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Multiple Perspectives: Evaluating Healthcare Information Systems in Collaborative Environments

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Introduction

Patient care teams play a critical role in health care. A wide variety of practitioners—nurses, pharmacists, social workers, physicians, and others—work together on a day-by-day, hour-by-hour, and even minute-by-minute basis to provide patient care [1–6]. Although these teams vary depending on their roles and responsibilities, they have become an important and integral feature of medical care. Consequently, we must ensure that we design information systems to appropriately support patient care teams. In this chapter, we argue that good system design requires us not only to develop information systems with teams in mind but also to evaluate them within the context of a team.

Healthcare System Development

Many current healthcare information systems are developed with a focus on the individual user [7,8]. However, these same systems are often utilized in teams to support collaboration [9,10]. For instance, the electronic patient record (EPR) is viewed by most people as a repository for patient information. Individual healthcare workers can access the EPR to find out details about the patient's condition. Although it does serve as a patient information repository, the EPR also helps support coordination among team members by providing them with information about what other team members have done for the patient [11]. Clinical systems such as the EPR have played a more collaborative role than originally anticipated by their designers. Yet, evaluations of healthcare technology usually focus on how well it supports the individual user, for instance, focusing on the suitability and effectiveness of the user interface for single-user interaction [12]. With a few exceptions [4,5,10], evaluating how well these systems support collaboration is often ignored. For clinical systems, we must not only evaluate how well they store the information but also how well they support the collaborative features of team members' work.

Evaluation Techniques

Evaluating information systems within a team setting is often difficult because of the multiple perspectives present in a team. For instance, in a study of an electronic patient record system in a surgical intensive care unit (SICU) [13], the first author examined a patient care team of residents, fellows, attendings, pharmacists, and nurses. Each team member brought different backgrounds, perspectives, and skills to the team. These different skills and perspectives had implications for the adoption and use of the patient record system in the unit. To understand how the system was used in the unit, the first author needed to examine how the different members utilized the system and had to evaluate it from as many different perspectives on the team as possible.

However, this type of evaluation is not easy because of the need to understand the technology from diverse perspectives. To address this challenge, healthcare researchers have used a wide variety of techniques and methods for evaluating information systems. These evaluation methods include *qualitative* techniques such as observations and interviews [14–16] and *quantitative* techniques such as surveys [17,18]. Although much of our discussion in this chapter focuses on qualitative evaluation techniques, we do not claim that these are the only techniques or even always the most appropriate for evaluating information systems. The suitable evaluation technique depends on the nature and scope of the particular study. In many instances, quantitative methods have played an important role in understanding information systems use in teams [19–21].

While quantitative techniques have provided important insights into information systems, our experiences as well as others [9,22] have shown that qualitative methods provide us some of the best approaches to trying to answer the "how" and "why" questions of evaluation studies [23]. These questions bring to the forefront the important role that information systems play in supporting team activity. For instance, the question "How can an information system make team coordination more effective?" is difficult to answer without examining the different ways that team members coordinate with each other and the type of work activities that require coordination. Qualitative techniques allow researchers to try to answer these questions in greater detail.

The main goal of this chapter is to discuss how to evaluate information systems used in patient care teams. We will provide the reader with examples of information systems evaluation and methods, drawing from the first author's field study of EPR use in an intensive care unit. The reader should, at the end of this chapter, have a better understanding of how to evaluate information systems used in teams. The chapter is outlined as follows. In the next section, we discuss teams and the importance of context. In the section on the SICU team, we provide a brief field study of a technology use within a team. In the section following that, we present qualitative

methods to evaluating information systems in teams. We then conclude with some comments about studying information systems use in team settings.

Teams and Context of Use

In this section, we discuss teams and technology use. First, we provide an introduction to teams. We then discuss healthcare teams. Finally, we discuss the importance of context in evaluating information systems.

Teams

Individuals rarely work independently in modern organizations. Instead, the dominant setting for work in these environments is interdisciplinary or multifunctional teams; people collaborating with others to accomplish their tasks. These teams play a vital role in an organization's ability to implement its goals.

