Mapping medical work:
Documenting practices across multiple medical settings

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Abstract

The paper explores how doctors and nurses use documents to share their knowledge within and across healthcare settings. In addressing this question I draw on a 15-month, multi-sited ethnographic study in several pediatric health care settings, following patients from primary care clinics, to emergency rooms, and in-patient units. The analysis focuses on the practices that go into documenting patients' histories and care, which include recordings on various on-line systems, preprinted forms, and whiteboards.

By combining the previously distinct lenses of 1) knowing in practice, 2) time-space analysis of social interaction, and 3) communicative genre and genre systems, I suggest that doctors and nurses employ various types of document genres to manage, not only their distributed knowing about patients' care, but also their own movements across time-space. I outline a perspective on documents and knowing which attempts to highlight the role of human practice in how people use documents to coordinate their activities, share their capabilities, and get things done in complex distributed organizational work.

The data suggest that doctors and nurses use medical documents as maps and itineraries to organize their distributed work practices. Doctors and nurses record patients' histories many times in different documents, with each document serving as a map and itinerary for a different constituency of people. Each of these documents is rarely used in isolation from other documents. Doctors and nurses constantly recombine the documents they use, which allows them to both appropriate documents from other settings into their local organization of work and build unique local combinations of documents. I introduce the concept of "re-localizing" to describe how doctors and nurses use documents to share their knowing within and across healthcare settings. Re-localization involves many healthcare professionals' parallel rewriting of a patient's history based on a recombination of each other's maps and itineraries and the patient's own accounts. By integrating the concrete case and the maps and itineraries based on those cases the notion of re-localization overcomes the dichotomy between the abstract and the situated, the local and global. Documents are not seen as mere vessels for abstract representations, but integral parts of distributed knowing within and across settings.

Keywords

Information System Use, Distributed Work, Organizational Knowledge, Time-Space Analysis, Communicative Genres, Medical Informatics

Introduction

This paper addresses a technology dream that is prevalent within the healthcare industry, most clearly articulated in the area of medical informatics: a universal patient-centered record which places a patient's entire history at doctors' and nurses' fingertips. Medical informatics researchers often use the hypothetical story of "Mr. Jones" to justify this dream. Mr. Jones is on holiday in Florida; when his wife goes to the beach, he decides to play golf. At hole three he collapses and is taken to a local emergency room. In the ER the doctors cannot access his medical record for information about his heart condition nor is there a relative they can reach to gather personal information. Without knowing what medications he takes and his history they cannot help him to the same degree as his own doctor.

For the last two decades the field of health care informatics has worked on developing "universal" patient-centered records linking distributed healthcare providers across organizational and departmental divisions. To date these efforts have proven remarkably unsuccessful. Researchers on the American Medical Informatics Association mailing list regularly have discussions on the topic of failure rates in healthcare information systems (IS). Though impossible to verify, some quote 80% failure rates for the implementation of medical information systems. Most often individual settings, departments, and sub-disciplines implement their own information systems. For instance, emergency departments will often have one electronic record system, the Intensive Care Unit (ICU) another, outpatient care a third, and nurses (in some hospitals) yet another nurse-use only online record system; rarely do these systems communicate.

The problem of developing large scale medical record systems facilitating the knowledge sharing among doctors, nurses and other care givers speaks to a larger theoretical question of how people use documents and information systems to coordinate their activities and share knowledge within and across organizational settings. The question becomes how organizations best support viable information systems that sustain their members' capabilities to operate effectively both within and across temporally and geographically distributed settings.

The issue has received increased attention in the management and organization studies literature with the proliferation of distributed organizations and virtual teams. A special issue of *Organization Science* on knowledge illustrates this debate (Grandori et al 2002) and its general push to differentiate different types of knowledge to account for the sharing of knowledge in various organizational settings. As Orlikowski (2002) points out, situated knowledge is often depicted in opposition to what is considered explicit and abstract knowledge. For instance, Polanyi's (1983) distinction between tacit and explicit knowing is often used to typify other dichotomies, such as local versus universal, know-how versus know-what, formal versus situated, canonical versus noncanonical (Orlikowski 2002: 253). One pole treats knowledge as abstract representations, a perspective that has informed studies of managerial cognition (Walsh 1995, Walsh & Ungson 1991). In the medical field this would represent the abstracted, explicitly represented and codified knowledge taught in medical schools. The other pole approaches knowledge as local, i.e. context-dependent, emerging from interactions and practices in particular contexts. This would be the knowledge involved in the practice of medicine within specific healthcare settings given changing collaborators and unfolding care for particular patients.

