan on the "suspicion of cancer" since this test will clarify whether there is a "reasonable suspicion of cancer" or if the issue is more likely to be depression. If the physician decides to indicate "suspicion of cancer" in the pancreas, the patient, according to the standardized cancer pathway, in principle should not yet be assigned to the pancreatic cancer pathway. This would entail a time frame of 3 days for the first diagnostic examination (Sundhedsstyrelsen 2009c) and the patient would be bumped up in the queue for additional diagnostic examinations, maybe leaving other patients with unclear symptoms behind. However, if the physician refrains from indicating "suspicion of cancer," the waiting time for diagnostic examinations (CT-scans i.e.) in practice might be up to 2 months.

Primary tumour or metastasis. Patients referred with the category "reasonable suspicion of pancreatic cancer" will be booked into several specialized diagnostic examinations. However, if the CT scan does not reveal a primary tumour in the pancreas but does reveal metastasis, we have a complex case of unidentified primary tumour. The patient has cancer. However, the standardized pancreatic cancer pathway is not suitable for the patient because the primary tumour is located in another organ or part of the body. It is the primary tumour that dictates the diagnosis and treatment and subsequently the cancer pathway. The result of the ultrasound scan (or/and other types of examinations) becomes an important factor for sorting patients with potential cancer. Which part of the body is scanned and the method by which it is scanned is immensely important for detecting the location of the primary tumour. At the same time, unnecessary scans should be avoided due to the risks that come with excessive use of radiation—another concern for the physician to take into consideration. In treating cancer, the primary tumour must be found because the primary tumour is the source for metastasis in the rest of the body. Therefore, although choosing the path for patients with potential cancer might seem like a process involving a simple decision of whether or not the patient is believed to have, for example, pancreatic cancer, it may take time to detect the location of the cancer. Instead, the process requires various examinations.

Obvious suspicion of cancer. The examples above illustrate the complexities of cancer diagnosis. However, there are patients where the process is more or less straightforward. These are not the patients in focus in this paper, but it is important to clarify the difference between the "easy" patients that may fit in to a standardized cancer pathway and the "complex" patients. If a patient presents to a GP with significant weight loss and pain in the area of the pancreas, the GP, according to the standardized cancer pathway, should refer the patient straight to the radiology department to have an ultrasound scan. If the ultrasound scan shows some suspected malignancy, the "easy" patient should then, according to the standardized cancer pathway, be assigned to the pancreatic cancer pathway. The GP should therefore consult the surgical department at the relevant hospital to admit the patient, simultaneously turning the responsibility for the patient over to the surgical department. In practice, the standardized cancer pathways consist of a number of pre-booked times in the electronic booking systems reserved for patients where there is a reasonable suspicion of cancer. The surgical department should be able to book these times for a particular patient on very short notice, thereby reducing waiting times to a minimum in the case of the non-complex patient.

5. Analysis: identifying informal sorting mechanisms

Sorting patients prior to diagnosis where symptoms are unclear cannot be done by simply applying the standardized cancer pathways as a formal classification scheme for sorting patients. The question, then, is how are patients with symptoms of potential cancer sorted in practice in the pre-diagnostic work? The following analysis empirically investigates sorting practices involved when patients with potential cancer are being examined, and it identifies two essential informal sorting mechanisms. The analysis is divided into three sub-sections. First we introduce how the main gatekeeper—the GP—sorts patients with unclear symptoms. Then we explore the informal sorting mechanisms that organize the collaborative engagement between the GP and the receiving hospital. Here we show that handling diagnostic examinations is not a simple process of applying a standardized cancer pathway, but instead includes negotiations between multiple heterogeneous actors sorting patients. These multiple heterogeneous actors and the results of their work (scans, blood tests, biopsies, etc.) are all involved in deciding whether to interpret symptoms as potential cancer symptoms. Moreover, we show that the organization of work is concentrated towards queue management of patients waiting for diagnostic examinations. To handle the complexity of queue management, healthcare professionals enact two informal sorting mechanisms: subtle categorizing (Sub-Section 5.2) and collective remembering (Sub-Section 5.3).

5.1. Sorting patients in practice

One central actor in the sorting of patients is the GP. In Denmark, each citizen is connected to one GP who then provides care on a permanent basis. The GP is the gatekeeper to more specialized treatment in the healthcare system, so patients present their chief complaints and the GP decides whether he or she can help the patient or whether the patient has to be sent to a specialist. GPs can also order various types of examinations and tests. Investigating how patients with symptoms of potential cancer are sorted, it is important to note that some cancer patients present to the GP with almost no signs of serious illness. When the diagnosis is unclear, the direction of symptoms becomes important to determine the level of urgency. One of the GPs in the general practice office explains:

> Knowing him for 18 years, I had a feeling that something was the matter with this patient. He complained about things that could not be detected. He has always been in a good state of health and exercised twice a week. Though, in some periods he had dyspepsia [stomach acids] and had been medicated. When he first came to see me, he complained that he had been feeling daily discomfort below his left rib for about 3 weeks. It seemed that he was unaffected and there were no filling to be detected in his stomach, although he was sore there. So we agreed to try medication to prevent the dyspepsia, and if he did not feel better within 2 weeks' time, he would return. (General practitioner, GP office, July 2nd, 2009)

The patient in this case has unclear symptoms, and according to the patient's record, his only history was a prior case of dyspepsia, which is considered a rather common, unproblematic condition. The patient is also exercising twice a week; nevertheless, his good health has changed. To understand the direction of symptoms, the GP treats the known diagnosis of the patient (dyspepsia), and initiates a range of diagnostic examinations of the heart, stomach, lungs, and colon. All turned out fine, except his infection number [CRP] was higher than the normal range:

> The patient still had some problems with the dyspepsia, although, he felt that the medication had helped a bit. I was worried about his infection numbers that were now 49, and they were only supposed to be around 8. If it was a stomach wound, the patient would have *Campylobacter* [bacteria], and for this reason we agreed that I would prescribe antibiotics. The gastroscopy of the stomach did not reveal anything, and we agreed that he would return a week later, after finishing the antibiotics. (General practitioner, GP office, July 2nd, 2009)

The medication for dyspepsia does not treat the problem, and at the same time the infection numbers are rising. The GP suspects a stomach wound, and the patient starts taking antibiotics. In this way, treating the possible stomach wound is part of the diagnosing, and the patient is to return to the GP in 1 week. However, at the same time, the GP decides to refer the patient to the hospital for an ultrasound scan to make sure that it is not something more serious than a stomach wound. The text displayed in the electronic referral writes: "*63 year-old man that has been treated for dyspepsia for many years, in March first appearance of daily discomfort under left rib, the pain is projected to the back.*" This text does not indicate whether or not the patient is suspected to have cancer. At this time, the GP does not articulate cancer as a possibility and does not recognize it as such. However, the GP is still concerned for the health of the patient, so she phones the chief physician at the hospital and explains the situation before sending a referral for an ultrasound scan. The two physicians agree that the patient's situation is serious, but not critical, and decide to treat the patient as "sub-acute." The formal categories in the referral template are "planned" or "acute," thus they construct another category for this patient that cannot be ticked off in the formal template. The GP explains:

> I talked with the chief physician to make sure that they [the hospital] would understand that the referral should not wait too long, and we agreed that they would see him as sub-acute. So I hoped that they would see him within a week or so. I had asked the patient to come back the next day for a urine test; that was the last thing I had to do [to check the general state of health], and it was blank too. Infection numbers had risen considerably though, and I told him that this could not continue. He suffered from something. I called the acute section to admit him straight away. I remember that he asked me, on that particular day, if I insisted that he go straight to the hospital. He was on his way to do some form of exercise. (General practitioner, GP office, July 2nd, 2009)

The urine test is the last test planned by the GP to examine the patient's general health before the responsibility is to be taken over by the hospital, as agreed. However, it turns out that on the day of the urine test, the patient's infection numbers have increased from 49 to 160. This makes the GP change the level of urgency, and she calls the hospital again to have the patient admitted the same day, instead of a week later. The decision is all about where in the queue of patients it is appropriate for the particular patient to be located. It is no longer appropriate for this patient to queue with the other sub-acute patients; instead, the patient's condition is critical and requires immediate action. The example illustrates how the result of the patient being bumped up in one queue, namely the GP's queue (the patient is prioritized to see the GP quickly due to the high infection numbers), also affects the placement of the patient in the hospital queue where the patient is waiting for an ultrasound examination. Initially the patient is placed as "sub-acute," but this is changed to "acute." Results from one diagnostic examination influence the queue for other diagnostic examinations. The changed state of the patient means that at the hospital he is placed in the queue of patients that need an acute ultrasound scan by the acute care section instead of in the queue of patients waiting for planned or sub-acute ultrasound scans. The patient from the empirical example was diagnosed with pancreatic cancer after being admitted to the hospital and is thus an example of a patient diagnosed not by the hospital formally responsible for standardized cancer pathways in this region, but instead by the general hospital.

This example illustrates how the essential work of the GP includes dealing with unclear symptoms and sorting out the complexities when the observations of the patient (fit, healthy patient) do not fit the results of a test (increasing infection numbers). Moreover, it shows that it would have been impossible for the GP to assign the pancreatic cancer diagnosis to the patient on the first visit because the symptoms by themselves could be interpreted in various ways—as dyspepsia, a stomach wound, or pancreatitis. The example also illustrates that treating a possible diagnosis is part of the diagnostic work, and even the extensive list of diagnostic examinations of heart, lung, stomach, and colon does not make the actual diagnosis more apparent.

Thus, when the patient was admitted to the hospital, the physician had not yet articulated the diagnosis as cancer, and cancer was not written on the electronic referral. Still, the healthcare professionals prioritized the patient, bumping him up in the queue through other collaborative means, namely by phoning and later sending the patient through the acute care section. This example clearly shows that the practices of sorting of patients with potential cancer do not simply follow the pattern stipulated by the standardized cancer pathways. Nevertheless, concerned healthcare professionals in this case manage to collaborate across geographical and organizational boundaries when sorting patients appropriately by means other than the categories of standardized cancer pathways or even the categories embedded in the electronic referral systems.

5.2. Subtle categorizing as a sorting mechanism

Situations arise where the formal categories (“acute” and “planned”) within the referral systems are not fine-grained enough to capture the level of urgency of particular patients, which is essential for the sorting practices. In the example above we saw how the situated category “sub-acute” entered the sorting practice for the patient with unclear symptoms. The categories used within the electronic referral system to indicate urgency is a central tool generally used for guiding the sorting of patients, including cancer patients. Interestingly, using these categories is not simply about choosing between “planned” or “acute” and making compromised categories such as “sub-acute.” Instead, we discovered some indispensable sorting practices used by the healthcare professionals when negotiating the sorting of patients. We label these practices *subtle categorizing*.

When patients are referred by a GP to a hospital for diagnostic examinations, the main communication artefact is the referral template (either electronic or paper-based). In most situations, the referral template is the only communication between the GP and the hospital, even though in some situations they will telephone each other, as in the example above. Thus, a main role of the referral template is to communicate the GP’s interpretation of the patient’s condition and urgency to be able to place the patient in the correct order in the queue for the particular examination. This includes the possible use of ICD categories to indicate cancer. When the referral template ends up in the hospital department, the hospital department staff determine the urgency of the examination based on the referral and re-organize the queue for examinations. There are two queues: acute examinations and planned examinations.

Waiting time in the queue for planned patients might be as long as 2 months, depending on the urgency of the patient's symptoms and whether physicians suspect that it could be something serious. If the referral states "obs cancer," which translates to "observe cancer" (other words for this include obs pro cancer, obs malignancy, obs c), the urgency of the patient is quite clear, and it is easy for the hospital department staff to place the patient in the correct order. However, as we have illustrated, this is rarely the case. In most instances the GP does not explicitly write "obs cancer" because the symptoms will be quite unclear and multiple interpretations of these symptoms are possible. Thus, using the referral template as a communication tool, it is vital that the GP is able to communicate the urgency of the condition by other means than formal categories. So, how is urgency communicated within the referral template without applying the formal categories? Level of urgency is communicated using the free-text field in the referral template. Exploring the way the free-text field was used in the referral template, we found that the healthcare professionals had developed particular concepts and phrases, which each had particular connotations and meanings communicating the level of urgency. One example is "patient lost 20 kg." This phrase communicates from the GP to the hospital department staff that there might be a suspicion of cancer, thus indicating a high level of urgency. Another GP explains:

> I was consulted by this patient who complained about being very tired, although she used to be a morning person. While we were talking, she suddenly told me that she had lost 14 kg without doing anything to drop weight. It came as a complete surprise to me. At this point I had to stop the consultation and explain to her that, when she told me that she was tired and that she had also lost 14 kg and had little appetite, it made me think about serious illness. I asked whether she had noticed any change. This she denied. She had a sister that had died from breast cancer and a father that had died from some form of lung cancer. However, the patient herself seemed fine. So we agreed to have her X-rayed. In the regular system, filling in the referral note one needs to choose his words carefully; if the patient needs to be seen within short time, then a word like *cancer* is much more efficient than *fatigue* and *weight loss*, although most physicians will probably understand that cancer is suspected in both cases. (General practitioner, GP office, July 10th, 2009)

In this example the patient appeared fine; however, the patient's family history, weight loss, and the patient feeling tired makes the physician worried and he decides to refer the patient to radiology. The GP explains that the choice of words is critical. In the regular system (i.e., not assigning patient to a standardized cancer pathway) particular phrases will bump the patient up in the queue, whereas others will place the patient at the end of the line. Even though the GP is worried, he cannot simply assign the patient to a cancer pathway because he does not know which type of cancer the patient might have. Moreover, if he were to write "lung cancer," this would influence which types of examinations the patient would get. And if the actual diagnosis was not lung cancer, but required different types of examinations, then the whole process would be delayed. The GP has to communicate his suspicion with a clear indication that he suspects cancer, at the same time ensuring that the patient is sorted by the hospital in an appropriate manner. By using phrases or concepts like "fatigue" and "weight loss" or the formal category "obs cancer" in the referral's free-text field, the level of urgency is communicated to the receiving hospital department.

