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Unity in Diversity: Electronic Patient Record Use in Multidisciplinary Practice

Eivor Oborn
School of Management, Royal Holloway University of London, Egham TW20 0EX, United Kingdom, eivor.oborn@rhul.ac.uk

Michael Barrett
Judge Business School, University of Cambridge, Cambridge CB2 1AG, United Kingdom, m.barrett@jbs.cam.ac.uk

Elizabeth Davidson
Shidler College of Business, University of Hawaii at Manoa, Honolulu, Hawaii 96822, edavidso@hawaii.edu

In this paper we examine the use of electronic patient records (EPR) by clinical specialists in their development of multidisciplinary care for diagnosis and treatment of breast cancer. We develop a practice theory lens to investigate EPR use across multidisciplinary team practice. Our findings suggest that there are oppositional tendencies towards diversity in EPR use and unity which emerges across multidisciplinary work, and this influences the outcomes of EPR use. The value of this perspective is illustrated through the analysis of a year-long, longitudinal case study of a multidisciplinary team of surgeons, oncologists, pathologists, radiologists, and nurse specialists adopting a new EPR. Each group adapted their use of the EPR to their diverse specialist practices, but they nonetheless orientated their use of the EPR to each others' practices sufficiently to support unity in multidisciplinary teamwork. Multidisciplinary practice elements were also reconfigured in an episode of explicit negotiations, resulting in significant changes in EPR use within team meetings. Our study contributes to the growing literature that questions the feasibility and necessity of achieving high levels of standardized, uniform health information technology use in healthcare.

Key words: multidisciplinary; practice theory; electronic patient record; unity; IT adoption; information systems and organizational change; case study; longitudinal research; diversity

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1. Introduction and Motivation

Healthcare today is provided by highly specialized medical professionals working across a variety of settings. Specialization is embedded in a web of clinical fields, professional socialization, practice patterns, and medical technologies. Mol's (2002) study of the diagnosis and treatment of atherosclerosis vividly illustrates this diversity, highlighting how each specialist, and even the patient, experiences a "common" disease in multiple, diverse ways. Medical specialization contributes to advanced treatments for complex diseases such as cancer, but it also makes delivery of cost-efficient and coordinated care to individual patients difficult. As a result, healthcare policies increasingly call for coordination of care and multidisciplinary teams to bring diverse specialists together on behalf of the patient (Oborn and Dawson 2010).

Two approaches to fostering coordinated, multidisciplinary care involve enhanced communication, interaction, and coordination among specialists (Oborn and Dawson 2010). One is organizational, where multiple specialists are housed together in care units or departments or assigned to work jointly in care teams. The other is informational. In the latter case, the hope is that by converting paper patient records into more standardized, accessible electronic patient records (EPR), improved communication among providers will be possible and will result in greater coordination and collaboration of patient-focused care (Schoop and Wastell 1999). These approaches are complementary: improved information flow and access within an organizational setting is expected to improve communication among co-located practitioners, as well as to improve coordination among dispersed healthcare providers.

Despite such expectations regarding the benefits of health information technology (HIT) generally, and for coordination of multidisciplinary care specifically, the adoption of EPR systems has been neither fast nor problem-free (Ash et al. 2004). In addition to issues of system design and role changes associated with EPR applications (Bjørn et al. 2009, Davidson and Chismar 2007), the nature of disciplinary specialization makes it difficult to embed a generic, computerized EPR as a "one size fits all" information system to

foster coordination and communication among clinical specialists (Ellingsen and Monteiro 2003, Hanseth et al. 2006).

Characterizing HIT use and its adaptation in multidisciplinary care is important and has not yet been fully explored in the literature. In this paper, we draw on practice theories (Orlikowski 2000, Barnes 2001, Reckwitz 2002, Østerlund and Carlile 2005) to consider how technology use in multidisciplinary practice can enable unity across practice despite diversity of use. In our analysis of EPR use in a multidisciplinary breast cancer care team, we develop a process view of the dynamic *interplay of diversity of HIT use and unity in practice*. We highlight significant diversity in specialists' use of the system, reflecting the diverse nature of each groups' practices. Nonetheless, as specialists interrelated across their shared multidisciplinary practices, their use of the EPR helped build and support a level of unity in the MDT's functioning. These insights illustrate how interrelating among practitioners can mitigate the opposing tendencies towards diversity and enable translations so as to establish partial connections and a level of unity across team practice (Mol 2002). Attending to the tensions between these oppositional tendencies towards diversity and unity in EPR use across specialists in multidisciplinary team practice was more explanatory than examining doctors as a group, or even each specialist as an independent subtype.

Our study contributes several important insights on the potential use of HIT applications (such as an EPR) in multidisciplinary settings. We build on Orlikowski's (2000) practice lens view of situated, enacted technology use to illustrate how a nuanced analysis of embodied practices (Reckwitz 2002) can explicate key elements that contribute to diversity in the use of HIT among health specialists. We highlight how specialists' orientation to each other in shared multidisciplinary practice (Barnes 2001) presents a counterbalance to diverse uses, helping to shape how specialists incorporate technology into their practices and reciprocally to shape the technology object (the EPR) in ways that can foster unity across multidisciplinary practice. In doing so, we contribute to the growing body of literature that questions the degree to which standardized and uniform use of health information technologies is necessary to realize improved coordination in clinical care practices.

In the next section, we review relevant concepts from practice theory and EPR literatures that informed our understanding of HIT use in multidisciplinary settings. We then describe the case study and research methods. We present our findings on EPR-related practices of five specialist groups in the MDT (surgeons, radiologists, oncologists, cancer nurses, pathologists) and on their use of the EPR. We discuss the dynamic interplay of unity and diversity that influenced EPR use in the team. Finally, we consider implications for theory and insights for management.

1.1. A Practice Theory Lens on Health IT Use in Multidisciplinary Practice

Information Systems (IS) researchers have increasingly turned to theories of practice to better understand the embedded, situated nature of IT use and the consequences for organizational outcomes of IT implementation. In the institutionally complex, professionalized setting of healthcare (Scott et al. 2000), empirical studies that have adopted a practice lens provide in-depth insights on the "whys" and "hows" of HIT use in clinical practices, and thus on organizational successes and difficulties with HIT (cf., Bjørn et al. 2009, Boulus and Bjørn 2008, Ellingsen and Monteiro 2003, Jensen and Aanestad 2007). Such organizational-level insights can complement interorganizational and industry-wide assessments of the adoption and potential impact that health IT applications may have on issues of cost, quality, efficiency, and access to healthcare (Ash et al. 2004, Devaraj and Kohli 2003).

In a seminal work, Orlikowski (2000) explicated a practice lens to examine technology use. Reacting to the tendency to reify social structure as rules and resources embedded in technology by designers and appropriated by users in use, she defines *technologies-in-practice* as "the sets of rules and resources that are (re)constituted in people's recurrent engagement with the technologies at hand" (p. 407). In this theoretic view, people draw on the properties of a technology artifact and on skills, knowledge, expectations, and experiences to produce situated enactments of technology (p. 410). Orlikowski's (2000) practice lens thus emphasizes human agency and the enacted, emergent, situated, and provisional ways in which technologies are used in practice.

While Orlikowski's (2000) practice lens foregrounds the human actor's situated and provisional technology use, Reckwitz's (2002) formulation of practice theory suggests a complementary view of *technology as an object within embodied practices*. He draws on an array of 20th century social theorists (Bourdieu, Giddens, Foucault, Garfinkel, Butler, Latour, Taylor, and Schatzki) to "work out more precisely the points at which a theory of social practices can be distinguished from its theoretical alternatives, and how its basic vocabulary thus amounts to a novel picture of the social and of human agency" (p. 244). He defines *practice* (Praktik) as "a routinized type of behaviour which consists of several elements, interconnected to one another: forms of bodily activities, forms of mental activities, "things" and their use, a

background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge" (p. 149). Drawing on Reckwitz's granular and relational definition of practice, we suggest that information technologies may be treated theoretically as material objects that are (or may become) elements of a practice. Know-what and know-how related to the possible uses and manipulations of the IT object are embedded and interrelated with other elements of the practice, including bodily movements, objectives, emotions, and motivation. Individuals carry out practices, but practices per se do not belong to individuals. Instead, practices are the unit of social analysis in practice theory, according to Reckwitz. Thus, while we study individuals as they carry out a practice, note variations in how individuals actually carry out a practice, and acknowledge human agency in the ways in which technologies are provisionally enacted, the primary theoretic focus is on *practices* as the analytic object of interest.