Such a polarizing approach to knowledge is reflected in views on documents and information systems. The "explicit" view sees documents as containers for abstract, formal, homogeneous knowledge that can be easily transported across settings. The "local" view, in turn, would see these containers as not capable of capturing and disseminating local, messy, heterogeneous, and concrete knowledge. Taking a step back, one could argue that this framework addresses the question raised above, whether people can share situated knowledge beyond the context in which it is embedded. And, within the constraints of this dichotomy the answer is no. People share abstract codified knowledge - not situated and contextually embedded knowledge. This distinction becomes problematic, however, as it divides knowledge into two separate types. One, formal and abstracted, allows for the detachment of knowledge from its local context without losing it essence. The other type of knowledge simply pertains to the local and richly textured empirical world. Knowledge is depicted as either abstract, static, and separate entities or stable dispositions embedded in practice.

In other words, documents and the knowledge represented in them are pictured as hovering above the realm of the empirical and contextual. Two opposing discourses about the organizational role of documents and information systems easily follow (Berg 1997). On one hand, the power of information systems and formal tools resides within their ability to capture and detach knowledge from its context without losing its essence. The document provides a mode of transporting abstract knowledge across settings. An opposing discourse argues that formal and abstract knowledge captured in documents represents an impoverished version of the richness of the empirical world and situated knowledge. Abstract models cannot but delete the details of the heterogeneous work that they represent. This creates inflexible systems that will inevitably result in improper functioning when the information system is implemented (Ibid.:405). The first represents the dream of the universal patient-centered record; the second, is reflected in doctors' and nurses' distrust in the viability and timely implementation of large-scale medical information systems.

Because these positions seem too entrenched and the foundations too essentialist, I attempt in this paper to articulate an approach to documents that overcomes the dichotomy between local and universal knowledge. Following the lead of Lave (1988), Orlikowski (2002), and Giddens (1984), I tie knowledge to practice. With the emphasis on "knowledge-in-practice," our knowing emerges out of our actions as we enact our capabilities. In practice the abstract and concrete merge; in practice we interlock abstract maps or models with our ongoing situated work. Thus new competences emerge, higher levels of complexity can be reached, and activities can be coordinated across time and place. In other words, the universal and the local become mutually constitutive in the process of knowing.

The question remains: what role does document use play in active knowing? Equally important, if documents do not serve as mere containers for abstracted entities, how do people use them to coordinate their activities, share their capabilities, and enact their knowing across settings? In short: How do people use documents to share their knowing within and across settings? If we relate this question to the problems faced by the universal patient-centered record we must ask: how do doctors and nurses share their knowledge in the form of documents about patients across distributed healthcare settings? An answer to this question should inform, not only our understanding of how situated knowledge is shared across settings, but also information system design within the medical field and beyond.

Research Setting and Method

In order to address this question I studied the practices that go into documenting a patient's care across several healthcare

settings. In the course of a 15-month, multi-sited ethnographic study I followed pediatric nurses, doctors, and secretaries in their daily work. I spent approximately 2000 hours in five primary care clinics, one emergency room, and two hospital wards, focusing specifically on the documenting and care of asthmatic children. These "documenting practices" include the recordings made on various note cards, preprinted forms, on-line record systems, and whiteboards. In short, my *unit of analysis* is the work practices of doctors and nurses in documenting patients' care. The actors are doctors and nurses who care for patients moving through the locales they inhabit.

My answer to the question, how do doctors and nurses share their knowledge about patients across distributed healthcare settings, falls in three parts: First, I argue that medical records should be approached primarily as work practice-centered and only secondly as patient-centered. The use of the records does not primarily focus on the patient but the work practices of doctors, nurses and secretaries.

Secondly, I believe that doctors and nurses use medical documents as itineraries. I have chosen the term "itinerary" very carefully as it implies people's coordination across time and place. Hereby, I want to emphasize the temporal and spatial structures guiding the doctors' and nurses' work. If one has ever spent any time in a hospital it is clear that doctors and nurses constantly move around; what is less clear is that their movements are patterned by their use of documents.

Third, I introduce the notion of a re-localization to describe the process of sharing across distributed healthcare settings. I argue that the patients moving across settings are continuously made part of the local work practices of doctors and nurses.

