THE INFLUENCE OF INFORMATION SYSTEMS AFFORDANCES ON WORK PRACTICES IN HIGH VELOCITY, HIGH RELIABILITY ORGANIZATIONS: A RELATIONAL COORDINATION APPROACH.

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI‘I AT MĀNOA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN

INTERNATIONAL MANAGEMENT

AUGUST 2014

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Keywords: Information systems affordances, relational coordination, high reliability organizations, high velocity environments, adaptive coordination, health information technology, health care, intensive care unit
ACKNOWLEDGMENTS

Many people have supported my work on this dissertation. I would like to thank my family for being supportive and patient throughout this journey. I am very grateful to Tung Bui and my dissertation committee for guiding me and providing me with many insightful suggestions and comments. I would like to thank Elizabeth Davidson, Jody Hoffer Gittell, Gerald Kane and Hao Chih Ho for their support and the inspiring discussions on different aspects of this research. Finally, I would like to acknowledge the support that the Shidler College of Business has given me throughout this process. This work is dedicated to my parents.
ABSTRACT

This dissertation research investigates the interrelationships between information systems affordances and relational coordination in high velocity, high reliability organizations. Based on a qualitative case study of an intensive care unit and a general medical/surgical unit, I identified a set of nine distinct foundational information systems affordances for coordination related to accessibility and integration of information. Four affordances (i.e., Immediacy, Comprehensiveness, Interpretability, Visibility) were particularly essential for effective coordination in the high velocity environment. Enactments of information systems affordances within groups depended on feature fit as defined in the information systems affordance literature, but as importantly also on use of the electronic health record system by others and rules and regulations. Enactment variations of the four essential information systems affordances enabled or constrained relational coordination on a day-to-day practice level, depending on how team members incorporated verbal communication with adaptive or non-adaptive enactments of the meta-level affordances for Facilitation, Supplementation or Substitution of verbal communication in situations with varying time constraints and complexity.

This research contributes to the literature on information systems affordances by highlighting the importance of use variations by team members in addition to feature fit, and by proposing a meta level of affordances that contextualizes effects of foundational affordances on relational coordination. It further contributes to the literature on the implications of health IT on practices by showing how enactment variations of information systems affordances reflected collaborative relationships among professional groups and reinforced rather than mitigated challenging relationships among team members. Finally, this study contributes to the literature on Relational Coordination Theory by proposing an additional, distinct communication dimension ‘comprehensive communication’, which was critical for enabling the relational dimensions in day-to-day practice. The research highlights the importance of the practice level to examine effects of health IT on the relational dimensions of relational coordination.
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CHAPTER 1. INTRODUCTION AND MOTIVATION

Much of work in organizations is done in intensive work groups. Because of the complexity of many situations, these groups rely on sensemaking and rapid assessments as opposed to very structured decisions (Weick, 2009). There is a desire to use technologies to facilitate this work, but it is not clear if we make things better or worse when we add information technology in high reliability, high velocity settings.

I decided to study this phenomenon in health care organizations because they are examples of high reliability organizations (HRO’s), which operate in environments with high levels of uncertainty and high stakes of decision-making (Roberts, 1993). High velocity health care settings like intensive care units additionally require rapid decision-making and adaptive coordination in daily work practices (Faraj & Xiao, 2006). Further, health care organizations are multidisciplinary, professionally driven, and characterized by a strong hierarchical structure (Fichman et al., 2011). Current trends in health care include increasing medical knowledge, specialization, and interdependence (Nembhard & Edmondson, 2006). These characteristics suggest that cross-functional communication is critical for effective work practices and performance in health care organizations. Cross-functional communication in multi-disciplinary health care teams is also challenging (Rose, 2011). For example, miscommunication among team members and professional groups is noted in the literature as a major cause of medical errors (Sutcliffe et al., 2004; Kumar & Steinebach, 2008).

One of the purposes of health information technology (HIT) like electronic health record (EHR) systems is to support communication among health care providers. Therefore, the affordances of EHR systems for communication and their realizations in multidisciplinary groups are important for performance in health care delivery (Goh et al., 2011; Strong et al., 2014). However, evidence of the impacts of health information technology (HIT) on clinical quality and efficiency is still equivocal in broad, large-scale studies, and influence mechanisms are not well understood (Agarwal et al., 2010; Pinsonneault et al., 2012). Given the important role of information technology in high velocity, high reliability health care organizations, understanding how HIT enables or constrains work practices in multi-disciplinary teams and therefore impacts performance is an important issue for information
systems research and can also inform questions of how technology influences work in intensive work groups in organizations.

In order to understand how HIT affects performance in health care organizations, I focus on communication as one of the most critical characteristics of the health care context for effective work practices and thus for performance. In particular, I draw on Relational Coordination Theory, which identifies specific dimensions of relationships that are required for effective role-based coordination through communication in complex knowledge processes (Gittell et al., 2010). Empirical studies have shown that high levels of relational coordination are critical for performance in high reliability organizations, including health care organizations (e.g., Gittell et al., 2010).

I conducted a qualitative case study of an intensive care unit (ICU) and a general medical/surgical unit in a level two trauma center, with the goal to understand how health IT (i.e., the EHR system) enabled and constrained relational coordination in high velocity, high reliability situations. In particular, I developed a model of foundational and meta-level IS affordances for coordination and effects of enactment variations in groups on relational coordination. Though my research is directly applicable to high velocity health care, the complexity of work and importance of work groups is a general phenomenon in organizations. The question of how we use technologies to facilitate complex, non-routine work is relevant to other settings, and I hope to extend the scope of the theoretical model beyond its context in future research.

The dissertation is organized as follows:

In Chapter 2, I review key literature from the fields of information systems affordances, health IT, and coordination in high velocity, high reliability environments, which informed this research.

In Chapter 3, I discuss the research design and methodology of this qualitative case study.

In chapters 4 to 7, I review the data analysis and findings, which detail foundational and meta-level information systems affordances for coordination, components of their
enactments, and effects of enactment variations on relational coordination in multi-
disciplinary health care teams.

In Chapter 4, I discuss the collaborative nature of relationships in the ICU and
differences with GU and with consultants. I further review the core communicative processes
and the role of the EHR system in interactions among clinicians in each process.

In Chapter 5, I identify the foundational IS affordances for coordination in the ICU
and show that enactments of the affordances in teams depended on use of the EHR system by
others, rules and regulations, and feature fit.

In Chapter 6, I discuss enactment variations of four essential foundational IS
affordances for coordination and identify why variations occurred and how these variations
enabled or constrained relational coordination on a day-to-day practice level. I contrast
differences between the ICU, a general medical / surgical unit, and in interactions with
consultants. I introduce the central role of a new, distinct relational coordination
communication dimension ‘comprehensive communication’, which reinforced shared goals,
shared knowledge and mutual respect in day-to-day practice.

In Chapter 7, I synthesize variations and their effects. I demonstrate how effects of
enactment variations on relational coordination were contextualized and depended on how
team members enacted the meta-level affordances for Facilitation, Supplementation and
Substitution of verbal communication (i.e., how they incorporated verbal communication) in
situations of varying complexity and time constraints. Once again, I contrast differences
between the ICU, a general medical / surgical unit, and in interactions with consultants.

In Chapter 8, I conclude by discussing the findings. I propose a model of
foundational and meta-level IS affordances for relational coordination and consider the
theoretical and practical implications.
CHAPTER 2. LITERATURE REVIEW

In this chapter, I review key literature, which informed this research, from the fields of coordination in high reliability, high velocity environments, information systems affordances and health IT.

2.1. Relational Coordination and Organizations

*High Velocity, High Reliability Organizations*

Theorizing about information systems in high reliability, high velocity settings like health care organizations should be informed by the distinctive characteristics of the context, including high stakes and consequences of medical errors, multidisciplinary nature, professionally driven and hierarchical structure, strong influence of regulation, and complexity of IS implementation, and associated implications for learning and adaptation (Fichman et al., 2011).

Health care organizations are examples of High Reliability Organizations (HRO’s), which operate successfully in environments that are characterized by uncertainty and high stakes of decision-making and that are highly dependent on information support (Roberts, 1993). Accidents are more likely in these environments, and consequences can be disastrous. HRO researchers have suggested that successful organizations tend to mitigate the effects of crisis with certain organizational principles (Weick et al., 1999; Roberts, 1993; Roberts & Tadmor, 2002; Roberts et al., 2005), and have emphasized the importance of concepts such as distributed cognition, collective mind and sensemaking (e.g., Hutchins, 1995; Weick & Roberts, 1993). Health care organizations like trauma centers and their first responders, trauma units and intensive care units further operate in high velocity environments, where decisions must be made rapidly in daily work practices (Faraj & Xiao, 2006; Yun et al., 2005).
Adaptive Coordination

This study takes a practice approach, which recognizes the centrality of everyday activity to organizational outcomes (Feldman & Orlikowski, 2011). Effective coordination in high velocity, high reliability contexts requires work practices that support adaptive coordination, which is highly dependent on information and communication.

Situations in high velocity, high reliability organizations differ according to uncertainty, time constraints, and reciprocal interdependence of tasks (Gittell et al. 2010). When situations change, adaptive coordination is required (e.g., Argote, 1982). Health care teams have to adapt coordination to the task, the general situation and the team in order to operate effectively (Grote et al., 2010). Different concepts of adaptive coordination have been proposed and studied in relation to situational changes, such as expertise-based coordination practices and dialogic coordination practices (Faraj & Xiao, 2006), programmed and non-programmed means of coordination (Argote, 1982), directive and empowering leadership (Yun et al., 2005) and dynamic delegation (Klein et al., 2006).

For example, a study of a trauma unit found that two categories of coordination practices were necessary for effective patient care according to different coordination situations: expertise and dialogic processes (Faraj & Xiao, 2006). Expertise coordination processes “…facilitate the management of skill and knowledge interdependencies in a dynamic and highly situated context” to support information sharing across professional groups with different medical expertise (Faraj & Xiao, 2006, p.1158). The teams adapted their coordination to dialogic processes to deal with situations that involved disagreements about next treatment steps, deterioration of the patient despite treatment, compromised patient safety, or inappropriateness of protocols for an emergency. These practices (i.e., epistemic contestation, joint sensemaking regardless of Communities of Practice boundaries, cross-boundary intervention, and protocol breaking) occurred infrequently (i.e., in less than ten percent of situations) and typically involved contentious interactions between professional groups.

Communication is particularly important in dynamic environments (Ren et al., 2008). Adaptive coordination processes are impeded if participants lack awareness of processes beyond their immediate workspace (e.g., Ren et al., 2008), and if they do not contribute
Role of Professional Groups and Status Differences

Ensuring consistency of knowledge sharing is the most difficult expertise coordination practice (Faraj & Xiao, 2006). While specialization and hierarchy are necessary for the coordination of health care teams, epistemic differences between medical professionals and strong attachment to professional Communities of Practice may inhibit adaptive coordination practices. Status hierarchy is strong in health care organizations (e.g., Nembhard & Edmondson, 2006). The literature on organizational and group learning has increasingly advocated the importance of status and power and challenged rational models of expertise collaboration and learning (e.g., Bunderson & Reagans, 2011). These studies suggest that status differences can be inhibitive for coordination and adaptive responses. For example, status differences inhibited anchoring on shared goals and communication across boundaries, such as knowledge sharing, helping and help seeking behavior, and consideration of insights of lower-status team members (Bunderson & Reagans, 2011; Nembhard & Edmondson, 2006; Van der Vegt et al., 2010). Reports of negative effects dominate in the organization science literature, although positive effects on team learning were observed with certain leadership characteristics (Rose, 2011; Van der Vegt et al., 2010).

This is particularly problematic for collaboration in multidisciplinary health care practices, which are often characterized by ambiguity and struggle with developing meaning (Oborn & Dawson, 2010). For example, a recent case study of multidisciplinary decision meetings of medical teams showed participants’ focus towards own specialties including epistemic views, distinctive tacit knowledge bases and differences in how specialists viewed patients, and a large role of implicit hierarchies (Oborn & Dawson, 2010). Values, traditions and deindividualization based on hierarchical role structures play even stronger roles for legitimizing work practices in high velocity contexts such as trauma units (Klein et al., 2006) or emergency medical response. Cultural differences and trust also affected cooperation and information sharing in emergency medical response (Horan & Schooley, 2007; Horan & Schooley, 2005).
Relational Approaches to Coordination

Cross-functional relationships are essential, considering the increasing medical knowledge, specialization and interdependences enabled by new care practices and technologies (Nembhard & Edmondson, 2006). Relational approaches to coordination are particularly suitable to study cross-functional coordination in high velocity, high reliability health care contexts, because these approaches are recognized as valuable perspectives for explaining coordination of complex work processes and knowledge work (e.g., Gittell et al., 2010).

‘Conventional’ workflow-based approaches to coordination focus on interdependencies among resources and activities, and tend to assume that predefined mechanisms can be specified (e.g., Malone et al., 1999). Relational approaches to coordination argue that coordination of knowledge work and complex processes should focus on the interdependence of people, distributed specialized skills, and content and circumstances of coordination. Relational approaches to coordination in the literature include Relational Coordination Theory (Gittell, 2011), expertise coordination (Faraj & Sproull, 2000), Transactive Memory Systems (e.g., Brandon & Hollingshead, 2004; Lewis, 2004; Choi et al., 2010), and sensemaking (Weick, 2009).

Relational Coordination Theory

Relational Coordination Theory (RCT) is a theory of coordination that captures how people make work happen in the many situations involving non-routine work in high reliability organizations. Instead of focusing on abstract processes, workflows and resources, the argument is that if you can make the relationships happen, you can make the work happen despite the complexity. RCT focuses on cross-functional relationships, which are more challenging than relationships within functions due to epistemic and status differences between specialists (Gittell, 2011).

Relational Coordination Theory argues that coordination of knowledge work in high-reliability settings is carried out in the context of relationships with other group members and occurs through a mutually reinforcing circle of relational ties and communication ties (Gittell, 2011). Developed in the context of the flight departure process and applied to
numerous health care settings, the theory identifies dimensions of relationships, which are required for effective role-based coordination in complex knowledge processes (Gittell et al., 2008). The construct dimensions originate in the organizational literature on group processes (Gittell, 2001; Gittell, 2002; Gittell, 2006).

Relationships provide additional capacity for coordinating work (Gittell, 2006). In particular, participants must be connected by relationships of shared knowledge, shared goals and mutual respect for effective coordination, which is represented by frequent, timely, accurate, and problem-solving communication (Gittell et al., 2010). Effective communication happens:

1) When team members know each other’s roles in an interdependent work process instead of focusing on functional knowledge only (shared knowledge),

2) When team members work towards overarching goals and see the big picture instead of focusing on potentially sub-optimal functional goals (shared goals), and

3) When team members respect each other and are willing to communicate across hierarchical boundaries (mutual respect).

‘Shared knowledge’ represents the cognitive basis, or shared cognition, of coordination, while the ‘shared goals’ and ‘mutual respect’ dimensions seek to capture collective identity with the awareness of the value of others’ contributions as part of the overall work process (Gittell, 2006).
Figure 1 shows the Relational Coordination construct.

![Figure 1: Relational Coordination Theory (Gittell, 2011b)](image)

The communication dimensions of Relational Coordination Theory are grounded in research on coordination in organizations (Gittell et al., 2010). Effective communication is represented by frequent, timely, accurate and problem-solving communication in Relational Coordination Theory, while ineffective communication is represented by infrequent, delayed, inaccurate and ‘finger-pointing’ communication. Effective coordination has also been described as frequent, high-quality communication, where high-quality communication is represented by timely, accurate and problem-solving communication (Gittell et al., 2008). While high quality relationships promote frequent, timely, accurate and problem-solving communication, relational coordination studies have also shown that low quality relational dimensions promote infrequent, delayed, inaccurate and ‘blaming’ communication (Gittell, 2006).

Table 1 summarizes the communication dimensions of RCT with a short overview of their characteristics and example survey questions.
Relational Coordination Theory has received increasing attention in the organizational literature and has been applied to different organizational contexts. Jody Hoffer Gittell and colleagues have applied Relational Coordination Theory in several high reliability organizational contexts, including airline industry (Gittell, 2000; Gittell, 2000b; Gittell, 2001) and health care. Health care studies encompassed diverse empirical settings. For example, high levels of relationships were associated with effective surgical care delivery.