Given our interest in multidisciplinary health settings, we also consider how practices reflect more generally the historical, social, and professional distinctions and similarities among specialist disciplines and the nature of medical specialization, which poses significant challenges to integrating work across specialties (Heath et al. 2003, Oborn and Dawson 2011). Østerlund and Carlile (2005) highlight aspects of practice theories that are relevant to a theoretic understanding of multidisciplinary work. In an analysis of several practice theories of shared knowledge work, they highlight how each focuses on differences within practices around which relationships are built, the dependencies and interdependencies among these elements of practice, and the blurring of categorical boundaries that may result.

Following their arguments, we suggest that in multidisciplinary healthcare settings, differences among specialists and between specialist and multidisciplinary practices entail tensions around which a practice lens on HIT use might be built. Multidisciplinary approaches assume that specialist practices co-exist and interact, and new multidisciplinary practices may arise from the association and coordination among specialists to foster a unified approach to patient care. "Unity" suggests that specialists coordinate and collaborate with sufficient overlap to provide the best possible patient care (within the limits of medical knowledge and approved practices). However, specialists' ways of knowing and ways of acting differ significantly, making unity difficult to achieve. In her study of the treatment of atherosclerosis, Mol (2002) illustrates dramatically how practices are performed, technologies are utilized, patients are treated, and disease is understood in markedly different ways among specialists. Mørk et al. (2008) characterizes differences among clinical departments and specialties as epistemic cultures, in which the mechanisms for knowledge production are different and thus learning and sharing across practices is problematic.

A practice lens (Orlikowski 2000) suggests that differences in how specialists may use an HIT application are more than a question of what display screens or data fields each specialist group uses; they represent markedly different ways of knowing and acting related to information and information technologies. Using HIT applications to build and support unity in healthcare delivery entails overcoming knowledge barriers, which in turn requires more than making common information accessible; it requires rendering diverse information into credible and trustworthy knowledge (Ellingson and Monteiro 2003) to be used within diverse practices. Given the multiple forms of knowledge created and used within diverse practices, *translation* of the form and language of one practice into that which is credible and legitimate within another practice may be needed (Mol 2002).

In theorizing HIT use in multidisciplinary healthcare settings, our practice approach considers not only how *individuals* draw on and use technology within their practices (Orlikowski 2000) and how HIT applications become objects embedded within embodied practices (Reckwitz 2002), but how individuals *interrelate* their enactments across diverse practices and align their uses of technology with others. We draw on Barnes's (2001) conceptualization of *shared practice* to elaborate the notion of co-orientation and interrelating in practice: "What is required to understand a practice of this kind is not individuals oriented primarily by their own habits, nor is it individuals oriented by the same collective object; rather it is human beings oriented to *each other* . . . they are interdependent social agents, linked by a profound susceptibility, who constantly modify their habituated individual responses as they interact with others, in order to sustain a shared practice" (p. 32). Barnes provides such diverse examples as vegetarians, chiropractors, and a cavalry charge. In the first case, shared practice arises from individuals adopting routines, activities, attitudes, and knowledge that are recognizable as the same practice, similar to Reckwitz's (2002) notion of embodied practice. In the second case, the shared practice is enacted by widely dispersed and loosely connected agents, who nonetheless align their individual performances based on their knowledge or observation of the performances of other agents. In the third case, the shared practice involves multiple agents concurrently enacting the practice, by attending closely to each other's actions and enactments. In each instance, shared practices require conscious and calculated interrelating "by agents concerned all

Table 1 Key Concepts of Practice Lens for HIT Use in Multidisciplinary Care Settings

Theoretic concept	Description	Examples from empirical case
Practice	Routinized type of behaviors including interrelated elements, e.g., bodily activities, mental activities, "things" and their use, understanding, know how, states of emotion, motivational knowledge" (Reckwitz 2002).	• Surgeon's examination of a patient during a patient encounter • Pathologist's examination of tissue sample to determine presence or absence of cancer cells
Shared practice	Enactment of routinized behaviors in similar ways by multiple individuals, through heedfully interrelating and attending to each other's enactments (Barnes 2001)	• Similar enactments of surgeons' patient encounters • Similar enactments of pathologists' tissue analysis practice
Specialist practice	Discipline-based practices that reflect historical, social, and professional distinctions (Mol 2002)	• Surgeons' ways of knowing, analyzing, acting in clinical activities • Pathologists' ways of knowing, analyzing, acting in clinical activities
Multidisciplinary practice	Practices that draw from multiple specialties with coordinated, interrelated behaviors (Oborn and Dawson 2010)	• Patient encounters in the one-stop clinic, in which patient is treated by the team • Multi-disciplinary team meeting for joint decisions about patient care
Diversity of EPR use	Variety, heterogeneity, dissimilar or distinct ways of incorporating technology use into embodied practice (Orlikowski 2000, Reckwitz 2002)	• Surgeons' "click the box" entry of findings into EPR for speed, brevity • Pathologists' extended narratives in EPR providing nuance, visibility
Unity in diversity	Partial connections, established through translations, enable diverse disciplines to inform and shape each other's practice (Mol 2002). This enables unity in practice despite diversity of usage.	• Pathologists "narratives" are translated into tick box format to inform surgeons of the diagnostic category • Oncologists vision of patient outcomes to build research profile is translated to surgeons interests in clarifying local outcomes

the time to retain coordination and alignment with each other in order to bring them about" (p. 33).

In our context of multidisciplinary practice, we suggest co-orientation to each other enables partial connections to be established between specialist groups—partial in that an element of one specialist practice is not subsumed into that of another, but is *translated* to draw together and establish difference at the same time (Mol 2002). We refer to this as *unity in diversity* and develop this theoretic concept through the empirical case study analysis.

Table 1 summarizes the key conceptual elements of our practice theory lens on HIT use in multidisciplinary settings. In the following sections, we use this theoretical approach to examine how specialists coordinated and aligned their enactments of EPR use with each other as they incorporated (or not) the information object (the EPR) in specialist and multidisciplinary practices. Our analysis highlights how diversity of EPR use arose from the nature of the multidisciplinary work, yet diversity was attenuated, as shared MDT practices presented a counterbalancing influence which enabled the EPR to support a level of unity in multidisciplinary care.

2. Research Setting and Methods

"Royal" is a tertiary care university hospital[1] in England with a regional cancer centre. In 1995, the breast cancer specialists formed a multidisciplinary team, or MDT, to serve as the flagship for comprehensive, unified breast cancer treatment programs. Members of the team began twice weekly multidisciplinary meetings (termed "MDMs") to jointly decide on the clinical management of breast cancer patients. In 2001 the surgeons and surgical nurse specialists ceased working from the general surgery clinics of Royal and moved into a new location on the hospital campus, where they, along with radiologists, radiographers, and administrative staff were given office and clinic space.

When fieldwork began, the hospital had high national ranking, due in part to the breast cancer team's ability to meet government waiting targets. The new building that housed the MDT made it possible to develop "one-stop" clinics for breast cancer patients. Before the MDT clinic was established, a patient would begin with an appointment in a surgical clinic, then be referred with a different appointment to radiology services for imaging of suspected cancer. Following radiology, the patient would typically need another appointment with a surgeon to discuss the results of the imaging. If treatment ensued, the patient might begin appointments with an oncologist. In contrast, the one-stop clinic allowed the patient to see all clinicians required for diagnosis in

[1] A tertiary care hospital is a comprehensive services healthcare center, to which community or smaller hospitals refer patients. Tertiary hospitals often have specialized units, such as the cancer centre at Royal, a pseudonym.

one visit. It also facilitated the MDM joint decision-making approach. At the time of the study, the MDT included oncologists (three), radiologists (four), pathologists (three), surgeons (three), and specialist nurses in surgery and oncology (five). Oncology doctors and nurses remained in the oncology department of Royal but came over for twice weekly joint clinics in the new location. The pathologists, who did not meet directly with patients, attended MDM but remained otherwise located in the pathology department, across from the pathology lab, where specimens were dissected and mounted onto slides by lab scientists and technicians.

The first author began fieldwork at Royal in June 2003. During the fourth month of fieldwork a new, Web-based clinical information system (SubSys) was implemented. Team members used SubSys to record cancer-related information pertaining to patients seen in the clinics. The system interfaced with the hospital's administrative system. In addition to computer stations in the clinic and their own office areas, team members could use one of the five hand-held, portable tablet computers, purchased to allow data entry during patient consultations in the exam rooms. The surgical theatres used by the breast surgeons were set up for wireless connections to facilitate SubSys use during operations.

The oncology department, the regional cancer network, and the hospital jointly funded SubSys development and implementation. The oncology department was rapidly expanding and oncologists hoped to use the system to support ongoing clinical trials by improving access to clinical information and treatments. Starting with the breast cancer team, who expressed their willingness to be the first to implement the system, the regional cancer network planned to implement the cancer care system across all cancer groups (for example, gynecology, lung, urology) in the hospital and then extend access to other cancer centers in the region. During the field study, SubSys supplemented but did not replace the hospital's paper medical records; for example, pages could be printed from SubSys to be inserted into the hospital's paper records. Overall, the IT administrators and the clinical team considered SubSys a success, and it was gradually adopted in other tumor groups at Royal in the following year.