In a different example the free-text field in the referral contained a note that the "patient had lost 20 kg" and later in the text that a "little obs malignancy" was suspected. With the introduction of standardized cancer pathways, the phrase "obs cancer" in practice commits the healthcare system involved in the diagnosis to the pre-defined times between examination, results, and treatments. The patient categorized with "obs cancer" should be prioritized in all the sorting practices, placing other possibly ill patients later in the queue. In cases where the GP believes that the risk of cancer is less likely, the GP therefore does not have an interest in the patient jumping queues ahead of other possibly higher-risk patients. However, by using phrases and words mutually known by the healthcare professionals who are dispersed by geography and organization to indicate urgency without committing to a particular pathway, the healthcare professionals manage to collaborate and inform each other about their interpretation of unclear symptoms in such a way that it informs the sorting practices. This behaviour is an essential informal sorting mechanism when healthcare professionals manage the limited resources available for diagnostic examinations. They communicated the level of urgency through subtle categorizing. Subtle categorizing, in this way, is a vital informal sorting mechanism in the sorting practices of patients with potential cancer.

5.3. Collective remembering as a sorting mechanism

We have now shown that one essential informal sorting mechanism enacted in the sorting practices of patients with potential cancer entails subtle categorizing. However, in our investigations we found another vital informal sorting mechanism as well: *collective remembering*. It might appear odd that GPs and hospitals may communicate the level of urgency through these subtle ways instead of simply stating the facts. However, a crucial aspect of this way of communicating is founded in the widespread concept of "hospital memory." Hospital memory describes how GPs' referring practices affect the sorting practices within the hospitals. A GP in the study articulates hospital memory in this way:

> If I suspect cancer but I have no idea where it is located, this is the way I will have to do it if I want the patient to be seen within 3–4 days. Typically a chief physician looks at the referrals. The chief physician interprets the words that the GP has written. The same patient...well, if I only use *weight loss* and *fatigue* and words like that, then there are many reasons why this patient can

> wait a month. If I write *cancer obs pro* [obs cancer] then there is no question that I mean what I have written literally and that the patient should be seen within a short time. If the patient needs to be seen straight away, I will, of course, call them. But, in normal circumstances, I have seen these... "Ahh, this guy [GP] only writes it when something is the matter, he knows what he is talking about, there must be something wrong, he [the GP's patient] should have a time," whereas those [GPs] who will just send anybody have to wait a day longer. I know it sounds a bit tough, but I think that this is how things are in many places. (General practitioner, GP office, July 10th, 2009)

Hospital memory is a phenomenon known by healthcare professionals which indicates how the hospital perceives the GP's competencies based on the referral pattern of the GP. However, as the above quote shows, in understanding hospital memory as a sorting mechanism, it is essential that the mechanism entail not only how the hospital views the GP, but also how the GP views the hospital's view of the GP. Therefore, will we identify this vital informal sorting mechanism as *collective remembering*.

Collective remembering comprises practices where both the GPs and the hospital staff "keep track" of each other's collaborative actions and remember the interaction patterns between each party. The GP interprets the hospital (how long do the GP's patients have to wait), and the hospital interprets the GP's referral patterns (how many patients does the GP refer as cancer patients where it turns out to be a less serious diagnosis). In practice, this means that GPs have the collective remembering in mind when deciding whether or not to explicitly indicate suspicion of cancer in the referral template. According to a study of 1,186 out of the 3,500 GPs in Denmark on GPs' handling of patients with suspected lung cancer, GPs in Denmark reported that they hesitate to use the term "cancer" to avoid worrying patients (28%) and to avoid losing credibility among peer in hospitals by using the term too often (40%) (Bjerager et al. 2006). If a GP is known to "cry wolf" by using the formal indication "suspicion of cancer" too often, committing the hospital department to times and dates, it will affect how future referrals are handled.

Consequently, the GP has the huge responsibility of being a gatekeeper, ensuring that patients with a common disease are not assigned to a standardized cancer pathway to avoid risking that patients with a higher level of urgency will have to wait longer. The decision is further complicated by the lack of consensus among GPs and hospital physicians on the exact use of the term *cancer* (Sundhedsstyrelsen 2009a). Collective remembering influences the hospital's perspective on the local GPs, which is not directly visible in the communication artefacts—for example, electronic referrals—that handle the negotiating activities between the GP and the hospital. However, this does not reduce the effect of collective remembering as a sorting mechanism that silently guides the practices of sorting patients, which is mediated through telephone calls, referrals, and the results of diagnostic examinations.

In the following quote from the observation notes, the radiologist at the hospital provides an example of how collective remembering is part of deciding the priority of the patients referred for MR scans:

> The acute patients are taken first. Though, apparently this patient does not look like it is acute [the radiologist looks up the patient in the information system].... It is a boy, 12 years old, with some kind of bone outgrowth where the physician wants to make sure that it is not cancer. The physician has previously assessed that it is probably nothing malignant [the radiologist looks at the name of the physician that referred the patient at a glance]. I know all of the physicians in this hospital department and also which of them refer the most patients. [The radiologist writes in a small free-text field, "upper arm, tumour protocol, time within 2 weeks." This free-text is only visible in the hospital's information system and is used to guide the secretary that will book the patient electronically within the queue of patients waiting for an MR scan]. (Radiologist, Radiology Department, October 28th, 2009)

The example illustrates that the collective remembering of other physicians' ways of referring patients affects the priority of patients. The referral in this particular example is sent from another hospital department, which suggests that collective remembering also exists within the hierarchies between hospitals. Collective remembering plays a central role as a mechanism for sorting incoming referrals sorted by the radiologist. First, patients are sorted according to the categories "acute" and "planned," which are the formal categories generally used in the electronic referral templates. Then the radiologist sorts the patients within a local classification scheme on a scale 1–5, where one is acute and five is non-acute. This scale is similar to the triage acuity scale used to sort patients in emergency departments (Bjørn and Balka 2007; Tjora 2000). However, this scale has different interpretations depending on which kind of scan the patient is queuing for. In queues for MR scans, the 2nd level of urgency indicates that the patient can wait 2–3 weeks, whereas in queues for ultrasound scans, the 2nd level of urgency indicates that patients can wait 2–3 months if they are not suspected of having serious illness. Thus, secretaries need information on how the radiologist sorts referrals to be able to book patients appropriately in the electronic booking system, re-organizing the queue of previously booked patients to adjust for the new patients. Besides assigning a level of urgency to each patient, the radiologist can also write how many weeks the patient can wait in the free-text field in the hospital's information system. If he writes 2–3 weeks, this communicates to the secretary how much time he anticipates the patient can actually wait, and the secretary will schedule the actual plans for scans.

6. Discussion: layers in sorting practices

In general, sorting practices comprise a number of interrelated processes used by multiple geographically and organizationally dispersed healthcare professionals to prioritize patients based on their level of urgency and the limited resources available. Investigating sorting practices in Denmark related to patients with potential cancer, the decision to assign or not to assign a patient to a standardized cancer pathway has a large influence on how quickly and in what way the patient will be diagnosed and treated. If a patient is assigned to a standardized cancer pathway, the patient will be referred to a specialized hospital and quickly provided with diagnostic examinations. However, if the patient's symptoms are unclear and the patient is not assigned to a standardized cancer pathway, the patient will risk long waiting times for diagnostic examinations. Thus, the sorting patients prior to diagnosis is crucial to patients with potential cancer because it decides not only which hospital a patient will be referred to, but also which diagnostic examinations the patient will be getting and how fast.

Managing the sorting of potential cancer patients is a practice of queue management, as in how patients queue for ultrasound scans, blood tests, biopsies, and other diagnostic examinations. The results of each of these examinations affect the decision to assign the patient to a standardized cancer pathway or not. Thus, there is a recursive relationship between the queuing for and the results of the diagnostic examinations: if the results support a reasonable suspicion of cancer, the patient will be prioritized in the queue for additional examinations; if the results reject a reasonable suspicion, the patient will be placed at the end of the queue for future diagnostic examinations.

More precisely, our investigations of the sorting practices leading up to this decision revealed that the decision to initiate standardized pathways is not a simple process where one individual checks a box ("obs cancer") in the electronic referral template. Instead, we found a complex network of queue management where multiple actors from various geographical locations are involved in this decision. We also found that the decision to initiate a standardized pathway is not related to a particular time and place, but instead should be understood as a continuous negotiation process of collaborative activities, each adding to and affecting the decision.

The collaborative activities comprise referring, booking, examining, and communicating results between various hospital departments and the GP. Contributing to the collaborative activities, multiple interdisciplinary healthcare professionals (secretaries, radiologists, radiographers, general GPs, etc.) engage in continuous, interlinked sorting activities based on input from the other actors. In these sorting practices in the pre-diagnostic work, the formal classification scheme of standardized cancer pathways embedded in the formal documents has limited practical value. This was the case with the patient in the empirical example, where all tests came back clear and therefore the patient did not fit into the classification scheme. The patient had to get worse before it was possible to place him within another formal category, "acute," where he would get the ultrasound scan immediately, and which eventually led to the diagnosis of his cancer.

Exploring how the sorting of patients with symptoms of potential cancer is handled in practice when symptoms are unclear, we discovered two essential sorting mechanisms enacted by the healthcare professionals: subtle categorizing and collective remembering. As in all collaborative efforts, articulation work is required to manage the interlinked practices (Gerson and Star 1986; Schmidt and Bannon 1992), and in the case of potential cancer, it is handled through the use of various coordinative artefacts. The electronic referral template is such an artefact used as a communication medium between the GP and hospital, displaying important information that guides the sorting practices in the receiving hospital. Communicating the level of urgency is, in cases of unclear symptoms, done through implicit and subtle categorizing using "other" residual categories (Randall et al. 2007b; Martin et al. 2007), where the GP writes: "patient lost 20 kg" rather than "obs cancer." This informal sorting mechanism appears within the situated use of the electronic template, which is used as a coordination and communication artefact and allows dynamic compromises for action (Bowker and Star 2000). Whereas previous research divides diagnostic work into two different processes: (1) agreeing on the categories and (2) applying the categories of diagnosis (Blaxter 1978; Jutel 2009), we found that in the pre-diagnostic work the categories emerge in the situation while being applied to particular patients through the use of subtle categorizing when patients have unclear symptoms.

Thus, subtle categorizing communicates the level of urgency through a spectrum of categories (rather than mutually exclusive categories) that, in the medical profession, are interrelated with fine-grained degrees of suspicion of cancer. This is illustrated by the empirical example of the patient with considerable weight loss, which, according to the GP, makes a physician think about cancer, though not as strongly as if the word "cancer" were used explicitly in the referral. The challenge in applying subtle categories is that healthcare professionals without medical training, such as secretaries, are highly involved in the sorting of patients in the pre-diagnostic work, but these secretaries do not necessarily know the medical content of the subtle categories.

The other informal sorting mechanism we discovered was the role of collective remembering. In sorting incoming patients, the receiving department also evaluates the referral patterns of the GP who referred the patient. The GPs are fully aware of these practices and thus take into account how particular referral patterns might be evaluated. The GPs choose the wording on the referral wisely to ensure that subtle categories are not misinterpreted by the receiving hospital. However, collaborative diagnostic work requires that the participants act in a manner relative to one another's diverse perspectives and representations (i.e., subtle categories) to manage situations of ambiguity and uncertainty (Nevile 2009). We found clear indications that the participants carefully interpret the decisions of others. However, we also saw that in high-risk situations, the healthcare professionals would use the phone rather than the referral to reduce the uncertainties and potential misunderstandings. Other research states that in medical treatment practices with high variation, professional discretion becomes very important (Wennberg 1984). We do not claim that there are high variations in cancer treatment, but that in the pre-diagnostic work, where the end result is still open-ended, variations in examination and diagnostic treatment are evident. Because of the uncertainty in the pre-diagnostic work, the interpretations of previous healthcare professionals' actions are crucial. This is done by reading the free-text information on the referral in light of the experience with the physician that referred the patient in the same way as prior research found that healthcare professionals "read" the actions of others to interpret the identified uncertainties (Hartswood et al. 2003).

The professional discretion in the pre-diagnostic work is pertinent. Even though various diagnostic examinations are done, they do not necessarily result in a clear reasonable suspicion of cancer. The direction of symptoms is essential when the GP interprets the hospital (how long will the GP's patients have to wait) and the hospital interprets the GP's referral patterns (how many patients does the GP refer as potential cancer patients where it turns out to be a less serious diagnosis). We label these track-keeping practices collective remembering. Collective remembering is performative (Bannon and Kuutti 1996) and contains a recursive relationship between the interpretation of the referral and the referral patterns, and it has a clear influence on queue management of patients.

It is essential to point out that in cases where standardized cancer pathways are not initiated, it is not necessarily the same as *nothing* is being done at all, nor that healthcare professionals resist the stated formal purpose of the standardized cancer pathways (Berg 1997; Bowker and Star 2000). Instead, these cases might be the result of the mediation of ongoing work where the GP and the hospital departments manage the patients' trajectories with respect to direction of symptoms. To get the work done—and when the diagnostic tests do not reveal obvious signs of cancer—diagnosing patients involves articulation work that mediates and manages the relationships between the various heterogeneous actors.

In the same way, the GP relies on articulation work when continuously negotiating the decision with the hospital departments, who might agree to take responsibility for patients even though clear symptoms of cancer cannot be established according to the standardized cancer pathways. In diagnostic work, it is essential to orchestrate diverse perspectives to reduce the risk of premature narrowing (Watts-Perotti and Woods 2009). As long as the patient has an unknown diagnosis, the case is open for interpretation. The reluctance of premature narrowing is what distinguishes the pre-diagnostic work from the diagnostic work. The electronic referral templates embed formal categories for particular diagnoses to support coordination and communication. The wrong use of formal categories has implications not only for the patient that is sorted on this basis, but also for other patients that, in the worst case, will have to wait even longer for diagnostic examinations. However, by subtle categorizing and collective remembering, the GP has an alternative way of coordinating the level of urgency while avoiding a premature narrowing of the process.