<table>
<thead>
<tr>
<th>Communication Dimensions</th>
<th>Characteristics, grounded in organizational literature (Gittell, 2011b; Gittell, 2006)</th>
<th>Sample Survey Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent</td>
<td>Frequency of communication • Highest level: frequent communication • Lowest level: infrequent communication Important for coordinating interdependent work and for building relationships through repeated interaction</td>
<td>How frequently do you communicate with each of the groups about the status of … patients? (1=never, 5=constantly) (Gittell et al., 2010; Gittell, 2002) How frequently did you communicate with each of these people about the status of patient X? (Gittell et al., 2008)</td>
</tr>
<tr>
<td>Timely</td>
<td>Timeliness of communication • Highest level: timely communication • Lowest level: delayed communication Important for task performance in interdependent work</td>
<td>Do people in these groups communicate with you in a timely way about the status of … patients? (1=never, 5=always) (Gittell et al., 2010; Gittell, 2002) Did these people communicate with you in a timely way about the status of patient X? (1=never, 5=always) (Gittell et al., 2008)</td>
</tr>
<tr>
<td>Accurate</td>
<td>Accuracy of communication • Highest level: accurate communication • Lowest level: inaccurate communication Important for task group effectiveness in HRO’s, implications for trustworthiness and knowledge seeking</td>
<td>Do people in these groups communicate with you accurately about the status of … patients? (1=never, 5=always) (Gittell et al., 2010; Gittell, 2002) Did these people communicate with you accurately about the status of patient X? (1=never, 5=always) (Gittell et al., 2008)</td>
</tr>
<tr>
<td>Problem-solving</td>
<td>Problem-solving nature of communication • Highest level: communication focused on solving the problem and sharing responsibility • Lowest level: conflict &amp; communication focused on finger-pointing, blaming, blame avoidance Important for task performance in interdependent work, to adapt collectively to unanticipated negative situations</td>
<td>When an error has been made regarding joint replacement patients, do people in these groups blame others rather than sharing responsibility? (1=never, 5=always) (Gittell et al., 2010; Gittell, 2002) When problems occurred regarding the care of patient X, did these people blame others or work to solve the problems? (Gittell et al., 2008)</td>
</tr>
</tbody>
</table>
in hospitals (Gittell, 2002) and with job satisfaction and resident quality of life in nursing homes (Gittell, 2008b). Recent research has also explored the role of the theory in other organizational contexts. For example, a study of three organizations in the software, electronics and finance industries showed that high levels of relationships predicted learning from failures in organizations by enhancing psychological safety, which encouraged team members to discuss issues across functional roles (Carmeli & Gittell, 2008). Relational coordination levels in cross-agency coordination of criminal justice and social service agencies influenced outcomes associated with reentry of offenders (Bond & Gittell, 2010). Further, a recently proposed a model of relational bureaucracy theorized the contributions of relational coordination between workers, relational coproduction between workers and customers, and relational leadership between workers and managers on outcomes in organizations (Gittell & Douglas, 2012).

The relational coordination research community has grown in recent years, and other researchers have also applied the theory in different contexts. The primary area of application has been health care. For example, Noel et al. (2013) showed that relational coordination scores were associated with scores that assess chronic illness care. Cramm and Niboer (2012) showed that the implementation of the chronic care model of disease management in primary care practices improved care delivery by increasing the level of relational coordination among different professional groups. Rachna et al. (2008) used relational coordination theory to explain how health care organizations in a decentralized supply chain surrounding the treatment of heart attack patients coordinated effectively and achieved significant process improvements in the absence of formal incentives because of close relationships between providers.

Recent research has also applied relational coordination to other service industries like retail and banking. For example, Mayer et al. (2009) found that relational coordination among service employees contributed to customer satisfaction and perceptions of service quality in retail. Dossa and Kaeufer (2013) considered relational coordination as a part of organizational ethics for sustainable financial innovations.

While many researchers have applied the relational coordination construct in its original form in different contexts, to my knowledge no research has proposed an additional communication dimension for Relational Coordination Theory.
The level of relational coordination has been linked to performance (i.e., effective and efficient health care delivery) in several large-scale empirical studies across hospital units and clinic sites (e.g., Gittell et al., 2010). Performance effects of relational coordination are expected to be highest in high velocity settings with uncertainty, time constraints, and reciprocal task interdependence (Gittell et al., 2010). The Relational Coordination Research Collaborative provides a quantitative assessment of relational coordination through a seven-item questionnaire, which several large health care organizations like Kaiser Permanente have begun to incorporate in their practices to assess the culture of cross-functional communication in teams or to evaluate the effectiveness of selected training programs (Relational Coordination Research Collaborative, 2014).

**Relational Coordination Theory and IT Effects**

A major interest area in the relational coordination community is organizational learning and the types of interventions that can increase the level of relational coordination in teams, units or organizations. Examples of interventions include cross-functional meetings, training and boundary spanners (Gittell et al., 2010).

One area of research that is not as well developed is a thorough understanding of the role of information systems for relational coordination. The relational coordination research community acknowledges information systems as a cross-functional coordination mechanism and structural intervention with potential effects on relational coordination (Gittell, 2009). However, few empirical studies have focused on information systems as one particular intervention with potential effects on relational coordination. These studies utilize quantitative models, with a composite index for relational coordination and lean measures for information systems use (i.e., number of cross-functional interfaces mediated by IT, perceived frequency of use, inclusiveness) (Gittell, 2000; Hagigi, 2008; Gittell, 2009). While there is evidence of positive associations between information systems use and the level of relational coordination, there are also examples of negative associations (Gittell, 2000; Gittell & Weiss, 2004).

A goal of this dissertation study is to bring depth to the role of information systems that the relational coordination literature has not yet acknowledged.
2.2. Information Systems Affordances

I draw on the literature of information systems affordances, because the concept better captures the complexity HIT use than lean measures when multidisciplinary groups use multifaceted information systems in non-routine work for coordination.

The information systems affordances (IS affordances) literature is an emerging research stream in the information systems research community. IS researchers adapted the concept from ecological psychology to explain how information system features make actions possible. A common example from ecological psychology is that a chair may offer a person the opportunity for sitting. This opportunity or potential for action is not a property of the chair. Instead it is a property of the relationship between the features of the chair and the goals and abilities of the person (Gibson, 1977).

A seminal paper in the information systems field defined IS affordances as “…the possibilities for goal-oriented action afforded to specified user groups by technical objects” (Markus & Silver, 2008, p.622). Others have described affordances simply as capabilities (Zammuto et al., 2007) or “…what the user can do with the technology” (Goh et al., 2011, p.568). Recent research has proposed a more detailed definition of IS affordances as “…the potential for behaviors associated with achieving an immediate, concrete outcome and arising from the relation between an object (e.g., and IT artifact) and a goal-oriented actor or actors” (Volkoff & Strong, 2013, p.823).

A challenge using the IS affordances concept with more intuitive names like ‘capabilities’ is that these capabilities may be interpreted as properties of the information system. However, the definitions have in common that information systems provide potentials for action that arise from the relation between features and users. For example, Volkoff and Strong (2013) identified standardizing affordances of an enterprise system in a manufacturing organization. Standardization was built into the system. Instead, standardizing affordances were potentialities that may or may not be actualized in different ways.

The relational concept offers a rich approach to study effects of information systems, because it allows us to conceptualize the opportunities, but also the different use patterns that arise from how features relate to goals and capabilities of specific users and user groups (Markus & Silver, 2008; Volkoff & Strong, 2013). Functional groups in health care teams are
strongly attached to their professional Communities of Practice regarding training, knowledge and work practices, even when they work together in highly interdependent processes like those in intensive care (e.g., Faraj & Xiao, 2006).

The IS field still struggles with how to best adapt and apply the concept of affordances, but recent literature has greatly developed the concept for information systems and added complexity and nuances.

While the term affordance has often been used in a generic way in IS research, some recent literature has identified specific IS affordance types in different settings. For example, two studies identified different IS affordances in the context of health care, which primarily fall into four general IS affordance categories for communication, decision making, accountability and compliance associated with HIT in health care organizations (Sebastian & Bui, 2012). The first study is a longitudinal analysis of an electronic health record (EHR) system implementation in a multi-site medical practice (Strong et al., 2014). The researchers identified eight affordances of the EHR, including capturing and archiving digital data, accessing and using information anytime/anywhere, coordinating care across sites and providers, standardizing and monitoring operations, substituting providers for each others and shifting work across roles, and incorporating information for decision making. In the second longitudinal study, the authors identified evolving affordances of a Computerized Documentation System (CDS) throughout the implementation process of the technology (Goh et al., 2011). In that study, the researchers identified functional affordances such as legible and timely information, reduced redundancy and efficiency in the pre-implementation phase, and abilities to develop templates, to remotely monitor care, and to create graphs associated with advanced features of the CDS in the refinement phase.

Other researchers have recently identified specific IS affordances in the areas enterprise systems and software systems in organizations (Volkoff & Strong, 2013) as well as social media (Majchrzak et al., 2013; Treem & Leonard, 2012). For example, enterprise systems in a manufacturing organization provided basic affordances for recording and accessing information, standardizing and integrating affordances, and visibility affordances and controlling affordances (Volkoff & Strong, 2013).

It is also important to recognize that IS affordances may enable or constrain outcomes, because they are potentials that can be realized in different ways (Majchrzak et al.,
For example, recent research identified an IS affordance of ‘metavoicing’ enabled by social media, which makes it possible for people to react to others’ content very quickly and publicly. The authors theorized that metavoicing can be productive or inhibitive for how online knowledge conversations happen, depending on which mechanisms are triggered (i.e., rapid feedback by many people versus promotion of biased information) (Majchrzak et al., 2013). In the case of the enterprise system, the authors argued that realizing basic affordances for recording accurate inventory data was difficult due to the complexity of the system (Volkoff and Strong, 2013).

Further, the existence of multiple affordances of an information system or even a feature of an information system raises the question of how these potentials may interact in reinforcing or conflicting ways. Volkoff and Strong (2013) argued that we must understand the nature of relationships among affordances in order to understand how certain affordances are actualized. In a longitudinal analysis of an EHR system implementation in a multi-site clinic, the researchers found that the EHR provided multiple affordances, which were related to the same or different goals and interacted with one another in dependencies of various strengths (Strong et al., 2014). For example, actualizations of the affordances for capturing and accessing patient data supported the affordance for coordinating patient care.

How groups deal with IS affordances may be critical for how productive or inhibitive they are for relational coordination. Two recent studies contended that consistency in groups, defined in different ways, could link affordances to organizational outcomes. Leonardi (2013) showed that an engineering team, whose group members used the same features of a new technology for working on similar tasks, experienced a change in informal advice networks. In contrast, no changes in informal advice networks occurred in another team, whose members did not use a common set of features. He argued that the group-level network change was associated with a shared affordance, which arose from the using the same features and being able to interchange their work and compare output.

Strong et al. (2014) noted that consistency of individual actions across functional groups in a multi-clinic health care setting played a role in how organizational affordances were actualized and therefore how organizational outcomes were supported or constrained. The authors argued that consistency of actualization actions was achieved when actualization outcomes were compatible, for example when managers and physicians agreed on standardizing tasks as opposed to requesting standardization and tailoring of contributions by
others. However, case studies have shown that consistency of actions regarding affordances is not easy to achieve. For example, Anderson (2011) observed a variety of physician behaviors in response to enhanced EHR access to facilitate cross-functional work among nurses and physicians.

A goal of this dissertation is to contribute to the literature on IS affordances by identifying specific affordances for coordination in the high velocity environment and examining how the EHR system enables or constrains relational coordination based on enactments of these potentials in multi-disciplinary groups.

2.3. Research on HIT and Practices

In the previous section, I have reviewed recent literature on affordances in the IS field. Several studies have applied the concept of affordances to examine effects of HIT on practice in health care organizations (Strong et al., 2014; Goh et al., 2011; Anderson, 2011). Since I conducted the study in the context of health IT, I now review the health IT literature more broadly in the context of how technology affects practices and relationships in health care teams.

Many research studies have been published in the last ten years in the context of HIT. A recent co-citation analysis of HIT research identified HIT in organizational settings, IT adoption and acceptance, and health care quality issues as the most important HIT topics in IS journals and medicine journals (Gallivan & Tao, 2014).

Table 2 summarizes example studies and key issues in the three focus areas. In the following section, I review some example studies.
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<tr>
<th>HIT Topic</th>
<th>Example Studies</th>
<th>Key Issues</th>
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<tr>
<td>Adoption and Implementation</td>
<td>• Kohli &amp; Kettinger, 2004</td>
<td>Slow adoption and difficult implementation processes e.g.,</td>
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<td></td>
<td>• Lapointe &amp; Rivard, 2005</td>
<td>• Implementation and adoption influenced by resistance, power, identity</td>
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<td></td>
<td>• Davidson &amp; Chiasson, 2005</td>
<td>• Importance of Technology Use Mediation, participatory design, ‘clan control’</td>
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<td></td>
<td>• Lapointe &amp; Rivard, 2007</td>
<td>• Implementation and adoption influenced by resistance, power, identity</td>
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<td></td>
<td>• Cho et al., 2008</td>
<td>• Importance of Technology Use Mediation, participatory design, ‘clan control’</td>
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<td>• Bjorn et al., 2008</td>
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<td>• Jensen et al., 2009</td>
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<td>• Wurster et al., 2009</td>
<td>• Importance of Technology Use Mediation, participatory design, ‘clan control’</td>
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<td></td>
<td>• Mishra et al., 2011</td>
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<td>• Venkatesh et al., 2011</td>
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<td>• Rippen et al., 2012</td>
<td>• Implementation and adoption influenced by resistance, power, identity</td>
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<td>Safety</td>
<td>• Ash et al., 2004</td>
<td>Improvements in accuracy but new challenges for safety e.g.,</td>
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<td></td>
<td>• Berger &amp; Kichak, 2004</td>
<td>• CPOE facilitated medication error risks</td>
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<td>• Koppel et al., 2005</td>
<td>• Improvements in accuracy but new challenges for safety e.g.,</td>
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<td>• Parente et al., 2009</td>
<td>• CPOE facilitated medication error risks</td>
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<td>• Harrington et al., 2011</td>
<td>• Improvements in accuracy but new challenges for safety e.g.,</td>
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<td>Practice</td>
<td>• Davidson &amp; Chismar, 2007</td>
<td>Conditional changes in work practices e.g.,</td>
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<td>• Kane &amp; Labianca, 2011</td>
<td>• IS avoidance</td>
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<td>• Oborn et al., 2011</td>
<td>• Differences in multidisciplinary practices and roles</td>
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<td>• Goh et al., 2011</td>
<td>• Unintended consequences of change in other routines</td>
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Most studies of HIT in the IS field have focused on implementation and adoption. For example, IS researchers have examined resistance to IS implementations. Lapointe and Rivard (2005) found that group resistance behaviors emerged from individual behaviors in early stages of implementation. Lapointe and Rivard (2007) examined implementation success of a clinical information system in three hospitals and proposed a theory of IS implementation, which considered individual use, resistance and organizational configuration models for better predictions of implementation outcomes. Mishra et al. (2011) found that assimilation of EHR systems were influenced by identity reinforcement or deterioration in physician practices. Venkatesh, Zhang and Sykes (2011) argued that variations in initial HIT adoption were associated with network ties (i.e., more connected doctors were less likely to use an E-health care system). Cho et al. (2008) used Actor Network Theory to understand how complex contextual dynamics of existing work practices and institutional setting contributed to challenges with a radiology system implementation. Jensen et al. (2009) combined institutional theory and sensemaking theory to understand the
implementation outcomes of an EHR system in a clinical setting, while Wurster et al. (2009) considered how political and cultural issues contributed to a challenging implementation of an HIT system in a hospital. Kohli and Kettinger (2004) examined adoption of a CDSS system in a hospital by physicians when the implementation was led by the administration versus by physicians. Initial resistance and more widespread adoption in a second physician-led implementation showed the role of social influence by the physician ‘clan’.

Other studies also considered the role of user participation in HIT design and implementation. For example, Davidson and Chiasson (2005) focused on Technology Use Mediation processes in EHR system development and use. TUM processes were crucial for effective assimilation and highly dependent on the institutional environment. Bjorn et al. (2008) emphasized the importance of participatory design with system designers and practitioners in order to achieve effective implementation in regards to standardization and contextual flexibility. Rippen et al. (2012) proposed an organizational framework of HIT implementation, which considers technology, use, environment, outcomes and temporality as five key aspects to capture the complexity of HIT implementations.

Other studies, primarily in the health care informatics field, have looked at how miscommunication or mistakes due to HIT can cause errors and safety issues. Recent research found positive effects of EHR systems on key patient safety measures related to national Medicare inpatient data (Parente et al., 2009). However, a number of studies have argued that HIT improves safety by including automatic checks, yet also introduces new safety issues and errors. For example, a study of a Computerized Physician Order Entry System (CPOE) found that the system facilitated medication error risks due to fragmented and non-intuitive displays (Koppel et al., 2005). A recent review of the health care informatics literature suggested that HIT systems alleviate issues and provide new safety concerns associated with the complexity of systems (Harrington et al., 2011).