The research reported here is drawn from a year-long, interpretive field study of the MDT in the breast cancer clinic. This methodological approach allows the researcher to gain in-depth understanding of and insights on the subject matter in its natural setting from the perspective of organization members and to gather and assess various primary and secondary data sources on phenomena of interest (Langley 1999, Walsham 1993). The first author obtained access and appropriate ethics approval as part of a broader research project to study multidisciplinary collaboration in cancer services. She collected data from the sources outlined in Table 2.

Formal interviews were semi-structured, including topics such as patient care and decision making as well as SubSys use; most were recorded and transcribed. Some interviewees were not comfortable with a recorded interview, and several individuals asked the researcher to turn the recording off, checking visually that the machine was not operating, before proceeding to speak about highly sensitive issues. The first author interviewed all core team members and key medical trainees as well as office staff, including secretaries, who worked closely with the clinicians. IT personnel (three) involved in constructing and implementing the new system were interviewed; two patients known to the first author were also interviewed. During multidisciplinary clinics, the first author took detailed notes on what happened and asked clinicians for further elaboration when appropriate. The scenarios reported in the findings section were based on specific observational sessions that were typical of other observed practices; variations from the prototypical practice are highlighted in the presentation of findings.

The authors analyzed this extensive, detailed data set (over 400 pages of textual data) in the following ways (Golden-Biddle and Locke 1997). The first author developed thematic coding across disciplinary groups. She incorporated insights from medical and nursing sociology and compared and contrasted narratives with EPR studies in other settings to identify

Table 2 Sources of Data from the Study

Interviews (28 total)	Observation
16 physicians	23 multidisciplinary meetings (MDMs)
4 nurses	11 other meetings
3 IT administrators	19 multidisciplinary clinic sessions
3 office staff	
2 patients	Documentation
Informal discussions during regular on-site visits over 13 months observation with MDT members	MDT email circulars, SubSys forms, and lists Documents (research studies, clinical trials), Treatment protocols, referral templates

current knowledge. This resulted in five related narratives that served as intermediate findings, bridging the field study and the analysis presented here. This analysis highlighted the diverse ways in which specialists interacted with patients and other specialists, made clinical diagnoses and decisions, and used informational sources, including SubSys, in their day-to-day work.

Data that addressed how each group adopted and used SubSys, their expectations concerning the system, and their medical practices related to SubSys use were drawn from these narratives and detailed data sources. The authors developed analytic displays to summarize data (Denzin and Lincoln 1998), which compared SubSys use and practice dimensions across specialist groups. The authors then developed the narrative account of findings regarding MDT members' SubSys use, focusing on two types of practices in which the informational resources of SubSys were particularly relevant: the patient encounter, as practiced by each group of specialists, and the MDM joint decision-making meeting. Focusing on SubSys use in MDT practices allowed an integrated, multilevel analysis of individual and group use within the organizational setting of Royal. In this analytic stage, the authors drew on the theoretic foundations outlined earlier to examine MDT members' interpretations of SubSys and their actual use of the system in relation to other aspects of practice. The authors considered how specialists' enactments of SubSys use and their patient encounter practices were mutually adjusted and how this adjustment became an explicit negotiation within the MDM practice. The authors then synthesized analytic insights to consider the implications for the evolution of the EPR to support MDT work.

The research design and methods are in concert with Klein and Myers's (1999) principles of interpretive research, in particular the iterative analysis of "parts" of the case study (such as the specialist practices) and a holistic interpretation of the whole, development of general theoretic concepts from the idiographic case data and attention to multiple interpretations and voices of study participants.

2.1. Multidisciplinary Practice: Diversity and Unity

The EPR system, SubSys, was intended as a repository of clinical data on cancer patients that would be useful to specialists in their clinical work, in joint decision-making on patient care, and ultimately, to assess long-term clinical outcomes. Here, we analyze two multidisciplinary practices for which SubSys was particularly relevant. The first practice, the patient encounter, draws on the situated history of each specialist group and incorporates diverse tools and technologies as specialists focus on disparate aspects of the patient's illness and treatment. Yet, patients came to the "one-stop" clinic setting to be assessed by a team, rather than a particular specialist; team members were adamant that patient management was a team responsibility with shared accountability. A key component of the patient encounter was to document relevant assessments and findings, so other team members could draw on this knowledge in their own encounters. Our analysis foregrounds how specialists incorporated SubSys into their patient encounter primarily to align with their specialist practice elements but also to accommodate the practices of others in the MDT. The second practice, the multidisciplinary patient management meetings (MDM), drew all specialists into a joint decision-making exercise. We highlight how the team's use of SubSys changed abruptly when resources essential to this practice were lost; the analysis revealed how the team effectively reconfigured elements of the MDM practice and of Subsys use in that practice.

2.1.1. Surgeons' Patient Encounter Practice. *Dr. S glances at his watch and picks up the referral notes. After reading, he briskly walks to the adjoining room, a nurse close behind. Dr. S warmly greets the patient sitting on the bedside. Taking a seat, he asks about her symptoms and whether he might assess her. The patient removes some clothing and Dr. S stands beside her, asking a few more questions whilst waiting. He palpates the normal and abnormal breasts carefully going over the contours of the lump. He gives the patient an indication of his initial thoughts on the nature of the lump and explains that "we will need to take some pictures." Returning to the joint clinic room, he sits at the computer terminal and opens a new patient file in SubSys to document the nature of his findings. Scrolling down he ticks relevant boxes and marks the diagram indicating the lump's location.*

Surgeons met with all patients for brief scheduled encounters during their initial visit to the clinic. They also encountered some patients later in the operating theatre or on inpatient wards.[2] They began each clinic encounter in the joint clinical documentation area by reading through the paper referral (usually from a GP) and any previous hospital records, which had been pulled together by clinic administrators. When running late, surgeons frequently did this whilst walking towards the assessment room next door.

Historically, surgeons have been focused on organs: was there a palpable lump in the patient's breast and what was its texture? They consistently sought to specify such findings and decisions as tersely as possible. SubSys allowed them to document quickly,

[2] Ethnographic observations were limited to activities in the clinic or offices and did not include treatment or inpatient encounters.

using tick boxes and marking the diagram. During the patient encounter, they moved through sitting and standing positions quickly, using few objects for diagnosis, and directly assessing the lumps manually. Although portable tablets were available for use in the exam room, surgeons found the tablets awkward, as it took their attention away from the patient and direct, hands-on examination. After their assessment, surgeons returned to the joint documentation area. If time allowed, they documented their findings directly onto SubSys. If behind schedule, they picked up another set of patient notes to begin the next assessment, and entered several assessments together at a later time. Initially surgeons dictated or wrote their assessments; with a few months' experience they adjusted their practice to enter the notes themselves electronically, but they rarely used SubSys for subsequent patient encounters or for reading the patient's history.

One reason surgeons made the system work in their patient encounter practice was that it supported their professional values of brevity and action. Surgeons expected the clinic (and other events) to run on schedule. They spent around five minutes seeing a patient and were highly structured in their assessment. Referring to the nature of a surgeon's practice, a nurse explained:

> The surgeons . . . have a very clear-cut approach . . . . They are very organized, highly efficient. They are caring . . . but very clear on their boundaries.

Surgeons' use of SubSys revealed and supported how they related to other colleagues but also drew from their distinct values, such as being concise and on time. The surgeons were particularly orientated towards how radiologists would be assessing the patient and what "pictures" would be taken. In documenting on SubSys, they would indicate to radiologists what diagnostics the patient might need; for example the surgeon might recommend a biopsy in their terse prose. The surgeons did not document psychosocial issues mentioned by the patient, as it was expected that nurses would be documenting these details. Whilst they understood that oncologists' primary goal for SubSys was to develop research knowledge, surgeons developed a vision for a system that could interrelate the team's disparate practices into knowing local outcomes for the team as a whole. They translated the oncologists' vision of patient outcomes for research purposes to their own interests in knowing patient outcomes for local treatment audit. A surgeon's comment illustrated both his frustration that the system did not yet meet this expectation and his trivialization, yet tolerance, of the oncologists' expectation regarding data collection for research:

> [SubSys] does not allow us to know the outcomes or survival at the moment . . . [SubSys] should do that for us . . . that is the only reason to have it . . . the oncologists wanted all this stuff about date of menarche, how many children the patient had, did you breastfeed them. That is an example of trash that no one will ever use . . . so we collect all this stuff . . . and we don't even know what our local reoccurrence and survival is . . . .
> (Surgeon)

Thus, surgeons' use of SubSys was framed in relation to other elements of their patient encounter practice—their access to resources (such as administrators), their bodily movements and characteristic actions, specialist knowledge, and professional values but also reflected their interrelating with other specialists as part of the multidisciplinary team.