We propose conceptualizing the informal sorting mechanisms of collective remembering and subtle categorizing guiding the decision to initiate standardized cancer pathways as being enacted in layers of sorting practices. The layers of sorting practices comprise collaborative, interrelated, iterative practices of constructing, organizing, re-organizing, and merging the multiple queues of patients. Patients with potential cancer are simultaneously situated within multiple queues for various diagnostic examinations and treatments (scans, medications, blood tests, biopsies, etc.) in various organizational contexts. The results from each examination influence a patient's placement within other queues, and each time a new order for a test and treatment is sent by the electronic referral template, the patient's level of urgency is re-evaluated (taking previous results into account) related to the existing queue for the particular examination. Previous research on diagnostic work in emergency call centres also points to diagnostic work is a multi-layered process (Paoletti 2009). However, whereas Paoletti defines the multi-layered process simply as a process where various subjects are involved in diagnostic work (Paoletti 2009), we suggest a more detailed conceptualization related to the collaborative sorting practices involving the management of multiple queues simultaneously.

7. Conclusion

What counts as work varies between perspectives, leaving out essential activities crucial for getting the work done (Star and Strauss 1999). In this paper we give voice to parts of the work invisible to the standardized cancer pathways that is involved in the practice of sorting patients with symptoms of potential cancer. While the *arena of voice* forms the formal sorting mechanism—the standardized cancer pathways—the *layers of silence* comprise the constructing, organizing, re-organizing, and merging of multiple queues involved in the sorting practices guided by two informal sorting mechanisms: subtle categorizing and collective remembering. We have investigated sorting practices of patients with potential cancer in the pre-diagnostic work that precedes the decision of whether or not to initiate a standardized cancer pathway. And we have shown how sorting practices influence how the level of urgency is evaluated in future decisions.

Thus, initially we asked how sorting patients with symptoms of potential cancer is handled in practice in the pre-diagnostic work. Based on ethnographic studies of the sorting practices, we argued that sorting practices are structured in layers of collaborative, interrelated, iterative practices of constructing, organizing, re-organizing, and merging the multiple queues within which each patient is simultaneously situated. We further argued that these practices are guided by the formal sorting mechanism of standardized cancer pathways and are handled by the informal sorting mechanisms of subtle categorizing and collective remembering. We conceptualized the sorting mechanisms in pre-diagnostic work as a practice used to reduce the effort involved in prioritizing a patient in relation to other patients and the available resources. Sorting mechanisms include interpretation work framed by the participants' perspectives based upon their existing knowledge and experiences with the subject area and people involved. *Subtle categorizing* is used to communicate the level of urgency through a spectrum of categories (rather than mutually exclusive categories) as in the way "weight loss" is used to communicate fine-grained observations of the particular patient relevant for the placement in queues. *Collective remembering* is used to monitor the referral patterns between physicians relevant for prioritizing and sorting patients in examination queues. The monitoring of referral patterns recursively affects how urgency is communicated between hospital departments and GPs and hospital departments in between.

The basic concern of sorting practices is to prioritize patients queuing for examinations and treatment. Conceptualizing the practices of sorting patients with potential cancer as a collaborative process has implications for the design of electronic booking systems. Thus, our study shows that booking examinations and treatment is not a simple, straightforward process of deciding whether or not to initiate a particular standardized cancer pathway; instead, this process is preceded by essential sorting activities involving multiple actors. Designing electronic systems upon a linear path would risk jeopardizing the fine-grained informal sorting mechanisms enacted by the healthcare professionals. Whereas this type of healthcare information system typically focuses on schedules, times, and coordination for internal use in particular hospital departments, our study points out that sorting patients before initiating pathways is not simply a process of deciding on a date and time.

Thus, we found that the formal categories of such systems—"acute" and "planned"—had different meaning depending on the type of diagnostic examination. Moreover, we found that the "meaning" varied depending on the context of the patient as well as the context of other patients queuing for these specific diagnostic examinations. In this way, we argue that the activities, which should be supported by electronic booking, are much more than the administration of dates and times. Instead, these systems should support the interlinked, complex collaborative practices of sorting patients, applying informal sorting mechanisms in the pre-diagnostic work in addition to formal sorting mechanisms. This insight suggests that the design of electronic booking systems should be seen as a resource system more than a calendar system, where results from diagnostic examinations feed into and inform the continuous re-sorting of patients in queues for diagnostic examinations. In this way, secretaries, physicians, radiographers (whoever is involved in pre-diagnostic work) have information about all of queues in which the patient is present—including information about new results, which might trigger re-sorting in other diagnostic queues.

This important contribution changes and re-frames the basis for the design of electronic booking systems for diagnostic examinations, suggesting a move toward systems that support the collaborative sorting practices of queue management. Moreover, new results from diagnostic examinations inform the re-sorting of the patients in the other queues, supporting the narrative story-telling activities of diagnostic work. Participants involved in the pre-diagnostic work need information about the multiple queues in which the patient is located as well as the results of diagnostic examinations because these might cause re-sorting of the patients in other related queues. Sorting practices are thus layered practices of queue management, and sorting out patients with potential cancer is a collaborative activity between geographically distributed heterogeneous health-care professionals.

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Chapter 3
The Clinical Work of Secretaries: Exploring the Intersection of Administrative and Clinical Work in the Diagnosing Process

Naja L. Holten Møller and Signe Vikkelsø

Abstract Diagnostic work is often defined by the skill of clinicians whereas the contributions of non-clinicians, for example secretaries, tend to fade into the background. The secretaries are deeply involved in diagnostic work through the eligible administration of patients in the collaborative electronic information systems. This study explores the *secretaries' role* in diagnostic work, focusing specifically on the context of diagnosing cancer. It identifies four key activities of secretaries that are essential for diagnosing patients: We argue that the secretaries' role is positioned at the intersection of clinical and administrative practices and not limited to support of articulation work of clinicians and administrative work. Secretaries also carry out activities that fall under the core definition of clinical work. This clinical dimension of the secretaries' work, we argue, should be embedded in the design of collaborative systems to support the diagnosing process.

3.1 Introduction

Diagnostic work is often understood as a particular type of collaborative work that is "clinical" or "medical" at its core [1–4]. So it is the work of clinicians, ranging from physicians assessing patients, to technicians running tests, and nurses tending to patients while taking note of their condition. Secretaries, from this perspective, are the "right hand" of clinicians, ensuring that physicians, test results, and patients are brought together at the right time and place [5–9]. Despite the fact that secretaries are central to the core of clinical work (defined by Bardram [5] as examining the patient's illness and condition, requesting and interpreting clinical information, decision-making concerning the patient's illness and condition, further medical treat-

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ment of the patient's illness and condition, and monitoring the effect of it), and that diagnostic work is defined in relation to this core clinical work, surprisingly little attention has been paid to the role of secretaries in diagnosis. This study empirically investigates the role of secretaries in both a radiology department and a medical department. We find that secretaries are central to diagnostic work and identify four particular activities where this is evident when secretaries: (a) examine the patient's condition, (b) interpret the clinical information, (c) monitor the follow-up, and (d) further inform the patient's trajectory. These activities constitute an intersection of clinical and administrative work where secretaries become involved in the handling of patients through the collaborative electronic information systems. The formal distribution of power when secretaries become involved in diagnosis is not the focus; the analysis focuses strictly on how to further specify the secretaries' role.

In the following we start by introducing the collaborative electronic information systems, RIS-PACS and OPUS-OCW, that were the subject of the secretaries' work in the study reported here. Then, we explore four specific examples of how secretaries contribute to the diagnosis of patients in a radiology department and a medical department. Third, we discuss the combined clinical and administrative content of these examples and point to the way in which it specifies the secretaries' work. Finally, we conclude that a detailed understanding of secretaries' work as intersecting is crucial to the support of collaborative systems.

3.2 Background

In Denmark, collaborative electronic information systems such as RIS-PACS (Radiological Information System—Picture Archiving and Communication System) and OPUS-OCW (Open Clinical Workspace) were implemented in recent years as part of a national strategy for the digitalization of the health service [10]. In terms of diagnostic work, the national strategy is focusing in particular on support of radiology to ensure better and faster diagnosis. Secretaries' work is an implicit part of the national strategy that has as its purpose the connection of the entire health service in Denmark. RIS-PACS and OPUS-OCW are both multi-module access portals. RIS-PACS is primarily oriented toward radiology (administration and picture archiving). The medical department uses OPUS-OCW, which supports a broader spectrum of clinical practices (administration, medication, monitoring, etc.). These systems are intended to support continuous and smooth coordination of the clinical and administrative work. While systems such as RIS-PACS and OPUS-OCW are increasingly prevalent in diagnostic work, there are several reasons why it is crucial to place secretaries at the center of analysis. First, the development of, and experimentation with, collaborative electronic information systems has been occasion for reappraising rather than dismantling the role secretaries play. Second, the implementation of these systems has not simply supported existing practices but rather entailed reorganization of activities and responsibilities [9, 11]. This reorganization confirms the classic argument of Hughes and others: that new kinds of technology may interfere with existing roles and the organization of work [1, 12]. Given that roles are in flux, the very understanding of what kinds of work practices comprise diagnostic work needs to be re-examined.

3.3 Theoretical Framework

In order to understand the organizational positioning of the secretary, we will argue that this role cannot be understood simply within administrative or "supportive" terms or by the concept of "articulation work." The secretary is deeply involved in the core "clinical work", but this aspect has remained under-theorized. In the following we will briefly review the way secretaries work has been conceptualized in the literature.

3.3.1 Secretarial Work

Secretarial work is by no means a new subject. Research within CSCW and related fields has expanded our understanding of the secretary's role in various fields of collaboration. Secretarial work has been addressed broadly in relation to directing assistants [13, 14], secretaries [15–17], medical secretaries [5, 7, 18–21], clerical workers [1, 22], office workers [23, 24], and coders [25]. A shared departure for this research is the argument that secretarial work is something that cannot be performed by everyone. Pointing to the knowledge work, CSCW research has demonstrated that understanding the role of secretaries is important for the design of collaborative electronic information systems in various fields of collaboration.

Secretarial work, as has been demonstrated in CSCW, is rarely recognized as knowledge work. Instead, a secretary is often thought of as someone who simply connects clients with software or answers phones and types. In contrast to this simplified picture, it has been shown, for example, that the software relies on secretaries' work in different ways [14, 25]. Müller demonstrated how the work of a particular type of secretaries—telephone operators—is about collaborative refinement of clients' requests and not just connecting the software (database of telephone numbers) and the clients. Hence, knowledge work is defined by the domain-specific memory and use of domain-specific patterns of meaning, and Müller demonstrates that this is also a characteristic for telephone operators [14].

Somewhat related, the key activities of the medical secretary have been characterized as: printing clinical information [20], transcribing and filing physicians' dictations [26], locating files [19], and being a receptionist [7, 37] Often, however, the secretary's role is described as "collaborating" with nurses and physicians or "providing clerical support" [5, 7, 19, 20, 26, 37]. It remains somewhat unclear how the work of the medical secretary is "knowledge work" and how it relates to what is seen as the core clinical work, which diagnosis is a part of.

3.3.2 Clinical Work

"Clinician" is a rather broad term that covers professions doing work in a clinic or work that is related to the observation and diagnosis of patients [27]. The performance of clinical work typically relies on different types of specialties and is thus essentially collaborative. This is particularly true in relation to complex diseases, such as cancer [7]. Bardram characterizes the performance of clinical work as a circular process roughly consisting of five activities [5]: (a) examining the patient's illness and condition, (b) requesting and interpreting clinical information, (c) decision-making concerning the patient's illness and condition, (d) further medical treatment of the patient's illness and condition, and (e) monitoring the effect of it. These activities define clinical work, Bardram argues; but they are determined by the actual condition of the patient [5]. Clinical work varies across patients (for example, how fast symptoms develop and hence can be diagnosed). This variety very much affects the work environment of clinicians. Few settings are as rich in detail as clinical settings [5, 20, 27], which, in the words of Strauss et al., consist of places "where very different resources (space, skills, ratios of labor force, equipment, drugs, supplies, and the like) are required" to carry out the work ([27], p. 6). At the same time, clinical work is dispersed across time and space; and, the coordination or articulation of this work is pivotal.

3.3.3 "Articulation Work" in Clinical Settings

The support of articulation work—or the reduction of effort involved in articulation work of others—is a classic job of secretaries besides administrative work. The organization of clinical work relies on articulation work to bridge the various types of specialties involved in clinical work [5, 8, 27]. Articulation work, from this perspective, defines a type of "supra work process" that supports the accomplishment of distributed activities [28]. Articulation work is an ongoing and shared concern of clinicians to make the collective work add up to more than discrete bits of accomplished work [27]. Secretaries are reported as part of this process, for example, when they structure and send information in collaborative electronic information systems that support the clinical work [5–7, 20, 21]. Here, the articulation work of clinicians, for example, structuring information, is the core work of secretaries.

Emphasis has often been placed on the role of shared repositories and objects for this articulation work [26, 29]. The concept of "boundary objects" points to objects that are "weakly structured in common use and become strongly structured in individual-site use" ([30], p. 393). In a clinical setting boundary objects can serve *different* purposes for different communities of practice (such as clinicians and secretaries) and still maintain some common sense of purpose across them [26, 29–31]. Equally important, the central concept within CSCW of "common information space" [32], such as that provided by a collaborative electronic information system, also allows different communities of practice to pursue *different* purposes. Secretaries clearly play a role in the establishment and maintenance of such "boundary objects" or "common information spaces," and hence in the support of articulation work [33]. It is in relation to the pursuing of a *shared* purpose of different communities of practice that the secretary's role in diagnostic work is explored.

3.3.4 The Clinical Work of Secretaries?

While we find the above conceptualizations of secretaries' work important, we also note that the secretary tends to be seen as an administrative function or as part of the articulation of clinical work [5–9]. There is no explicit account of the way secretaries might also be partaking directly in the clinical work, which diagnosis is a part of. While this is no surprise in light of both common sense and formal distinctions between the job of physicians, nurses, and secretaries, we will show that secretaries also carry out tasks that fall under the core definition of clinical work.