Implementation and safety studies of HIT are relevant to understand the context of HIT in hospitals. However, in this dissertation I focused on effects of HIT on relationships and communication practices in an organization with an established EHR system. Some studies in the IS field have focused on implications for practices and disruptions of practices due to HIT. Of these studies, few have looked at the implications of HIT once implemented on relationships and communication in health care teams, and even fewer have focused on high velocity environments.
Three HIT studies on affordances fall into the category of literature that focuses on implication on practices (Strong et al., 2014; Goh et al, 2011; Anderson, 2011). Strong et al. (2014) developed a theory of actualization processes of organizational affordances based on a longitudinal study of an EHR system implementation in a multi-site health care organization. The researchers found that realizing EHR potentials was an individual-level process that depended on individual abilities, features and characteristics of the work environment such as resources and norms. Consistency, extent and alignment of individual actions contributed to the emergence of organizational level outcomes. Goh et al. (2011) conducted a longitudinal study, in which they found that routines changed after implementation of a Computerized Documentation System. The researchers examined two routines of different complexity in an ICU (i.e., multidisciplinary round and consult), and found that both routines evolved through interactions with the new technology as the technology’s affordances evolved as well. In this process, leadership and personal innovativeness were critical in enabling virtuous cycles of coevolution of routines and affordances. Anderson (2011) examined nursing work practices in the context of HIT affordances and argued that work practices were influenced by difficulties of acting on affordances. Behavioral changes associated with work practices occurred in particular at the affordance threshold.

Davidson and Chismar (2007) considered implications of HIT for practices by examining social structure changes associated with the implementation of a CPOE system in a hospital. Although clinical roles were not altered dramatically, changes in skills, tasks, and interactions were evident. The research noted the importance of institutional forces in how technology influenced changes in practice.

Novak et al. (2012) also highlighted the complexity of IT implications for practices. The researchers found that changes in the medication administration routine associated with a new system triggered unintended changes and challenges at the intersection with other routines.

Kane and Labianca (2011) examined passive post-adopter resistance to using HIT. IS avoidance by physicians affected patient care depending on the physician’s position in the group’s workflow. While physicians developed compensating network structures for IS avoidance, negative effects on patient care outcomes occurred when these individuals were central in teams.
Oborn et al. (2011) examined implications of an EHR system on use practices in a multi-specialty clinic setting. Although this study does not focus on a high velocity setting, it is very relevant for this dissertation in several ways. The researchers observed vastly different roles of the EHR for practices across professional groups. For example, surgeons and nurses included very little IT use in patient encounter practices, while radiologists used IT extensively. On the other hand, EHR use also enabled unity across practices despite diverse specialist practices, because specialties used the system to align themselves to assessments by others. An interesting question is if this effective ‘non-standardized’ use of the EHR system among specialties also applies to effective multi-disciplinary work practices in a high velocity setting such as an ICU. This study is also highly relevant because it illustrates variations of status and the importance of existing relationships in use practices of the EHR.

Lastly, a recent study in the health care informatics field contributed an overview of practices of acute care clinicians and showed the importance of physician documentation in the EHR for practices associated with understanding patients’ conditions, communicating with others and making decisions (Penoyer et al., 2014).

A goal of this dissertation is to contribute to the IS literature, which focuses on the implications of HIT, once implemented and integrated into use by multi-disciplinary teams, on practices and relationships. This dissertation further offers the additional perspective of a high velocity setting.

Following the review of key literature, I now present the guiding research questions for this research study.
2.4. Research Questions

I had two guiding research questions to investigate the interrelationships between IS affordances and relational coordination in high reliability, high velocity organizations for my field research:

1) How do different IS affordance types affect Relational Coordination?
   - I expected that different IS affordance types for coordination offer distinct opportunities and may have distinct effects on the relational coordination dimensions.
   - I expected that IS affordance types interact in productive or inhibitive ways for relational coordination by reinforcing each other or conflicting with each other.

2) How do group-level enactments of IS affordances influence potential effects on Relational Coordination?
   - I expected that enactments of IS affordances in teams play a critical role for enabling or constraining effects on relational coordination.
   - I expected that differences among professional groups and status influence enactments of IS affordances in teams.

Summary

In this chapter, I reviewed key literature from the fields of coordination, information systems affordances, and health IT. These research streams inform the study of information systems effects on relationships and communication in a high reliability, high velocity health care setting. I established the research questions, which focus on identifying information systems affordances for coordination and examining their effects on relational coordination, considering the role of how these affordances are enacted in multi-disciplinary groups.

In the next chapter, I will review the research design and methodology for conducting this qualitative case study in a trauma center.
CHAPTER 3. RESEARCH DESIGN AND METHODS

3.1. Introduction

I utilized the case study as a research strategy as suggested by Eisenhardt and Graebner (2007, p.25): “Building theory from case studies is a research strategy that involves using one or more cases to create theoretical constructs, propositions and/or midrange theory from case-based, empirical evidence.”

In particular, I conducted an in-depth, interpretive case study of an intensive care unit to examine effects of information systems affordances on relational coordination in a high velocity, high reliability environment. A single case study is suitable for developing a detailed contextual understanding of an IT artifact (Davidson & Chismar, 2007). I further examined a general medical / surgical unit in order to contrast differences with the intensive care unit.

I chose a case study methodology and qualitative method because it is a rich, flexible method to explain complex interactions among IS users, organizations and technology (Dubé & Paré, 2003; Myers, 1997). I wanted to understand how multi-disciplinary teams use the electronic health record system in each work process, which affordances the system offers for communication, how groups enact these potentials and how this matters for relational coordination. Further, a qualitative method is most suitable to understand information systems affordances and their enactments, which are nuanced and contextual (Volkoff & Strong, 2013). Lastly, few empirical studies could inform my research regarding implications of HIT on multi-disciplinary relationships and communication in high velocity post-adoption settings. A case study methodology is considered as useful when few previous empirical studies exist (Benbasat et al., 1987; Lee, 1989).

3.2. Case selection

The research site was a level two trauma center in an urban environment with more than 1,200 physicians and more than 3,000 employees. In 2007, the hospital implemented the Epic EHR system, which has been used and integrated in inpatient and outpatient processes hospital-wide. Epic is one of the most successful vendors of health information systems in
the United States, and many hospitals have implemented or are in the process of adopting Epic EHR systems.

The primary focus of this case study was a medical intensive care unit (ICU) within the trauma center. The ICU is a unit in the hospital, which provides care for critically ill and high-risk patients. Overall, approximately eight dedicated ICU physicians (i.e., intensivists), seventy nurses, as well as ICU respiratory therapists and ICU pharmacists worked in the ICU. Specialist physicians and peripheral team members such as physical therapists were consulted and only visited the unit when necessary. Because ICU patients were critical ill and required close monitoring, one nurse was responsible for one to two patients during a shift. At any time, one to two ICU physicians, residents and up to eighteen nurses worked with approximately eighteen patients in the ICU. The ICU had several residents who worked in the ICU for one month at any time, as the trauma center was associated with a university medical school and participated in resident training programs. Further, the ICU provided a Rapid Response Team and trauma team for emergencies in other hospital units.

The secondary focus of this case study was a general medical / surgical unit (GU) in the trauma center, which focused on patients with medicine diagnoses such as cellulites, GI bleeding, pneumonia, and diabetes. The unit had a high turnover with approximately five days average length of stay and eight to ten discharges per day. The unit had thirty-two beds and a general team of approximately sixty-five clinicians, including forty-five nurses. Nurses typically worked with four to five patients during day shifts, five to six patients during evening shifts, and six patients during night shifts. Most primary physicians were hospitalists, who were frequently assigned to the unit but had patients in several units.

I chose an ICU in a trauma center as the primary empirical setting because intensive care units meet the requirements of complex, dynamic, time-constrained, and stressful high reliability settings with dynamic teams (i.e., shifts and rotations), specialized knowledge and hierarchy (Gittell et al., 2010; Rose, 2011). Further, the ICU used health information technology, in particular the electronic health record system, in all core communicative processes. I added the GU in the second phase of the study in order to better understand the roles of IS affordance types and their enactment variations for communication in a lower velocity environment with a more dynamic, loose team structure. For example, specialized ICU attending physicians (i.e., intensivists) were physically present in the unit throughout the whole shift and conducted a daily multi-disciplinary meeting (i.e., the round). In contrast, GU
attending physicians (i.e., hospitalists) were responsible for patients on different floors and often visited a particular unit once per day.

**3.3 Data Collection Process**

The primary data collection method was semi-structured interviews, in accordance with the requirements of the University of Hawaii Institutional Review Board and the Medical Research and Institutional Review Committee of the trauma center. I did not record observations as a data collection method, in accordance with the requirements of the Medical Research and Institutional Review Committee of the trauma center. However conducting all interviews in the units allowed me to observe clinicians’ interactions in the core communicative processes and their use of the EHR system for my own understanding of processes, information systems affordances and communication dynamics.

The Medical Research and Institutional Review Committee of the trauma center conducted an approval process of approximately six months. An intensivist in the ICU agreed to be the subinvestigator for the project. The intensivist helped me to identify and recruit ICU physicians, consultant physicians and residents. He further introduced me to the ICU nurse manager, who enabled access to ICU nurses, ICU respiratory therapists and consultant physical therapists. The ICU nurse manager further facilitated contact with a nurse manager, who enabled research access in the GU. I could typically conduct additional ad-hoc interviews with clinicians who were willing to participate in an interview after scheduled interviews in the units. I interviewed several participants from each professional group when possible, in order to maximize cross-functional participation and variations in opinions (Miles & Huberman, 1994).

The data collection process was iterative. I prepared for data collection with two preliminary test interviews with an ICU nurse and an ICU physician from two hospitals not associated with my empirical setting. I learned about the EHR system by participating in online course modules and by familiarizing myself with the system in the ICU training area. I met with the subinvestigator several times to learn about the pertinent topics related to the EHR system.
I conducted a total of forty-one interviews that ranged from approximately thirty minutes to ninety minutes in length, depending on the availability of participants. Two interviewees participated in both phases of the data collection. Figure 2 summarizes the data collection process through semi-structured interviews.

In the first phase, I completed eighteen cross-functional interviews in the ICU. In the second phase, I completed twenty-three cross-functional interviews in the same ICU and in a GU. In both phases, I also conducted interviews with consultant clinicians who typically visited units when primary physicians consulted them for additional expertise.

In the first phase of data collection, my goal was to understand the core communicative processes and to identify the IS affordance types for coordination. Interview questions targeted detailed step-by-step descriptions of how interview participants used the EHR information system in each core communicative process.

I created an initial theoretical sampling strategy, in which I chose interview participants and questions with the goal to obtain a comprehensive picture of professional groups, situations and IS affordances for coordination (Eisenhardt, 1989). I identified the core communicative processes (i.e., handoff, round, order, consult, documentation in notes) through a literature review (Goh et al., 2011), preliminary interviews, and conversations with the subinvestigator at my research site prior to data collection (Eisenhardt & Graebner, 2007). The strategy categorized communicative processes according to involvement of...
clinicians of the same or different disciplines and status. Figure 3 shows the theoretical sampling strategy with the goal to capture and understand the core communicative processes and interactions between different professional groups.

Figure 3: Theoretical Sampling of Core Communicative Processes Within Unit

I asked interview participants to describe their work, interactions with others and use of the EHR during patient handoff, order processing and management, multidisciplinary rounding, consulting, and documentation in notes. For example, when nurses began a shift in the ICU, they spoke about tasks and key issues for a patient with the nurse who ended the previous shift. In this core communicative process, team members of the same discipline and status typically communicated verbally and often used the EHR system at the same time. In this context, I considered how team members enacted the coordination potentials of the EHR system in the absence of professional and status differences.

On the other hand, ICU team members met each day in the morning for a formal multidisciplinary round, where each resident presented an assessment of a patient and other team members discussed questions and looked up pertinent information in the EHR. In this core communicative process, the team established the goals for the day. In this context, I considered how team members enacted the coordination potentials of the EHR system in the presence of professional and status differences.
I completed the first phase of data collection when theoretical saturation and redundancy was reached in interview responses (Lincoln & Guba, 1985). I discussed the findings and utilized a theoretical sampling strategy to modify interview questions for the second phase of data collection.

My goal for the second phase of data collection was to obtain more specific answers about effects of the identified IS affordance types on relational coordination. I dedicated the majority of question to communication with notes, which emerged as a key communicative process among professional groups in the ICU and particularly with consultants. I added six interviews in a general medical/surgical unit in order to gain perspective on the identified IS affordance types in a lower-velocity setting, as well as to understand enactments of affordances in an environment where teams did not work in close proximity as was the case in the ICU.

I focused the questions in the second phase of data collection on expertise coordination situations (i.e., coordination situations that focus on knowledge sharing in a dynamic and highly situated context) versus dialogic coordination situations (i.e, infrequent emergency situations that include contentious interactions) (Faraj & Xiao, 2006). Although I was interested in both types of situations, interview participants rarely mentioned dialogic coordination situations when describing day-to-day relational coordination. I decided to focus the limited interview time on expertise coordination situations in order to add a more contextualized understanding of these situations to the coordination literature.

I completed the second phase of data collection when theoretical saturation and redundancy was reached in interview responses (Lincoln & Guba, 1985). I presented and discussed preliminary findings and conducted the final data analysis.
3.4. Data Analysis Process

I conducted coding in Excel and with the Dedoose coding software. I utilized descriptive coding in the majority of the coding process (Saldaña, 2009). I began the coding process with high-level a-priori codes to identify coordination affordances of the EHR system and gain an overview of the relational coordination dimensions in the ICU. I conducted several rounds of coding on both sets of interviews to iteratively refine IS affordance types, emerging themes of enactment components and meta-level affordances, as well as relational coordination effects. I utilized pattern coding for a more inferential set of codes that explained enabling and constraining effects of IS affordance types on relational coordination in day-to-day practice (Miles & Huberman, 1994; Saldaña, 2009). The list of codes, including classification as descriptive or pattern codes, can be found in Appendix A. Two dissertation committee members coded sub-samples of the content in order to verify the reliability of my coding (Miles & Huberman, 1994).

In the data analysis of the interviews conducted in first phase, I identified a set of nine affordances for coordination. I used the definition of an IS affordance as “…the potential for behaviors associated with achieving an immediate, concrete outcome and arising from the relation between an object (e.g., an IT artifact) and a goal-oriented actor or actors” as a guideline (Volkoff & Strong, 2013, p.823). I followed recent IS literature to identify affordances: “Through observation and/or interviews with questions such as “what did the technology enable you to do,” “what did it make more difficult to do,” “what did you use the technology for,” … the actual events that allow for retrodiction back to the affordances can be uncovered” (Volkoff & Strong, 2013, p.823). With this guideline, I identified IS affordances based on descriptions of actions towards immediate, concrete outcomes that are associated with the group-level goal relational coordination.

Participants describe actions related to each IS affordance type from an information access perspective and from an information sharing perspective. Positive and negative statements described different enactments of IS affordances and often indicated the experience with coordination in these situations. I therefore coded both positive and negative statements as evidence of an IS affordance type. In this process, I recognized three components that determined how IS affordances for coordination were enacted within groups (i.e., use by others, rules and regulations, feature fit) and how coordination was experienced. I further recognized that four foundational IS affordance types were critical for effective
Relational coordination in this empirical setting (i.e., Immediacy, Visibility, Comprehensiveness and Interpretability), which focused the data analysis of the second phase interviews.

The data analysis of the second phase interviews confirmed the essential role of the three components for enactment of IS affordance types in the ICU as well as in the GU. In the first round of coding, I coded affordance types, group-level enactments of affordances types, and enabling or constraining effects on relational coordination. When I focused on understanding the greatest challenges with relational coordination described in the interviews, I recognized an emerging theme of meta-level affordances (i.e., Facilitation, Supplementation and Substitution of verbal communication), which were critical for how enactment variations of the foundational affordances in teams affected relational coordination. I further applied emerging codes, which captured reasons for variations of how team members enacted affordances.

The GU had the following theoretical significance in the data analysis of the second phase interview data.

- The GU interviews showed that the identified IS affordance types and enactment components were not unique to only one unit and the high velocity context.

- ICU team members in the first round interviews repeatedly noted that communication and relationships were strong among ICU core members because of the close proximity, which was not the case with consultant physicians or among team members in general units. In the data analysis, I therefore compared enactments of IS affordances and relational coordination effects among team members of different professional groups and status, and contrasted these differences in the data analysis.