Let me turn to Sophie's case, an actual example from my data, not a hypothetical scenario such as Mr. Jones' heart attack.

Empirical Findings

Sophie is a 10-year-old girl with a bad asthma attack. When I meet Sophie for the first time, she is lying in a hospital ward bed with an oxygen tube in her nose. It's 10:30 on a Thursday morning. Two doctors and a medical student are simultaneously leaning over her, three stethoscopes pressed to her chest listening, eyes turned to the ceiling. The medical student and the two doctors, an intern and a senior resident, take notes as they interview Sophie and her mother about her asthma attack and previous history. Among other things, they learn that Sophie has been hospitalized once before, two years ago. As a toddler, Sophie frequently suffered from bronchiolitis, which was later diagnosed as asthma. However, this is not the first time Sophie has her history taken. Actually, she has had her history taken repeatedly.

Sophie's current asthma attack started the previous afternoon. In response, Sophie's mother had called their primary care clinic and talked with the nurse, who took her history and asked

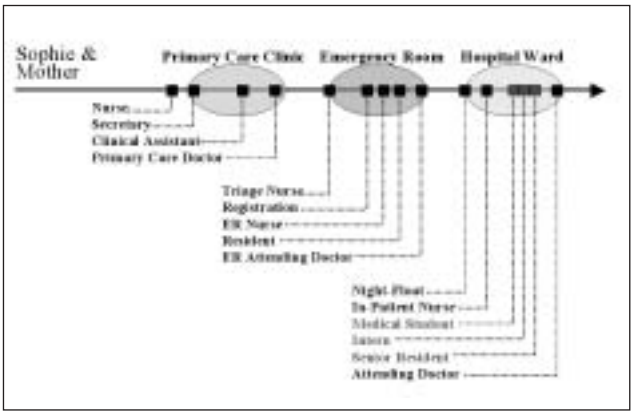

Figure 1. Repeated History Taking

them to come and see the doctor. In the clinic the secretary and a clinical assistant briefly interviewed and recorded Sophie's history, then sent her to see the doctor. By this time, it was late in the afternoon and the doctor's clinic was about to close. The doctor gave her a nebulizer treatment and suggested that Sophie and her mother go to the emergency room. The treatment helped a little bit, but on their way to the ER, Sophie sitting in the back seat, was still wheezing heavily. They arrived in the ER. At the front desk the triage nurse interviewed the mother and Sophie and documented this information in a flow sheet, then sent the mother to the registration desk. After several hours in the ER the doctors decided that they wanted to admit Sophie to the hospital. She required nebulizer treatments more than every 2 hours.

By the time the three doctors (including the medical student) enter Sophie's room, Sophie and her mother have described Sophie's medical history 11 times, and each time, the doctor, nurse, clinical assistant, or secretary documented this history at least once. If Sophie had suffered from a more complicated or less familiar disease her history would have been taken even more times.

Based on Sophie's case, it is not difficult to motivate the dream of the universal patient record. Healthcare is an immensely complicated social system. Hundreds of nurses, secretaries, and physicians are constantly on the move. They collaborate with colleagues within one clinic, across departments, and across institutions. They coordinate their activities across the places that the patients, like Sophie, travel. They coordinate their activities across time to make sure that there always will be somebody to care for Sophie and patients like her. Having all the information they need, at their fingertips, would presumably save them and the patient from reporting and documenting their histories again and again. Nevertheless, a closer look at work activities of doctors, nurses and secretaries, and in particular, the practices that go into documenting the patient's histories, ultimately questions whether the universal patient record should be the ultimate goal. Let me return to the three doctors interviewing Sophie.

Documents serve as itineraries

After they have examined Sophie and interviewed her mother the three doctors all go to the doctors' conference room in this medical unit. The medical student grabs a clean Progress Note sheet at the nursing station. Behind two glass walls, known as the aquarium, the intern and the senior each find a computer terminal. The intern logs on to an on-line system, "House Officer Sign-Out" (HOSO). The senior resident logs into the senior resident note system. They each start documenting Sophie's case. The intern will never read the senior resident's notes and vice-versa. To understand the rationale behind these repeated documenting practices let me elaborate a little bit more one how the intern uses her document. Let us call her Donna.

Donna writes her notes in an on-line document shared with only four other interns. She records the vital signs, O2 level, and makes a list of tests and other procedures needed. The rest of the day Donna attends to patients and documents in the HOSO what tasks she has completed and what tasks lay ahead. She uses the HOSO as an itinerary for her activities -- where does she need to be and at what times? The same can be said for her fellow interns. The on-line document serves as the backbone for the coordination among these five interns.