2.1.2. Radiologists' Patient Encounter Practice. *Dr. R liaises with Dr. S about the patient, Mrs. Hunter. Dr. R tells the radiographer the patient is ready for x-rays and opens her file on SubSys to skim through the record. He enters the Hospital System through SubSys to check for previous tests. He goes to the waiting area and introduces himself, escorting Mrs. Hunter to the radiology rooms and explaining the sequence of events. The radiographer takes the x-ray; later Dr. R works with the radiographer to do an ultrasound and biopsy. He summarizes his findings on SubSys under the appropriate diagnostic headings and ticks the relevant boxes. He opens a new diagnostic section of SubSys and scans in two key films. Needing to check on a missed detail, he carries the portable tablet to the patient and enters the data directly whilst speaking with her. He flags a note that a biopsy has been sent to pathology, which will automatically bring her up for the list at next week's MDM meeting.*

The radiologists met with patients at an early point in the assessment process and would orient their patient encounter according to the surgeons' documentation, yet they draw on their own values, knowledge and use of objects. When reviewing a patient's findings they would generally log into SubSys to look up patient details electronically and thus gain quick access to the surgeon's notes. They decided which imaging technologies would be appropriate, moving between rooms to access machines. Thus the patient encounter often extended into several intervals, exam rooms, and technologies. Radiologists were observed to take the portable tablets into the patient assessment area to record information whilst interacting with the patient. They were well versed in using computers and accustomed to using medical technologies as a central tool in practice, to technology mediating and interrupting their interactions with the patient. Hence, carrying around the portable tablet, and using it whilst interacting with the patient, was consistent with other elements of their practice. Having a graphical knowledge focus, they assessed potential diagnoses and responses to treatment by examining the characteristics and potential changes in films taken

at standard intervals. They used SubSys to document their clinical impressions of tests, and would flag on the system a connection with pathology, the subsequent diagnostic, and use SubSys to interrelate diagnostics for the upcoming MDM.

Such uses of SubSys were consistent with, and embedded in, other elements of radiologists' patient encounter practice. In contrast to surgeons, radiologists more fully integrated use of SubSys as the patient record during the patient encounter in these multiple ways:

> Radiologists look back over the pathway and get all their information from SubSys rather than look at the notes. But the surgeons will ask their secretaries to do it, so the secretaries will pull up SubSys and . . . look . . . . The radiology guys have been always very good at entering their data. (System Administrator)

Radiologists not only used SubSys in their practice, but they acted to shape the technology per se to better fit their practice and those of the wider team. Radiologists' willingness to ensure their findings and data were incorporated into SubSys, and, as discussed later, their leadership incorporating the system in the MDM sessions, reflected emerging professional values, as radiologists have become more interactive with other specialists. One radiologist commented on this transformation:

> Radiologists, historically, used to be back sitting in a dark room—sitting there with their glasses on. They didn't speak to people. But actually now, they are rather the hub of the hospital and have to be great communicators. (Their emphasis)

The lead radiologist had a personal interest in computers and was the clinical champion for SubSys. The radiologists were active in the user group meetings and gave regular feedback on the design of SubSys. As a result SubSys had a particularly well-developed interface for the clinic assessment of radiologists, who influenced the design by being active participants:

> We would ask the clinicians what they needed, though we typically used radiologists as an example. (System Administrator)

Thus radiologists were influential in orientating the resulting affordances of the SubSys design, as well as the availability of patient data in the system (through their own practices) to the needs of the wider team.

2.1.3. Pathologists' Patient Encounter Practice. *Mrs. Hunter's biopsy arrives in pathology and technicians dissect and prepare the tissue onto slides sticking to a meticulous protocol. Sitting at her microscope, Dr. P reaches for the several dozen glass slides in her tray. She inspects the pink and blue stains on each slide, looking for abnormal tissue. She tries to quantify "how abnormal is tissue in each slide," "how much of the tissue is abnormal," and "what type of abnormalities are seen." Taking her head off the microscope she turns to the patient's file on SubSys. She skims the radiology summary, then writes a detailed description of her overall impression of the disease. She turns to the microscope to check a detail in a key slide and resumes writing. Rereading her entry, she then scrolls up the page to quickly tick the appropriate boxes, labeling the disease.*

The pathologists encountered the patient by examining minute cellular details in order to specify the histology label.[3] They did this sitting in a removed laboratory office peering through a microscope, yet they were able to access any notes other team members had entered. They integrated technology objects, such as microscopes and lab instruments, as tools for diagnosis. The basis for the pathologist's inspection revolved around numerous tissue samples, which were examined comparatively under the microscope with standard samples seen in the past. Each case was unique and cells were on a continuum in all dimensions on which pathologists reported. While pathologists have extensive classification systems, not all cells in a tissue will look the same and providing the diagnostic label is not as straightforward as assumed by nonpathologists. A pathologist explained the dilemma when making a diagnosis:

> Our [knowledge is not] conclusive . . . . Some things are black and white and these are easy to specify . . . but there are also some areas of grey . . . . As you get more experience . . . pathologists learn how they will consistently call a particular presentation . . . . "Is it yes or no doctor," the patient asks and a shade of grey is not acceptable . . . . Having to tick boxes to fill in forms and databases accentuates this tendency to erase the grayness and makes [diagnoses] more clear-cut than they really are.

Just rhyming off the numbers by clicking the tick box seemed to miss the nuances of the particular specimen. In documenting via rigid categories pathologists were orientated to the doctor needing to counsel the patient, usually an oncologist or surgeon, and translating their narrative to the need for straightforward "yes-no" answers (via the disease staging tick box) to a complex picture. However, the pathologists preferred to use free text rather than the tick boxes and menu choices of SubSys; when they filled in the menus, they sometimes made mistakes, selecting the wrong label. This became a source of frustration for other team members who did not regularly read the lengthy narrative. Yet, pathologists spent considerable time making sure that the narrative record was accurate.

> Pathologists have always written a free text descriptive story about what pathology is. . . . [They] are very

[3] A histology label is the basis for the tissue diagnosis that incorporates scores for how aggressive and advanced the disease is.

> attached to their free text so they feel that they won't give that up . . . . They agree [to fill out the pull down menus] . . . but they don't see it as the medical record; they see the free text as the medical record . . . . So they will make sure the free text is accurate but not the [tick boxes]. (System Administrator)

A system administrator recounted that one of the entries concerning the pathology diagnosis was 16 pages long, highlighting the issue. "*I want to give the whole story*," the pathologist explained.

In addition to the pathologists thinking the tick boxes were too definitive, ticking boxes did not illustrate the hours of work the way a long narrative did:

> I went through 70 slides . . . because you have to block off the area, to make sure that there isn't an invasive tumor, and work all the margins out . . . so you might . . . say four of the lymph nodes are negative, in seconds (during the MDM) but that might have been two hours of work! (Pathologist)

The pathology department was historically associated with the university rather than the hospital and was located in the other end of the hospital. Being tucked away in a remote corner of the hospital complex, other specialist groups had little inside knowledge or contact with pathology work. Pathology was regarded as an ivory tower, somewhat removed from the practicalities of patient management and other members of the MDT sometimes referred to it as "*the palace of truths.*" Given their ability to reveal "truth" few would challenge them, but pathologists had little say on what to do next with the patient, being isolated in their "palace" from the hectic patient environment. Using the system to document a narrative was a way of orientating their work towards the other team members so as to increase their visibility.

Thus, pathologists framed SubSys use consistently with their professional values of precision, detail, and nuance in diagnosis (the narratives), which were also evident in their actions, bodily movements, and specialist knowledge within the practice. Moreover, their use of SubSys may have reflected a desire for increased visibility of this work within the multidisciplinary practice of the team.

2.1.4. Oncologists' Patient Encounter Practice. *Dr. O sits pensively, reading over Mrs. Hunter's notes. After* 10 *minutes he walks to an adjoining room. He waits for a nurse to accompany him. He passes Dr. S, a surgeon, and comments, "How do you think she will take this?" Dr. S eyes him, "I don't think she is expecting it." Dr. O takes a seat and carefully explains Mrs. Hunter's details. She says little but her husband asks for clarifications. Dr. O shows them two treatment schedules and discusses her options. Mrs. Hunter's eyes are teary. Dr. O offers information about a clinical trial. They spend time discussing options and Dr. O concludes, "This is a lot to think about. Would it help if we call you later in the week?" Returning to the joint documentation room Dr. O is behind schedule; the next patient has been waiting* 45 *minutes. He quickly hand writes a note and enters a few details in SubSys. He finds the menu slow and difficult to navigate and mutters that he "will put it in later."*

The oncologist met with patients for variable periods of time ranging from 20 minutes to 90 minutes for the first encounter. During this time, the oncologist would discuss various treatment options, pointing to tables and schedules of treatment regimes. Tissues were often handed to tearful patients. Occasionally oncologists were observed to take a break after the patient encounter to settle their own emotions. The oncologist would regularly have follow-up encounters with patients during radiotherapy or chemotherapy treatment as well as annual follow-ups, establishing an ongoing relationship with the patient.