1) Within the ICU core team (close proximity),
2) Within the GU core team (lack of close proximity),
3) With consultants (lack of close proximity)
Relational Coordination on a Day-to-Day Practice Level

In the first phase of data collection, I asked about the relational dimensions (i.e., shared goals, shared knowledge, mutual respect) on a general level in line with the relational coordination survey items (e.g., Gittell et al., 2010). My goal was to obtain a general perspective of the collaborative nature of the ICU. I expected that the general collaborative or non-collaborative nature of relationships in teams influence how team members use the EHR for coordination (Oborn et al., 2011).

However, I also asked interview participants what the relational dimensions meant to them in daily practice because of the generic nature of the concepts. My goal was to ground the analysis in day-to-day enactments of practices, which includes situated use of technology (Oborn et al., 2011). This strategy allowed me to ask specific questions about effects of the EHR on the relational dimensions. It further allowed me to gain a nuanced perspective of the relational dimensions.

For example, clinicians agreed on a shared goal of ‘getting the patient better’. Some interview participants mentioned that consensus on such a goal among professional groups did not necessarily mean that consensus existed on how to achieve this goal. When I specified the relational dimension of shared goals to a practice level, I learned that ICU teams enacted this shared goal by establishing a plan of the day for each patient, which was discussed in the multidisciplinary round, shared in a daily progress note in the EHR and potentially revised and updated throughout the shift. On a day-to-day practice level, it was important how shared goals were translated into an integrated plan for the day and what role the EHR played in the process. While interview participants found it difficult to relate the role of the EHR to the high-level perspective of shared goals (i.e., ‘getting the patient better’), while they easily related the role of the EHR to the relational dimensions on a day-to-day practice level.

In this context, I coded the relational dimensions based on the practice level, as shown in Table 3.
<table>
<thead>
<tr>
<th>Table 3: Relational Dimensions on a Day-to-Day Practice Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit-Level Relationships (e.g., Gittell, 2011b)</strong></td>
</tr>
<tr>
<td>Shared goals</td>
</tr>
<tr>
<td>Shared knowledge</td>
</tr>
<tr>
<td>Mutual respect</td>
</tr>
<tr>
<td>Frequent communication</td>
</tr>
<tr>
<td>Timely communication</td>
</tr>
<tr>
<td>Accurate communication</td>
</tr>
<tr>
<td>Problem-solving communication</td>
</tr>
<tr>
<td>Comprehensive Communication</td>
</tr>
</tbody>
</table>

**Summary**

Chapter 3 summarized the research design and methodology of this qualitative case study. The following chapters focus on the data analysis. In Chapter 4, I will discuss the general collaborative nature of relationships in the ICU. I will contrast differences to relationships with consultants, as well as differences in relationships between team members in the ICU and in the GU. I will further introduce the core communicative processes and the role of the EHR system in interactions.
In the previous chapter, I discussed my focus in this research on the relational dimensions of relational coordination from a day-to-day practice perspective. I specified the dimensions from high-level relationships (e.g., ‘Do others share your goals for the care of a patient?’) to associated concepts that apply to daily coordination practices in order to ask specific questions on how the EHR enabled or constrained coordination among team members (e.g., ‘How does the EHR help you establish and communicate the shared plan of the day for a patient’). In chapters 5 to 7, I will focus on effects of how team members enacted the EHR coordination affordances on relational coordination in day-to-day practice.

In this chapter, I give an introductory overview of the general collaborative nature among professional groups in order to put into perspective how team members used the EHR and how different use patterns may enable or constrain relational coordination on a day-to-day practice level.

4.1. Perceptions of Unit-Level Relational Coordination

The Core ICU Team

The core ICU team (i.e., ICU physician, nurses, respiratory therapists and pharmacist) had developed strong working relationships among professional groups throughout the hierarchy due to the close proximity and stability of team members that worked together in the same unit. These strong working relationships were apparent in the positive perceptions of the relational dimensions on a high level within the ICU core team.

ICU team members shared positive perceptions of shared knowledge, or the general awareness of each other’s work with ICU patients. For example, an ICU nurse described the high level of knowledge that ICU physicians had of her work due to the close proximity of team members who often monitored critically ill patients together at the bedside.

“They [GU physicians] just stop by, right, whereas here they’re [ICU physicians] here all day. They see us, what we’re doing.” (ID10, ICU Nurse)
An ICU pharmacist reinforced the role of proximity in the shared awareness among team members.

"I mean obviously the people who work here all the time, they see what I do in rounds. Because of seeing my role there, they may come and ask me questions outside of rounds." (ID6, ICU Pharmacist)

Similarly, ICU team members shared positive perceptions about how clinicians in the ICU respected each other’s work with patients (i.e., mutual respect). For example, an ICU physician emphasized that each team member’s input across the hierarchy was considered in discussions.

"There are often differences in opinion, but discussion is always welcomed." (ID4, ICU Physician)

ICU nurses agreed that ICU physicians respected their work and suggestions. For example, an ICU nurse described her perception of respect by ICU physicians in the unit.

"Our experiences working with one another. You know, my ability to say ‘hey last time you did this it worked really well’, or ‘last time I did this, and it didn’t work well at all’. You know, that’s just history with somebody, that’s just working together. I think that’s because there’s more nursing autonomy here. And I think that’s because the serious level of illness, the patients tend to be more sick, and so that just requires more skills, a little more critical thinking, more bedside judgment. All those skills are important for nursing in the general medical floor, but in the ICU there is a sense of a little more respect for nursing ... Ultimately the attending physician has the authority to make decisions, but I think it’s pretty open as far as listening." (ID13, ICU Nurse)

An ICU pharmacist provided further support for the collaborative nature of the unit by describing the positive perception of mutual respect from other team members.

"I think a lot. I'm very fortunate. I mean that my unit is very pro-pharmacy. Yeah from the physicians on down I'm very valued." (ID6, ICU Pharmacist)

Finally, ICU core team members had positive perceptions regarding shared goals among team members in the unit. For example, an ICU physician described a common goal of getting the patient better, which was shared among team members in the ICU.

"The goal overall is to get the patients better, right, out of the ICU and working towards hopefully getting back to home, whatever their best health status is. I think that is pretty well shared between all the ICU team members." (ID4, ICU Physician)

Nurses shared this perception. For example, an ICU nurse described that all team members shared the goal of progress for the patient and discussed how to translate the goal into specific tasks for the day.

"Yeah. It’s always about the patient making progress. You know, so things like ‘oh let’s do this today’, like weaning and things like that. " (ID12, ICU Nurse)
Another ICU nurse similarly commented on the common goal among all professional groups of advancing the patient to a non-critical status.

"Yes, I think so. We all want positive outcomes. It’s always to get the patient extubated, get them out of the unit. That’s always it. We do what we can. It’s always the goal. Get them out." (ID9, ICU Nurse Night)

**Relationships with Consultants and Perceptions of Relationships in General Units**

While the ICU core team worked in close proximity, consultants came to the unit when their expertise was requested. The ICU core team had developed a network of consultants that they worked with frequently, however team members had mixed perceptions about relationships with different consultant physicians.

For example, an ICU nurse talked about a different perception of mutual respect from ICU physicians compared to consultant physicians.

"It is a great collaboration, especially in the ICU. I think here it’s different. I think in the ICU people feel very comfortable talking to the doctors. Consults it’s different maybe. The consults that come in ... the surgeons." (ID10, ICU Nurse)

These issues were not only associated with status differences, but they were grounded in differences between professional groups. Different levels of proximity and strengths of working relationships were important, because mutual respect helped in the process of coming to a consensus on how to reach high-level shared goals on a day-to-day practice level. For example, an ICU physician explained that disagreements among physician disciplines were common.

"The goal overall is to get the patients better, right, out of the ICU and working towards hopefully getting back to home, whatever their best health status is. I think that is pretty well shared between all the ICU team members. I think people have different thoughts about how to get there, and a lot of that is just based on how long they’ve been, where they trained, what their own personal philosophies about end of life care are ... there’s a lot of things that get put into that soup." (ID4, ICU Physician)

Another ICU nurse described more challenging interactions among ICU physicians and consultant physicians of different disciplines.

"I think they’re [ICU physicians] open to hearing suggestions. And then during rounds you know they always come to a final agreement. As far as physician to physician, I’m not too sure. I always hear people talking like they don’t agree with what they’re saying. Sometimes they just differ because that’s their specialty. Ok, fine, we’ll do what they say. And sometimes if they feel strongly, they kind of do their own recommendation." (ID12, ICU Nurse)
Similarly, peripheral team member found relationships more difficult when they were not integrated in a unit. For example, a physical therapist explained that proximity was essential to develop shared goals.

"It’s getting better. I think just being here and being around them, they can see what we do. The residents, because they haven’t really been exposed to us, so they might not know as much about what we do. I think the longer someone is here, the more they see what we do." (ID11, Consultant Respiratory Therapist)

ICU team members described perceptions of differences in relationships among clinicians in general units compared to the ICU, due to the lack of proximity. For example, an ICU resident noted the difficulties associated with reaching shared knowledge among team members in general units.

"Yeah, I think here is a little bit better, because we just walk and then you see each other. Sometimes if it’s very small thing they can just ask because it’s very easy. But at the floor, nurse usually only tell important thing, major change, that kind of stuff." (ID15, ICU Resident)

An ICU nurse explained her perception of a lower level of collaboration and mutual respect among physicians and nurses in general units compared to the ICU, due to the lack of proximity. In this context, she further mentioned the greater role of the EHR system in communication across the hierarchy.

"We are actually involved in the plan of care, we facilitate the plan of care. I feel like regular med/surg nurses, they do what’s stated on Epic, it’s their bible. Whereas we really talk and you know, you figure out as a team what you’re gonna do. It’s a lot different than just ‘oh I see an order to give a foley catheder. I’m just gonna put it in’, whereas we’ll be like ‘why do you need it’. We would have a discussion." (ID10, ICU Nurse)

Because the ICU received a new set of residents each month from general units and other hospitals, those relationships were most challenging within the core ICU team as residents adjusted to the ICU working environment. An ICU nurse commented on the sometimes less collaborative nature of discussions with new residents.

"Sometimes it’s the nurse versus the resident. And the attending will be like ‘well, the nurse knows this patient more, the nurse has been here longer and it’s your first day, so I’m gonna go with what the nurse says’." (ID9, ICU Nurse Night)

**Summary**

In the ICU, experience and teamwork in close proximity led to high levels of shared goals, shared knowledge and mutual respect on a unit level. The collaborative nature of relationships among team members involved in the care of ICU patients differed with
consultants and new residents. Relationships also appeared to differ among physicians and nurses in general units.

This general overview of high-level relationships indicated the importance of proximity and verbal communication among team members to reinforce shared goals and shared knowledge that promote effective patient care. I was interested in the implications of the EHR system for relationships among team members. In the next section, I review the core communicative processes and examine the role of the EHR in each process.
4.2. Overview of the Core Communicative Processes

Five core communicative processes (i.e., handoff, round, order, consult, documentation in notes) captured most daily interactions in expertise coordination practices (i.e., in non-emergency situations) among team members involved in the care of ICU patients. The use of the EHR system was contingent on the workflows in these processes. The following section introduces standard workflows for communication in each process as a basis for later discussion. It further contrasts the workflows in the ICU and GU when differences exist.

Handoff

In the beginning of a shift, professional groups needed to hand over patients and tasks to the incoming clinicians. This process was very important for effective coordination, because team members had to ensure that there no gaps in patient care occurred.

Table 4 summarizes the typical workflows for communication in the handoff process.

<table>
<thead>
<tr>
<th>Table 4: Core Communicative Process: Handoff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics</td>
</tr>
<tr>
<td>Participants</td>
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<td></td>
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<tr>
<td>GU (communicative workflow sequence)</td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Frequency</td>
</tr>
<tr>
<td>Information Exchanged</td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Technology</td>
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</tbody>
</table>
Handoff processes were conducted within professional groups in the beginning of shifts. ICU attending physicians typically began the shift with a verbal signout, patient exam at the bedside and subsequent EHR chart review as allowed by workload and time constraints. The handoff process of ICU residents typically included a very detailed EHR chart review as residents prepared for presentation of their patient in the multidisciplinary round. ICU nurses and respiratory therapists often utilized the EHR while they received verbal report of the previous shift.

Verbal handoff among ICU physicians focused on the key issues of the patient, while verbal handoff between ICU nurses and respiratory therapists focused foremost on communication of tasks and order status. All professional groups used multiple features of the EHR system in the handoff process with different priorities, depending on the handoff focus.

The handoff process occurred between team members of the same professional group and status, typically between team members who worked together in close proximity. The exception was GU attending physicians, who often relied on a written signout by physicians who ended the previous shift.

**Round**

The rounding process consisted of patient exams and discussions with team members about the care of patients for this day. This process was very important for effective coordination, because it served to establish the plan of the day (i.e., the shared goals in day-to-day practice) and created a shared awareness on key issues and contributions (i.e., shared knowledge in day-to-day practice). Table 5 summarizes the typical workflows for communication during rounds.
Table 5: Core Communicative Process: Round

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Overview of Workflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td><strong>ICU:</strong></td>
</tr>
<tr>
<td></td>
<td>- Most ICU team members (ICU attending physicians, residents, nurses, pharmacist,</td>
</tr>
<tr>
<td></td>
<td>respiratory therapist, consultants if available)</td>
</tr>
<tr>
<td></td>
<td>- Nurses were called for their specific patients</td>
</tr>
<tr>
<td></td>
<td>- Respiratory Therapist was called for specific questions, attended as workload</td>
</tr>
<tr>
<td></td>
<td>allowed</td>
</tr>
<tr>
<td></td>
<td><strong>GU:</strong></td>
</tr>
<tr>
<td></td>
<td>- No formal multi-disciplinary round – GU physicians conducted patient exams in</td>
</tr>
<tr>
<td></td>
<td>different units</td>
</tr>
<tr>
<td></td>
<td>- Some physicians spoke to other professional groups, in particular nurses, during</td>
</tr>
<tr>
<td></td>
<td>round</td>
</tr>
<tr>
<td>Frequency</td>
<td><strong>ICU:</strong></td>
</tr>
<tr>
<td></td>
<td>- Daily multi-disciplinary round (formal round, several hours)</td>
</tr>
<tr>
<td></td>
<td>- Night shift: mini-round (ICU attending physician and on-call resident walk to</td>
</tr>
<tr>
<td></td>
<td>patient rooms and speak with nurses)</td>
</tr>
<tr>
<td></td>
<td><strong>GU:</strong></td>
</tr>
<tr>
<td></td>
<td>- Daily round</td>
</tr>
<tr>
<td>Information Exchanged</td>
<td><strong>ICU:</strong></td>
</tr>
<tr>
<td></td>
<td>- Creation and Communication of Plan for the day for each patient (shared goals)</td>
</tr>
<tr>
<td></td>
<td>- Communication of tasks (orders)</td>
</tr>
<tr>
<td></td>
<td><strong>GU:</strong></td>
</tr>
<tr>
<td></td>
<td>- Daily round</td>
</tr>
<tr>
<td>Technology</td>
<td><strong>ICU:</strong></td>
</tr>
<tr>
<td></td>
<td>- Several features, including Results Review and Doc Flowsheets (lab results, vital</td>
</tr>
<tr>
<td></td>
<td>signs), MAR (medications), notes (consultant recommendations), Orders (translating</td>
</tr>
<tr>
<td></td>
<td>plan of the day through orders for the shift)</td>
</tr>
<tr>
<td></td>
<td><strong>GU:</strong></td>
</tr>
<tr>
<td></td>
<td>- Different professional groups/status</td>
</tr>
<tr>
<td></td>
<td>- Close proximity ICU</td>
</tr>
<tr>
<td></td>
<td>- Differences in proximity GU depending on physician</td>
</tr>
</tbody>
</table>

In the round, clinicians of different professional groups and status came together to discuss goals and tasks. The ICU team conducted a formal multi-disciplinary round each morning, in which they established a plan of the day for each patient and distributed tasks to professional groups through orders. ICU physicians also conducted an informal ‘mini-round’ in the beginning of the nightshift, in which they walked to patient rooms, reviewed plans for each patient and spoke with nurses at the bedside to answer questions or discuss concerns.

During the ICU multidisciplinary round, multiple team members used the EHR system concurrently to look up current information and enter orders, while residents presented analyses and proposed plans for their patients with a draft of their progress note. During the mini-round, ICU physicians utilized the EHR in the patient rooms for specific questions. During the round, clinicians used multiple features of the EHR.