In the late afternoon, just before going home Donna signs-out her patients to one of her fellow interns staying in the hospital overnight. The interns use the HOSO to structure their conversation. Overnight the on-call intern also uses the HOSO as an itinerary for his activities. And if anything happens to Sophie, he will add the event to the HOSO.

This collective on-line document summarizes all the team's patients and in what departments they can be found. It helps this small group of interns to structure where they need to go within the hospital. It also structures their use of time. The HOSO gives the times and places where tests should be taken, procedures preformed and patients seen. As an itinerary it is more than a mere list. I use the notion of itinerary as opposed to a map (de Certeau 1984). The latter describes different elements spatial position in relation to each other. The map implies stable positions of elements. In contrast, the itinerary takes into consideration vectors of direction, velocities, and time variables. An itinerary helps its users move in a field of interrelated mobile elements.

Figure 2a, 2b, and 2c depict how the HOSO serves as an itinerary. First, the HOSO helps the interns demarcate a flexible space for their collaboration. As illustrated in Figure 2a one can think of the HOSO as a flexible map. Patients like Sophie are distributed all over the hospital. The itinerary must change as new patients arrive in one department and other patients are discharged. So when Sophie gets admitted, Simon who suffers from Sickle cell disease is discharged after 10 days in the hospital receiving intravenous painkiller. Clara who suffers from a heart condition deteriorates and is transferred to the ICU.

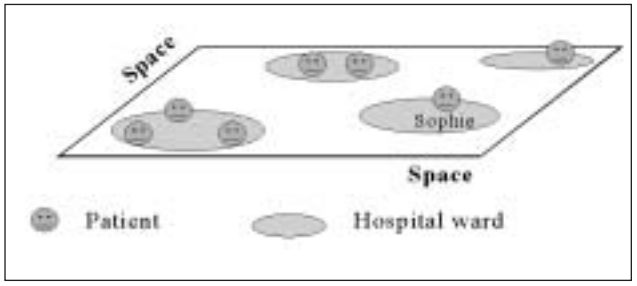

Figure 2-a. -HOSO as Itinerary : flexible space map

Secondly, as portrayed in Figure 2b the HOSO is also a temporally structured map in constant flux, depending on how much work each patient requires. When Donna records Sophie's case in terms of the tasks completed and pending she creates an itinerary of temporally structured activities, which can be seen in relation to the tasks associated with other patients. For instance, she writes that today we need to order a chest x-rays for Sophie, organize a meeting with the pulmonary consultant, and call her primary care doctor. Tomorrow we have to make sure that we evaluate her status to see if we can decrease her steroids dose.

Third, the itinerary helps Donna and her fellow interns navigate in their shared space and coordinate their activities. A glance at the HOSO allows Donna to plan her moves for the day and quickly redistribute her activities in relation to another intern when signing-out or in case their workload changes. When Clara requires the attention of two interns, Donna can quickly reorganize her movements and care for the other interns' patients as they focus all their attention on Clara's quick move to the ICU.

The same argument can be made for the documenting practices of nurses, senior residents, and secretaries. The senior resident examining Sophie, documents her history in the senior residents' on-line system. He shares these notes with other seniors, only. The senior residents work with interns during the day and share their work practices to the degree that they listen to the same kids' chests at the same time. Nevertheless, the interns and senior residents do not move in the same places nor follow the same rhythm. In the evenings senior residents will cover for other senior residents across the