The term "team" has been defined in a variety of different ways. Some researchers consider the term to be interchangeable with "group," especially "work groups" [24,25]. Hackman [25] defines three essential attributes for a work group:

1. Work groups are *real groups*. They are intact social systems, with boundaries, interdependence among members, and differentiated member roles.
2. They have one or more tasks to perform. The group produces some outcome for which members have collective responsibility and whose acceptability is potentially assessable.
3. They operate in an organizational context. The group, as a collective, manages relations with other individuals or groups in the larger social system in which the group operates.

Similarly, the classic self-managed, or autonomous, manufacturing team is six to 20 people organized around complementary tasks, with self-contained output [26]. Teams have been characterized in a variety of different ways: as an intellectual collective [27], a basic unit of performance [28], and a continuing work unit [29]. In organizations, five types of teams are said to exist: work teams, project teams, parallel teams (a.k.a. task forces), management teams, and ad hoc networks [29].

Although defining teams is difficult, one approach is to consider the dichotomies often used to classify groups (Table 3.1). Our working definition of teams is small groups in which participation is mandated by management. In teams, formal roles are prescribed by the organizational structure (managers don't stop being managers when they work on a team). Informal roles, such as team peacemaker, are emergent. Finally, time

Table 3.1. Properties and dichotomies commonly used to classify groups.

Dimensions	Examples
Setting	*Work:* Work group; occupational group; task force; team.
	Social: gang; religious group; club; sport team.
	Other: therapy group; political committee; jury.
Properties	Size (number of members)
	Amount of physical interaction among members
	Level of cohesion
	Extent of formalization of norms
	Extent of formalization of roles
	Extent of formalization of task
Dichotomies	Formal-informal
	Primary-secondary
	Voluntary-involuntary
	Small-large

matters in teams [30]. Teams have a task; that task is planned and carried out over a period of time.

Management guru Peter Drucker [31] argues that the strength of teams lies in their adaptability:

> Teams are adaptable. They are highly receptive to experimentation, to new ideas and to new ways of doing things. They are the best means available for overcoming insulation and parochialism.

Nevertheless, it is this adaptability that poses challenges for designing information systems to support teams. For example, the adaptability enabled by the integration of multiple perspectives on a healthcare team can be difficult to define and capture in the design of an EPR system.

Teams in Health Care

Within most healthcare organizations, teams can be split into two broad categories: nonclinical and clinical. Nonclinical teams focus on the business and other nonclinical aspects of the organizations such as patient billing and patient admissions and discharge. In contrast, clinical or patient care teams are responsible for making the patient care decisions [4]. The clinical teams consist of a wide range of workers—physicians, nurses, pharmacists, physical therapists, and others—who provide patient care. Although physicians, nurses, pharmacists, and other members may have different concerns, work, and motivations [32], their primary goal as a team is to improve the patient's condition. These teams range from the well-known patient care team in hospitals portrayed in popular American television shows such as *ER* to seldom-mentioned home healthcare teams [33]. However, whether clinical teams are well-known or not, they are central to providing care for the patient. In many organizations, there are often teams that contain both

types of personnel. For instance, teams dealing with technology implementation issues in hospitals often have both clinical and nonclinical personnel [34].

We focus on clinical teams in this chapter. Clinical teams play a crucial role in patient care and are of particular interest to researchers interested in developing and evaluating healthcare information systems.

Technology and Context of Use

Medical work is an inherently collaborative activity. Baggs and associates [1,2] found that poor collaboration between physicians and nurses in an ICU setting resulted in poor patient outcomes. To provide appropriate patient care, team members must interact frequently with each other. Information systems play a vital role in supporting this interaction. For instance, an information system such as the electronic patient record—as a repository of collected data, observations, and plans—is central to supporting teamwork. Team members routinely use the record to exchange patient care information. Physicians read nursing observations about the patient in the record and write orders for nurses to carry out. Therapists may read both nursing and physician notes before writing a therapy plan. The ability to exchange information through the record supports collaboration and coordination among healthcare team members.