Oncologists' knowledge focus was on cancer, mortality, and morbidity. They collected information to qualitatively document the patient's symptoms, rather than altering treatment decisions. As there were many pieces of information to document over a lengthy time period, oncologists found the current tick-the-box paper documentation simpler, and less obtrusive to use than opening numerous pull down menus on SubSys. A systems administrator explained:

> [Oncology has been slow to use SubSys] . . . . Because it's actually quite a lot of information gathering. The consultants [have to document] . . . a whole raft of problems, and they are all graded from 1 to 4.

Other MDT members found oncologists' limited use of SubSys puzzling:

> Oncologists like to have a lot of data available on the patient and their outcomes. (pauses) . . . . But it's interesting that they are not able to actually use SubSys to input their own treatment . . . . So even though it is an oncology initiative, they are further behind radiology and surgery in many respects . . . . (Radiologist)

Viewed in terms of the oncologists' practice, their limited use of SubSys in patient encounters was consistent with other aspects of their practice (e.g., descriptive symptom details and long-term trajectory of relating to the patient), though they hoped to use the system more in the future:

> They are developing screens for . . . chemotherapy toxicity . . . but it's an enormously complicated task, and you never produce exactly what you want on any computer screen, but it's a lot better than attempting to do without it, which is the situation we have at the moment. (Oncologist)

Their sponsorship and use of SubSys was also in line with their professional values regarding research. Oncologists valued clinical trials. Given the recent

rapid developments of cancer therapies they expected treatments to improve in the future and were committed to research using clinical trials; their key reason for advocating and resourcing SubSys was:

> Oncologists like to think of themselves as being far more evidence based, so we have a tradition of a lot more trials. (Oncologist)

> [Oncology professor] realized early on that if you want good clinical info that can support research, then you need a robust IT system. (Radiologist)

Keeping track of side effects to treatments was important for tracking a specific patient's outcomes in relation to published research, but doing so in the system was not essential. Instead, oncologists understood SubSys primarily as a way to support oncology research through easier access to information from the other disciplines. However, their vision for SubSys integrated the numerous disciplinary assessments into a cohesive framework orientated to oncology research.

2.1.5. Nurses' Patient Encounter Practice. *As she was about to go for lunch, Anna's phone rings. It's Mrs. Hunter. Whilst speaking, Anna reaches with her free hand to a small box and pulls Mrs. Hunter's yellow card. She rereads her earlier entry, stating that Mrs. Hunter was teary but brave, though her husband was not coping well. Mrs. Hunter explains she is not sure how to fit her life around the treatment. Her husband was working increasingly long hours and the kids had just started a new school. They discuss and then Mrs. Hunter begins to cry. Anna suggests Mrs. Hunter could return to the clinic and a visit is scheduled. Anna documents the discussion on her yellow card. Turning on the computer, she opens Mrs. Hunter's file. She records that an appointment was scheduled.*

All patients met with a nurse during their initial assessment and nurses made themselves available outside clinic hours. Thus, nurses had varying levels of contact with the patients, both face-to-face and by telephone; encounters were sporadic and intense. Face-to-face encounters frequently involved tissues, tears, and bodily contact, such as hands on a shoulder. The nurses focused on patients' experiences rather than illness presentation, and they had the potential to develop very intimate relationships with patients. The nurses used their yellow cards extensively, although one nurse occasionally added comments to SubSys. Nurses saw the cards as not merely objects for providing information, but in a way, representing the actual patient:

> We almost refer to these cards as "her." "Oh yes, there she is" or "I have got that lady."... They sort of replace the person we met because it is an association in our minds.... It is something to do with the yellow card. (Nurse)

The cards enabled them to translate information regarding the patient's social circumstances to the wider team while maintaining the distinction between biological medical patients and the social nature of patients as persons. As such, the yellow patient card became a tangible reification of the patient, whereas the electronic record was perceived to be unable to represent this relationship:

> [SubSys] is very structured.... We try to give a quite personable impression and approach to the people... and it is something to do with doing it all on a computer. [SubSys]...is more structured and clinical.... The personal touch, I suppose it comes together with the yellow cards. (Nurse)

In addition to being more structured, nurses were unable to hold and carry around electronic notes as they did yellow cards. Whilst the portable tablets did enable the nurses to carry the records around, the computer did not represent one particular patient in quite the same way as the yellow card. It therefore did not support the nurses' goal of being mindful of the patient's personal experience as a key element of their practice. The nurses also felt that the information that they collected via the yellow cards—their assessments of patients' experiences or family and emotional issues—were not entirely relevant to the rest of the team.

> We put in a few notes of our own to give us a bit of background—you know the family situation, and the person's psychological and emotional and social cycle...which we certainly wouldn't want going out, live and public—even if it is just for the team, I don't think we would want something so confidential go out of just our [nurses] circulation. (Nurse)

Interestingly, the doctors did not mind this absence; possibly doctors' tendency to dismiss information that nurses found important was also a factor in nurses' wanting to keep nursing information "private"—not just keeping the patient's private life from view, but keeping a private domain of nursing insights on patients. Thus, nurses used SubSys as an informational repository in support of their work with surgeons and other MDT members, but it was not directly relevant to their patient encounter practice, with its emotional and personal patient interactions. Their nonuse of SubSys oriented their assessment as a nursing activity, somewhat distinct from medical work and the medical record.

2.1.6. Summary of EPR Use in Patient Encounter Practices. Our analysis revealed how the members of each group of specialists aligned their use of SubSys primarily with other elements of their specialist practices, that is, the shared practices of their clinical discipline drawn from similar stocks of knowledge, institutional histories, tools, and so on. The result

was diverse patterns of SubSys use across the MDT. Pathologists' *idiosyncratic use* included free text summaries of cell descriptions to clarify their decisions, in addition to ticking appropriate boxes; surgeons' *limited use* reflected their reliance on administrative backup and their preference for brief comments and tick boxes, which represented concise categories and fit with their structured movements during the patient encounter. On the other hand, radiologists, who were accustomed to incorporating technological objects into their patient assessments enacted *extensive use* of SubSys to retrieve information and document findings. Nurses and oncologists' *nonuse*, though unexpected, did not negatively influence the team's work goals. Enactments of SubSys use generally resulted in the status quo relative to status, authority, and power of each group, and modest changes to each group's routinized behaviors in patient encounters. Nonetheless, over time, SubSys evolved into an informational repository, shared across specialists' practices that had limited, but still useful, properties to facilitate the operation of the one-stop MDT clinics.

2.1.7. Multidisciplinary Team Meeting Practice. Members of the MDT met twice-weekly in an MDM session, where patient management plans were discussed and agreed upon. The following observation note depicts the practice in the first months after SubSys was introduced:

Prior to the meeting, the radiologist prepares copies of relevant SubSys pages from a list generated by SubSys. He wheels the trolley containing paper records into the meeting room. The trolley has been put together by an administrator. Few come late or miss the MDM. At 8 A.M. *sharp in a darkened room, a radiologist, standing up at a podium, begins after the surgeon's nod. At his side are a stack of pages and films in the correct order so he can move swiftly through the list. An overhead projector displays images in the front of the room. At his side, a pathologist sits by a microscope, which is also connected to the screen. Nearby, at a facing table sit two surgeons and oncologists. A cart containing patient files in alphabetical order sits between the radiologist and surgeons. In tidy rows, other team members (and relevant medical trainees) sit facing the screens.*

The radiologist introduces the patient displaying a print out from SubSys and two subsequent x-rays. The pathologist continues the case by describing cellular findings, with microscope views displayed on the screen. At this point the meeting becomes less structured. Usually a surgeon from the head table will jump in and ask for more information or clarification, followed by an oncologist. Open discussion and debate ensues, with oncologists highlighting relevant clinical trials. Occasionally a nurse will add a point on the patient's home circumstances. The meeting is chaired by the lead surgeon, who quickly interjects if discussion digresses. When a clear plan has been formulated, he signals to the radiologist to move to the next patient. The administrator, with the help of a nurse, enters the plan into SubSys under the patient's MDM folder.