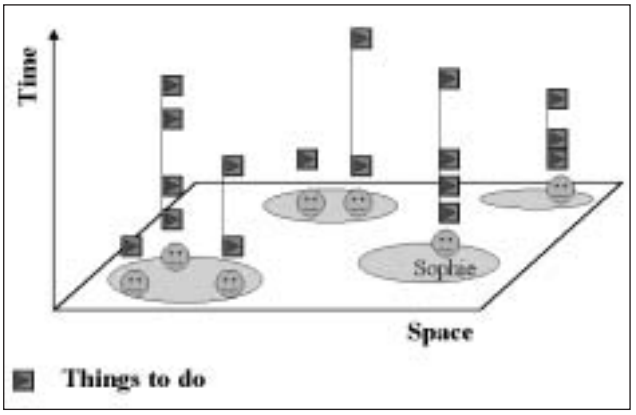

Figure 2-b. -HOSO as Itinerary : flexible time and space map

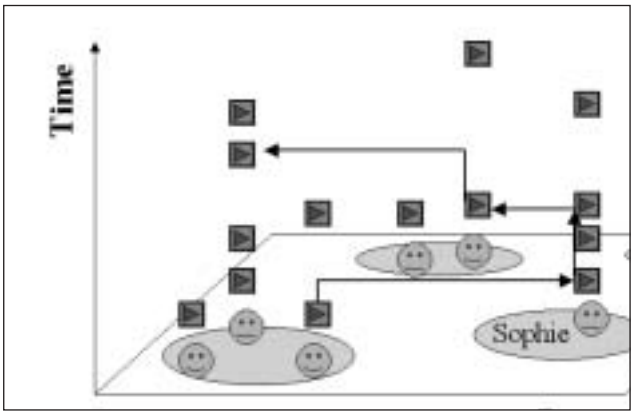

Figure 2-c. -HOSO as Itinerary : Donna's moves

hospital. The group of patients they care for does not completely overlap with that of the interns, nor do the temporal rhythms of their daily and monthly rotations coincide.

In short, documents serve as an itinerary for doctors and nurses' collective activities. Where should they go and when? How long should they spend on each patient in relation to the other patients? But, doctors and nurses do not only maintain one itinerary. In fact, Sophie's 14 histories get documented more than 30 times.

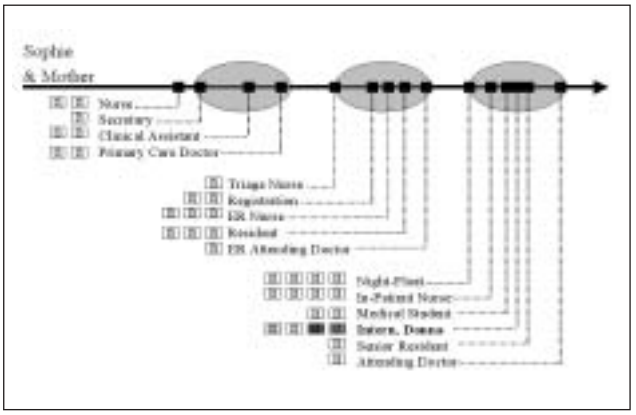

Figure 3 Multiple Documenting Practices

Combining and Recombining Documents

Donna, for instance, records Sophie's history multiple times. One document, the HOSO, she shares with her fellow interns; another, informally known as the Brain Notes, serves as her individual notes. A third, called Progress Notes, she records for nurses, secretaries and physicians in Sophie's unit; a fourth document, the discharge summary, she writes for physicians and caregivers outside the hospital.

Each of Donna's documents serves as an itinerary shared with specific other caregivers. Nurses, senior residents, and secretaries both in hospitals and in primary care clinics all maintain multiple documenting practices that facilitate their collaboration with particular other constituencies.

Each of these documents do not live isolated lives. Physicians and nurses carefully combine and recombine them through their daily work. For instance, when doctors and nurses make rounds in the ER they do not walk from patient to patient. They walk from flow sheet to flow sheet, to a pile of emails from primary care doctors, to a rack of test results, to a large whiteboard. By combining all these individual documents they develop a picture of the overall flow of patients through the ER and what bottlenecks they can expect in the near future.

In a similar manner, if a doctor or nurse wants to get a sense of patients' care trajectories across several medical settings, no one document satisfies this need. Donna and the other doctors and nurses do not record Sophie's history with all its details. They only document what is needed for them to make an itinerary and maintain their collaboration with a particular set of other colleagues. If Donna wants to learn more about Sophie's care trajectory that she cannot learn from interviewing her, she will combine multiple documents (i.e. itineraries). In some situations Donna will walk from document to document as the ER doctors do. In other situations she will flip through Sophie's medical record. The medical record compiles some of the many itineraries describing Sophie's case. By selectively combining and recombining documents in the medical record Donna constructs a longer-term yet imperfect representation of Sophie's trajectory.