In contrast, GU teams did not conduct multi-disciplinary rounds. GU physicians rounded with or without residents by examining their patients in different units and creating a daily progress note with assessments and goals for the day in the notes feature of the EHR.
GU physicians and nurses only met when GU physicians visited the unit. Some physicians emphasized speaking with nurses, while others did not.

**Order**

In the order process, physicians identified medications, tests or activities, which were required for the immediate care of a patient. Each task was associated with an order. This process was very important for effective patient care, because it translated goals for the day into tasks and task fulfillment by other professional groups, primarily nurses and pharmacists. Table 6 summarizes the typical workflows for communication associated with orders.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Overview of Workflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>ICU:</td>
</tr>
<tr>
<td></td>
<td>• ICU physicians entered orders to be fulfilled by other professional groups</td>
</tr>
<tr>
<td></td>
<td>• Nurses, respiratory therapist, pharmacist could enter verbal orders by physicians, which were then cosigned by the physician</td>
</tr>
<tr>
<td></td>
<td>• ICU residents were the point of contact for all orders (including orders from consultant physicians) to ensure alignment of goals and for teaching</td>
</tr>
<tr>
<td></td>
<td>GU:</td>
</tr>
<tr>
<td></td>
<td>• GU primary physicians entered orders to be fulfilled by other professional groups</td>
</tr>
<tr>
<td>Frequency</td>
<td>• Many orders entered during the round, additional orders throughout the shift as needed</td>
</tr>
<tr>
<td>Information Exchanged</td>
<td>• Tasks and associated reasons</td>
</tr>
<tr>
<td>Technology</td>
<td>Entering orders:</td>
</tr>
<tr>
<td></td>
<td>• Order feature</td>
</tr>
<tr>
<td></td>
<td>• In-basket feature for outstanding verbal orders to be cosigned by physicians</td>
</tr>
<tr>
<td></td>
<td>• Notes feature for documentation of assessment associated with orders</td>
</tr>
<tr>
<td></td>
<td>• Time-sensitive orders should include verbal communication</td>
</tr>
<tr>
<td></td>
<td>Receiving orders:</td>
</tr>
<tr>
<td></td>
<td>• Customizable: Outside patient chart: Information bar, Inside patient chart: Patient list, Patient Summary, (Order Review)</td>
</tr>
<tr>
<td></td>
<td>Monitoring order fulfillment:</td>
</tr>
<tr>
<td></td>
<td>• MAR, Results Review, bedside (ICU) or phone call to nurse (GU)</td>
</tr>
<tr>
<td>Relational Coordination Characteristics</td>
<td>• Different professional groups/status</td>
</tr>
<tr>
<td></td>
<td>• Typically close proximity ICU</td>
</tr>
<tr>
<td></td>
<td>• Typically no close proximity GU</td>
</tr>
<tr>
<td></td>
<td>• Typically no close proximity consult orders</td>
</tr>
</tbody>
</table>

Team members of different professional groups and status participated in the order process. The ICU team entered the majority of orders for a shift during the multidisciplinary...
round, as they established the plan for the day for each patient and translated the goals into specific tasks in the presence of the nurse responsible for fulfilling the tasks. Residents were the central points of contact for a patient and entered additional orders as needed during the shift. Time-sensitive orders were often accompanied by verbal communication. The teams used the order feature of the EHR system to enter orders and often communicated reasons for complex orders in the notes feature or through verbal communication. Nurses received orders in the EHR system in multiple features and through notifications outside and in the patient charts. Physicians typically monitored order fulfillment by checking for results in the EHR (typical for GU) or by monitoring patient responses at the bedside (typical for ICU).

In the GU, attending physicians entered orders during the round and throughout the shift based on their individual preferences and workflows associated with examining patients, creating progress notes and communicating with nurses. Nurses were mostly aware of orders only through the EHR, because GU physicians and consultants entered orders from remote locations.

**Consult**

ICU and GU physicians requested consultations when they needed recommendations by a specialist physician regarding a specific question, procedures, or therapy sessions. This process was very important for effective communication, because consultations by specialty physicians (e.g., surgeons, oncologists, infectious disease physicians, palliative care) were frequently needed in the ICU. Often, different consultants were involved in the care of a critically ill patient. Since consults varied by patient, they were not part of ICU routines. Instead, they represented interruptions to day-by-day routines, and clinicians had to make sure that they became part of the communication. Table 7 summarizes the typical workflows for communication associated with consults.
Table 7: Core Communicative Process Consult

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Overview of Workflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants</td>
<td>• ICU and GU physicians consulted specialty physicians or other professional groups (social work, physical therapy, occupational therapy, dietician) for specific recommendations</td>
</tr>
<tr>
<td>Frequency</td>
<td>• As needed</td>
</tr>
<tr>
<td></td>
<td>• Daily follow-up by consultant physician until issue resolved</td>
</tr>
<tr>
<td>Information Exchanged</td>
<td>• Specific questions about a patient and consultant assessment and recommendation</td>
</tr>
<tr>
<td>Technology</td>
<td>• Notes feature and verbal communication (vast majority of initial physician consults in ICU, forty to fifty percent of initial physician consults in GU)</td>
</tr>
<tr>
<td>Relational Coordination Characteristics</td>
<td>• Different professional groups/status</td>
</tr>
<tr>
<td></td>
<td>• No close proximity, though typically more verbal interaction between consultant physicians and ICU core team</td>
</tr>
</tbody>
</table>

Consultants documented their work in consult notes (i.e., in the notes feature of the EHR). Most consultant physicians also spoke to an ICU team member after the initial consult, while the majority of consultant physicians communicated recommendations for GU patients only with notes in the EHR.

Team members of different professional groups (physician specialties) and status (physical therapists, social workers) participated in the consult process. ICU and GU team members did not work in close proximity with consultants.

Overarching Expertise Coordination Process: Communication with Notes

Most team members involved in the care of a patient were required to file a daily note based on hospital regulations. I demonstrate the workflow for communication with notes in somewhat greater detail because its importance as an overarching process for coordination among team members.

Communication with notes involved team members of different professional groups and status, who did or did not work together in close proximity. Table 8 summarizes the typical workflows for communication associated with notes.
Team members filed notes throughout the day as early as their workload allowed. ICU physicians filed daily progress notes after the core team met in the multidisciplinary round, where team members came to a verbal consensus on shared goals (i.e., the plan of the day for the care of a patient) and shared knowledge (i.e., the role of each team member in the process). The expected time horizon for sharing notes (per rules and regulations) and reading notes (use by others, though not required per rules and regulations) in the core team was within the same day. An ICU resident and an ICU attending physician described the typical workflow for filing notes.

“Usually after rounds. Whatever we talk about in rounds, then I update my progress note. I start it in the morning, I pend it, and then talk about the patients in rounds, and then after rounds, whatever we decided to do, I update my note and then I submit it. So probably like 11 or 12 I guess.” (ID20, ICU Resident)

“Always after seeing the patient. As for when I actually get to see my patient depends on whether or not I get to them before rounding with the residents or after. So in general I am able to physically examine the patient after the residents have presented to me and we’ve talked about the overall general plans. So I usually get to my notes in the early afternoon. On really crazy days it can be pushed back to me sitting at home at 9pm and doing them, but ideally it’s right after I see the patient ... early afternoon.” (ID19, ICU Physician)

GU physicians similarly filed notes as soon as possible after they rounded and examined patients. For example, a GU physician explained how he incorporated documentation in the progress in his daily workflow.
“It varies. I try to write my notes right after I see my patients as often as I can. But often I get busy with patient care so I’ll write about half of them after seeing the patient and the other half I wait until later in the afternoon to write the progress note.” (ID25, GU Physician)

Most ICU and GU nurses tried to work on their notes during the day as allowed by time constraints and filed them towards the end of the shift. For example, an ICU nurse and a GU nurse demonstrated the similar workflow in both units.

“Depending on what happens. Generally I do one a day, towards the end of the shift generally unless there’s situations that happen during the shift that require documentation that would be in real time ... or as soon as I could do it.” (ID28, ICU Nurse Afternoon/Evening)

“It depends on how my day is going. If I have the time I can start a note right after my initial, my first assessment for the morning. I can do my flow sheets, I can do my patient education, I can do my progress notes, if I have the time I can do it all in one shot. If I tend to start getting busy, sometimes they don't get done until the end of the day. So I do it whenever I can. So even if I'm done and I'm not that busy but I can do it in real time or at the moment then during the course of the day I'm still adding on to it.” (ID33, GU Nurse)

Consultants filed daily consult notes on as long as they were involved in the care of an ICU patient. For example, an ICU physician and a consultant physician described the workflow for communication associated with consult notes.

“The written communication needs to happen once a day on the ICU patient. Depending on how active the subspecialist involvement is in the patient’s care, but usually they come and see the patient every day, and their note should reflect that.” (ID19, ICU Physician)

“Typically we write an initial consultation note at the time of or a few hours after the initial visit and then a daily progress note, which usually is written pretty much at the time of that visit. Occasionally things are very, very busy. I might stack up and write some notes at the end of the day.” (ID23, Consultant Physician)

When changes occurred that affected the care of the patient, team members often filed notes to document this change for awareness of the team, among other reasons. For example, an ICU nurse and a GU physician explained the role of notes for the awareness of other team members in the case of pertinent events.

“If it was a situation where the patient was decompensating or there was a real problem for me to be addressed right away, I would communicate verbally with the physician. Then I would do the note and I would expect that afterwards follow up other people would see the note.” (ID28, ICU Nurse Afternoon/Evening)

“I try to do verbal communication as the most effective form of feedback, especially when it comes to acute changes in the patient, but then I’ll generally document that after having the verbal communication.” (ID25, GU Physician)

Clinicians viewed notes as a way to share information to enable shared goals and shared knowledge with team members. Attending physicians focus on communicating shared goals with assessments and plan of the day to team members. For example, and ICU
physician and a GU physician talked about the role of the note to communicate shared goals and promote shared knowledge among team members.

“What the plan of THAT day is, what studies we have going, what treatments we have going, what the goal eventually is to get the patient out and move on.” (ID40, ICU Physician)

“I guess for me the function of the progress note is to help me think through the process. So it actually helps me organize things. I suppose secondarily, I would hope that they would get the assessment and plan out of it. In retrospect sometimes it’s useful to look at a physical exam finding, because you wonder ‘hey is this a new heart murmur’, so it’s nice to be able to go back and look at that. But by and large I think people just read the assessment and plan.” (ID36, GU Physician)

An ICU resident considered the purposes of ICU daily progress notes for coordination and emphasized the important role for shared goals in day-to-day practice between multiple specialties.

"The main one is for the goal of the patient. What we want to do each day. Second is assessment, if anything changed to the patient. Third is to make everybody in the same way, multidisciplinary or interdisciplinary between the doctors. They can go the opposite way. The progress note can make everybody to the same way. And communication. If anything that go out from the aim, they can talk by the progress note. The fourth one is monitor, remind, remember, write a short note what we need to do. Sometimes we forget. We have a lot of the patients. Five is maybe document in detail for the future of the patient. If the patient maybe one year, two year from now, we have what happened in that time. It’s very important that we know.” (ID17, ICU Resident)

Nurses and other professional groups focused on shared knowledge by communicating the most important issues that happened during the shift, their interventions and results. For example, a nurse and a respiratory therapist described the communication focus of their notes.

“What the situation was. How it occurred or how it was found. What actions I would have taken to alleviate the problem. And then if there was a result at the time or when there was a result, I want to document that.” (ID28, ICU Nurse Day)

“It’s just summarizing what our process was throughout the day. So people know what we’ve done. They could go to our flow sheet and single out every little column and kind of decipher what was done, but if we do a quick summary, then they can have a quick overview of what’s done ... But for the docs, some of them they like to read notes and they’re not always there to have a face to face communication with, so I think that’s where it’s important.” (ID37, ICU Respiratory Therapist)

Another ICU nurse explained the difference in communication focus on shared goals and shared knowledge among ICU physician notes, nursing notes and procedural notes.

"Progress notes are more like plan of care. Theirs is like a direction note in terms of the bottom part, the plan of care, because they still have a history, they have labs and they have plan of care. So that’s like kind of the direction we’re taking the patient in. Ours is more ‘This is what I saw, this is the direction, this is what I did, this is my result’. So ours is like correlating with their plan of care and then the RT’s is more like, you know, ‘I stuck the patient and this is the blood gas’ or ‘we intubated the patient because they couldn’t breathe’. ” (ID10, ICU Nurse)
Consult notes also had in common a focus on shared knowledge and could help to establish shared goals depending on assessments and recommendations, as primary physicians requested consults for additional input. For example, two consultant physicians who worked closely with the ICU demonstrated the roles of consult notes focused on recommendations and procedures.

“In my notes, I usually have large paragraphs that I’m writing to try to explain my thinking about how I put it together, what I said to the family, what they said to me, how we presented this to the family and how we can move forward … I want my notes to represent what I think is going on, what I recommend doing about it. And I try to be as transparent as possible.” (ID23, Consultant Physician)

“Because I do very specific things, my goal is to communicate the procedure that I performed. So usually I will do a biopsy, so I want to make sure that people see where I took the biopsy from, the location, and what the result was. I’m gonna make sure people understand why my note is there and what I did and what it showed, what the result was.” (ID31, Consultant Physician)

The examples show the important role of notes for establishing shared goals and shared knowledge in day-to-day practice.

**Summary**

This chapter showed that team members perceived highly collaborative relationships among professional groups across the hierarchy in the ICU core team, while general relationships appeared to be at a lower level with consultant physicians, and between physicians and nurses in general units.

The overview of the core communicative processes further showed the importance of handoff, round, order, consults and communication with notes for effective coordination among team members. Most processes involved team members from different professional groups and with different status. In the ICU, these team members typically worked together in close proximity, while GU physicians and consultant physicians only spoke with team members when they visited a unit. While clinicians used the EHR greatly in each core communicative process, the role of verbal communication was strong in the ICU.

The analysis in the following chapters takes into consideration that team members may enact the EHR affordances for coordination in ways that reflect these different collaborative perceptions. Different enactments may have consequences for how affordances may enable or constrain relational coordination in day-to-day practice in these processes.
CHAPTER 5. FOUNDATIONAL INFORMATIONS SYSTEMS AFFORDANCES FOR RELATIONAL COORDINATION

In the previous chapter, I showed the complexity of the core communicative processes in high velocity health care and the important role of the EHR for communication in each process. I further showed that collaborative relationships, which were stronger with shared experience and close proximity, were important for effective coordination among health care professionals of different disciplines and status. These collaborative relationships were at a high level in the ICU, but weaker with consultant physicians, new residents, and among physicians and nurses in general units.

In this chapter, I expand on the role of the EHR for coordination. In particular, I show how the EHR provided affordances, which allowed clinicians to coordinate in the core communicative processes.

Section 5.1. shows that EHR provided users with a set of nine distinct IS affordance types that were directly related to relational coordination. Four of these IS affordance types primarily supported sharing and accessing information, while five IS affordance types captured different aspects of integrating information through effective presentation in the EHR. I focus only on discussing the action potentials, i.e., how each IS affordance type could enable coordination.

Section 5.2. discusses affordances beyond the action potentials. How the action potentials were translated into communication depended on how they were enacted in groups. In particular, enactments were dependent on use of the EHR by others, rules and regulations, and feature fit.
5.1. Foundational Affordances for Coordination

I identified nine foundational IS affordance types for coordination, which could be differentiated into Accessibility affordances that related to availability of information in the EHR, and Integration affordances that related to presentation of information in the EHR.

Figure 4 summarizes the foundational IS affordances for coordination in this high velocity, high reliability setting. In the following sections, I introduce each IS affordance type and demonstrate potentially enabling effects for coordination with examples.

![Figure 4: Foundational Affordances of the EHR System for Coordination in the ICU](image)

5.1.1. Accessibility Affordances

The EHR provided users with affordances for sharing and accessing information, which were enabled through documenting patient care in notes, orders and flowcharts, for coordination with others. In particular, the EHR supported users in sharing and accessing information instantaneously, remotely, across time and in multiple sources, concurrently with other users.
1. Immediacy

The EHR provided users with an affordance for sharing and accessing information instantaneously among team members. Table 9 shows three examples of how the affordance for sharing and accessing information instantaneously helped team members coordinate with others in day-to-day patient care.

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<thead>
<tr>
<th>Table 9: IS affordance for Immediacy</th>
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<tbody>
<tr>
<td>Definition</td>
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<tr>
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</tr>
<tr>
<td>Accessing and sharing information in the EHR instantaneously</td>
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In the first example, an ICU nurse accessed up-to-date lab results, which were available in the EHR shortly after she requested the tests. Enacting the IS affordance for Immediacy enhanced timely communication, which enabled shared knowledge of the most current data on the patient, which team members could discuss in the verbal handoff.