A key function of the MDM was to display specialists' assessments of the patient, gathered through patient encounters, and to decide, as a team, on the course of patient treatment. Specialists focused their assessments on specific aspects of cancer care, whereas the MDM exposed members to a broader perspective on patient illness. MDT members saw the MDM as very important, because it brought unity to the patient's management plan, enabled members to learn from each other, maintained visibility for the groups involved, and was a key aspect of government regulations promoting integrated healthcare. They enacted this shared multidisciplinary practice through interrelating to each other:

> It made you be more aware of what you yourself were doing, as you were putting your actions in practice on the line for others to examine . . . your practice becomes easy for others to see . . . . You can't just hide your mistakes as they will be picked up by someone.
>
> (Radiologist)

The MDM connected diverse elements of multidisciplinary practice more closely in time and space than the patient encounter, thus rendering the process of orienting to each other more visible. Each specialist group had diverse roles in the sessions and in using the EPR; the surgeons' assessments were photocopied (by clerical staff) from SubSys and displayed on a screen while a radiologist summarized the notes; the surgeon familiar with the assessment added more nuanced commentary. Nurses continued to hold a supporting role by guiding the real-time data entry process to ensure accuracy in terminology. As the scenario illustrates, numerous objects were used in the MDM practice—paper files, microscopes, projectors, and so on. Initially, SubSys use was enacted primarily as a backstage informational resource. The surgeons held overall control and maintained rigorous time keeping, and largely determined SubSys usage. The surgeon team leader maintained that displaying patient information from paper copies meant the meeting would not be interrupted by technical failure or cumbersome menu navigation. As a result, administrative staff supported the meeting with background work compiling patient files, photocopies from SubSys and subsequent data entry, with nurses providing a supportive role for limited direct data entry into the EPR during the MDM. During the meeting, the doctors engaged in unhampered discussion.

The MDM practice remained fairly consistent over the following months, although SubSys's value as an information repository grew as patients returned to clinics for more encounters and system entries of previous meeting decisions became available. Given

radiologists' success integrating SubSys into their practices, the lead radiologist wanted to integrate SubSys into MDMs rather than bringing in paper records or hard copies of films, as it gave added flexibility to the range of patient information that could be viewed:

> I would like to use [SubSys] more effectively at the MDM. We should be able to have the surgical drawings be put directly onto the system and then be able to display these during the MDM to be more efficient and sophisticated. (Radiologist)

The surgeons were firmly in control of the meetings, however, and they believed the team could get through the material quicker using paper, as there was no time lag between screens. This use of SubSys in the MDM practice was consistent with their approach in patient encounters: *limited use* of SubSys to enable quick documentation, relying on secretarial support and paper for obtaining patient histories.

The situation changed rapidly on June 16 (nine months after initial adoption). The team leader sent a team-wide email stating "*the MDM's will cease to occur in their present format.*" The senior administrator had met with the surgeon and explained that due to three office staff vacancies her "girls" did not have time to collect all the x-rays and paper notes for the MDM, a task which took over a day. As it would take months to hire new staff, the lead surgeon outlined a radical new procedure for a scaled-down version of the meeting, where only a few patients would be discussed and attendance was no longer critical. The subsequent MDM (June 17) was a dramatic change from the usual. Instead of discussing some 25 cases, only three were reviewed and half of the normal attendees were present. Radiology and pathology slides were not shown via projector. The surgeon leader sat at the front table, alone, now facing the rowed audience, with paper folders scattered open on the table. He had been at the office since 6 A.M. reviewing charts. He outlined a patient case as he understood it and asked pointed questions to senior colleagues. The meeting was over in 20 minutes.

During clinics and informal discussion throughout that week, numerous clinicians commented on how the MDM was "*in a mess*." A surgeon commented that it was "*a crisis and the MDM was falling apart*" and a radiologist volunteered, "*the MDM is falling apart because the girls do not have time to put it together*" and continued to lament about the confusion that the lack of MDM discussion was causing in the clinic that day with regards to the patients attending.

The crisis triggered an active period of reflection and negotiation about MDM practice and the use of SubSys within it. At the regular executive team steering meeting (June 18) the lead surgeon invited all interested members to an open discussion on "what to do with the MDM." The lead radiologist suggested that SubSys could be used to facilitate the meeting discussion and elaborated on how this could be achieved translating the available patient data in SubSys to the team needs in the MDM. Other proposals were also given, such as running the clinics without the MDM and discussing patients informally according to perceived need, or holding smaller MDMs within the joint clinic room where they could search for most of the files as they went along. An oncologist asked if someone else could collect the paper records. No clear conclusion was drawn, but discussion continued informally.

The next week, the leader, through an email circular, again restructured the MDM into two submeetings consisting of postoperative patients who would be discussed from paper notes and pre-op patients who would be discussed using SubSys to pull together the relevant information. Having few alternatives, the surgeons agreed to let the radiologists partially run the meetings through SubSys. During this switch over, routine patients who followed set protocols were dropped from the MDM discussion; yet a wider subset of patients received discussion than at the preceding week's MDM. The lead radiologist encouraged the system administrator to attend. She sat adjacent to him as he stood at the front.

For the subsequent biweekly executive steering meeting in early July, using the radiologists' advice, the lead surgeon suggested another restructuring of the MDM. SubSys could be used during the other portion of the meeting, so that post-op patients would also be discussed using SubSys to support informational requirements. He elaborated his plan on an email circular stating there would now be no need for paper notes at the meeting as SubSys could fully support their informational needs, except for the nurses who continued to bring their yellow cards. The previous MDM had run smoothly with minimal time lags. However, the radiologist explained (in an informal interview) that he had "spent several hours prepping for the meeting to make sure everything worked."

As the surgeons were not as familiar with the technology, control was given to the radiologists to restructure and run the MDM, setting up beforehand to make sure the screens needed would be saved in the "MDM folder" of SubSys. Whilst this background work took time initially, the radiologist felt it was necessary to ensure the system use was seen in a positive light by the surgeons.

> The system is too slow to start at the main tree file sorter for each patient and then pull up the required picture, move out of the section, back to the tree and then into another file. But if [we] chose in advance which screens we would want to show, such as the

> patient assessment and surgical notes drawn in, and perhaps an ultrasound view, then we program the system to display the images in this order . . . the meeting has to move through quickly, and that is seen as priority.

Thus over a period of one month, the MDM was restructured and successfully run without paper files. The radiologist's *extensive use* of SubSys as an integrated, hands-on informational tool became seen as a better way to access patient information and the best alternative to keep the MDM functioning. The decision to do so was surrounded by tension but was cooperative and negotiated. The system administrator continued to attend at least portions of the meetings for the rest of the month, giving input occasionally and developed a closer working relationship with the team. Interestingly, radiologists took on a more central role, evident not only in their orchestration of the meeting folders (replacing the administrative staff) but more prominently in the pacing, sequencing, and contents of the MDM sessions. However, the surgeons were still in control of the overall decisions made about the conduct of the meeting.