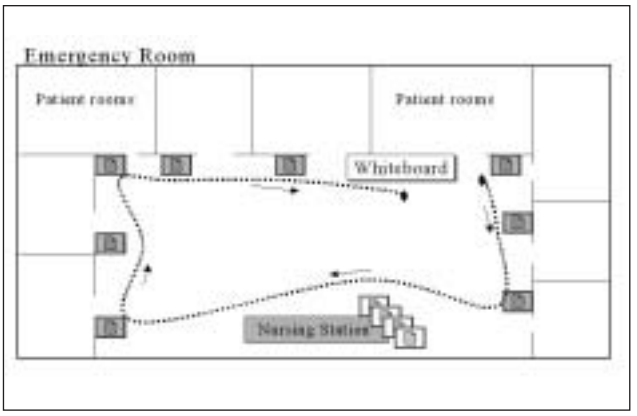

Figure 4. Recombining Documents

Re-localization

Taking a step back, one may ask what happens to Sophie when she moves from primary care, through ER and inpatient unit, to outpatient care. As she wheezes her way through one history after the other, she gets, what I call, re-localized again and again, through multiple and intersecting documenting practices. By re-localization I mean that patients are made part of the work routines of each local setting. As illustrated in Figure 3, patients are made part of the local work practice where doctors and nurses care for not only Sophie, but many other patients by documenting practices to coordinate their distributed work with specific other caregivers. The documents serve as itineraries

for their coordination and medical professionals need an itinerary for each group of people with whom they collaborate. Some the collaborators work in the same department; in other cases they work in different institutions. To put it differently, Sophie gets re-localized through the itineraries used by numerous groups to organize their distributed work. If Sophie does not get mapped onto these itineraries, she "falls off the map" and she does not receive care.

In brief, medical documents are not so much patient-centered records as practice-centered records. To coordinate patients' care across settings nurses and doctors combine and recombine multiple documents. What become pivotal are not individual documents, but their intersections. To understand Sophie's trajectory one must understand how knowledge gets shared as documents, and thus itineraries, get combined and recombined within and across settings. This is a re-localization process.

Discussion

If we want to further articulate this process of re-localization we need a framework that allows us to distinguish the practices that go into documenting patients' care within and across settings. I find Orlikowski & Yates' notions of "communicative genres" and "genre systems" (Orlikowski & Yates 1994, Orlikowski & Yates In Progress, Yates et al 1999, Yates et al 1997) particularly helpful in distinguishing between medical documents, and understanding their role in the overall re-localization process. The genre framework, I argue, helps differentiate the work practices that go into documenting patients' care. Orlikowski and Yates' work on document genres is just one example of several authors that focus on the temporal and spatial dimensions of social practice (Giddens 1987, Gregory 1994, Harvey 1996, Schultze & Boland 2000) and specifically the temporal and spatial dimensions of document genres and their use (Bakhtin 1986, Bakhtin 1996, Hanks 1996, Hanks 2000).

Orlikowski & Yates (Orlikowski & Yates 1994) define a genre as a socially recognized type of communicative action habitually enacted by organizational members to realize particular communicative and collaborative purposes. For instance, most people know the genre of the memo, meetings, expense form, or CV. Doctors in this particular hospital all know the HOSO, progress note, and flow sheet genres. Most genres can be identified by their purpose and form.

More recently, Orlikowski & Yates has introduced the notion of "genre systems" to describe the complex interconnections among genres in activity systems (Orlikowski & Yates 1998). They characterize genre systems as socially enacted structures that "serve as institutionalized templates for social interaction." A genre system is a series of interdependent genres that comprise a social activity. For instance, the dissertation chapter draft genre and advisor-meeting genre that structure a Ph.D. student's work with his or her committee chair can be typified as a genre system. A genre system, as an organizing structure, connotes expectations among the actors about the interaction's purpose, content, form, participants, time, and place (Orlikowski & Yates 1998). That is, the why, how, what, who, when and where the interactions take place.

For example, Donna's documenting of the Sophie's history in the HOSO forms a genre system in relation to her work and communication with the four other interns. The use of the HOSO interconnects with the morning round genre and afternoon sign-out genre, which, in turn, marks important times in their daily and weekly rotation cycles. In a similar fashion, Donna's Progress Notes form a genre system in relation to her coordination with other doctors and nurses in Sophie's unit, their daily rounds, check-ups, and their division of labor. Similar analyses can be made of Donna's other documenting practices.

Donna writes four different documents, as mentioned earlier. A more precise way to articulate this is to say that Donna engages four distinct genres, each part of distinct genre systems. In other words, the genre system framework allows me to specify the different practices that go into documenting patients' care. But how do we distinguish the four times Donna records Sophie's history as well as the 30 other recordings of Sophie's history?