3.4 Research Method

The study reported here was conducted in a mid-sized hospital that specializes in patients with general symptoms. These patients are particularly important when investigating the initial diagnosis because they often fail to meet the formal criteria for referring patients to hospital departments that specialize in cancer. The study focused on two departments: the radiology department and the medical department. *The radiology department* provides important examinations critical for the initial diagnosis of complex diseases such as cancer. The staff in the radiology department includes specialists of radiology, radiographers, and secretaries. *The medical department* has several sub-sections specializing in different areas of medicine (such as diabetes, gastroenterology, cardiology, etc.) as well as four outpatient clinics and an acute care section. The medical department diagnoses a number of patients with cancer every year in collaboration with other departments, although, this is not the specialty of the department. The staff of the medical department includes specialists of medicine, secretaries, and nurses.

The study was ethnographically informed [34, 35]. The initial diagnosis process—and the secretaries' role—was explored through detailed analysis of ethnographic notes from observations of practices related to diagnostic work, as well as *in situ* interviews and semi-structured interviews, artifacts (schedules, classification

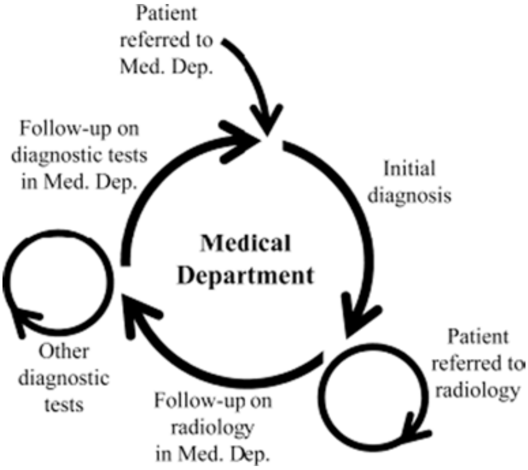

Fig. 3.1 Distribution of responsibilities during the initial diagnosing process

schemes, etc.), and images. Observations were conducted by the first author over a period of 13 months. In total, the first author spent 118 h observing practices and conducting *in situ* and semi-structured interviews. Prior to commencing these observations, preliminary observations were conducted, in total, 14 h. Data were analysed right from the beginning of the data-constructing process. In this way, data collection and data analysis together formed an iterative process of analyzing themes that emerged as being essential for the process of diagnosis, for example, variations of secretaries' work. Data were continuously contested by presenting it to the secretaries and clinicians when observations were resumed. Secretaries' as well as clinicians' insight provided useful interpretations for further collection and analysis of data. In this way the contesting of data in one stage became the preconception for the collection of data in the next stage and a way of reasoning in the analysis [36].

3.5 Analysis: The Clinical Work of Secretaries

In Denmark, secretaries are often the first hospital staff to handle requests of diagnostic examinations and incoming referrals, which positions secretaries as central to diagnostic work. In the following analysis, we explore the role of secretaries in four specific examples of activities involved in diagnostic work. First, we analyze how secretaries participate in the examination of a patient's condition in order to ensure that severe patient cases are given first priority. Second, secretaries' clinical interpretations are analyzed. Third, we analyze how secretaries evaluate patients to make sure they received appropriate follow-up. Finally, we analyze how secretaries further inform the patient trajectory. Figure 3.1 illustrates the relationship between the radiology and the medical department and the distribution of responsibilities during the initial diagnosing process.

3.5.1 Examining the Condition

To even begin the process of diagnosing a patient will have to be referred to a clinical department. In the medical department the referrals are received by the general secretaries' office (the medical secretariat) before patients are distributed to the "local" secretariats in the sub-sections. Most referrals are received electronically, but they may also be received as paper referrals. The referrals are printed (if received as paper referrals they are scanned so that they are also registered in the electronic information system) and then distributed to plastic trays that each sub-section has in the general secretariat. Although, it might seem to be a somewhat trivial task, while distributing the printed referrals to the sub-sections, this secretary, the following example shows, is simultaneously examining the patients' conditions. Reading through the free-text of one of the referrals the secretary quickly realizes that she has to take action. The free-text reads:

> 77 year old woman, known to have COLD [chronic obstructive lung disease] as well as afli [atrial fibriliation], recently started treatment with Maravan. Referred acute since the patient has macroscopic hematuria and development of various ecchymosis of OE. Had INR [international normalized ratio] taken in lab >7.5. (Referral for the medical department, September 30th 2009)

The secretary's examination, in this example, is highly relevant for the diagnosing of the patient. The electronic referral template allows the referring physician to indicate the condition as either "acute" or "planned". The patient in this example is categorized in the referral template as "planned" indicating that this patient may wait. However, the free-text tells the secretary an entirely different story: Reading through the free-text, the secretary underlines the text "acute" with a yellow marker and then explains that an INR>7.5 (a measure of the blood coagulation) is problematic, before she comes to the conclusion that this patient will have to be handled "acute" and not as a patient that can wait. The patient, the secretary explains, is not supposed to have an INR this high.

When she looks up the patient in the collaborative electronic information system her suspicion is confirmed. In the collaborative electronic information system it is registered that the patient (despite the fact that the referral was sent electronically to the general secretariat) has already been admitted physically through the hospital's acute care section. Knowing this, the secretary may cancel the referral in the collaborative electronic information system. To make sure that it is also clear to the clinicians why the referral is canceled, she notes this information in the comment field. When done, the secretary throws out the printed copy of the referral and continues to read through the rest of the referrals received in the general secretaries' office that morning.

The example illustrates exactly how the secretary gets involved in diagnostic work (examining the condition of the patient). While this work is not something that any of the clinical staff are aware of (unless they read the comment in the collaborative electronic information system), it influences the diagnostic work. If the patient had not been admitted, it would have been a potentially dangerous situation.

Even if the patient had been admitted (physically) but the secretary had not reacted adequately (electronically), this would have been disturbing to the diagnostic work. Eventually the clinical staff would have been the ones to make sure this patient was receiving proper diagnostic care. However, in terms of timing, this assurance would have occurred much later than when the secretary noticed the seriousness and took action.

3.5.2 Interpreting the Clinical Information

Another department equally important for the diagnostic work is the radiology department. Radiology often guides the next diagnostic step as clinicians are trying to understand the nature of patients' symptoms. The secretary is the first person to receive referrals for radiology. The rule is, the secretary in the radiology department explains, that all referrals should be scheduled the day they are received, as a way to ensure that patients are not waiting because of the administration of the referrals. In this way, the radiology department tries to avoid patients waiting for reasons other than clinical ones. The incoming referrals are lined up in a list in the radiology information system, RIS-PACS.

Also the radiologist on call, located downstairs in the protected space of the CT-scanner and MR-scanner, takes notice of the referrals as the electronic list of referrals fills up. The radiologists have a work space next to the CT-scanner and the MR-scanner so that they can pay attention to the scanners and access the collaborative electronic information system at the same time. RIS-PACS is used by the radiologist for describing the scans, and in between the description of scans the radiologist interprets the information in the referrals so that the secretary can continue to schedule them.

Back in the secretaries office the next electronic referral for a CT-scan is waiting to be scheduled. The referral is received like any other electronic referral (automatically listed one after the other in RIS-PACS). The radiologist has added a priority and specified the program and sequence of the particular scan. Reading through the electronic referral template, the secretary interprets the wording of the referring physician and the radiologist, which both says something about the way the scan is to be carried out, she explains. Scheduling a CT-scan is not the same as scheduling an MR-scan or any of the other scans, it is revealed when the secretary glances at a protocol hanging above the secretary's desk entitled "CT—The short version".

The presence of the protocol in the secretaries office is surprising at first due to the clinical nature of it. The exact same A3-sized (11.7×16.5 inch) protocol is hanging downstairs next to the radiographers as well as in the radiologists' work space. The CT-protocol is a clinical tool used by the radiologists; the CT-scans each require specification of the appropriate sequence and program before the radiographer can perform the CT-scan. The CT-protocol, for example, specifies that "tumour detection" corresponds to sub-protocol number 6A in RIS-PACS and also specifies the situations where, for example, contrast is needed. The secretary confirms that the various clinical information corresponds.

The example illustrates how the secretaries' work (specifying the protocol and sequence while scheduling the CT-scan) involves an artefact (the CT-protocol) that is strictly clinical while checking the clinical history for other conditions that may influence the way the CT-scan is carried out (contrast or not). Although the clinical information on the choice of program and sequence is not filled in by the secretary, she does become involved in the diagnostic work when she once again interprets it. In the convey of information the secretary makes sure that the patient is supposed to have contrast when this is specified.

3.5.3 Monitoring the Clinical Follow-up

When the scan has been performed it appears in a list in RIS-PACS. The medical department can then retrieve the scan for their department and sub-sections. The responsibility for retrieving scan results in the medical department is placed with the "local" secretaries in the sub-sections. In the sub-section for medical acute care patients, the secretaries share the office space with the physicians and nurses. There are always two secretaries on duty; one takes care of the many *ad hoc* tasks and the other types the physicians' dictations. The secretary who is responsible for *ad hoc* tasks retrieves the results of patients' scans in RIS-PACS and makes sure that a physician takes responsibility for the particular scans so that they are followed-up.

This routine was established, the secretary explains, to avoid adverse events. Before this, the sub-section sometimes experienced that it was unclear who was responsible for the follow-up, which presented a risk to the patients if the result was, for example, cancer related. The secretary explains this while sorting printed copies of scan results into three piles: (1) scan results that have to be signed by the physician responsible for the patient; (2) scan results that the physician on-duty may sign before it is sent to the patient's GP; and (3) scan results that must be signed by another department because the patient has been transferred there. The secretary carefully reads the result of the scan and then reads the newest part of the continuation (clinical notes). In this way, she tries to make sense of the results and how they should be sorted (as 1, 2 or 3). When the secretary is uncertain, she consults the physician on-duty.

The physicians also monitor RIS-PACS, but only when they have requested the scan themselves. It is possible that a physician will call their colleague in the radiology department prior to the release of a scan, the secretary explains, to have a first indication of whether the result points in one direction or the other (cancer or not). The secretary gets up to consult the physician on-duty working at a computer in the background. The scan results are not printed simply to be distributed; the secretary's responsibility is quite literal, she says, when the secretary returns with the signature of the physician. The secretary's name is printed at the bottom of the paper copy that is later saved in the patient record. If no physician has signed for the printed result it is her responsibility, the secretary explains and points to her name at the bottom of the paper.

The example illustrates that while printing scan results might seem as extra work or doing the same work twice, in the sense that a physician already has the scan in mind, the secretary is not just printing scan results to remind the physician. The real task is the sorting and the overall monitoring involved in this activity where physicians share the responsibility for the patient. The secretary does not monitor the single patient like the physicians do; instead the secretary monitors all the patients. Physicians schedule changes, and since the physician may be at the ward 1 day and in the clinic or at a conference the next, patients are sometimes left in a vulnerable situation. The secretary makes sure scan results are followed-up and therefore gets involved in the diagnosing process in a crucial way.

3.5.4 Further Informing the Clinical Trajectory

The "local" secretary in the medical sub-sections is the person responsible for registering that the diagnosing process has come to an end in the collaborative electronic information system, OPUS-OCW. The act of registering this clinical milestone (a) indicates the change of responsibility for the patient (if responsibility is to be turned over to another clinical department or the GP) and (b) signals to the medical department itself that no further action is taken. In this way, diagnosing is accomplished by the secretary who registers the final diagnosis—at least in a formal sense.

The secretary, sitting with the paper record in front of her, looks up the patient in the system (OPUS-OCW). The physicians in the medical department decided that they could not come any closer to a final diagnosis for the patient. The secretary now has to find out how to close the patient's case, she explains. This happens every now and then, that no diagnosis is set, but the patient's case still has to be closed. Flipping through the paper record, the secretary notices that there are several pages in the continuation (the clinical notes) that are obsolete. The secretary prints a new, complete edition of the electronic continuation and replaces the previous one.

The electronic registering is part of a larger setup where the patient's status is reported to The National Patient Register (LPR). Although the purpose of the registering is somewhat clear to the secretary, who is also aware of and tries to register the patient according to the registering guide (spending time reading through it several times), it does not help her. To get her work done, the secretary instead interprets the patient's "unknown" diagnosis in a way that to some extend informs the further diagnosis process. The secretary's interpretation is that she can "close" the patient's trajectory to one of two patient categories in the electronic information system:

"HA" [The patient is already diagnosed]
"HF" [The patient is being diagnosed]

After some time of going back and forth between the registration guide the secretary finally decides to register the patient as "HF," although, she notes, this does not fit the registration guidelines if taken literally. The code “HF,” the secretary explains, is used to register that the patient is still being diagnosed. Therefore, to register the patient as “HF” (being diagnosed) is somewhat contradictory to the fact that “HF” in this case is “closing” the diagnosis of the patient. But, a decision has to be made, and that is what she chose to do. In this way the secretary becomes involved in diagnostic work by deciding how to close the diagnosis of the patient that further informs the diagnosis process in other departments—or, the process if the patient returns.

3.6 The Intersection of Clinical and Administrative Work

Articulation work, according to Strauss et al., is the ongoing and shared concern of clinicians to make the collective work add up to more than discrete and conflicting parts [27]. Strauss et al. do not explicitly mention secretaries’ work (the underlying point being that articulation work is carried out not only by administrators but also by clinicians), which is perhaps why the opposite point is not made: that clinical work is carried out not only by clinicians but also by “administrators” such as the secretaries explored in this study. While “articulation work” and “work” are analytical concepts difficult to separate in practice, this is not only an omission of Strauss and colleagues. Secretaries’ work is well described within CSCW and related fields. However, it tends to be conceptualized using the limited terminology of secretaries as administrators, or support of clinicians’ articulation work to manage the intersection of administrative and clinical work [5–9]. In general, a considerable part of secretaries’ common work is to support the articulation work and administrative work necessary for the diagnosis of patients, but not all of it can be understood as such.