When evaluating information systems used in teams, it is important to understand the *context* in which the technology is utilized [35]. Most evaluations focus only on the interaction between the user and the system; they tend to ignore the environment around the system. The lack of contextual understanding of the system could lead to inaccurate evaluations of a system. Orlikowski's [36] examination of an organizational adoption of *Lotus Notes*™ points to the importance of context. If she had not examined the organizational structure and found that disincentives for information sharing exist, then individuals looking at the low adoption levels of the information sharing tool *Lotus Notes* could have blamed the system itself for the failure, not the organizational context. Thus, Orlikowski's examination of the organizational context of the system allowed her to more accurately evaluate the system. Forsythe's comments about the importance of context further highlights its importance in evaluation studies. She [37] argues that:

> The lack of contextual features also raises questions about whether important components of meaning are missing from the analysis.

Without examining the context, researchers would have a difficult time understanding the true reasons for a system's success or failure. Kaplan and Duchon [21] note that "the stripping of context buys 'objectivity' and testability at the cost of a deeper understanding of what actually is occurring." Therefore, removing the context of the system could make it easier to

evaluate some aspects of the system. Yet, conversely, it would make it more difficult for researchers to examine issues such as the system's "fit" with its environment when evaluating the system.

Understanding the context of use is an important component to evaluating information technology use in teams. This requires evaluators to understand the team's daily work activities in order to understand how a particular technology will be used by team members. One way to accomplish this is via the ethnographic field study method. In the next section, we provide an example of a field study from our research.

SICU Team: A Field Study of Information Systems Use

This study took place in the surgical intensive care unit (SICU) of an 840-bed urban teaching hospital [5,11,38]. The SICU provides intensive care-monitoring, invasive and noninvasive, for patients requiring special attention after a surgical procedure. It consists of two 10-bed units each of which has the same technologies, staffing, and physical layout. Information technology plays a crucial role in this SICU. An EPR system—CareVue—mediates much of the work among unit staff, especially physicians, nurses, and pharmacists. The staff has used CareVue for more than 9 years and is well acquainted with its functionality [39]. Originally implemented in the SICU, the system is now in use in eight of the other nine ICUs in the hospital.

To collect data, the first author observed work of the SICU patient care team over a seven-month period. He collected data through more than 30 interviews and observations. The interviews were taped and transcribed. He also collected and analyzed CareVue application and internal communications, including written policies, procedures, and meeting notes.

SICU Team

Although the SICU had a wide variety of workers, the core of the SICU team consisted of:

- Three surgical residents.
- Two surgical fellows (to supervise the residents).
- Surgical attending—a surgical faculty member headed the team.
- SICU pharmacist—a pharmacist was assigned to the SICU team.
- Nurses—the SICU had 50 critical care nurses.

The primary goal of the SICU team is to stabilize patients as quickly as possible so they can be safely transferred out of the unit. Effective and timely coordination between physicians, nurses, and pharmacists is critical, otherwise the patient will suffer. In one observed example, a nurse failed to notify the physician that the patient's sodium was rising to dangerous

levels. If the physician had been notified quickly, he would have been able to give the patient medication to lower the sodium. However, the physician only found out about the sodium levels six hours later, by which time the patient's condition had deteriorated so far that the physician had to intubate the patient to protect her airways. As the example highlights, team members work under constant time pressure that can affect patient care. Therefore, on a daily basis, the physicians, nurses, and pharmacists must successfully coordinate their activities to ensure appropriate patient care.

SICU Team Work

The SICU team has both formal and informal responsibilities. Formally, the SICU team must visit all the patients in the unit two times a day—morning and afternoon rounds. Informally, team members must continuously collaborate with each other to ensure that patients receive appropriate medication. To provide a better understanding of how CareVue is integrated into the work practices of the SICU, we briefly present two team work examples: morning rounds and medication administration.