In the medical setting I found that the last three aspects of genre systems to be particular helpful in differentiating the many different recordings. The who, when, and where were the most helpful tools categorizing these different documents. Based on that I could better understand the purpose, the form, and content.

Genre Type	*Communicative Practices*	*Maps & Itineraries*
	Brain Notes	
Who	Donna	
When	Any time during one shift	When to do in the course of one shift
Where	In Donna's coat pocket	Where to find patients across locales
	HOSO	
Who	Four interns	
When	Daily and weekly rotation cycle	When to do in relation to other interns
Where	Terminals in doctors' conference rooms	Where to find patients and colleagues across locales
	Progress Note	
Who	Doctors and Nurses	
When	Rounds, before and after seeing patients	When to do in relation to other practitioners
Where	Outside patients' room	Where to find patients and collaborations within a locale
	Discharge Summary	
Who	Doctors, Nurses, and Secretaries	
When	End of care, Beginning of care	When to do in relation to other practitioners
Where	Institutions' central record system or in ward	Where to find practitioners across locales

Figure 5 - Donna's Four Document Genres

For instance, it was interesting to observe that in her practices Donna made clear distinctions between her four different documenting practices or genre systems. However, when I asked her, she had a hard time distinguishing between them. I experienced the same with other doctors and nurses. To

Donna the overall purpose of her four versions of Sophie's history remains the same: to record Sophie's history and care. The same can be said about the content and form. Donna records, for instance, her history on note cards, on-line systems, and preprinted forms. I had a hard time finding variations in the forms until I asked questions about the participants, times, and spaces.

To illustrate the importance of these three aspects of each genre system, I begin with Donna's recording in the HOSO and the Progress Notes. For the HOSO the participants are five interns and their use is structured by the daily and monthly rhythm of their rotation cycle. They access and share the HOSO on terminals found in the doctors' conference rooms across the hospital. The Progress Notes' participants include doctors, nurses, and secretaries in Sophie's unit. Staff members time their use of the Progress Notes to the morning rounds and before and after they see patients. The Progress Notes can be found outside patients' rooms.

To these genre analysis I will argue that there is another side to the temporal and spatial use of the records, that of the itinerary. The use of the HOSO provides a flexible coordinative structure creating expectations about, on the one hand, when to do tasks in relation to other interns, and on the other hand, where patients are located within the hospital. In a similar fashion, the Progress Notes create expectations about when to do tasks in relation to other occupational members and where to find patients and collaborators. In other words, where the genre system framework highlights the temporal and spatial structure of the communicative actions (i.e. when and where we use the documents), I suggest that we also take into consideration how these genre systems are used to structure the participants' general work practices in time and space. The genre system concerns not only a string of communicative actions, but informs us about how people structure and coordinate their non-communicative actions in the activity system. In short, the genre system allows me to distinguish Donna's different documenting practices. Now that we can differentiate the various documenting practices it also becomes easier to understand how they combine and recombine. Let me return to the example of ER rounds to illustrate the point.

Combining documenting practices

Most of the documents involved in the ER rounds serve as itineraries for specific doctors and nurses treating each patient. By recombining them the ER staff creates a new temporal and spatial framework for their interactions. Each flow sheet used in the ER helps a nurse, two doctors and maybe a consultant to guide their "when and where to do what" in relation to each other in regard to one patient. During rounds staff recombine many flow sheets and other documents, and in the process create a new itinerary with a different configuration of participants, time and place. As they combine and recombine the documents during rounds staff members create a new genre system involving all staff members in the ER and pointing to the when and where to do what in regard to the entire patient population in the ER. Their recombination of multiple documents creates an itinerary for the overall flow of patients through the ER. In other words, by recombining documents doctors and nurses create a new itinerary helping them to determine when and where to focus their activities within a larger activity system, the entire ER. In this way a document (i.e. specific genre) can be part of more than one genre system.

In this manner the patients constantly get re-localized into each setting as they travel through, and in the process become part of many combined and recombined genre systems enacted by doctors, nurses, and secretaries. Some of these genre systems and their itineraries concern the coordination in the limited space of one patient's room. Other genre systems stretch across several medical settings.

A number of these recombined documents comprise socially recognized genre systems. Many others are more loosely related. Often doctors and nurses improvise combinations among particular documents as part of their reactions to a constantly changing environment. Donna could request records from the outpatient asthma nurse related to Sophie's primary care clinic and thereby create a combination one normally does not find in the hospital.