In the second example, an ICU pharmacist explained to new residents how the EHR assisted in instantaneously sharing orders with nurses.

In the third example, an ICU Respiratory Therapist gained up-to-date knowledge of the patient through documentation by team members from different professional groups. He could access the notes instantaneously in the EHR as soon as team members filed the notes.
2. Mobility

The EHR provided users with an affordance for sharing and accessing information to and from any location among clinicians. Team members could access the EHR remotely from any location in the hospital, and physicians could also access the EHR from remote locations outside the hospital. Table 10 shows three examples of how the affordance for sharing and accessing information remotely helped team members coordinate with others in day-to-day patient care.

<table>
<thead>
<tr>
<th>Definition</th>
<th>Examples</th>
<th>Potential RC Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accessing and sharing information in the EHR remotely</td>
<td>“To a degree [I am aware of what others do]. Whatever they put in the chart, yeah. Definitely from the nursing side. So I can sit in my office and look at things like vent changes without having to necessarily go visit the patient’s room. Yeah so I can kind of monitor somewhat what other people are doing, like nursing staff and respiratory therapist.” (ID14, ICU Physician)</td>
<td>Supports shared knowledge between physician and team members who document in flowcharts through frequent and timely communication in the EHR</td>
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<tr>
<td></td>
<td>“I can see who’s in charge or who is resident or which surgeon, because all the information is there. And it also helps that you can do it remotely. Because I take calls from home, so when they call me in the middle of the night I can look in and also learn about the patient.” (ID31, Consultant Physician)</td>
<td>Supports shared knowledge between consultant physician and other team members through timely communication and comprehensive communication of all pertinent documentation in the EHR</td>
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<tr>
<td></td>
<td>“It can be accessed anywhere. I can be on the phone with someone, anywhere in the hospital, potentially even their house if they have Epic at their house. And I can say ‘ok, can you put in an order for what you’re asking me to do’. Or vice versa, they can be in their car telling me ‘could you please do x, y, and z? Can you put in an order?’ And it’s done instantly. I don’t have to wait. It’s right there.” (ID13, ICU Nurse)</td>
<td>Supports shared goals between physician and nurse through timely communication of order</td>
</tr>
</tbody>
</table>

In the first example, the ICU physician accessed data, which nurses and respiratory therapists documented hourly in flowcharts, remotely from his office. Enacting this affordance provided a subset of data on the patient through which the ICU physician had shared knowledge of other team members’ actions and the status of the patient.

In the second example, the consultant physician accessed the EHR remotely from home to answer urgent questions about patients. Enacting the mobility affordance provided
all available documentation on a patient through which the consultant physician gained shared knowledge of other team members’ work with the patient in order to make recommendations to primary physicians.

In the third example, the nurse was able to coordinate instantaneously with physicians who were not in the unit. Physicians remotely entered orders that the nurse needed to proceed with patient care in a time-constrained environment. Enacting the affordance for sharing information remotely enabled the team members to align goals and translate them into tasks. The examples also demonstrate that team members enacted different affordances at the same time. In these cases, the affordance for sharing and accessing information remotely reinforced the affordance for accessing information instantaneously.

3. Reviewability

The EHR provided users with an affordance for sharing and accessing information across time with other team members. Documentation in the EHR was permanent and could be accessed by any team member over time. Table 11 shows three examples of how the affordance for sharing and accessing information across time helped team members coordinate with others in day-to-day patient care.

<table>
<thead>
<tr>
<th>Table 11: IS affordance for Reviewability</th>
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<tbody>
<tr>
<td>Definition</td>
</tr>
<tr>
<td>Accessing and sharing information in the EHR across time</td>
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</table>
From the perspective of day-to-day coordination, clinicians primarily accessed information across time to find out what happened in the previous shift and to determine trends with the most current data. In the first example, an ICU physician accessed nursing notes in the beginning of each shift for an overview of what happened during the night. Enacting the affordance for accessing information across time provided descriptions of major issues by the nurse at the bedside. The ICU physician gained shared knowledge through timely and comprehensive communication of these issues after the nurse has left the unit.

In the second example, an ICU physician viewed notes by physicians, who were consulted by other ICU physicians. Enacting the affordance for accessing this information across time provided an awareness of the consultants’ work with the patient as well as an understanding of recommendations, which frequently influenced the core team’s decisions on the goals and treatment plans for patients.

In the third example, an ICU pharmacist entered notes that other team members could review when she was not in the unit. Although pharmacists were not required to file notes unless they are consulted, enacting the affordance for sharing narrative information across time provided an additional understanding to documentation of the data in the Medication Administration Record, which ensured that other team members did not have to contact pharmacists for clarifications or make mistakes in complex cases.

4. Simultaneity

The EHR further provided users with an affordance for sharing and accessing information in multiple sources and concurrently with other team members. Table 12 shows three examples of how the affordance for sharing and accessing information in multiple sources helped team members coordinate with others in day-to-day patient care.
Table 12: IS affordance for Simultaneity

<table>
<thead>
<tr>
<th>Definition</th>
<th>Examples</th>
<th>Potential RC Implications</th>
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<tbody>
<tr>
<td>Accessing and sharing information in the EHR in different sources &amp; concurrently with others</td>
<td>“I’ll look at some of the big picture items before we round. So I’ll look at all the notes to see what the consultants have written in the last 24 hours. I’ll review all the data from that day – labs, any pertinent radiographic, the diagnostic studies, so that I’m kind of prepared to move the big picture part of patient care forward in rounds.” (ID4, ICU Physician)</td>
<td>Supports shared knowledge and shared goals between physician and consultants &amp; shared knowledge with other team members documenting in flowcharts through timely and comprehensive communication in charts</td>
</tr>
<tr>
<td>“If they’re busy, like they’re intubating someone or someone’s in crisis, they cannot come to me, then I’ll just go right into Epic, you know read the H&amp;P, read the current settings, ABG’s, treatment schedules, and then I’ll have all the hard information.” (ID5, ICU Respiratory Therapist)</td>
<td></td>
<td>Supports shared knowledge and shared goals between respiratory therapists in the beginning of the shift through timely and comprehensive communication in the EHR</td>
</tr>
<tr>
<td>“Sometimes I bring my own computer to the morning rounds, but more often than not there are about six other people using Epic simultaneously on that same patient that we’re all discussing. So I just rely on them to navigate Epic while I listen and take handwritten notes on the plan of care.” (ID13, ICU Nurse)</td>
<td></td>
<td>Supports shared knowledge through timely communication to every user in the EHR</td>
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<tr>
<td>“It’s up to date, it’s not like a folder that if someone’s using it, I have to wait until they’re done. I can’t look at the chart. We can all kind of look at the chart at the same time.” (ID10, Consultant PT)</td>
<td></td>
<td>Supports shared knowledge and shared goals through timely communication to every team member in the EHR</td>
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</table>

In the first example, an ICU physician viewed multiple sources in the beginning of the shift to obtain an overview of the patient. Enacting the affordance for accessing information in multiple sources provided recommendations from consultants as well as current flowchart data and test results, through which the ICU physician gained knowledge of pertinent information and a guideline for establishing shared goals in the multi-disciplinary round without having to collect information and contact multiple contributors.

In the second example, a respiratory therapist accessed multiple sources in the EHR to gain an understanding of the patient when the outgoing respiratory therapist was not immediately available for a verbal handoff. Enacting the affordance for accessing information in multiple sources provided a subset of information (‘the hard data’) that could
contribute to aligning goals in the absence of verbal communication to facilitate the verbal discussion in the time-constrained environment.

The third and fourth examples demonstrate the affordance for sharing and accessing information not only in multiple sources, but also concurrently with other users. In the third example, several team members accessed and shared information in the same patient chart at the same time while discussing the patient during the round. In the forth example, a consultant physical therapist explained that the EHR enabled clinicians to access the same patient chart from any location without having to look for the physical copy and waiting until another team member had completed documentation. Enacting the affordance for accessing and sharing information concurrently with others provided timely access to information in discussions or from different locations through which users gained shared knowledge and aligned goals in the absence of verbal discussion.

5.1.2. Integration Affordances

Integration affordances offered action potentials beyond access or availability of information in the EHR system. The EHR provided users with affordances for mentally processing and integrating information to visualize a patient holistically when coordinating with others. In particular, the EHR assisted users in documenting information in comprehensive, understandable, legible and accurate ways and presented it in different ways to be noticed by other team members.

5. Visibility

The EHR consists of multiple features and information sources within features. For example, the notes feature of the EHR contains multiple notes by all providers filed over time. The chart review feature contains multiple charts and flowcharts. The EHR provided users with an affordance for emphasizing and noticing important information among multiple sources in the EHR. Table 13 shows three examples that demonstrate how this affordance helped team members to navigate the EHR in order to coordinate with others in day-to-day patient care.
In the first example, a physical therapist used the filters in the note feature to show only the notes of physical therapists as opposed to notes by all providers. Enacting the affordance for finding and noticing pertinent information provided flexible presentation of the data through which the user obtained an overview of other physical therapists’ work in a timely manner.

In the second example, the ICU respiratory therapist referred to the ease of navigating to specific flowcharts and finding specific information compared to paper charting. Enacting the affordance for finding and noticing pertinent information supported timely and comprehensive communication, which reinforced shared knowledge in discussions with other team members.

In the third example, an ICU nurse mentioned a feature (i.e., the results review), which integrated different sources of data in one intuitive interface. Enacting the affordance for finding and noticing pertinent information supported comprehensive communication

<table>
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<th>Table 13: IS affordance of Visibility</th>
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<tr>
<td>Definition</td>
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<tr>
<td>Emphasizing and noticing pertinent</td>
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<tr>
<td>information among multiple sources</td>
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<td>in the EHR</td>
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In the first example, a physical therapist used the filters in the note feature to show only the notes of physical therapists as opposed to notes by all providers. Enacting the affordance for finding and noticing pertinent information provided flexible presentation of the data through which the user obtained an overview of other physical therapists’ work in a timely manner.

In the second example, the ICU respiratory therapist referred to the ease of navigating to specific flowcharts and finding specific information compared to paper charting. Enacting the affordance for finding and noticing pertinent information supported timely and comprehensive communication, which reinforced shared knowledge in discussions with other team members.

In the third example, an ICU nurse mentioned a feature (i.e., the results review), which integrated different sources of data in one intuitive interface. Enacting the affordance for finding and noticing pertinent information supported comprehensive communication
through which the user gained shared knowledge with all team members who documented in the different data sources.

While Visibility (i.e., the affordance for finding and noticing important information among multiple sources in the EHR) was primarily an Integration affordance for clinicians, it had characteristics of an Accessibility affordance when team members could not find information, though they knew that this information is available in the EHR.

6. Comprehensiveness

The EHR provided users with an affordance for finding and documenting all necessary information and nuances within a source in the EHR. For example, a source is a single note or flowchart. Table 14 shows three examples that demonstrate how this affordance helped team members to coordinate with others in day-to-day patient care.

<table>
<thead>
<tr>
<th>Table 14: IS affordance of Comprehensiveness</th>
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<tbody>
<tr>
<td>Definition</td>
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<tr>
<td>Finding and documenting all necessary information and nuances within a source in the EHR</td>
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In the first example, an ICU nurse explained that notes offer the opportunity to document their care of a patient during a shift in detail. Enacting the affordance for documenting a comprehensive account of the shift could support relational coordination in
practice by providing an awareness of the team member’s work with the patient across the
certainty and aligning goals in particular based on progress notes by physicians.

In the second example, an ICU nurse described how she created daily notes with a
focus to communicate details on patient care. Enacting the affordance supported
comprehensive communication that enabled shared knowledge with other team members.

In the third example, an ICU nurse considered the role of comprehensive
documentation in the flowchart for verbal communication by physicians. Enacting the
affordance for Comprehensiveness provided an overview of the nurse’s shift through which
physician could gain obtain shared knowledge.

While Comprehensiveness (i.e., the affordance for finding and documenting all
necessary information and nuances of patient care within a source in the EHR) was primarily
an Integration affordance for clinicians, it had characteristics of an Accessibility affordance
when team members were not allowed to document certain informal information and
impressions because of the status of the patient chart as a legal document.

7. **Interpretability**

The EHR provided users with an affordance for understanding information and
presenting easily interpretable information within a source in the EHR. For example, a source
is a single note or flowchart. Table 15 shows three examples that demonstrate how this
affordance is relevant to coordinating with others in day-to-day patient care.

<table>
<thead>
<tr>
<th>Table 15: IS affordance for Interpretability</th>
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<tbody>
<tr>
<td>Definition</td>
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<tr>
<td>Understanding information and presenting easily interpretable information within a source in the EHR</td>
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</table>
In the first example, an ICU respiratory therapist created notes for physicians in order to improve physicians’ understanding of the documentation by respiratory therapists, although it was not required for this professional group. Enacting the affordance for presenting information in an easily interpretable format provided timely information that was focused on increasing physicians’ awareness.

In the second example, an ICU nurse explained that consult notes offered the opportunity for consultants to communicate their recommendations in an easily interpretable way to team members who were not present for verbal communication. Enacting this affordance could support comprehensive communication that enabled shared goals between consultant and core team.

In the third example, an ICU nurse considered progress notes as helpful to gain shared knowledge and shared goals through reading the physicians’ assessments and plans about a patient. However, while the EHR provided users with an affordance for presenting information in clear and intuitive ways, non-coordination factors also played a role in how team members created notes. I will address these factors in the next section and chapters in the context of enactments of IS affordances.

8. Legibility

The EHR provided users with an affordance for reading and sharing information in the EHR, regardless of handwriting style. Table 16 shows three examples that demonstrate...
how this affordance helped team members to coordinate with others in day-to-day patient care.

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<tr>
<th>Definition</th>
<th>Examples</th>
<th>Potential RC Implications</th>
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</thead>
<tbody>
<tr>
<td>Reading and sharing information in the EHR effectively, regardless of handwriting style</td>
<td>“You can read the notes, which is a huge step up from the way it used to be, trying to decipher people’s handwriting.” (ID19, ICU Physician)</td>
<td>Supports shared knowledge among team members through accurate communication in notes</td>
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<td>“I like it rather than written charting, because some people have really poor penmanship, so there’s no mistake. It’s very clear about what people are saying.” (ID10, Consultant Physical Therapist)</td>
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<td></td>
<td>“One physician in the SICU called us this morning and, you know, said ‘Look at my patient’s x-ray, what do you guys want to do about it?’ We told him, and then at the end of the day we write up exactly what we did, each hour, for his patient. And we may not see him this afternoon because he’s a surgeon and doesn’t come up here a lot, but if he makes it up here this evening after we’re gone he’ll look right there. And it’s easy to read, it’s nobody’s scribbly handwriting. It’ll be right there in a nice capsule for him to see when he comes back.” (ID5, ICU Respiratory Therapist)</td>
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</table>

The examples show the importance of this affordance for supporting shared knowledge through accurate communication in the EHR. An ICU physician and a consultant physical therapist spoke about the affordance for legibility from an information access perspective in the first and second example, while an ICU respiratory therapist mentioned the important role of legible information in presenting information effectively to a consultant surgeon.

9. **Accuracy**

The EHR provided users with an affordance for receiving and sharing accurate information in the EHR. The EHR supported users with various alerts, safeguards and triggers when entering medication orders and flowchart data. The EHR also assisted users by auto populating current data into notes. Table 17 shows three examples that demonstrate how the affordance for receiving and sharing accurate information in the EHR helped team members to coordinate with others in day-to-day patient care.
In the first example, an ICU physician explained how alerts presented users with additional information in medication orders. Enacting this affordance provided best practice data through which users could mentally process and integrate information on a patient, including medications prescribed by other clinicians. In the second example, an ICU nurse talked about the similar role of alerts for data entry in flowcharts.

In the third example, an ICU respiratory therapist used the EHR during the handoff to verify verbal information and discuss any discrepancies. Most clinicians who used the EHR regularly during handoff spoke about how it helped in part to identify issues in verbal communication.