Morning Rounds

SICU morning rounds play an important role in the unit's patient care process. The goal of morning rounds is to discuss and decide on a plan of care for that day for each patient. During morning rounds, the SICU team visits each patient. The team begins by viewing x-rays of all the SICU patients. After examining the x-rays, the team "rounds" on each patient. Each of the three residents is responsible for a certain number of patients in the unit. During rounds, the residents "present" their patients to the team. As a resident outlines the patient's current condition, vital signs, and other information, the fellow and other team members view the patient's record on the CareVue workstation. They do this both to verify the resident's information and to gather other pertinent information. As one fellow stated, "It is much easier for me to find the information in the system than to wait for them [residents] to give it to me." After the resident presents, the fellow examines the patient. The team then discusses the patient's condition and decides on the plan of care for the day. After all the decisions are made, a resident writes a progress note in the patient's CareVue record.

Medication Administration

Ordering and administering medication requires collaboration between physicians, nurses, and pharmacists. In routine situations, most surgeons use a standard set of drugs. However, for complex cases, nurses and pharmacists often provide information that help physicians tailor the medication prescription. Since nurses are constantly by the bedside, they can

inform physicians about the patient's physical and mental state. This information can help physicians to decide whether a current drug and dosage are appropriate. If physicians need to prescribe a drug for a problem with which they are not familiar, pharmacists can provide a list of appropriate medications.

Nurses must collaborate directly with both physicians and pharmacists. When ordered to give an unfamiliar drug, nurses commonly ask the physician why it is being given, especially when the drug causes discomfort or pain to the patient. Most physicians want the nurse to understand the plan of care and will answer such questions readily. The nurses also ask the pharmacist questions concerning the medication and dosage administration. For certain kinds of drugs, such as pain relievers, it is the nurse who observes the patient's response most directly, and whose opinion is usually given high regard by physicians for subsequent pain medication orders.

CareVue: Supporting Collaboration

During morning rounds and medication administration, SICU team members must continuously interact with each other in order to provide appropriate patient care. CareVue plays an important role in supporting this collaboration among team members. In the following section, we describe how CareVue supports collaboration during the medication administration process.

Awareness

One important way that CareVue supports collaboration among team members is by providing "awareness." Dourish and Bellotti [40] define awareness as "the understanding of the activities of others which provides a context for your own activity." Individuals can more efficiently coordinate their work if they know about one another's activities. Bricon-Souf and colleagues [41] argue that one way to support successful collaboration is to share information about users' work activities. An EPR can provide users with this awareness, if it is designed to incorporate:

- Knowledge of others' work activities
- Knowledge of an individual's own work activities

CareVue's presentation of medication information supports awareness. All healthcare providers need information about the patient's medication; however, the exact information they need varies with their roles. CareVue provides a different view of the data to different team members (Figure 3.1). These customized views of shared information allow team members to remain aware of what other team members are doing in the medication process. Physicians (Figure 3.1A) can see what medications have been