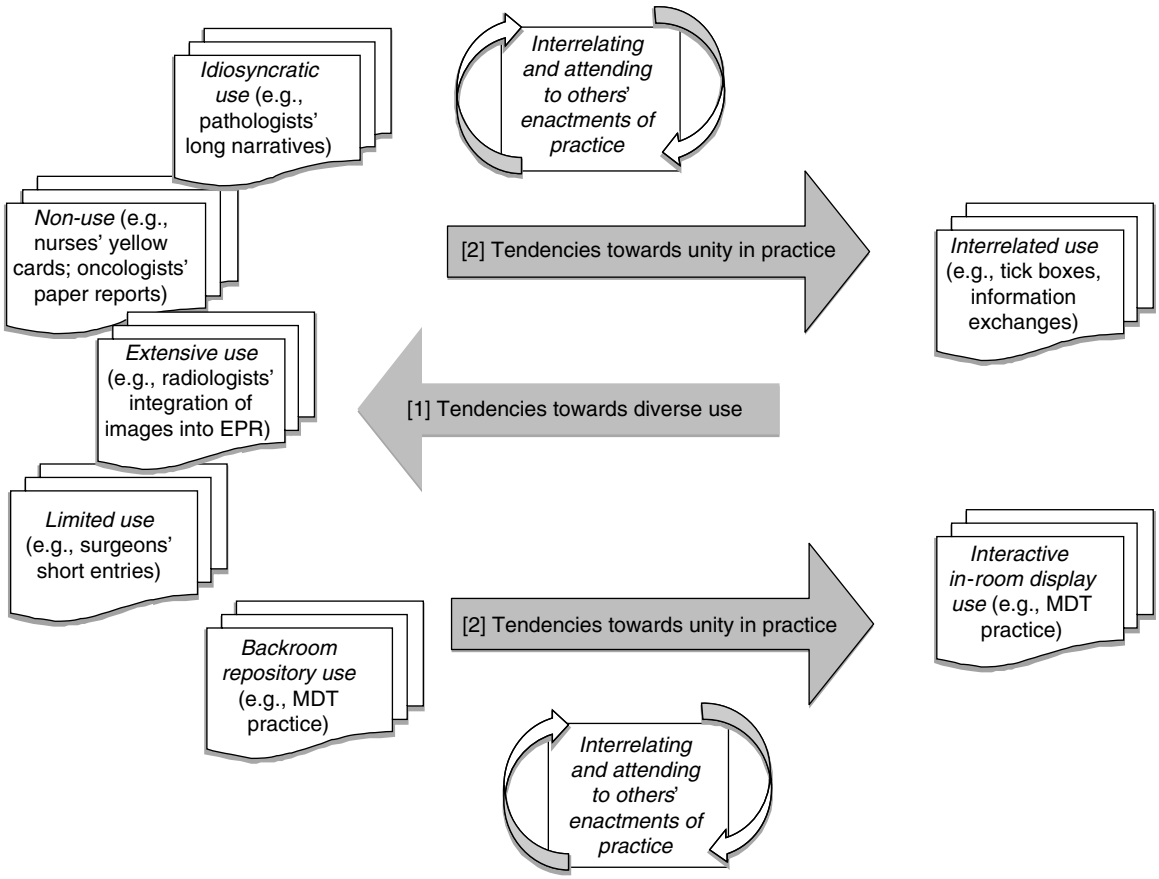
In theoretic terms, our analysis illustrates how a reconfigured use of the EPR emerged from the reconfiguration of MDM practice elements: *SubSys-as-backroom-repository* was replaced with *SubSys-as-information-display*. Change was evident in processual adjustments related to handling patient data, in altered enactments of social structure (the more central role of the radiologists), and in affordances of the EPR (populating the "MDM folder" with compiled patient data and images). The latter technological change was enabled by SubSys use in the patient encounters, through which necessary patient data accumulated in the system. The revised MDM enactment presented a more unified approach to incorporating SubSys into the team's multidisciplinary practices and reflected the shared values and goals of team members for the MDT generally and the MDM practice in particular. Of particular note, the revised enactment of EPR use in the MDM proved to be essential to preserving a level of unity in decision-making about patient care by MDT members, as the "crisis" episode illustrated. Nonetheless, alignment of EPR use in the MDM with specialist practices was also evident; in the radiologists' more comprehensive use of the EPR and the surgeons' insistence on rapid display and turnover of cases.

2.1.8. The Dynamic Interplay of Unity and Diversity. This case highlights the tensions and accommodations inherent in multidisciplinary work where individuals are enmeshed in aligning to both specialist and multidisciplinary practices. We suggest that there are two tendencies that reveal the tensions and accommodations across these practices (see Figure 1). Rather than being sequential, these tendencies can overlap, coexist, and are interdependent in multidisciplinary work; together they help account for how the EPR was adopted and used across the team's practice at Royal.

1. *Tendencies Towards Diversity in Use.* Using Reckwitz's (2002) view of embodied practice, we were able to unpack different elements of practice and so provide granular insight as to *why* individuals enact technology in different ways. Thus we appreciate specialists' historically situated knowledge, bodily movements, emotion, and so on, as we consider the fit and relationality of the EPR, as an object in practice, with other practice elements. Because specialists' practices differ significantly from one another along these elements, we would expect that fitting EPR use with other elements of practice could generate a diverse array of uses among different specialists, yet each group might enact the EPR in a relatively stable way. These multiple uses of the EPR co-existed and supported the multiplicity of practices. For instance, surgeons' *limited use* of the EPR in the patient encounter as a useful patient-data repository could facilitate efficient decision making regarding patient treatments, whilst nurses considered the EPR to be overly structured and impersonal and thus not useful in sharing stories of women struggling with cancer, leading to *nonuse* in their patient encounters. This nuanced attention to the socio-materiality of EPR use—to "the material forms and spaces through which humans act and interact" (Orlikowski 2007, p. 1438)—additionally considers the embodied and affective aspects of practice, aspects which have generally been lacking in current literature (Jones and Karsten 2008).

2. *Tendencies Towards Unity in Practice.* Specialists were attentive and knowledgeable of each group's practices and EPR usage across the team. Drawing from Barnes (2001), we noted that interrelating among specialists allowed the MDT members to maintain coordination and alignment with each other to jointly produce shared multidisciplinary practices. Interrelating occurred in part through their EPR use and contributed to unity across the team's practices. Shared multidisciplinary practices were evident in the one-stop clinics' patient encounters, as each group considered their own and other specialists' roles and contributions to integrated patient care. In this setting, each group enacted EPR use within their specialist practices but in ways that enabled information sharing, coordination, and communication between specialists as they sought to be oriented to each other. In the MDM, interrelating to achieve shared multidisciplinary practice was evident in team members' discussions and joint decision-making regarding patient care. The EPR served as an informational object in

Figure 1 The Dynamic Interplay of Unity in Practice and Diversity of Use at Royal



the MDM, first as a background repository for data collection, and later, as an in-the-room display system. The utility and importance of the EPR to enable unity in the way the MDT delivered breast cancer care to patients was thus evident in both settings, by allowing clinicians to monitor and orient to each others' practices so they could adjust their own practice accordingly.

The oppositional tendencies towards unity across multidisciplinary team practice and diversity in use are manifest in day-to-day enactments of practices; over time, use patterns may evolve and stabilize. Of course, any single pattern may be potentially unstable, as alternative possibilities coexist (Mol 2002). Episodic change through explicit negotiations, in which practice elements are reconfigured and new usages emerge, is also possible. This ongoing process of reconfiguring is highly reflexive (Hanseth et al. 2006), enabling mutual interactions between the healthcare professional and the EPR "enabling each other to affect each other" (Berg 1997, p. 97) in a sociomaterial manner (Orlikowski 2007). Episodic negotiation and change was most vividly demonstrated in the MDM crisis. The process was a reflexive one as team members' ability to renegotiate technology use was dependent on their relationality with one another in both specialist and multidisciplinary practices. The result of this episode of reconfiguration was a revised enactment of the EPR system in the MDM practice. Interestingly, this reconfiguration occurred months after the deployment of the EPR in the MDT's practices, when we might anticipate that use patterns had become institutionalized and thus resistant to change (Orlikowski 2000). Here, the interplay of diversity and unity, which is foregrounded in this practice theory lens, suggests how inertia might be overcome.

It is difficult to speculate what patterns of EPR use, or more broadly, health IT use, are likely to emerge from the dynamic interplay of unity and diversity in multidisciplinary settings. Numerous contextual factors influence the evolutionary paths and emergent uses that develop in an organizational setting. With this cautionary note, we suggest some possibilities. The importance of both social and technical change to achieving benefits of HIT is well recognized (cf. Davidson and Chismar 2007). In settings in which multidisciplinary practices are well established with specialist practices, opportunities for integrated EPR use to foster unity in multidisciplinary practice are more likely. At Royal, the multidisciplinary team, one-stop clinic, and MDM were established prior to the

introduction of SubSys and were highly valued by team members. Thus, when the crisis occurred and the MDM practice was jeopardized, specialists were willing to change their enactments of SubSys in the meetings in order to preserve it. The institutionalization of MDM practice which preceded EPR use was thus an important contextual factor that facilitated coordinated, interrelated EPR use within patient encounters, and foundational in reconfiguring MDM practice, as critical elements of relationality between the diverse elements of practice had been established (Østerlund and Carlile 2005). In settings in which the influence of disciplinary practices outweighs the value placed on a group's or organization's multidisciplinary practices, we would expect diverse use patterns to prevail, with limited overlap or coordination in EPR use and thus less contribution to unity across multidisciplinary practices.

Although the EPR was enacted in the many specialist practices in diverse ways, it nonetheless sufficed to connect the multiplicity of practices (Mol 2002). That is, diverse uses, arising from each specialist's practice, coexisted with sufficient overlap so that the utility of the EPR and coherence across the team was achieved. Making connections between the diverse practices required translations, and translations are never smooth as they draw together *and* establish difference at the same time (Mol 2002). Translation was demonstrated by pathologists' use of the EPR, which involved the filling out of standardized cancer staging tick boxes as well as detailing long narratives on cell histology. The pathologists' narratives were translated into a tick box for the surgeons, where they served to inform surgical decision making. The narrative and ticked boxes did not mean the same thing, but one (in this case the narrative) could be translated into the other. Our analysis suggests that such translations are central to, and enable, multidisciplinary practices that display unity in diversity, so as to establish sufficient partial connections between specialist practices. These connections arose through specialists' interrelating in shared practice, which allowed the different specialists to inform and shape each other's diverse EPR uses.