<table>
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<tr>
<th>Table 17: IS affordance for Accuracy</th>
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<tbody>
<tr>
<td><strong>Definition</strong></td>
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<tr>
<td>Accessing and sharing accurate information in the EHR</td>
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<tr>
<th>Examples</th>
<th>Potential RC Implications</th>
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<tbody>
<tr>
<td>&quot;From an order entry standpoint especially on the pharmacy end, there are some safeguards with say drug interactions. And I think the pharmacy folks, or maybe Epic, have programmed alerts that pop up if you’re ordering something that is a bad mix with something they’re already on. You get this big ‘boom’, this thing, this order adverse reaction alert, and you have to go through some steps to check yourself, to make sure it’s really what you were intending. Or did you know that they were on this other medication.” (ID4, ICU Physician)</td>
<td>Supports shared knowledge between physicians through accurate communication in orders</td>
</tr>
<tr>
<td>&quot;Human error can happen whether you’re writing on a piece of paper, whether you’re typing in a computer, or whether you’re speaking from memory. And so I think the computer helps minimize the human error, like if you type in ‘999999’, it’s gonna go ‘flag, that’s not accurate’. So there is a small amount of checks and balances in the computer usage in Epic that you wouldn’t have any other way.” (ID13, ICU Nurse)</td>
<td>Supports shared knowledge between nurse and other team members through accurate communication in flowcharts</td>
</tr>
<tr>
<td>&quot;I can look at their charting for 12 hours. After 12 hours, the person gets a little fuzzy, especially if they have a heavy workload. As they’re briefing me on their patient, I can see what they’ve charted throughout the night, you know respiratory rate, tidal volumes, pressures in the chest, saturation ABGs, lung cells. I see all of that as they’re briefing me. And if there’s something that catches my eye, you know I can say ‘just a minute, what is this’ or ‘what is that?’&quot; (ID5, ICU Respiratory Therapist)</td>
<td>Supports shared knowledge between respiratory therapists through accurate communication in flowcharts</td>
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</table>
5.1.3. Essential Foundational IS Affordances for Coordination

While all identified IS affordance types were important for effective coordination using the EHR system, four essential IS affordances were most important for team members’ experiences with relational coordination in this high velocity context. In order to coordinate effectively with others in a time-constrained environment, clinicians depended on being able to access up-to-date information from others instantaneously (i.e., Immediacy), understanding information because it was clear (i.e., Interpretability) and contained all necessary details to continue the care of the patient (i.e., Comprehensiveness), and quickly noticing pertinent information (i.e., Visibility). Challenges with coordination were primarily associated with enactments of the four primary IS affordance types in groups.

The other foundational affordances (i.e., Reviewability, Simultaneity, Mobility, Legibility and Accuracy) were necessary but not sufficient to support coordination with others in this empirical setting. Their role for coordination depended on enactments of the four essential IS affordances within groups.

For example, the IS affordance for sharing and accessing information in multiple sources (i.e., Simultaneity) supported coordination to the extent that nurses entered information a timely manner (i.e., Immediacy).

“You can see trends, you can see labs, the patient’s whole history is there. But Epic is only as good as the information that I put in. If the nurse is busy and like nothing’s been put in for five hours, then you have nothing. You don’t know what’s going on. So it’s only as good as the user that’s using it at that moment.” (ID10, ICU Nurse)

The IS affordances for sharing and accessing information in multiple sources and across time (i.e., Simultaneity and Reviewability) supported coordination to the extent that team members could notice pertinent information in time constrained situations (i.e., Visibility).

“Epic is an endless supply of information, dating back to their first time that the electronic record got entered, including their records at other hospitals. I mean it’s just ... it’s like comparing a pamphlet to the World Wide Web. Epic contains it all. All the data is there, except for the intangibles. It’s about all details. Some extraneous, some very pertinent ... [The yellow sheet] It’s a summary. Rather than looking through something that could potentially be 12 or 15 or more screens through Epic, it’s all on one 8 by 10 piece of paper. So that’s what I find helpful about the yellow sheet.” (ID13, ICU Nurse)

Further, the IS affordance for sharing and accessing information across time (i.e., Reviewability) supported coordination to the extent that nurses charted all necessary information (i.e., Comprehensiveness).
"We can see for example if we order a medication, and let’s say I admit somebody at 6pm and then I come back the next day and I want to get a sense for how much of that medication they required, I can go into Epic and look at a MAR report, and it will tell me when they got their doses. So yeah, as long as ... again it’s somewhat dependent on user input or data entry, so the nurses have to be entering it.” (ID4, ICU Physician)

Similarly, the IS affordance for sharing and accessing information remotely (i.e., Mobility) supported coordination to the extent that team members leveraged remote access the share time sensitive information (i.e., Immediacy).

“At least the physicians have remote access outside, they don’t even have to be on a Queen's computer. I would love to have that, but I don't, I have to be here. But I can have it on my laptop, even if I'm in a meeting. So that does help with timeliness, right you don't have to ... for the physician to walk back down to your unit and write an order or give a verbal order.” (ID6, ICU Pharmacist)

On the other hand, the IS affordance for sharing and accessing information remotely (i.e., Mobility) did not support coordination when remote team members were not aware of important information because of delays in information sharing or information access. Documentation delays were common in critical situations, and team members typically viewed notes when their workload allowed it.

“I have colleagues who sit in offices all day and do the same things, but they're sitting in their office. The main reason I sit out here, so I can hear what's going on. If the resident comes to update the intensivist who's sitting right behind me, I can hear what's going on. Right, if they're suddenly taking the patient to a procedure, or to a new test that we hadn't talked about, I see it because I'm sitting right there. Right, I'm sitting right behind the secretary who's organizing things, or the nurse who comes by and says something. That's why I sit out here, so I can hear that kind of stuff. And on a patient level, for me as a pharmacist, I may not have gone back into their progress notes unless I knew I was waiting for something specific. Right, so from a nursing standpoint, they only have a couple of patients, so they should be looking. But when you're in the middle of doing it, especially if the patient is busy, you may not go back to the note.” (ID6, ICU Pharmacist)

Similarly, the affordances for sharing and accessing legible and accurate information supported coordination with others to the extent that information was available, noticeable, comprehensive and understandable.

Figure 5 summarizes the foundational IS affordances for coordination and highlights the four essential IS affordance types for coordination in this high velocity, high reliability setting.
Because of the importance of the four essential IS affordance types for how team members experienced coordination with others in this case setting, I focus on these affordance types going forward. In the next section, I will show how the essential foundational IS affordance types were enacted in groups. In the following chapters, I will show how enactment variations of the essential foundational IS affordance types affected relational coordination in day-to-day practice.
5.2. Enactment of IS Affordances within Groups

When team members used the EHR to coordinate with others, they enacted the action potentials of the foundational affordances, which I introduced in the previous section. Some examples in the previous section indicated that enactments of affordances and immediate outcomes could differ in groups, with potential implications for effective relational coordination.

Relational coordination is a group-level goal, instantiated around certain individuals at certain times. Team members’ experiences with coordination using the EHR were related to how other team members used the EHR, rules and regulations, and feature fit for achieving immediate, concrete outcomes associated with the coordination goal. These three components shaped enactments of the foundational IS affordances in groups and determined the individuals’ ability to realize an affordance.

In this section, I demonstrate the critical role of the three components ‘use by others, rules and regulations, and feature fit’ for how the essential IS affordances are enacted in groups. The three enactment components are important for chapter six, because they indicate why or why not teams leverage the action potentials for effective coordination.

5.2.1. Use by Others, Rules and Regulations, and Feature Fit in Enactments of Immediacy in Groups

Enactments of the affordance for sharing and accessing information instantaneously within groups were shaped by use by others, rules and regulations, and feature fit.
Immediacy and Use by Others

Table 18 demonstrates how a team member’s ability to leverage the affordance for
Immediacy in their work depended on how others used the EHR.

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<thead>
<tr>
<th>Table 18: Enactments of Immediacy within Groups: Use by Others</th>
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<tr>
<td>“There’s often a delay. I know for myself, we have to get through rounds before I do my notes. I can’t do my notes while we’re rounding, because it just takes away from the educational dynamic and it slows down rounds. And so rounds take three hours. So it might be noon before I’m putting my thoughts on paper in Epic, whereas we saw that patient three hours ago. Same with the consultant physician who comes by. May have seen the patient, may have dictated their note, but the note won’t be transcribed and actually signed for hours, maybe a day or two. Flow sheet stuff is a little more real-time. Easier to do. But what I call higher level of communication, when you’re putting down narrative-type stuff, it’s harder to make timely, or right away.” (ID4, ICU Physician)</td>
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<tr>
<td>“Before I see the patient, I always ask the nurse ‘Hey I’m gonna go in, I’m gonna do this with the patient. Is it ok?’ Because sometimes, you know, it’s so dynamic working in this setting. Like if something happens to a patient, the nurse might not have time to go in the chart and write down what happened. If something happened 10 minutes ago, and I’m coming in, and they’re still taking care of that, or if it just happened and they’re going to do something else, then I talk to the nurse ‘Oh you know this just happened, you need to come back later.’ (ID11, Consultant Physical Therapist)</td>
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<tr>
<td>“If they just put the order in, I might never look at that. I might be so busy the whole day. The residents are different than our intensivists. It’s totally different, the way they talk about the plan of care and changes. They’ll go ‘Did you see I put that in?’. I’m like ‘No. You gotta tell me if you want something done’. I might be in doc flowsheet for five hours because I’m so busy just documenting things. In the beginning it’s rough, and then it gets easier once they figure out it runs a little different.” (ID10, ICU Nurse)</td>
</tr>
<tr>
<td>“I believe it nearly perfect, but some may be missed. Physician may be not read at the time, or timing they read they’re really busy they read late at night. That is my concern, so everything I think we should have a backup. Such as written progress note, we need to, if everything is important, we need to talk too by verbal communication.” (ID17, ICU Resident)</td>
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</table>

In the first example, an ICU physician explained how the availability of notes in the EHR to team members depended on when the notes were entered and signed by others. In the second example, a physical therapist typically spoke to nurses before seeing patients because nurses were not be able to document updated information in the EHR until critical situations were resolved. In the third and forth examples, an ICU nurse and an ICU resident explained that expectations of instantaneous information sharing with notes and even orders were problematic in the time constrained environment.

The examples show that although the EHR provided users with an affordance for instantaneously sharing and accessing information, enacting the affordances in a way that supports timely communication was difficult. Timeliness of information sharing or access by others varied.
Immediacy and Rules and Regulations

Table 19 demonstrates how a team member’s ability to leverage the affordance for immediately sharing and accessing information in the EHR in their work depended on how rules and regulations influenced use variations.

### Table 19: Enactments of Immediacy within Groups: Rules and Regulations

| “The charting is required. But you don’t have to put it in that second. Like I can do my assessment and then go back and put it in hours later. It’s only as good as the person that’s using it.” (ID10, ICU Nurse) |
| “They [notes] are highly helpful because it really guides you in the thought processes behind the care. But would it be essential? No, because that’s not a legal order for a nurse to carry out. So a doctor or physician couldn’t say to you ‘well my note said, why didn’t you do it’. They could say to you ‘well my order was, why didn’t it get done’. You’re legally obligated to acknowledge and carry out orders. You’re not legally obligated to read notes. They help you [laughs]. You should read them, but you can’t always get to them.” (ID13, ICU Nurse) |

In the first example, an ICU nurse noted that rules and regulations allowed for flexibility and variations in when others enter current information in the EHR. In the second example, an ICU nurse explained that rules and regulations state that nurses must respond to physician orders, but they were not required to read physician notes. While most nurses read notes, physicians could not expect instantaneous sharing of information through notes.

Immediacy and Feature Fit

The examples in the previous section showed that specific features (e.g., notes, orders results, review) were associated with the affordances. Table 20 demonstrates how a team member’s ability to leverage the affordance for Immediacy in their work depended on feature fit.

### Table 20: Enactments of Immediacy within Groups: Feature Fit

| “It’s instantaneous access. Like for instance I have worked where we didn’t chart the meds on a computer. Medications administered. So the physicians, if they really wanted to know when certain meds were administered, they had to track you down, look at the paperwork of it.” (ID13, ICU Nurse) |
| “Sometimes it can be frustrating when the computer is a little bit slow and you have to wait as you click through screens and navigate through screens. It can be frustrating to wait, even a few seconds can seem like a long wait when you’re wanting to look at the data.” (ID13, ICU Nurse, Handoff) |
| “Sometimes the computers don’t act the way you want them. You know, you want everything like this [claps hands]. And of course it’s not like that. I know they get a lot of use, and sometimes the system’s a little slow, but overall it’s better than paper charting, thousand percent.” (ID5, ICU Respiratory Therapist) |
In the first example, an ICU nurse contrasted physicians’ ability to instantaneous access the medication record in the EHR, while they had to search for similar information in a paper chart. In the second and third example, an ICU nurse and a respiratory therapist explained how enacting the affordance for accessing information instantaneously could depend on the EHR.

5.2.2. Use by Others, Rules and Regulations, and Feature Fit in Enactments of Comprehensiveness and Interpretability in Groups

Although Comprehensiveness (i.e., the affordance for sharing and finding all necessary information within a source) and Interpretability (i.e., the affordance for understanding information and presenting easily understandable information within a source) are distinct affordance types, clinicians often experienced Interpretability as highly dependent on Comprehensiveness. I therefore analyze the two IS affordance types in one section.

Enactments of the affordances for Comprehensiveness and Interpretability within groups were shaped by use by others, rules and regulations, and feature fit. Table 21 demonstrates how enactments of the affordances within groups were shaped by use by others.

<table>
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<th>Table 21: Enactments of Comprehensiveness &amp; Interpretability within Groups: Use by Others</th>
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<tr>
<td>“It depends on the quality of note [laughs]. Some doctors write a little bit. I don’t know how they do. I have to call. Some doctors write in detail what medicine they want, so I know the plan. Sometime they didn’t put the order, they didn’t put a note in there, so I don’t know. So I have to call.” (ID15, ICU Resident)</td>
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<td>“Everybody’s style is a little different, there are some patients that the residents aren’t involved in, we each put our own notes in. I tend not to incorporate all of the labs and stuff, only the relevant things. There are others, not just within our group but other consultants who just like to incorporate all the … you know there’s a way in Epic to bring in every single lab piece. It gets to be 6, 7 pages. You don’t really need it in the note. The content of the note can be a bunch of objective data, but it’s hard to pull together what the person’s thinking writing the note.” (ID4, ICU Physician)</td>
</tr>
<tr>
<td>“Sometimes it [the EHR] helps because you can look up stuff. Other times it’s still relying on how the nurse charted. Like I heard that there were issues with a patient and that something happened, but I can find no record of it in [Epic]. So I’m still gonna have to go talk to the nurses who were on.” (ID6, ICU Pharmacist)</td>
</tr>
</tbody>
</table>
In the first example, an ICU resident explained that her understanding and ability to move forward with patient care depended on how much detail consultant physicians included related to recommendations in notes. In the second example, an ICU physician added that it was difficult to find pertinent information for his work in notes when others included too much detail in the form of auto-populated data. In the third example, an ICU pharmacist spoke about variations in Comprehensiveness from the perspective of Accessibility when nurses did not document an important event in a note. In the fourth example, an ICU nurse described variations in how nurses write notes about their shifts.

Comprehensiveness and Interpretability and Rule and Regulations

Table 22 demonstrates how rules and regulations influenced how the affordances for Comprehensiveness and Interpretability were enacted in groups. In the first example, an ICU nurse explains how clinicians’ ability to include important information in a note was constrained rules and regulations about the patient chart as a legal document. In the second example, an ICU respiratory therapist commented on variations if and how often members of his professional group created notes because it was not mandatory. In the third example, a physical therapist mentioned the difficulty of sharing information with other professional groups in the EHR because of specific required terminology, which constrained to what extent others could interpret the information in notes.

Table 22: Enactments of Comprehensiveness & Interpretability within Groups: Rules & Regulations

"A LOT of stuff, such as maybe psycho-social impressions of patients or families you wouldn’t feel comfortable putting in a medical record, things like ‘this person is irritating’, ‘this person is demanding’, ‘this person is really anxious’. Things that you would never put in a medical record can be spoken face to face.” (ID13, ICU Nurse)

"I would say there’s a percentage of us that use it more than the rest of the respiratory therapists. I’d say that’s about 20%. The rest of them are just now coming on with writing the progress notes. And there’s that small group that always writes and makes it easy for the physicians. And the rest are, you know, catching on little by little. And then of course there’ll be the few that won’t do it until you step on their necks, right? For..." (ID18, ICU Nurse)
Comprehensiveness and Interpretability and Feature Fit

Table 23 demonstrates that feature fit influenced how the affordances for Comprehensiveness and Interpretability were enacted in groups. For example, an ICU nurse commented on peculiarities of the EHR for certain types of orders, which influenced her experience with the affordance for understanding and interpreting information when creating an order.