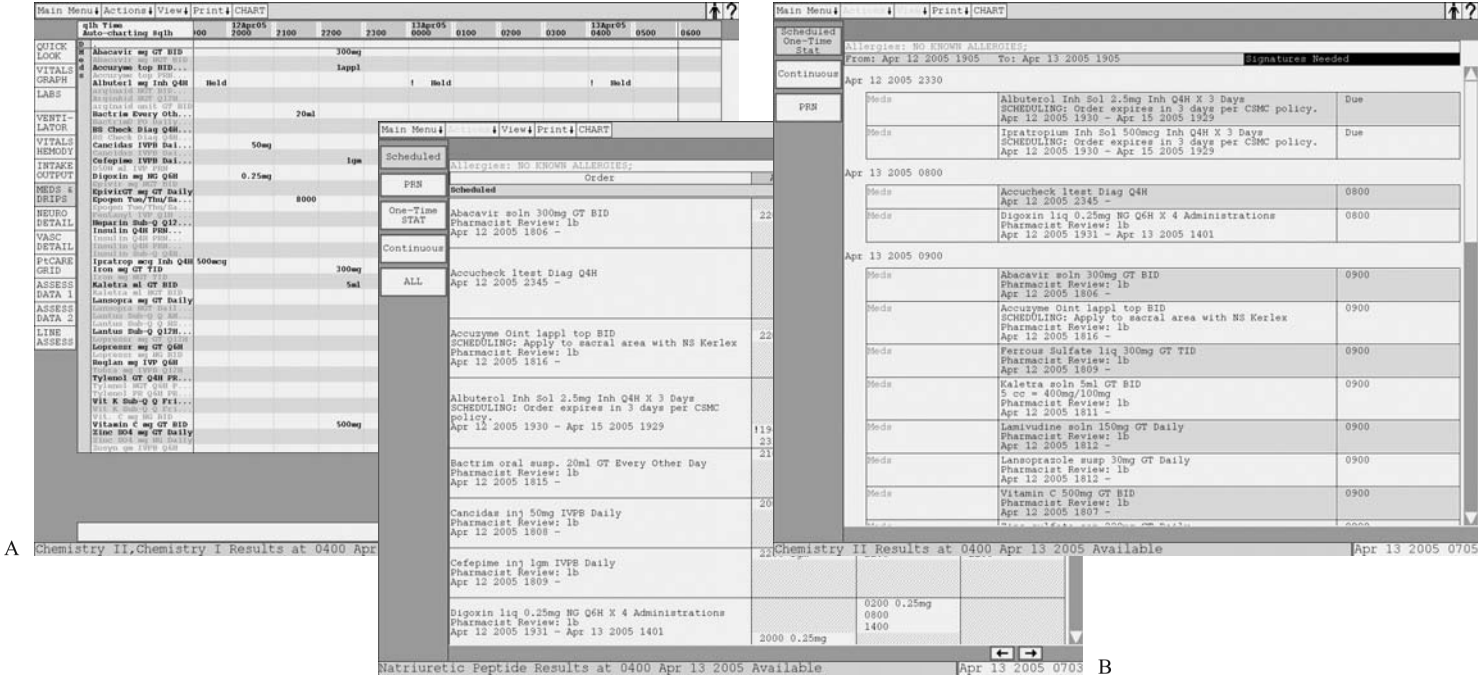

FIGURE 3.1. (A) Physicians use the medication section of the CareVue Flowsheet to check on patient medications. It provides them with the dosage and administration time. (B) Nurses and pharmacists use the Medication Administration Record (MAR) to provide them with the more detailed information on each medication. (C) Nurses also use the nursing Medication Worklist to keep track of their work activities. It lists the medications for a patient and when they need to be given.

administered and are scheduled to be administered by the nurse. Since physicians need to quickly survey the status of the treatment, the Flowsheet provides them with quick information about the nurses' past and future work actions regarding patient medication. If physicians have any questions about these actions, they can look elsewhere in CareVue or contact the patient's nurse.

Nurses and pharmacists use a different visual interface, the Medication Administration Record (MAR) (Figure 3.1B). The MAR provides additional details about each drug and keeps nurses and pharmacists aware of each other's activities regarding the medications. When a pharmacist approves each medication, he adds an electronic signature to the MAR that is visible to the nurse. Thus, the nurse is aware that the pharmacist has checked the drug for appropriateness, route, and dosage. To administer medications effectively and on time, nurses use another view of the MAR, the Medication Worklist (Figure 3.1C). The Worklist provides a time-ordered list of the medications, dosages, and administration times for all drugs due to be administered on the current nursing shift. The Worklist allows nurses to know what actions the other team members expect from them in the near future. For convenience, nurses can chart drugs as "given" or "held" directly on the Worklist. Such information instantly appears in the other members' views. CareVue's ability to transform information into different views that are understandable to each member helps the members remain constantly aware of each other's activities.

Clinical systems are not simply information repositories of patient data but rather are an integral part of the collaboration among healthcare team members. This field study described how an EPR supported team activities such as medication administration. The system kept team members informed about each other's activities, allowing them to coordinate their work more effectively. Evaluating the system to see how effectively it supported "awareness" required using qualitative methods that allowed us to examine not only the system but the environment (e.g., work) surrounding the system. In the next section we discuss in more detail qualitative research methods.

Qualitative Methods

Qualitative methods are the leading technique for investigating organizational and technological settings in research on collaboration (e.g., [42,43,44]). In health care, these methods have also been widely used to study technology use in teams (e.g., [5,45,46]). Using qualitative methods requires the system evaluators to become ethnographers—observing work environments, artifacts, and human interaction to form an understanding of the culture of a given technology setting in order to accurately evaluate the system.