Conclusion

It is time to return to the question of how people share situated knowledge across settings. My answer is that doctors and nurses share situated knowledge through their use of documents (i.e., itineraries) and the combination and recombination of multiple documents, what I term the re-localization process.

I find that documenting practices generate itineraries guiding actions across time and place, i.e. the "when" and "where" to do "what". Based on these types, we can understand the format and content of the different documents. We can understand what patient information is included and what is left out. The notion of itinerary adds to the analytical power of the genre system framework. A genre system creates not only expectations for the temporal and spatial structure of the communicative actions but also the general guide to the activities of the participants.

Finally, the notion of re-localization suggests a relational approach to documents. A document genre takes on its meaning from the specific configuration of participants within a temporal and spatial point of reference. As doctors and nurses recombine a document by altering the participants (who), times (when), and places (where) of its use they also modify the document and its recognized purpose, thus producing an instance of a different document genre or genre system. The recombined documents serve as new guidelines for the practices of a different configuration of participants. In other words, the notion of recombination offers a dynamic approach

to genre and genre system analysis. A document can becomes part of many different genre systems and genre sets. As a doctor or nurse recombines a document into a new guideline for a different constituency of people enacting other temporal rhythms and regions, they may also alter the purpose of the document.

Doctors and nurses use documents to structure their everyday gathering of medical data, facilitate their communication, and allow for the comparison over time and between different settings and patients. They do so by reducing the details from several sources including their own interactions with Sophie and other staff members' documents. In other words, documents are abstracted, selective, and structured maps and itineraries of more richly textured work practices. The question becomes, how could medical information systems best support the sharing of such situated knowing across settings. Let me briefly outline some implications for information system design.

Implications for Participatory Design of Information Systems

The findings suggest that the design of medical information systems should take as their point of departure the work practices of doctors and nurses, and only secondly the patient. Accordingly, the practice or process should guide the construction of medical taxonomies supporting these systems. Here, I imagine a medical information system built along the lines of the Process Handbook developed at M.I.T. (Kim 2000, Malone & Crowston 1994, Malone et al 1999, Yoshioka & Herman 1999). The relationships one builds are not so much between objects, but rather relationships between processes.

Given the use of documents as itineraries it would make sense to provide many different formats and selections of information (i.e. how and what). In other words, Donna should be able to pull up information in four different ways. One would help her coordinate with the four interns, another would serve as her individual notes, and so forth. In the design process each of these types should be classified according to the who, when, and where; the participants, time, and space.

Last, but not least, the notion of re-localization suggests that we should not build centralized and universal medical information systems, but rather decentralized systems developed and implemented at the level of individual departments and sub-disciplines. This would make the work of intersecting these different decentralized systems crucial. Here, data mining and natural language processing would provide helpful tools in facilitating the connections among multiple decentralized systems and allow different constituencies (i.e. participants) to retrieve the information that supports their work practices across time and space.

In order to realize these capabilities one would need to give IS professionals a central role in the daily work of individual healthcare settings. As it is now IS professionals are more marginal than janitors. In one of the hospitals I studied the IS professionals lived in a trailer literally at the fringes of the hospital. They could barely have been more insignificant to the daily workings of the hospital. This seems incongruous when looking at the amount of time healthcare professionals use to discuss how best to intersect existing information systems. In each medical unit and clinics I observed I participated in regular, if not by weekly, meetings where doctors, nurses, and secretaries discussed how better to intersect existing information systems and documents. As few of these participants had the capability to engage in changing the electronic information systems, the changes they could implement most often involved paper forms. In order to implement decentralized changes in information system use, one would need to have IS professionals participate in these meeting and be able to contribute to the discussions. It would also be helpful if doctors and nurses came out of medical school with a least a basic comprehension of these issues. An integration of information system management into the medical curricula or offering elective IS courses targeted to the medical field would serve as a first step in this direction.

In summary, to link the information systems involved in the recording of Sophie's may histories, one would have to build medical information systems from the bottom up. Such an endeavor would involve supporting doctors and nurses use of multiple and intersecting information systems at the level of local departments and sub-specialties. Slowly, by focusing on the intersections among these many documenting practices I expect that one could move toward a higher degree of integration among the many information systems involved and a more efficient sharing of knowledge within and across healthcare settings. In other words, I am not arguing that one should not strive to save Mr. Jones while on holiday in Florida. Rather, instead of striving for a universal patient-centered record we should build large-scale record systems from the ground up taking as our point of departure the work practices of doctors and nurses.

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