In addition to these supportive and administrative functions, we have shown that secretaries also play an important role in the diagnosis of patients: examining the condition; interpreting the clinical information; monitoring the follow-up; and further informing the trajectory. At the intersection of administrative and clinical work, the secretary carries out activities that fall under the core definition of clinical work, for example, when the secretary distributes referrals. To distribute the referral is formally the secretary’s task; however, while doing this task she simultaneously becomes aware that the patient is at risk of not receiving the sufficient treatment and therefore takes action. Bardram describes how a core clinical activity of a physician is the change of a request if the physician, for example, finds it insufficient to address the stated problem of the patient [5]. The example illustrates how the secretary also carries out clinical work in the same way as the physician. However, the direct partaking of the secretary in clinical work should not be understood as coincidental practice. Rather, we argue, this partaking follows from the positioning of the secretary at the “intersection” of, formally separate but practically enmeshed practices, namely administrative and clinical work.

We emphasize the concept of “intersection” in order to draw attention to the fact that formal and common sense definitions of tasks and job responsibilities do not always, and in fact seldom, mirror exactly the reality of work. This is by no means a new observation [21, 27]. But, as we have illustrated, the understanding of the work of medical secretaries in previous research has stayed relatively true to such common sense and formal distinctions, even though organizational reality can be empirically shown to be different. The concept of "intersection" entails that clinical work does not come in clearly demarcated chunks and that practitioners often seesaw between tasks in a fashion that makes it hard to distinguish where one type of work ends and another begins. This is particularly relevant to CSCW because the design and use of collaborative electronic information systems often suffers from poor understandings of the actual collaborative work and of the specific ways in which this work is divided and coordinated. The concepts of "common information spaces" and "boundary objects" seek to address the same type of intersecting or "crossing" activities that we argue also characterize diagnostic work. However, the use and discussion of these concepts tends to be concerned with how to support articulation work for practitioners to be able to collaborate across their *different* practices [26, 29–32].

While Bannon and Bødker point to a need for more attention to the issues of managing boundaries [32], their focus is predominantly on the handling of articulation work and not so much the crossing or intersecting activities. We address the intersecting work of secretaries and clinicians. Based on the empirical examples of secretaries' work, we argue that, in relation to the work itself, it is necessary to be open about the division of work when designing collaborative electronic information systems. This is, for example, evident when the secretary takes care of the follow-up of the scan results: to formalize her responsibility the secretary has to print a copy of the scan result and sign it. The system reveals the name of the physician who requested the scan and therefore formally is responsible for the follow-up. Hence, this example shows that it is not enough to assume the reality of formal boundaries or job descriptions. The secretary also plays a central role in the follow-up. Therefore, these collaborative electronic information systems should be designed to support the practices at the intersections of conventional boundaries as well.

3.7 Conclusion

Secretaries' work is of central interest to CSCW. Despite this interest, the secretary's role has been given surprisingly little attention in relation to diagnostic work. We have emphasized the need to explore the secretary's role as part of diagnostic work just as is done in other fields of collaboration. Diagnostic work is often defined by the skills of clinicians while secretaries' work tends to slide into the background. Some of the most significant CSCW research emphasizes how articulation work is carried out by physicians, which is perhaps why the opposite point is not often made: that clinical work is also carried out by secretaries.

Secretaries handle patients in collaborative electronic information systems. As collaborative electronic information systems that integrate administrative and clinical tasks are becoming increasingly prevalent in diagnostic work, there is good reason to place secretaries at the center of attention. We aim to further specify the "intersection" of clinical work and administrative work in relation to the process of diagnosing patients. The research question we explored is: what role do secretaries play in diagnostic work, and how is it related to the use of collaborative electronic information systems?

We explored this question in our analysis of various activities of secretaries in a radiology department and a medical department. The two departments are often involved in the initial diagnosing of potential cancer. Diagnosing potential cancer is a complex, collaborative activity that involves various specialties, particularly in the initial part of the process where symptoms can point to a range of conditions. The secretaries reduce the effort involved in clinicians' articulation work during this process. However, as the analysis illustrated, the secretaries' contribution is also achieved through work that fall under the core definition of clinical activities—this may be an advantage from a timely perspective.

Subsequently, the contribution of this study lies in empirically showing how secretaries, in addition to their administrative tasks and their support of clinicians articulation work, also carry out clinical tasks. Thus, we specify how exactly the secretaries work is located in between, or at the "intersection" of, formally separate but practically enmeshed practices, namely administrative and clinical work. This suggests, we argue, that the clinical dimension of secretaries' work should be embedded in the design of collaborative systems supporting diagnostic work.

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Achieving Continuity of Care: A Study of the Challenges in a Danish and a US Hospital Department

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Abstract. Continuity of care is a central topic for healthcare practice and is closely related to issues of collaboration. Thus, studying continuity of care from a CSCW perspective can help us understand what makes continuity of care in practice. In this paper, we show how collaborative technologies are appropriated differently in two cases, one in Denmark and the other in the US. We illustrate how this appropriation is dependent on challenges particular to the organizational context of work. Studying the practices in two different hospital departments we found that in practice achieving continuity of care depends on two main characteristics in the organization of work, namely 1) the constitution of roles and 2) the responsibility for care linked to the appropriation of collaborative technologies. These characteristics of the organization of work create different solutions to the challenges of discontinuity when physicians appropriate mundane collaborative technologies: patient records and pagers. To understand how continuity of care is achieved in practice we have to study the appropriation of technologies, the paper argues, and by comparing across cases we may begin to discern challenges that cut across context – and their different origins.

1 Introduction

This paper focuses on continuity as a central aspect of clinicians' work and a topic for CSCW research (Ellingsen and Monteiro 2006; Fitzpatrick and Ellingsen 2012). Continuity of care is regarded as a principle that applies in different clinical settings despite the various contexts through which collaborative technologies for support of continuity of care are appropriated (Denmark's Board of Technology 2006; US Office of the National Coordinator for Health Information Technology 2010). When continuity of care has to be enacted in practice, the challenges of context-dependent discontinuity become available in how technologies are appropriated. To support continuity of care we thus need to understand what characterize these challenges to continuity in different contexts.

Consequently, previous research has pointed out how, for example, the particular characteristics of private healthcare in the US challenge continuity of care when patients move between various providers (Cebul, Rebitzer et al. 2008). Or, how in a Danish context of public healthcare continuity becomes a challenge when the provider forms one tremendously variegated organization that physicians have to maneuver within (Mønsted, Reddy et al. 2011). The challenges experienced in relation to computer support of continuity of care still imply technical issues; however, the context-related issues in terms of the sociological, cultural, and financial challenges are equally important (Fitzpatrick and Ellingsen 2012 citing Kaplan and Harris-Salmone 2009).

Context is traditionally rendered important in CSCW-studies: Continuity of care is considered in relation to the appropriating of technologies and artefacts in the particular context of work where they are used (Bardram 2004). Context, this research shows, is highly relevant for how clinicians' appropriate technologies. For example, a comparative study across two oncology clinics in Austria shows how practices diverge due to the differences of the organizational context determined by the organization of work spatially and by the information systems (Schmidt, Wagner et al. 2007). To handle the challenge of differences in a design context, the study suggests a focus on higher-order commonalities in the coordinative practices:

> "Here the focus is not on the rationale of specific practices in order to determine what is 'essential' and what is 'accidental', but to identify, if possible, the elements and rules of combination out of which coordinative artefacts and protocols are or could be combined and recombined" (Schmidt, Wagner et al. 2007: 9).

Meanwhile, commonalities have been explored mainly from the perspective of technologies and artefacts focusing on, for example, clinical documents and how they are generally used for several purposes (Schmidt, Wagner et al. 2007) or how repositories of clinical information are made relevant in the particular context (Winthereik and Vikkelsø 2005). Few (Schmidt, Wagner et al. 2007; Balka, Bjørn et al. 2008) have paid attention to what commonalities characterize the organization of hospital work in terms of the higher-order challenges that are embedded in these artefacts and technologies.

The importance of understanding the organization of work is illustrated in a comparative study of clinical work in Canada and Austria suggesting that 1) the political – and policy-making – context, 2) the institutional/organizational context, and 3) the system and workplace design context are all relevant for understanding how technologies are appropriated (Balka, Bjørn et al. 2008). Within each of these levels of context, a range of interdependent and inter-linked factors inform the understanding of the use of technology, including, for example, staffing and how relationships with external services are managed throughout the clinical work (ibid):

> "Here the wider organizational issues that directly frame the space for systems design and that in turn are responses to policy and administrative measures taken by municipal and state agencies are negotiated and implemented" (Balka, Bjørn et al. 2008: 518).

Addressing continuity of care from this perspective we need to investigate the *linking practices* by which technologies are appropriated in local contexts to handle challenges of discontinuity. By studying continuity of care in terms of linking practices across empirical settings in two different contexts we are thus able to conceptualize the broader commonalities. This paper in this way extends and contributes to the line of previous CSCW-research (Schmidt, Wagner et al. 2007; Balka, Bjørn et al. 2008; Boulus and Bjørn 2010) that brings about broader aspects of healthcare (e.g., in terms of commonalities) by studying context-dependent issues (e.g., staffing and relationships with external services) of in-depth empirical cases.

This paper brings empirical observations from a Danish and a US hospital medical department, both of which deploy electronic patient records (EPRs) and pager technology to support continuity of care. However, the appropriation of these technologies, we show, is quite diverse and different across the settings. The research question explored in this paper is: How is continuity of care achieved in everyday practice, and what are the commonalities that characterize the challenges of discontinuity across the two settings? In this way, the contribution of the paper is two-fold: To provide empirical observations of how continuity of care is achieved in two different contexts as well as to conceptualize the basic characteristics of technology use in continuity of care as the way responsibility of care and constitution of roles are performed in healthcare practices.

The rest of the paper is organized as follows: We begin with related research addressing the inter-relationships that characterize clinical work in studies of collaborative technologies, focusing in particular on EPRs, phoning, and pagers (section 2). The research method follows, including the Danish case and the US case (section 3), before turning to the analysis (section 4) that forms two narrative stories of how continuity of care is achieved on a particular day as part of everyday use of EPRs and pagers in the Danish and the US cases. Next, we discuss the challenges to continuity of care (section 5), but from a comparative perspective so that issues that cut across the two cases on a) responsibility of care and b) constitution of roles become visible. Finally, the paper is concluded (section 6). Here, we end with suggestions for a conceptualization of broader conditions and challenges for continuity of care that drive the technology use as well as the required technology support of practice.

2 Related research

To support continuity of care is a matter of ensuring coordination and effective communication so that tasks are not disintegrated in the complex organization of clinical work (Strauss, Fagerhaugh et al. 1985). Therefore, collaborative technologies are also central for support of continuity of care (Meum, Monteiro et al. 2011). By linking the clinical specialties through collaborative technologies such as the EPR, it becomes possible for clinicians to handle complex issues (Berg 1998). Continuity of care is a social practice of appropriating technologies and the various inter-related artefacts within the situation where they are used (Bardram 2004). To achieve continuity of care is particularly important where several specialties get involved in the care of a patient (US Institute of Medicine 2001). This means that when specialties collaborate around a certain organization, as, for example, teams, this shapes the hospital clinical work and how coordination and effective communication is achieved in practice (Strauss, Fagerhaugh et al. 1985).

The effort to support continuity of care in hospitals is documented by studies of EPRs (Hartswood, Procter et al. 2003; Heath and Luff 1996; Berg and Winthereik 2003). These studies show that it is difficult to support electronic sharing of subtle nuances of clinical work between the various clinicians involved in the care of patients (Cabitza, Simone et al. 2009). In fact, clinicians (still) rely on informal documentation to handle tasks such as “abstracting” to get the big picture of the status of their patients and planning within their particular context (Heath and Luff 1996; Hartswood, Procter et al. 2003; Park, Pine et al. 2013). Previous CSCW-research also found that physicians translate rather than transfer clinical information sent electronically between providers for it to be useful in the specific context of work (Winthereik and Vikkelsø 2005; Meum and Monteiro 2011, Mønsted, Reddy et al. 2011). When new care providers have to make sense of other physicians’ entries, the correct interpretation of a patient’s record can be hard to decipher (Mønsted, Reddy et al. 2011).

Consequently, phoning and consults supported by pager technology play a crucial role for how clinicians link their individual and yet inter-related activities (Brown and Randell 2004; Bardram and Hansen 2004; Scholl, Hasvold et al. 2007, Lee, Tang et al. 2012). The pager technology enables the assignment of roles, and previous research of a hospital emergency department (ED) points out how pagers are effective for interrupting or getting a hold of a particular specialist or type of staff (Lee, Tang et al 2012). Clinicians typically perceive this type of interruption as a problem causing errors in hospital clinical work (Brown and Randell 2004; Bardram and Bossen 2005). To make a positive difference to the care of patients within the larger organization of work, including letting clinicians prioritize between tasks and patients, it is crucial that interruptions are qualified, for example, by providing text messaging as an integrated part of the pager design (Lee, Tang et al. 2012). This allows the clinicians to make judgments about the urgency of the call relative to the particular task or patient being treated while taking into consideration the larger organization of work.

What is not clear from this previous research is how context-dependent challenges in terms of the wider organizational issues matter for how technology is appropriated. Previous CSCW-research illustrates how clinicians' inter-linked activities are carried out across specialties, and why studies of collaborative technologies often address the inter-relationship of clinical specialties as a basic condition in how clinical work is organized and carried out. Yet how clinicians make relevant the collaborative technologies in everyday practice to handle challenges to continuity of care that are specific to their particular context remains unclear. This paper will explore how mundane collaborative technologies: EPRs and pagers are appropriated to achieve continuity of care in two different contexts, and by comparing across cases we may begin to discern the broader commonalities of challenges – and their different origins.

3 Research method

To explore how continuity of care is acted out across different contexts, two workplace studies were conducted in hospital medical departments between August 2009 and December 2011 – one in Denmark and one in the US. By studying this subject across settings, and by also relating it to previous studies (Strauss and Corbin 1998; Schmidt 2000; Schmidt, Wagner et al. 2007), the paper contributes to a better understanding of challenges to how continuity of care is achieved in practice.