Data Collection

Using ethnographic techniques such as observations and interviews, researchers have examined a wide variety of social phenomenon in situ [47,48]. Phenomena that are most amenable to qualitative research are those that have multifaceted interdependencies that make it difficult to separate the independent and dependent variables; this is especially true in complex settings where technical, organizational, and social factors intersect (e.g., [36,49]). Ethnographic techniques used by researchers include observations, interviews, and artifact collection.

- *Observations*. In qualitative field study, the researcher must engage in direct observation of the study environment (i.e., the field). The researcher attempts to be a faithful witness to the working lives of people being studied [47,48]. Observations are logged while the researcher is *looking*, *listening* and *asking* questions (*ibid*.). The ratio of each activity is dictated by the environment and events being observed. The researcher must strive to faithfully document his observations as they occur, avoiding injecting his opinion or bias. For example, for the field study described in the previous section, the first author directly observed work in the SICU for seven months; he was given permission to don a white coat and carry a clipboard while shadowing different members of the patient care team. In the early stages of his observations, he hung around the unit during the day taking field notes about worker–worker interactions, worker–system interactions, and general work practices. He observed both day-shift and night-shift work. He also attended regular meetings organized and attended by the CareVue operations team.
- *Interviews*. Compared to observation, interviewing trades breadth for depth with regard to understanding each team member's roles, responsibilities, and perspectives. Interviews are commonly conducted using a semistructured list of topics for discussion. The list is used as a guide for conversation, not as a questionnaire that is read verbatim [47,48]. The researcher must strive to avoid leading questions. At times, she must also be willing to permit the interview subject to recast the interview questions in a language and context that is relevant to the subject. The degree to which an interview subject *recasts* the interview questions provides data about him and about the work environment that can be used to refine the questions for subsequent interviews. To better understand patient care team members' jobs as well as their views about CareVue, the first author conducted a number of interviews at his field site. The interviews lasted between a half-hour and forty-five minutes in length. The interviews were driven by a previously prepared set of questions; however, this set of questions was only a guide to topics of interest. In many cases, the interviews took different and interesting turns that provided the author with greater insight into people's work practices. The interviews were tape-recorded and transcribed for later data analysis.

- *Artifact collection*. Artifacts are physical objects in the environment that are significantly meaningful to the members of the work team. For example, in the field study described above, the first author collected documents recording the policies and procedures of the SICU. He also collected screenshots of the various CareVue software interfaces used by members of the patient care teams.

The data collection techniques provided the tools to gather rich, informative data. However, the data are meaningless unless they are appropriately analyzed.

Analysis

Qualitative data are characteristically text-based and voluminous. Transcripts from interviews and notes from observations of a modest study often constitute hundreds of pages of text. The question becomes, how does one distill meaningful patterns, or theories, from this unstructured body of text? The researcher does not distill the data; instead he creates and distills analytical categories that describe meaningful uniformities in the data. Theories about the data emerge through an iterative process of comparing and delimiting categories [50,51]. This approach to data analysis is known as *grounded theory*. Applied to information systems in health care, grounded theory dictates that the abstract principles formulated to describe a healthcare setting must be grounded in the data and thus must be the product of inductive rather than deductive reasoning. A detailed discussion of grounded theory is beyond the scope of this chapter, yet an understanding of the philosophy and techniques is warranted.

The ethnographic approach to the analysis of qualitative data involves reviewing the data and creating a classification scheme to describe (i.e., *code*), all relevant observations. The creative researcher can generate innumerable descriptive categories to code her data. How does she know when she is finished coding her data? Glaser and Strauss [51] provide these two heuristics: *parsimony* and *scope*. The researcher achieves parsimony of categories through careful comparison of each category to all others to verify that each category is unique. The researcher achieves parsimony of theory through integrating categories into cohesive conceptual clusters. Integrating categories is a natural byproduct of the constant comparison of categories. The researcher achieves scope when she delineates the boundaries of the categories (e.g., what the category does and does not apply to).