We also note that some diversity in patterns of HIT use may be beneficial. As many studies have documented, implementing HIT has been problematic, with clinicians (notably doctors) resisting mandated use of technologies such as EPRs (cf. Lapointe and Rivard 2005, Kohli and Kettering 2004). Allowing each specialist group at Royal to fit SubSys use with other elements of their practices, even if they do so in diverse ways, may have encouraged system use and mitigated resistance. Moreover, individuals' enactments of technologies are situated and contextual (Orlikowski 2000). The nurses' practices of using the yellow card for their patient encounters, as well as their use of SubSys to support surgeons' patient encounters and in the MDM meetings, illustrated how individuals in multidisciplinary practices can artfully enact multiple types of use related to the same information systems. Even nonuse of the EPR for some aspects of their practices (by nurses and oncologists) did not prevent the team using the system to achieve a level of unity in multidisciplinary practices; given surgeons' impatience with the data that others valued (pathologists' long narratives, oncologists' patient demographic data), withholding some data from the EPR may even have promoted unity.[4] Diversity in use might also facilitate innovation in practices by enabling renegotiation of the various elements, as specialists bring different approaches to the attention of others (as we saw in the MDM reconfiguration).

3. Discussion

In this study we investigated how unity across a multidisciplinary team's practices was enabled through EPR use, despite diverse usage patterns. We drew on Reckwitz (2002) to explain how EPR use was adjusted to various elements of specialist practice, tending to diverse uses. Paying close attention to the detailed elements of clinical practice is an important yet overlooked level of granularity in health IT research, which often lumps "doctors" as a single category. We drew on Barnes (2001) to explicate the ways in which co-orientation and interrelating of individuals engaged in both specialist and multidisciplinary practices helped counter trends to diverse uses. This analysis highlighted how technology use can become enacted as a collective accomplishment within shared practice. These theoretic insights allowed us to build on Orlikowski (2000) to develop a practice theory lens of HIT use in multidisciplinary settings that foregrounds the dynamic interplay of unity of practice and diversity in use. This theoretic approach can inform our understanding of the role of HIT in professional practice across different health disciplines (Heath and Luff 2000).

Our study has several implications. The practice lens that we adopt here suggests an alternative emphasis on how individuals' systems use might be treated theoretically. Reckwitz's (2002) formulation of practice theory posits that know-how, goals, motives, emotions, and even typified bodily movements, belong to the *practice as the unit of social analysis*. In our analysis we considered how information technologies, as material and informational objects within practice, were adapted to and fit with other

[4] We thank an anonymous reviewer for insights on the implications of these use patterns.

elements of specialist and multidisciplinary practice. In doing so, we took care not to reify practices as "standard operating procedures" but to ground observation in the day-to-day enactments of practice(s), and to treat technology use as situated and provisional. Our study further suggests that characterizing individual- or group-level use of technology as either "use/adoption" or "nonuse" oversimplifies usage patterns. An individual engaged in multiple practices may enact a variety of entangled uses with the same information system across different practices. For example, nurses exhibited *nonuse* regarding the technology in their patient encounters but exhibited *limited use* to support surgeons in their encounters (to look up information for them) and to assist with data entry during the multidisciplinary meetings.

Given the growing importance of multidisciplinary teamwork and the number of specialties involved in delivering healthcare, our study highlights the importance of taking seriously the diverse nature of clinical practices. Apart from the nurses who frequently accompanied doctors in patient encounters, each specialist interacted with patients independently from others, though they used the system to orient themselves to the assessment of others. This co-orientation to others through the EPR enabled individuals to draw on a wider knowledge base and to coordinate their patient encounters, such as when surgeons indicated to radiologists which assessments they anticipated were needed, and when radiologist flagged biopsies being sent to pathology. Translation of knowledge (Mol 2002) across specialists was also evident, for example, in pathologists' use of "tick boxes" for other team members. In situations where individuals are similarly engaged in shared practices, focusing analytic attention on how individuals collectively enact technology use through interrelating and co-orientation with others, and the translations of knowledge between practice that occur through HIT use, may be useful, rather than analyzing use patterns by focusing on individuals' stated preference or attitude towards a technology.

Another key implication of our study is that divergent goals within multidisciplinary practice need not be in conflict with regard to effective HIT use, as diversity does not *preclude* cohesion and integration. Moreover, in multidisciplinary work, a degree of diversity in use appears to be reasonable and even necessary. There are tensions inherent in the diverse ways of enacting technology and accommodations arising from the multiple "worlds" of specialists; the ordering effects of one "world" may create disorder in others (Hanseth et al. 2006, Mol 2002). We can usefully conceptualize multidisciplinary practices as partially connected: one specialty does not subsume the other; instead, the diverse practices inform each other and shape each other (Mol 2002). A shared information system such as an EPR can be used to coordinate this multiplicity of practices into a unity. That is, HIT that supports diverse goals of specialist practices may nonetheless provide team-level integration of knowledge, which is a key challenge for multidisciplinary teams (Bunderson and Sutcliff 2002), as we saw with the team at Royal.

Our study also provides relevant insights for HIT designers, practitioners, managers, and policy-makers who direct HIT investments. Given the complexity, nuances, and diversity of medical practices (Mol 2002, Mørk et al. 2008), it is not surprising that the introduction of practice-spanning information systems, such as an EPR, often result in mismatches between the system as designed and its fit within practices and the need for ongoing adjustments, episodic as well as in day-to-day use, to accommodate the system (Azad and King 2008, Boulus and Bjørn 2008, Davidson and Chismar 2007). One response has been to promote standardized, integrated design of systems and uniform use of health information systems (Stead et al. 2005). Yet many studies (cf. Kohli and Kettering 2004) highlight the issues with trying to force system use and standardization onto health care professionals. Striving for high levels of integration in design and use may be problematic (Bjørn et al. 2009); such a system is likely to satisfy few if any specialists and may prompt resistance behaviors (LaPointe and Rivard 2005).

Some health IT scholars have questioned the feasibility of striving for high degrees of standardization, integration, and uniformity (Berg 1997, 2001; Ellingsen and Monteiro 2008; Hanseth et al. 2006; Timmermans and Berg 2003). Our study supports and extends earlier work (Ellingsen and Montiero 2003, p. 91), which proposes that EPR systems do not need to integrate seamlessly in order to be effective in clinical care and that redundancy and ambiguity in how and where information is recorded and utilized may even promote robust interactions across clinical practices. Nonetheless, a degree of design standardization undoubtedly facilitates multidisciplinary practice, as seen by how surgeons' prefer to read pathologists tick box summaries (similar to their own) rather than free text narrative. Standardized EPR design elements (Hanseth et al. 2006, Timmermans and Berg 2003), represented by "core" data such as the tick boxes of the cancer staging, may act as boundary factors (Bjørn et al. 2009). Limited use of boundary factors within a technology design that is flexible enough to accommodate diverse uses in a range of practices may be sufficient to facilitate communication across different specialist groups (Østerlund 2008) within a multidisciplinary practice.

4. Conclusion

Our paper makes three primary contributions. First, we theorize two opposing dynamics inherent in multidisciplinary work, namely a tendency towards diversity in use according to a holistic relation between information technology objects and the unique elements of shared specialist practice, and a tendency to unity in practice as team members orient towards each other to align and coordinate across shared multidisciplinary practice. This process view highlights tensions between these oppositional tendencies that may better explain why and how health IT comes to be used in particular ways and with particular outcomes in multidisciplinary settings, beyond examining doctors as a group or even each specialist as an independent subtype. Second, we build on Orlikowski's (2000) practice lens by going beyond a focus on individual-level enactments of technology structures to highlight the embodied, collective, and interdependent influences among and between individuals (Reckwitz 2002) engaged in shared practices (Barnes 2001) as they incorporate health IT into those practices, which is characterized by the concept of *unity in diversity*. Third, we contribute to the growing literature that calls into question the current emphasis on standardization as an optimal goal in HIT usage.

Our study findings reflect the experiences of the multidisciplinary team at Royal and their specific context; thus the empirical findings per se cannot be generalized to other settings (Lee and Baskerville 2003). However, we suggest that our practice theory understanding of IT use in the complex institutional environment of healthcare may be helpful in explaining outcomes elsewhere, particularly in other professionalized settings where the focus is on how multidisciplinarity might be supported by shared information systems and technologies. We believe our focus on *unity in diversity* will be important in guiding future research related to technology use in multidisciplinary contexts. Given the current focus in many nations to increase technology use in healthcare contexts and the concomitant drive towards increasing specialization and multidisciplinarity, we suggest our practice perspective provides a novel and timely approach.

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