The US medical department is located in a large teaching hospital (university hospital). The hospital employs more than 3,500 personnel serving more than 300,000 outpatient visits to the hospital and nearly 17,000 inpatient visits per year. The medical department, which this study focused on, is organized into six teams. Each team consists of an attending physician (specialist), a senior resident, two residents, and two medical students. During weekends an attending physician and a resident cover for a team. Each team admits up to 20 patients, and the teams are usually on-call 2 days a week. While the team is located on a particular floor of the hospital, patients are spread out on different floors. Teams of physicians, however, are not sub-specialized within the field of internal medicine – only wards are organized by sub-specialization. At each of the wards located on the different floors a “nurses’ station” is placed on the ward close to the patients. The medical department staff includes nursing assistants, nurses, tele-monitoring technicians, physicians specializing in internal medicine, and residents who are not yet specialized.

The Danish medical department is located in a teaching hospital that is in the process of becoming a university hospital. The hospital employs more than 1,300 people serving more than 110,000 outpatient visits to the hospital and more than 39,000 inpatient visits per year. The medical department under study is organized into 5 wards. The wards are sub-specialized in, for example, initiating diagnosis and treatment of medical patients with general symptoms of disease (AVA), or specialized diagnosis and treatment of gastroenterological patients, endocrinological patients, etc. Each ward counts 1–2 attending physicians (specialists) at all hours, 1 senior resident, 1 resident, and numerous medical students. Patients are admitted seven days a week and at all hours. On weekends, 1–2 attending physicians cover patients that are admitted. The medical department staff includes secretaries (nursing assistants), nurses, physicians specialized in internal medicine, residents not yet specialized, and medical students. All staff of the ward are located in one conference room.

In total, the author spent 51 hours in the Danish hospital medical department and 40 hours in the US hospital medical department observing practices and conducting *in situ* and semi-structured interviews. The data collection and analysis followed an iterative approach emphasizing the ad hoc collection and contesting of data for rigor analysis (Klein and Myers 1999; Ellingsen and Monteiro 2006). The data from these two studies were analyzed through several rounds of analytical writing to identify themes across the cases (Emerson, Fretz et al. 1995). This iterative process resulted in a comparison of the US workplace study and the Danish workplace study focusing on how continuity of care is achieved to handle challenges specific to each context. The process of writing continued until the point where there was only marginal change in the analysis (Eisenhardt 1989).

4 Analysis: Two stories of how continuity of care is achieved as part of everyday practice

The following two narrative stories, although based on observations across several clinicians and on several days, are told from the perspective of a single day, including the subtleties of how technologies are appropriated as part of everyday practice.

4.1 Danish case

The first story begins in the medical sub-section AVA. This section initiates diagnosis before sorting patients to other subs-sections of the medical department that consists of 5 outpatient clinics and 5 sub-sections (including AVA). The medical department uses a monthly rotation plan resulting in different physicians present at the AVA every day, with the exception of a permanent attending physician. This arrangement means that the larger group of physicians gets time to see patients in the outpatient clinics the days they are not on-duty. The outpatient clinics are of particular interest to the physicians because they allow them to follow patients and treat them for a longer period of time.

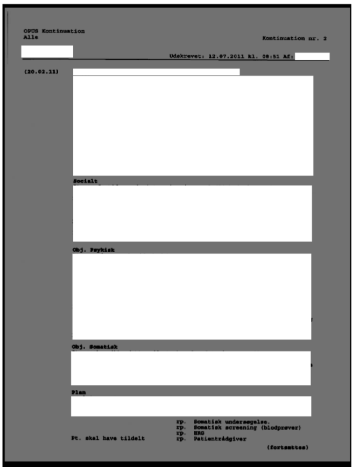
4.1.1 Linking clinical information

On this particular morning the permanent attending physician, Dr. V, together with the attending physician, Dr. M, and a senior resident, runs AVA. A resident physician helps out admitting patients. The day begins at 8:05 am with a morning conference together with the rest of the medical department's physicians. An hour later the overall coordination across sub-sections is accomplished and the physicians head back to the ward. AVA operations have a straightforward goal (initiating diagnosis), and all jobs are tied together by the monthly work plan of the medical department prescribing the specific jobs of physicians on every day of the month as a central tool for how work is carried out.

As the physicians return from the morning conference to AVA a little before 9 am, the rest of the staff (nurses and secretaries) have already prepared status reports for patients that are ready to be seen by a physician. AVA's conference room is located on the ward and works as both a nurses' station and physician and secretary workspace. Patients are distributed between the two attending physicians and the senior resident, all of whom are preparing to do rounds at patients' bedsides. AVA admits patients on all days, and whenever a patient is transferred to one of the other sub-sections new patients are admitted. This means that there is typically a constant flow of patients in AVA.

The hospital requires that an electronic form, the "continuation" (Figure 1), be filled out as part of everyday practice to prevent the slip in responsibility that could occur from the organization of work around clinicians' specialties. This organization of work is further complicated by the fact that hospitals in the local region divide responsibility between them on different levels of specialization and specialties. The distribution of responsibility between public hospitals is regulated by the national government and managed by the regional government to ensure that standards of care are high. The principle of organization is that practice makes perfect; the rare conditions are therefore only handled by a few hospitals.

The continuation form can be accessed from all regional hospitals. As part of the EPR, the continuation provides information on the patient's admissions described chronologically, one after the other, and information on the patient's anamnesis, dispositions, and allergies. The continuation also includes what clinical activities have been initiated during a particular admission. In principle the provider is the public, but in practice the patient moves between various providers of healthcare that will depend on what the chief complaint of the patient is, how critical it is, and which hospital treats this condition. Therefore, AVA may also receive patients from other hospitals and/or transfer patients. Although the referring physician is expected to decide what hospital the patient is sent to, in practice this is a negotiation with the receiving hospital department.



OPUS Kontinuation
Alle

Kontinuation nr. 2

[redacted]

Udskrevet: 12.07.2011 kl. 08:51 Af: [redacted]

(20.02.11) [redacted]

[redacted]

Socialt

[redacted]

Obj. Psykisk

[redacted]

Obj. Somatisk

[redacted]

Plan

[redacted]

rp. Somatisk undersøgelse.
rp. Somatisk screening (blodprøver)
rp. EKG
Pt. skal have tildelt rp. Patientrådgiver

(fortsættes)

Figure 1. Ex. of continuation form in the Danish case

Dr. M’s first patient of his morning rounds is an 83-year-old woman, and the continuation indicated she most likely has a lung infection. The patient was previously admitted to a different hospital in the local region, Dr. M notes, at which time she was also quite ill. He turns to the list of medications. As he prepares to the patient’s bedside he consults the nurse responsible for this patient. The nurse record (kardex) with the patient’s vitals (e.g., the pulse and the patient’s general condition) is on the desk in front of them as they discuss the patient. The patient keeps having water in the lungs.

The monthly schedule often results in patients potentially seen by the same physician only once: with the exception of the permanent attending physician, the physicians typically rotate to other jobs the next day. For example, the monthly rotation plan assigns the job of “front-line” physician to residents and the job of “backup” to attending physicians. Because the attending physician is seeing this patient for the first (and maybe last) time, reviewing the patient’s records (electronically and on paper) takes time. The free-text in the continuation is made up of sections up to 35 lines in length separated by headings; the text is a uniform typeface and size that makes it challenging to get the overall picture of the relationship between previous admissions.

Both of the attending physicians are rather busy as 21 of AVA's 24 beds are occupied, and they work through their patients without interfering with each other. Dr. M notes down a few details from the patient record on a piece of paper before finally going to the patient's bedside. He keeps the paper with the extract of clinical information in his pocket all day. During the day Dr. M takes out the paper several times, crossing out and adding things, for example, as the change of a patient's vitals requires that his first calculation of medication is adjusted. While the continuation assembles clinical information about patients from a long-term perspective, the piece of paper that he keeps in his pocket visualizes to Dr. M his interpretation of what is done presently.

Back in the conference room Dr. M calls the hospital's general acute care section that admitted the 83-year-old woman to discuss with them her previous admissions because he believes there is a problem of co-morbidity (multiple diagnoses). The patient's condition does not get better because she cannot tolerate diuretics. Dr. M. realizes this when carefully going through the continuation where it was stated that the patient was previously admitted to the nephrology department for kidney problems. The acute care section agrees on his analysis and they decide to change the patient's treatment.

4.1.2 Linking clinical specialties

A third attending physician, Dr. J, shows up in the AVA conference room. He is the attending physician responsible for consults that day. Physicians in the medical department carry a pager that is assigned to them in the monthly rotation plan of the medical department along with a specific responsibility (e.g., backup). Since there is a new team each day, the pagers specifically facilitate these shifts so that getting a hold of a particular type of specialist is straightforward. A small display shows the phone number of the ward that paged the physician.

As the attending physician, Dr. J, begins his round, he carries with him a pager corresponding to the role of "backup". He leaves AVA to carry out a consult for a patient in one of the wards of the surgical department. Consults may be requested electronically or by calling the pager number, or by contacting a specialist personally in cases where this person is known to have a certain experience. The office of the attending physician, Dr. J, is located a little away from the ward; he does not spend much time there but just checks that no one has left any messages for him.

Whether a physician carries a pager or not depends on his or her assignment. It is crucial that there are no "stray" pagers if the system is assigning roles by pagers and the monthly rotation plan is to work securely. When Dr. J arrives at the surgical department he walks straight to the conference room, which is also the nurses' station. The senior resident there is worried about a patient, a 17-year-old boy that had surgery in the colon recently, who now has dark stool, which may suggest bleeding from the colon. The patient was referred for surgery by the medical department.

Dr. J is the backup but he is also regularly seeing patients in the outpatient clinic specializing in gastroenterology, and Dr. J in this case remembers the patient from a previous admittance. To confirm to himself that it is in fact the same patient that he saw previously, Dr. J recalls details about the patient from memory and has the resident confirm them from what is stated in the patient's record. Together they flip through the paper record. The attending physician confirms the medication of the patient and they agree to have the patient's colon checked again. Dr. J then returns to AVA to see what the next consult is.

The pager technology helps physicians link their work across clinical specialties by assigning consults to a particular physician and thereby reducing the interruption of the larger group of physicians. However, for Dr. J carrying the pager work becomes slightly more cumbersome, it is illustrated, when the pager goes off several times in a row and he is not able to trace the call – or return it while the line remains busy. The simplicity of the pager design, which does not support texting, means that there is never any doubt whether a call was followed-up when the pager shifts hands. However, to the physician carrying the pager, it is cumbersome to make judgments about the particular call.

Dr. J is paged several times within a short time, which makes him worried when he cannot tell from the information displayed by the pager who might be calling him. To mitigate this he walks to the information desk located centrally in the hospital. The information desk is able to trace all in-house numbers, including this one. When Dr. J arrives at the ward paging him, he learns that a resident there simply got confused about the system of paging and the procedures for requesting a consult. And while Dr. J in this case is not interrupted in his work, he feels that he has to investigate the matter straight away.

What the Danish case shows is how physicians achieve continuity of care by appropriating patient records and pagers as they go about their everyday work: The patient record requires some appropriation to be useful in the context where inquiries are listed continuously. The relation between the inquiries is not clear for the physician; it takes some linking across cases before he actually sees the reason why the patient continues to have water in her lungs. The challenges to continuity of care are thus interdependent with the context and how EPRs are shared between different levels of specialization and specialties.

To handle the challenge of distributed responsibility for a patient, the physician relies on the entries in the continuation form of the various specialties and levels of specialization that previously saw the patient. But for the continuation to also be useful, the attending physician visualizes essential clinical information on a piece of paper that he keeps in his pocket and edits throughout the day. In this way, continuity of care is achieved as the physician realizes that the 83-year old woman was previously admitted for kidney problems and that she is probably not responding positively to the medication because she cannot tolerate diuretics.

The complex organization of work where a different team of physicians runs AVA every day (and the other wards as well) also makes the linking of care across specialties rather complex. To keep responsibility clear within this complex organization of work, the pagers only provide simple forms of communication. However, where possible the particular physician still tries to link previous acquaintance with the patient in the consults as he goes about his work and also to use his personal acquaintance with the patient when deciding what the next step should be.

We will now turn to the story of how physicians achieve continuity of care as part of daily practice in the US medical department by appropriating patient records and pagers so that challenges in the particular context are met.

4.2 US case

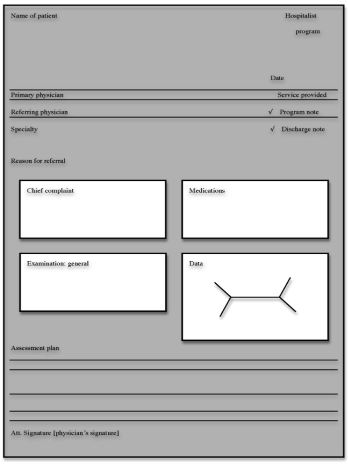
The story in the US case begins with Team B in the medical department. Six teams run the medical department that admits patients in a rotation; two days a week each of the teams is responsible for admitting patients. Team B is one of these teams. The teams run for a month each before another team of physicians takes over while the old team rotates to other activities and departments. Team B resides in one of the six conference rooms off the ward, separate from the nurses' stations. During the two days of their rotation the team admits patients within all areas of internal medicine. The days where Team B is not admitting patients it focuses on following up on patients' conditions and on discharging patients that are ready either to return home or to a nursing facility.

4.2.1 Linking clinical information

Team B consists of the attending physician, Dr. A, whose specialty is internal medicine; the senior resident, Dr. G, training to become a specialist in internal medicine; 2 resident physicians, Dr. J and Dr. M, and 2 medical students. These physicians form Team B for a month. When the attending physician arrives in Team B's conference room at 8 am, the rest of the team has already been at the hospital for a while checking on their patients. Either one or the other of the two residents is responsible for each patient. Yet should an acute situation emerge, the attending physician has to be available at all hours.