For example, in analyzing interviews with patient care teams, the data may reveal that both physicians and nurses need to track the administration of medication. When the data document a nurse or physician making a mental note of the next time a particular medication must be administered, this might be categorized as "awareness of medication administration schedule." Yet, when the data document a physician scanning records

for the frequency and synchronicity of administration of multiple medications to assess the possibility of a drug interaction, this might be compared and then integrated with the "schedule" category and labeled "awareness of co-administration of medications." Various additional variables about medication administration, such as the route a nurse must use to deliver the drug or the physician's personal preference for one particular drug over another may be contained in the data that are not categorized. They are not categorized to maintain parsimony of the categories and to focus the scope of the analysis on the awareness of medication administration schedule rather than execution of medication administration (e.g., route) or medication preferences.

By constraining the scope of the analysis in this manner the researcher may theorize about the effectiveness of various EPR interfaces on collaboration—in our example, the data would reveal that an interface that provides a separate administration schedule for each drug may be sufficient for the nurse but may be entirely inappropriate for the physician. Thus the researcher's theories about the effectiveness of an EPR interface emerge through the parsimonious use of descriptive categories, through the integration of categories, and by scoping the analysis to observations that pertain to information awareness.

Themes

Here we ask the reader to recall several key themes discussed in the CareVue field study. We consider these themes to be a few of the universal properties of collaborating in teams that are germane to the evaluation of information systems. These themes include *workflow dependencies*, *awareness*, *multiple perspectives on information*, and *shared artifacts*. We will briefly discuss each of the themes for purposes of providing specific questions to ask when evaluating information systems use in teams.

Dependencies

Some degree of workflow dependencies exist in all team work. The factory assembly line is the canonical example of highly interdependent team work. Factory automation is evaluated based on the effectiveness by which it isolates and orders the dependencies between factory workers along an assembly line. The dependencies of a patient care team are less visible due to the intellectual nature of the work, nevertheless they are present. The medication administration process highlights the interdependences that exist among members of a patient care team. The physicians order the medications but do not have the ability to continuously monitor the effects of the medication on the patient. The nurses can monitor the patient but cannot order the medications that are needed by the patient. Finally, the pharmacist cannot order the medications nor monitor the patient but has the detailed knowledge of particular medications needed by both the physi-

cians and nurses. Therefore, each team member depends on the other members in order to successfully carry out the medication administration process.

To expose and analyze dependencies on a patient care team, a researcher may ask questions regarding how work is ordered, reordered, communicated, delegated, and controlled for quality. Questions may include: How is a patient's presenting condition assessed and documented? How is the presenting condition communicated to the team? How is a patient diagnosed? Once a diagnosis is made, how is the plan of care documented and shared with the team? How is the quality of care assessed?

Awareness

Members of work teams must share detailed information about their activities and knowledge with each other in order to coordinate their work. Often, awareness is achieved through peripherally monitoring the conversations or behaviors of others in collocated workspaces; for example, air traffic controllers routinely monitor the pilot–controller conversations of their teammates in the control tower [42]. On first examination, peripheral auditory monitoring may remain undetected by the researcher—since it is peripheral and auditory—and it may even seem inconsequential. Yet consider the consequences of implementing an information system that converts conversations in an air traffic control tower from a verbal format that is easily monitored by all occupants of the tower to a textual format. According to data from ethnographic studies of air traffic controllers, doing so would likely slow the detection of incidents when conflicting flight instructions are given to pilots.

Similarly, shared awareness among members of patient care teams is vital to maintaining high quality care. Patients suffer when awareness breaks down. In his evaluation of the CareVue EPR system, the first author observed an incident reported above in which a nurse noted that patient's sodium was rising to dangerous levels, yet failed to notify the physician. If the physician had been alerted quickly (i.e., if there were a shared awareness among the nurse and physician of this condition) the physician would have medicated the patient to lower the sodium. Unfortunately, the physician learned about the rising sodium levels only after the patient's condition had deteriorated so far that he had to intubate the patient. Likewise, shared awareness about the time and route a medication is administered is crucial to delivering quality patient care.