The conference room is, in general, central for Team B's work practices. The team meets here for the morning rounds. As part of the morning rounds the residents, Dr. J and Dr. M, prepare "follow-up notes" (Figure 2) for all patients, assembling the medical values (e.g., blood pressure), medications, and the plan for the patient. The hospital requires that a follow-up note is filled out each day of the admission for each patient and signed by the attending physician by the end of the day. The note forms a kind of patient résumé similar to that found in the EPR of the hospital, but focusing on the patient's condition on that particular day.

The follow-up note has an important relationship to the patient's health insurance because it is the hospital's documentation to bill procedures and to potential patient lawsuits because it sums up the patient's condition and the steps taken. How patients are covered depends on their health plan (Medicaid, Medicare, or by health insurance as part of their employment). The interpretation of the patient's insurance conditions is an integrated part of the work of Team B's physicians throughout a patient's admission.



Name of patient
Hospitalist
program
Date
Primary physician
Service provided
Referring physician
√ Program note
Specialty
√ Discharge note
Reason for referral
Chief complaint
Medications
Examination: general
Data
Assessment plan
Att. Signature [physician's signature]

Figure 2. Ex. of follow-up note in the US case

The 3-layered carbon paper of the follow-up note ensures that it is completed in 3 copies: a bluish copy (for the billing department), a yellow copy (for the paper record), and a pink copy (for the attending physician's personal records). The attending physician later explained that the handwritten notes make the clinical process stand out more clearly and, should it come to a lawsuit, the adding and crossing out of text helps give an expression of the process nature of the work done. Over time, through a process of various tests and observations, in most cases it will be possible to decide on a diagnosis.

However, Team B's morning rounds illustrate that the follow-up note is, at the same time, a central part of the clinical work when physicians closely follow the development of a patient's condition on every day of the admission. At the center of the follow-up note the newest medical information is visualized. The current state of the patient is crucial to making decisions about the next step. And, while the follow-up note is formally completed for administrative purposes, it is also a convenient daily visualization of the direction of the patient's condition.

The patient's possible change of provider between admittances means that the residents cannot be sure that the electronic record is complete except for the current admittance. The patient's employment is typically what determines the type of health plan the patient has and therefore at what hospital the patient is admitted. The hospital EPR is one source of the information registered in the follow-up note. However, by closely analyzing the patients' conditions, the physicians overcome the challenge of discontinuity in the EPR when information is explored by the same person day-after-day.

Morning rounds take place either in the conference room or at patients' bedsides. This morning physicians sit down around the conference table where they admitted several patients the day before, and this makes it convenient to discuss the details of patients' conditions. The attending physician flips through the follow-up notes laid out on the table in front of him until he finds the patient that Dr. J is presenting to the team. He looks at the follow-up note and starts to ask the team questions about the possible reasons for the increase in this patient's ammonia level. They will not begin any treatment until they have all of the lab results, the attending physician concludes, and he makes a few notes on the follow-up note.

4.2.2 Linking clinical specialties

As the morning rounds end, the attending physician leaves to carry out consults that were ordered by other departments. Meanwhile, the residents make sure the next diagnostic steps for Team B's patients are carried out. Two types of consults may be requested: 1) the formal "request for a specialist consult", and 2) the informal "curbside consult", where specialists discuss the diagnosis at the patient's bedside. A third option is family meetings, which is a formal meeting set up with several specialists and the family of the patient.

Consults are requested through the hospital's intranet, which is connected to the system of pagers, or by using the pager number of a certain physician directly. Much of the physicians' work takes place as they are traversing the hospital corridors; pagers make them available for communication while they are seeing patients. The pager also allows the physician to receive a text message and take a quick look at it to decide if the request is urgent enough to disrupt whatever he or she is doing. If the physician is in the middle of a physical examination of a patient, for example, the text message allows the physician to respond later, if the request is not acute.

The pagers are personal and follow Team B's physicians throughout their rotation. In this way the pager allows the physicians to build relationships through both formal and informal consults. The pager provides the physician with the possibility of texting similar to SMS. On her way to see a patient, the resident, Dr. M, stops by the nurses' station to text the senior resident in the nephrology department "Hi, this is M, I have a consult for you regarding patient no _ _ _ _".

The resident physician, Dr. M, had already discussed her patient with the senior resident from nephrology several times that week. When the senior resident in the other department responds to her request for a consult that was communicated by paging, they both already know the details of the patient. The senior resident returns the call shortly after and they discuss the details of the patient that concern whether it is Team B or the urology department that should perform a certain procedure. They quickly come to the conclusion that this must be the responsibility of Team B, and Dr. M writes down a few notes that she later types into the EPR. This formal communication is kept as part of the EPR, in contrast to pager communication.

The pager thus supports the possibility that pager messages can be used as more than just an advanced "alarm" that goes off when someone needs to get in touch with the physician. The option of paging also provides the physicians with a less formalized way of communicating with other specialties about what the next clinical step should be. The pagers, in this way, provide a space for the physicians' informal communication that in the end may seem like detours but are actually important in the process of excluding other possibilities in the patient's condition.

What the US case shows is how physicians achieve continuity of care by appropriating patient records and pagers as they go about their everyday work. The EPR in this case requires some appropriation to be useful in the context where it mainly supports an overview of radiology, lab results, and the record of the current admission. However, it does not support an overview across the patient's admission other than in the particular hospital. The organization of work by month-long teams helps the physician to overcome challenges of discontinuity because it is the same physician that collects and interprets the clinical information throughout the patient's admittance.

Physicians in the US case operate within a context where the course of events can mean a lawsuit. The process nature of the follow-up note and pagers provide them with a way of communicating effectively about a patient's condition. Support for this process cannot be taken for granted within this particular context. Yet the appropriation of patient records and pagers in this way is only possible because of the limited reach of the organization to other specialties within the same hospital.

Teams constituted for a month at a time (also in other clinical specialties) means that physicians' linking of the clinical work may rely on a certain degree of recognition in relation to the specific patient. This is clear from how the pagers allow physicians in Team B to link their work across their formal job title (e.g., senior resident), but also by their experience with the patient in question, when the same senior resident has given advice concerning a particular patient over a period of time.

5 Discussion: Challenges in continuity of care

Continuity of care is a central aspect of clinical work and how it is collaborative by nature when several specialties get involved to handle patients' various conditions. By linking the clinical information and the clinical specialties it becomes possible to handle complex issues – which has also been a main driver for support of clinical work by collaborative technologies, for example, EPRs (Berg 1998). Thus, from this perspective continuity of care defines a practice of linking so that tasks are not disintegrated in the complex organization of clinical work (Strauss, Fagerhaugh et al. 1985).

Continuity of care is achieved in the Danish and the US hospital medical departments through addressing similar concerns for providing the best possible care under the particular circumstances. Both departments accept patients with a wide spectrum of symptoms that are handled routinely in morning rounds where the patients are discussed in relation to the change in their condition to decide on the next step.

The technologies that the two medical departments deploy are also similar. EPRs offer an overview of radiology and lab-results, inquiries of the patient, and the plan for what ought to be done next. The pagers in both cases work by the roles of physicians depending on their level of specialization (e.g., senior resident) and clinical specialty (e.g., nephrology). Pagers support the linking of specialties by providing a way that consults may be requested.

However, there are significant differences between the two cases. The staffing (continuous vs. shifting physicians), spaces (off the ward vs. on the ward), and inter-relationships with services outside the hospital (defined vs. distributed organization) make the US case and the Danish case different in essential ways. The challenges of achieving continuity of care are thus different in the two cases, despite their common medical aim. Nonetheless, they both illustrate how continuity of care is accomplished.

The major difference lies in how roles are constituted around the responsibility for care. In the US case the roles of the physicians are continuous over a period of a month, which makes the extra effort of handling roles in clinical work less cumbersome. The same people seeing the same patients make hand-over less of an issue. This is quite different in the Danish case, where the change in responsibilities places more focus on the work of handling roles, which is illustrated by the physicians' use of pagers as mainly connecting "functions" rather than facilitating interpersonal communication.

Continuity of care is challenging in the US case in the way that the patients might have quite discontinuous admittances depending on their healthcare coverage. This means that the entries on the patient's admissions are often incomplete and there might be aspects that are overlooked in the clinical work. In contrast, in the Danish case the entries across the patient's admissions are continuously added within the region's hospitals, increasing the length of the continuation document. Because of the shifting physicians in the Danish case the written documentation becomes critical in the hand-over between physicians from day-to-day, but also when patients move between hospitals.

In this way, continuity of care is handled by the appropriation of the EPR in the Danish case and by pager communication in the US case to overcome the challenges specific to the different contexts of work. Only by comparing the appropriation of technologies in the two cases from the perspective of context, the broader commonalities across the Danish and the US case becomes visible. Here we see how physicians' appropriation of EPRs and pager technology is different across cases. The comparative analysis makes visible how in the Danish case and the US case the challenges that make physicians appropriate technologies are context-dependent.

In the US case the responsibility of physicians is evident in the hospital's documentation practices, but links back to the general individual responsibility of physicians in the US in case of lawsuits. This is illustrated by how the hospital and the individual physician both keeps a copy of the follow-up note, because, according to the attending physician, the adding and crossing out of text helps give an expression of the process nature of the work done. The follow-up note is thus crucial both formally and in practice when physicians decide on the direction of a patient's condition.

In the Danish case only the hospital keeps a copy of the patient's record. The collective responsibility of a patient's care is evident in how the hospital organizes the clinical work, as illustrated by the listing of one admission after the other in the continuation, which makes the physician extract information to understand the nature of the patient's current problem. The responsibility of the patient's care is thus linked through the entries in the continuation, and is made relevant by the attending physician on a day-to-day basis.

Previous CSCW-research on how Danish hospital physicians decipher the entries of other physicians (Mønsted, Reddy et al. 2011) supports this finding on challenges of clinical entries into EPRs in the Danish case, which are, however, context dependent. The challenges to physicians' work making entries in the EPR relevant to their particular context are not simply a matter of the nature of that clinical work (Heath and Luff 1996), this paper and previous CSCW-research illustrate, but are also a matter of the organization of work in which the EPR is used.

To elaborate, whereas the key challenge in the Danish case is the hand-over via long-term entries into the EPR and that patients very seldom see the same physician, the key challenge in the US case is the lack of long-term entries of the into the EPR. These challenges are also accommodated differently in the two cases. In the Danish case the long-term entries into the EPR seek to handle challenges specific to the complex organization, whereas in the US case the instance of creating a short-term linking between physicians and patients means the challenges of incomplete long-term entries lessen.

The pager technology in both the Danish case and the US case relies on different roles for the physicians to link clinical work across specialties when consults are requested from other departments. Hence, physicians in the US case collaborate as a team constituted for a month at a time, whereas in the Danish case most physicians rotate between tasks of the medical department from day-to-day – but in a steady routine over months. The linking of specialties by consults in the Danish case is thus one of many jobs that physicians are assigned by the monthly work plan to run the medical department.

The linking of specialties in the Danish case takes place as physicians coordinate – and negotiate – what is the right combination of specialty and level of specialization. Different hospitals specialize in different types of patients. In the US case the range of this type of negotiation is restricted to a single hospital. The comparative analysis of the US case and the Danish case suggests that physicians' linking of clinical specialties is dependent on both the organization of work (e.g., the monthly work plan), but also the distribution of responsibility beyond the particular hospital.

The appropriation of the pager technology in the US case shows how physicians appropriate or tailor the pagers to support the organization of work limited to the particular hospital. Other hospitals are mainly relevant if patients are transferred there, but then it is more so a matter of the conditions in the patient's health plan. The challenges particular to the context in the US case concern issues of how physicians may also create a space for their informal communication on the process of care, which is not saved in the same way as information entered into the EPR.

The commonalities from both cases that bring forward how continuity of care is achieved in practice are that continuity of care is acted out based upon how work is organized in terms of the responsibility for care and the constitution of roles. Both responsibility and roles are organized differently and provide certain conditions and challenges for continuity of care, which then also drive the technology use as well as the required technology support of practice.

The essential contribution of this paper is the identification of a) responsibility for care and b) the constitution of roles as important elements and rules of combination in relation to how technology is appropriated within the particular context where it is used; the empirical cases illustrate how continuity of care is acted out in practice. These two inter-dependent and interlinked factors – responsibility of care and constitution of roles – can thus help us understand in broader terms the challenges across context of technologies to support continuity of care.

The challenges to continuity are characterized in essential ways by the patients' circulation between providers, which makes practices of linking part and parcel of physicians' everyday work. This aspect of clinical work is often promoted as a way to politically raise awareness about the provision of healthcare across time, setting, and specialty (Ellingsen and Monteiro: 443). This paper points to the importance of understanding what continuity of care comes to mean in practice as it is inter-related and interdependent with the organization of work in terms of the responsibility of care and constitution of roles.

6 Conclusion

This paper explored how continuity of care is achieved through the appropriation of technology as part of everyday practice in a Danish and a US hospital medical department. Comparing these two cases at the level of the broader commonalities (Schimdt, Wagner et al. 2007), it becomes clear how the linking of clinical work is challenged in both cases across lines of responsibility of care and the constitution of roles, although the origin of the challenges is context-dependent.

Our data illustrate how the challenges of continuity of care in the US case concern the lack of long-term documentation of the patient's condition in the EPR, whereas in the Danish case the lack of continuity lies squarely in the parade of changing physicians for each patient. While the challenges are different in the two cases, they both mirror the broader organizational structure of healthcare provision in a Danish and a US context and the challenges that are addressed by different tailorings or appropriations of technologies.

To accommodate challenges of lack of documented care for a patient over time due to conditions of private healthcare where patients move between providers depending on how they are covered by their health plan, the relative continuity between the patient and the physician becomes central in the US case to support the clinical work. Differently, to accommodate the challenges of public healthcare where there is one provider but the patient still moves between hospitals depending on their condition, physicians rely on the long-term documentation of the care of a patient in the Danish case.

It is not up to this paper to promote either of these approaches. Rather, the paper attempts to shed light on how continuity of care is achieved as part of everyday practice – and what role context plays. In both in the US case and the Danish case valuable lessons can be learned from the ways technologies are appropriated to accomplish continuity of care in practice if the goal is new, improved practices.

7 Acknowledgments

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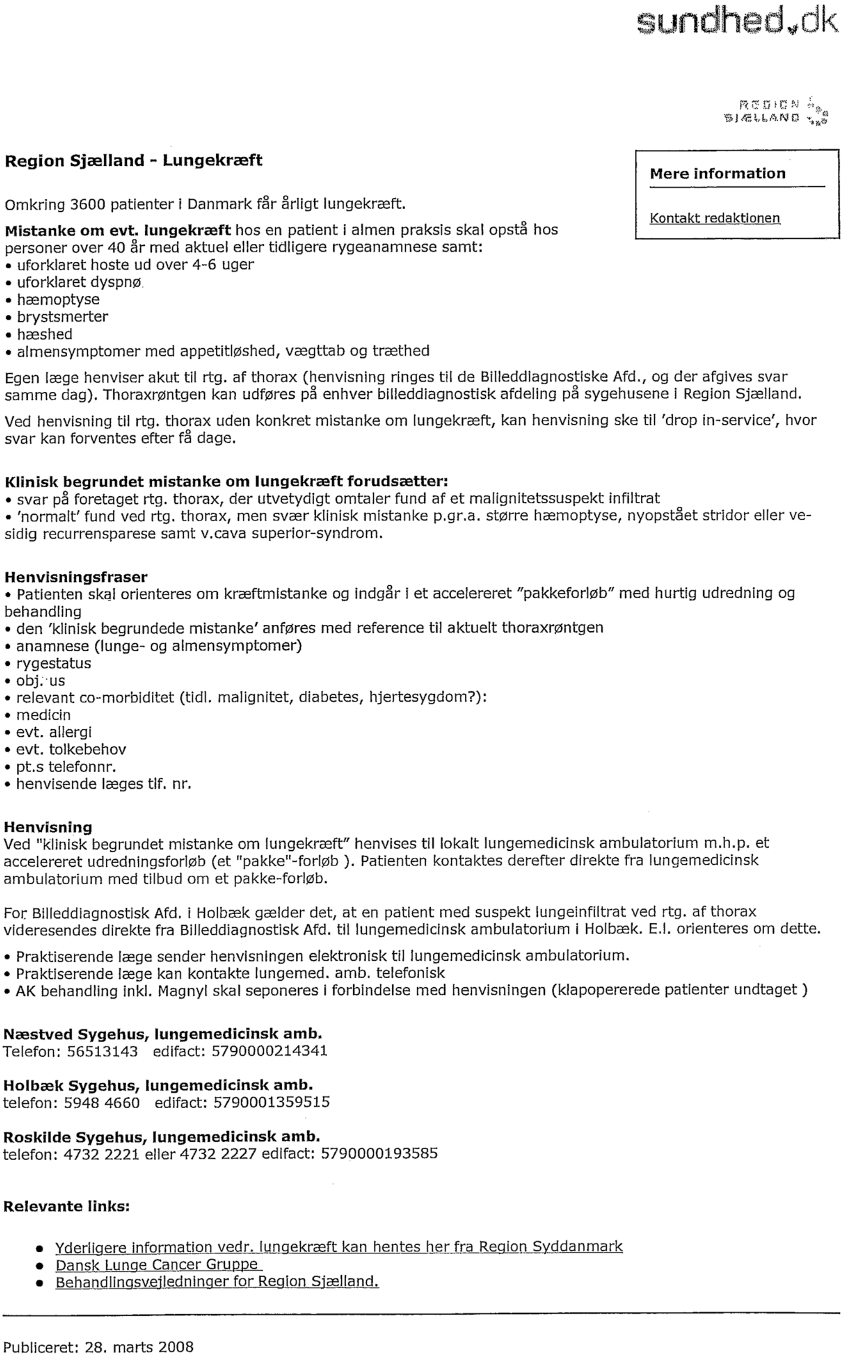
Appendices

Photo Conference room with monitors displaying results of diagnostic examinations (CT-scans, MR-scans etc.) to be coordinated by the radiology department at Køge Sygehus with the medical department. The radiologist sits by the small monitors on the right while the medical specialists sit in the middle of the room in front of the large monitors.

Appendix A



sundhed.dk

REGION SJÆLLAND

Mere information

Kontakt redaktionen

Region Sjælland - Lungekræft

Omkring 3600 patienter i Danmark får årligt lungekræft.

Mistanke om evt. lungekræft hos en patient i almen praksis skal opstå hos personer over 40 år med aktuel eller tidligere rygeanamnese samt:
- uforklaret hoste ud over 4-6 uger
- uforklaret dyspnø
- hæmoptyse
- brystsmerter
- hæshed
- almensymptomer med appetitløshed, vægttab og træthed

Egen læge henviser akut til rtg. af thorax (henvisning ringes til de Billeddiagnostiske Afd., og der afgives svar samme dag). Thoraxrøntgen kan udføres på enhver billeddiagnostisk afdeling på sygehusene i Region Sjælland.

Ved henvisning til rtg. thorax uden konkret mistanke om lungekræft, kan henvisning ske til 'drop in-service', hvor svar kan forventes efter få dage.

Klinisk begrundet mistanke om lungekræft forudsætter:
- svar på foretaget rtg. thorax, der utvetydigt omtaler fund af et malignitetssuspekt infiltrat
- 'normalt' fund ved rtg. thorax, men svær klinisk mistanke p.gr.a. større hæmoptyse, nyopstået stridor eller ve-sidig recurrensparese samt v.cava superior-syndrom.

Henvisningsfraser
- Patienten skal orienteres om kræftmistanke og indgår i et accelereret "pakkeforløb" med hurtig udredning og behandling
- den 'klinisk begrundede mistanke' anføres med reference til aktuelt thoraxrøntgen
- anamnese (lunge- og almensymptomer)
- rygestatus
- obj. us
- relevant co-morbiditet (tidl. malignitet, diabetes, hjertesygdom?):
- medicin
- evt. allergi
- evt. tolkebehov
- pt.s telefonnr.
- henvisende læges tlf. nr.

Henvisning
Ved "klinisk begrundet mistanke om lungekræft" henvises til lokalt lungemedicinsk ambulatorium m.h.p. et accelereret udredningsforløb (et "pakke"-forløb). Patienten kontaktes derefter direkte fra lungemedicinsk ambulatorium med tilbud om et pakke-forløb.

For Billeddiagnostisk Afd. i Holbæk gælder det, at en patient med suspekt lungeinfiltrat ved rtg. af thorax videresendes direkte fra Billeddiagnostisk Afd. til lungemedicinsk ambulatorium i Holbæk. E.l. orienteres om dette.

- Praktiserende læge sender henvisningen elektronisk til lungemedicinsk ambulatorium.
- Praktiserende læge kan kontakte lungemed. amb. telefonisk
- AK behandling inkl. Magnyl skal seponeres i forbindelse med henvisningen (klapopererede patienter undtaget)

Næstved Sygehus, lungemedicinsk amb.
Telefon: 56513143 edifact: 5790000214341

Holbæk Sygehus, lungemedicinsk amb.
telefon: 5948 4660 edifact: 5790001359515

Roskilde Sygehus, lungemedicinsk amb.
telefon: 4732 2221 eller 4732 2227 edifact: 5790000193585

Relevante links:

- Yderligere information vedr. lungekræft kan hentes her fra Region Syddanmark
- Dansk Lunge Cancer Gruppe
- Behandlingsvejledninger for Region Sjælland.

Publiceret: 28. marts 2008

Billeddiagnostisk Afdeling (BDA), Køge
"Kræftpuljetider" til billeddiagnostik i forbindelse med "kræftpakker" for patienter med lungecancer, colorektal- og hoved/halscancer pr. 01.09.08
Bemærk nyt "kræftsøger-nummer"

Pr. 1. september 2008 indfører Billeddiagnostisk Afdeling, Køge "kræftpuljetider" i forbindelse med "pakkeudredningen" af patienter med begrundet mistanke om lunge- og colorektalcancer. Afdelingen har dagligt friholdt et antal "kræftpulje-tider" i CT- og MR skannerne og vores colonrum. Disse tider er reserveret Medicinsk, Kirurgisk og Halskirurgisk Afdeling.

Roskilde, Billeddiagnostisk Afdeling varetager som hidtil udredningen af patienter med begrundet mistanke om hoved/halskræft. Ring til "kræftsøger" 70-5310 som hidtil.

Der bliver pr. 1. september 2008 oprettet en "kræft-hyler" på Køge, Billeddiagnostisk Afdeling. Denne søger får hylernummer 70-5403.

Når der ønskes en undersøgelse, som indgår som led i en **"kræft-pakkeudredning"**, skal den læge, der har patienter, sørge for, at der bliver fremsendt henvisning/er (hver undersøgelse sin henvisning og husk kontrolskema ved MR) i WEB-order. Umiddelbart herefter kan man ringe på "kræft-søgeren" og få udmeldt undersøgelsestid(er), som den kliniske afdeling med det samme videreformidler til patienten.

Det er som altid en speciallæge, der med sit navn skal figurere på henvisningen. Afsendelsen af denne og kontakten til "kræftsekretæren" kan ske både ved plejepersonale eller sekretær.

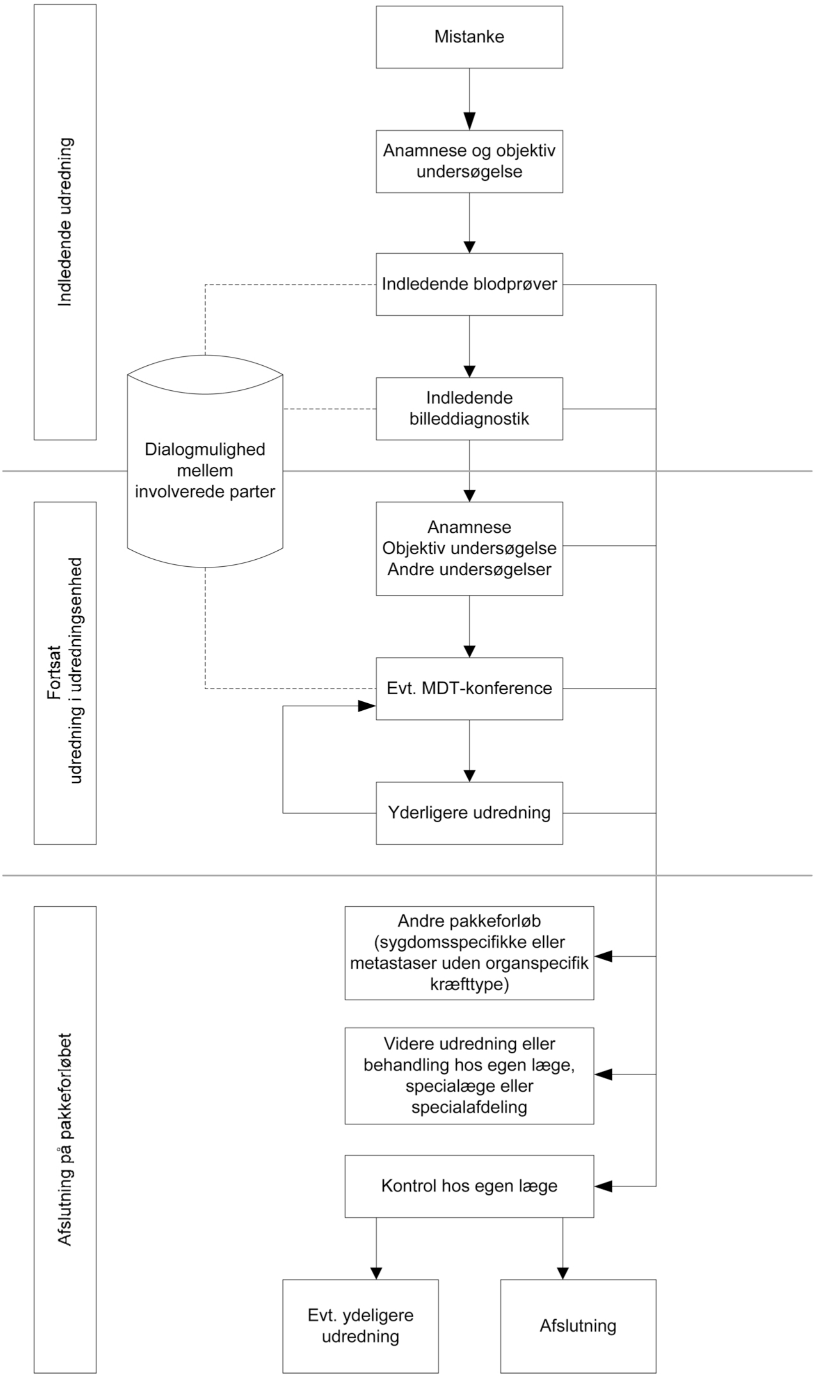
Det er vigtigt at give BDA besked, hvis den udleverede "kræftpuljetid" ikke anvendes. Dette skal ske til "kræftsekretæren" via "kræftsøgeren" senest 36 timer før undersøgelsestidspunktet. BDA vil da kunne anvende tiden til andre patientkategorier.

Retningslinier gældende pr. september 2008:

- **Send henvisning i WEB-order (og ved MR også udfyldt kontrol-skema)**
- **Ring på "kræftsøger" 70-5403 (læg røret på efter tone og afvent opkald)**
- **Få en puljetid af "kræftsekretæren"**
- **Meld tiden ud til patienten**
- **Meld tilbage til "kræftsekretær" via søger senest 36 timer før undersøgelsestidspunkt, hvis tid ikke skal bruges alligevel!**

NB! Det skal kraftigt pointeres, at disse "kræftpuljetider" og måden at få dem udmeldt på udelukkende gælder for patienter, der starter et forløb på begrundet mistanke om en af de ovennævnte kræftformer.
Al øvrig diagnostik relateret til kræft skal ske efter henvisning til BDA på sædvanlig vis og ikke ved opkald til kræftsøger. BDA skal venligst anmode om, at dette overholdes.

På afdelingsledelsens vegne



Sundhedsstyrelsen 2011