Thus, when evaluating information systems in healthcare settings the researcher must carefully probe issues of awareness among team members. Research questions may include: How is information about a patient (vital statistics, medical administration, patient complaints, history, etc.) formally documented in the system? How is this information formally shared among members of the team (consider how it is verbally shared as well as how and when it is printed from the system)? How is this information informally

shared: via impromptu conversation, marginalia in written records, special numeric codes sent via numeric pagers, and so forth? To what extent does the system accommodate informal observations and annotations? For what periods of time do different kinds of information remain relevant? To what extent does the credibility of the information provider affect the way information is documented and used? What happens when awareness breaks down? How does the information system under evaluation help or hinder information sharing?

Multiple Perspectives on Information

The discussion of CareVue's Flowsheet in the field study provides a nice example of multiple perspectives on information in an EPR interface [5]. Recall that in CareVue, physicians can see not only nurses' past medication administration but also future medication administration activities. Nurses see a time-ordered list of the medications, dosages, and administration times for all drugs due to be administered on the current nursing shift. These two different views provide the team members with different information required to carry out their responsibilities, while preserving the uniformity of the underlying medication data.

When evaluating the appropriateness of an information system vis-à-vis multiple perspectives on information, the researcher might ask the following questions: What are the information needs of each member of the work team: How are these needs similar across the formal work role and how are they unique? What, if any, information can be shared in a universal format (by what media, in what level of detail)? What information must be tailored to specific work role and why? What are the consequences of one member of the team viewing, editing, or deleting information intended for the other members?

Shared Artifacts

In the context of this discussion of information systems evaluation in healthcare settings, a shared artifact is any meaningful object that is manipulated by multiple members of a work team to aid in patient care. For example, in the ICU unit studied by the first author, a whiteboard at the nurses' station constituted a shared artifact that warranted study. This whiteboard was used by the entire team to track who was assigned to which patient and where each patient was located on the ward. Although every member of the patient care team read information from the board, only the clinical partner (an aide to the nurses), was normally permitted to edit the information on the board. This use of a whiteboard has implications if the assignment information is ported to electronic format such as an EPR. It would dictate that the patient assignment and room location would be read-only to all members of the team; permitting all members of the team

to have editing privileges would conceivably undermine the ability of the clinical partner to maintain accurate information.

Thus, to understand artifacts that have implications for EPR and related healthcare systems, the researcher must ask questions such as: From what physical objects do team members obtain vital information? How is this information vital to caring for the patient, coordinating work, documenting work, and so on? How do different team members in different work roles use artifacts similarly? How do they use them differently? What are the consequences of one member using a given artifact in a manner customarily intended for another member?

Summary

Evaluating information systems used in teams requires researchers to understand not only the technical aspects of the system but also the work and interactions of team members who use the system. Researchers using methods such as grounded theory combined with qualitative data collection techniques of observations, interviews, and artifact collection have gained tremendous insight into technology use in teams. Yet, there is still much work to be done. To ensure that information systems effectively support collaboration in teams, we must rigorously evaluate these systems using methods appropriate to studying teams in the healthcare setting.

Additional Readings

There are a number of books and articles that provide useful insight into teams, evaluation of information systems, grounded theory, and other issues we have discussed in the chapter.

Further information about teams can be found in:

Jon R. Katzenbach and Douglas K. Smith, *The Wisdom of Teams: Creating the High-Performance Organization* (HarperCollins Publishers, 1993).

Ed. R. Hackman, *Groups that Work (and Those That Don't): Creating Conditions for Effective Teamwork* (Jossey-Bass Publications, 1990).

Two good examples of ethnographic field studies are:

Julian E. Orr, *Talking About Machines: An Ethnography of a Modern Job* (Cornell University Press, 1996).

Richard Harper, *Inside the IMF: An Ethnography of Documents, Technology, and Organisational Action* (Academic Press, 1998).

For more details about grounded theory, please read:

Barney G. Glaser. and A.L. Strauss, *The Discovery of Grounded Theory: Strategies for Qualitative Research* (Aldine, 1967).

A. Strauss and J. Corbin, *Basics of Qualitative Research: Grounded Theory Procedures and Techniques* (Sage Publications, 1990).

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