Table 23: Enactments of Comprehensiveness & Interpretability within Groups: Feature Fit

"I think sometimes it’s hard to know what to order. Like say you need interventional radiology to put in a line, a central venous catheter like a dialysis catheter. You don’t know how you should put the order in. Like logically you would think 'line insertion' or something like that, but really you have to order it through angio. So I think sometimes it’s difficult knowing what words Epic is looking for to put that order in. It’s not something that’s really obvious. Sometimes it’s confusing in how you should put the order in for things that we don’t order a lot. For things we order a lot, we’ve done it how many times. We get it.” (ID10, ICU Nurse)

5.2.3. Use by Others, Rules and Regulations, and Feature Fit in Enactments of Visibility in Groups

Visibility and Use by Others

Enactments of the affordance for effectively emphasizing and noticing pertinent information among multiple sources within groups were shaped by use by others, rules and regulations, and feature fit. Table 24 demonstrates how a team member’s experience with the affordance for Visibility in their work depended on how others used the EHR.
Table 24: Enactments of Visibility within Groups: Use by Others

“I think a source of frustration sometimes on the part of different groups is in some of the demands and things we ask, we may not know what all their demands on their time are or what they have to do. Or we’re asking for certain information and it may be easily accessible and we just don’t know how they operate within Epic well enough to get the information ourselves. So if I want a specific piece of information, maybe it’s in a certain flowsheet, and I just don’t know where it is, because there are a lot of functions.” (ID4, ICU Physician)

“We all look at Epic. But we look at what we want to look at. You know, what’s important for our particular provision of care.” (ID13, ICU Nurse)

“A dialogue! Instead of a fragmented ‘Hi, I’m this doctor, let me write my dissertation’, ‘Hi, I’m this doctor, let me write my dissertation’, and with barely, barely a mention of them to the surgeon and to the nephrologist. They’re not talking to each other. ‘Hi I’m talking about kidneys’, ‘I’m talking about … something else’. And they don’t intermesh. Use a forum. Why not? Yeah, it seems too simple [laughs].” (ID18, ICU Nurse)

In the first example, an ICU physician noted that physicians might ask nurses for information, which was presented in easily noticeable ways in the EHR. In the second example, an ICU nurse noted that clinicians looked at the EHR selectively. While selective use patterns may suggest effective enactment of the affordance for noticing pertinent information, they could also make it more difficult for a team member to share and emphasize pertinent information effectively to other team members. In the third example, an ICU nurse commented on the difficulty to gain an integrated view of pertinent information among the notes of different consultant physicians, who focused only on their area of expertise without integrating information with others.

Visibility and Rules and Regulations

Table 25 demonstrates how a team member’s ability to leverage the affordance for Visibility in their work depended on rules and regulations.

Table 25: Enactments of Visibility within Groups: Rules and Regulations

“I think Epic, that’s a part of their permanent chart. That’s a legal document. Whereas this [the yellow sheet] is just our daily goals. And orders are legal. If there was a part of Epic that wasn’t a part [of the legal document], that probably would be good.” (ID10, ICU Nurse)

“I think there must be a possibility ... if it’s anything like Cerner, which I didn’t care for, but it’s moldable by the entity that’s using it. You know, it’s reprogrammable basically. You can make it do what you want to do. And I’m sure there’s a way or a place that you can make that information centralized for all the specialties.” (ID18, ICU Nurse)
In the first example, an ICU nurse described the influence of rules and regulations on how team members could emphasize pertinent information in the EHR. ICU teams used a paper sheet of daily goals for a patient ['the yellow sheet'] in part to enhance the visibility of daily goals for nurses in an informal way that was not included in the patient chart as a legal document. In the second example, an ICU nurse mentioned the role of the particular hospital, including its rules and regulations, in influencing how the affordance for emphasizing and noticing important information in the EHR could be realized in groups.

Visibility and Feature Fit

Table 26 summarizes examples that show the role of feature fit for how a team member could leverage the affordance for Visibility in their work.

<table>
<thead>
<tr>
<th>Table 26: Enactments of Visibility within Groups: Feature Fit</th>
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<tr>
<td>&quot;The notes can be rather cumbersome, that is to say that you can have a note put in for anything, and it gets to be a really long list. And sort of finding what I need from notes can be a little bit challenging. There’s tabs across the top for original consultations or operative report, but the day to day stuff is all lumped in together. And so it can take a little while to find.” (ID4, ICU Physician)</td>
</tr>
<tr>
<td>&quot;If a new order has arrived that I knew nothing about, it’s highlighted with a special yellow or tan kind of alert. There are several ways to know. First before you open the chart, it’s like a bar that you click on to open the chart. On that bar, the chart’s not even open, you can see a flag that says ‘new orders’. I don’t know what they are, but I know when I open this chart I see new orders inside. It’s similar to the old system where they had a plastic tab that would come out. You’d call flagging it. And this plastic tab would say ‘hey look here, there’s new orders inside’. So we have that on the front of the electronic chart. When you open the chart, then the new orders are highlighted at the top. Special attention is made. And then we’re required as the RN to click on a button that says that we acknowledge that, meaning we have read it.” (ID13, ICU Nurse)</td>
</tr>
<tr>
<td>“I always go back to the results review. That’s a really great section of that chart of Epic. It consolidates so much of that stuff ... the imaging and the heart studies and labs, and it’s all located in one spot. Coz so much of our medicine is so numbers based. And so it’s nice to see those trends and stuff right there. And you can eliminate, you just want to see the hemoglobin, last 20 hemoglobins, you can look at that without having to look through a paper chart.” (ID18, ICU Nurse)</td>
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In the first example, an ICU physician spoke about challenges in finding pertinent notes among multiple notes in the EHR feature. In the second example, an ICU nurse explained how the EHR highlighted new orders before and after opening a patient chart and therefore supported noticing important information. In the third example, an ICU nurse mentioned how the ‘Results Review’ feature of the EHR helped him notice pertinent
information among multiple sources through the way it was consolidated in a section of the patient chart.

5.2.4. Interactions

In addition to interactions of the other foundational affordance types with the four essential IS affordances, interactions occurred among the IS essential affordances. In particular, the IS affordances for Visibility, Comprehensiveness and Interpretability interacted with the IS affordance for Immediacy in reinforcing or conflicting ways that may influence effects on relational coordination. Further, enactments of the IS affordance for Comprehensiveness influenced how team members could interpret information (i.e., Interpretability).

Figure 6 visualizes the interactions among the four essential IS affordance types for coordination in high velocity settings.

For example, enactments of the affordance for sharing and accessing information instantaneously within groups (i.e., Immediacy) were reinforced or constrained by how easy it was for team members to emphasize and notice pertinent information. The respiratory therapist could quickly access information because of the intuitive organization of data across flowcharts (i.e., Visibility affordance, see Table 13).
"I can look back at what happened yesterday and the day before that and the day before that, so if they ask me what’s been happening, I can look back real quick. You know, you don’t have to get the book and find the right date and the page in the book, you can just go right to it with Epic." (ID5, ICU Respiratory Therapist)

On the other hand, the ICU physician had to spend time looking for a specific note because of the organization of notes in the EHR (i.e., Visibility feature fit, see Table 26).

"The notes can be rather cumbersome, that is to say that you can have a note put in for anything, and it gets to be a really long list. And sort of finding what I need from notes can be a little bit challenging. There’s tabs across the top for original consultations or operative report, but the day to day stuff is all lumped in together. And so it can take a little while to find." (ID4, ICU Physician)

Enactments of the affordance for sharing and accessing information instantaneously within groups (i.e., Immediacy) was also reinforced or constrained by the quality of information (i.e., Comprehensiveness and Interpretability). For example, a respiratory therapist created notes with the goal to provide easily interpretable and therefore very quick information access for physicians (i.e., Interpretability affordance).

"It’s hard for them [ICU physicians] to look at my flowcharting, you know, because there’s so much on there and so many little numbers, and they’ve told me they found it a lot easier when I use Epic and put it in the progress notes. It’s all really condensed for them. Key things, it’s just what I’ve done today. I received them on this, I weaned them, I was unable to wean them and why, or if somebody’s had problems and what my response to that problem was. It’s right there. It’s quick. If you think 20 seconds, they’ve got my whole day right there." (ID5, ICU Respiratory Therapist)

In contrast, the ICU pharmacist had to contact nurses when she could not find important information in the note.

"Sometimes it [the EHR] helps because you can look up stuff. Other times it’s still relying on how the nurse charted. Like I heard that there were issues with a patient and that something happened, but I can find no record of it in [Epic]. So I’m still gonna have to go talk to the nurses who were on." (ID6, ICU Pharmacist)

**Summary**

In this chapter I showed that the EHR offered a distinct set of Accessibility affordances and Integration affordances associated with the group-level goal of coordination to clinicians. Four IS affordance types and their enactments within groups were particularly important for how the EHR supported or inhibited coordination with others in this empirical setting: Immediacy, Visibility, Comprehensiveness and Interpretability. Enactments of the IS affordances for Visibility, Comprehensiveness and Interpretability interacted with the
affordance for Immediacy in reinforcing or conflicting ways. Enactments of IS affordances within groups depended on use by others, rules and regulations and feature fit.

In the next chapter, I will present how enactment variations of the four essential IS affordance types enabled or constrained relational coordination on a day-to-day practice level in different processes.
In Chapter 5 I showed that the EHR provided users with a set of affordances, which offered potentials to enhance coordination. Enactments of these affordances in groups depended on use of the EHR by team members, rules and regulations about use, and feature fit.

In this chapter, I show that variations in enactments of affordances, whether based on individual differences, time constrains or other demands of the organizational environment, supported or constrained coordination. Enabling or constraining effects of the affordances for Immediacy and Comprehensiveness and Interpretability on relational coordination were primarily associated with use of the EHR by other team members, while effects of the affordance for Visibility were strongly dependent on variations of feature fit. The importance of verbal communication to mitigate potentially constraining variations arose as a common theme.

This chapter is organized as follows:

Sections 6.1., 6.2. and 6.3 discuss enactment variations of the IS affordances for Immediacy, Comprehensiveness and Interpretability, and Visibility, and their effects on relational coordination. Each section begins with an overview table of all variations, which were important for relational coordination, organized by the core communicative processes (i.e., communication with notes, order, round, handoff). I then discuss selected examples in more detail.

The focus of each section is the ICU. I highlight contrasts in the communication with consultant physicians and to enactment variations in the GU and their effects on coordination GU.
6.1. Enactment Variations of Immediacy within Groups and Relational Coordination

Effects

The EHR offered the action potential for instantaneously sharing and accessing information. However, enactments of this potential were varied. In this section, I show why this was the case and what it meant for relational coordination.

The previous chapter showed that enactments of the IS affordance for Immediacy within groups depended on use of the EHR by others, rules and regulations, and feature fit. While all enactment components influenced how quickly a team member could access information by other team members and share information with other team members, the dominant component and source of variations was use of the EHR by others, supported by rules and regulations that allowed for flexibility in the timeliness of sharing information in the EHR.

In this section, I show how enactment variations of the affordance for accessing and sharing information instantaneously based on use of the EHR by others affected relational coordination.

Enactment variations of Immediacy related to communication of plans and recommendations, plan changes, and time-sensitive orders by physicians in the EHR were essential for coordination in teams. Further, nurses had to take into account enactment variations of Immediacy in documentation for coordination in the handoff.

Table 27 summarizes the enactment variations of Immediacy and discusses when these use patterns affected relational coordination with team members adversely.
<table>
<thead>
<tr>
<th>Process</th>
<th>Enactment Variation</th>
<th>RC Implication</th>
<th>Examples</th>
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</table>
| Notes            | **Communication of plans and assessments**                                         | Primary RC dimension: Timely Communication                        | • ICU teams established SG and SK in the multidisciplinary round. Immediacy of progress notes was not essential.  
• When GU physician rounded without speaking to nurses, nurses waited for the progress notes and called throughout the day to obtain information on the plan.  
• When consultants transcribed notes and did not speak to the core teams in ICU or GU, physicians could not obtain SK and align goals with the physician they consulted |
|                  | Immediacy of information sharing by others in EHR affects RC:                       | Variations could constrain SK & SG, unless physicians also communicated verbally |                                                                                                   |
|                  | Physicians shared progress notes mid-day earliest, Consult notes could be delayed by 2 days | **Issues were not common among core ICU team members because of multidisciplinary round and proximity** |                                                                                                   |
| Communication of plan changes and time-sensitive recommendations | Immediacy of information access by others in EHR affects RC:                  |                                                                                   | • When ICU residents updated the note but did not speak with the nurse, it was likely that a nurse’s awareness of a plan change was delayed  
• When consultant physicians included a time-sensitive recommendation in a note but did not speak with the core team, it was likely that the core team’s awareness of a plan change was delayed |
|                  | Team members could not check for updated notes regularly during the day             |                                                                                   |                                                                                                   |
| Order            | **Communication of time-sensitive orders**                                         | Primary RC dimension: Timely Communication                        | • ICU teams entered many orders during the rounds while communicating verbally with the nurse  
• Most physicians spoke with nurses outside of rounds to create immediate awareness of the task  
• Some variations occurred in the ICU primarily with residents. When physicians entered urgent orders in the EHR but did not speak with nurses, it was likely that the nurses’ awareness of orders was delayed |
|                  | Immediacy of information access by others in EHR affects RC:                       | Variations could constrain SK, SG & MR between physicians and nurses, unless physicians also communicated verbally |                                                                                                   |
|                  | Team members could not check for new orders regularly during the day               | **Issues were not common among core ICU team members because of multidisciplinary round and proximity, close monitoring of patients** |                                                                                                   |
| Nursing Handoff  | **Communication of tasks in the end of the shift**                                 | Primary RC dimension: Timely & Accurate Communication              | • Incoming nurses had to speak with outgoing nurses, because it was likely that shift documentation in the EHR was not complete yet  
• When incoming nurses received verbal report without viewing the |
The overview table showed that enactment variations of the affordance for
Immediacy occurred in all core communicative processes. In communication with notes, immediacy of information access and sharing depended on when physicians had time to file the notes in the EHR, and when other team members had time to view the notes in the EHR. Similarly, in the order process physicians could not assume that nurses would immediately receive an order only because of instantaneous availability in the EHR, because nurses could be busy with patient care and other documentation. In the handoff process, clinicians had to consider potential documentation delays in the EHR, depending on critical situations and other conflicting demands on the time of clinicians in the previous shift. During the round, immediacy of information access was similarly determined by when others made the information available in the EHR.

Depending on the variations, shared knowledge and shared goals in day-to-day-practice could be constrained if timely communication of plans and pertinent events did not occur. In all processes, it was therefore important how team members incorporated verbal communication. For example, the timing of the progress note was not essential to communicate shared goals in the ICU, because ICU team members had met in the multidisciplinary round and established those goals together. In contrast, the timing of the progress note was very important for nurses in the GU, if GU physicians had not spoken to them in the morning.

The following sections discuss some important variations and their effects on relational coordination through timely or delayed communication in more detail.
Example 1: Communication of Plans and Assessments with Notes

Rules and regulations specified that clinicians of most professional groups were required to file a daily note, but allowed for variability in use patterns. In the ICU, enactment variations of Immediacy with progress notes were not essential for shared knowledge and shared goals. Timely verbal communication in the multidisciplinary round enabled shared knowledge and shared goals. The primary purpose of daily progress notes was communication across space and time rather than communication to the core team that participated in the multidisciplinary round. For example, an ICU resident explained that team members who participated in the round did not wait for the daily progress note, because they were aware of goals and team members’ contributions.

“I don’t think people sit by the computer and wait for our notes to come out. And during our rounds, we actually call the nurses there. So they listen to us present the patient, so they kind of get an idea of the plan as well. So they know the plan ... the big picture of the plans, and then you know they can look at our notes later.” (ID20, ICU Resident)

An ICU physician mentioned that daily progress notes were valuable for timely communication of a patient’s plan for the day to team members who were not able to attend the multidisciplinary round.

"So for my own notes, it’s my way of putting down or our way, because the resident will put a note and then I will put an addendum on it, and it’s sort of our impression of what’s going on with the patient and then the plan for the day, diagnostically and therapeutically. And it’s nice to have that in writing, because after rounds we break up, and then so other people who come in, who maybe involved in the care of that patient – doctors, nurses, RT’s – can read what’s going on, what we were thinking. So it’s for posterity sake if you will. Even if it’s only for the next 24 hours.” (ID4, ICU Physician)

In the GU, the same enactments of Immediacy in the EHR affected timeliness of communication and constrain shared knowledge and shared goals between physicians and nurses. A GU nurse explained that nurses experienced variations depending on individual physicians.

“Very few of them [talk to me], and that’s frustrating, because there’s a few of them that are wonderful, and every time they come to see a patient they’ll connect with me. I’m always watching for them because if I see them I chase them down, just to stand by and hear and be able to say ‘so what’s our goal today, what are we trying to achieve’. But otherwise they’ll come, they’ll see the patient, do their charting and they’re gone, and I may be in another room and I never saw them even come to the floor ... I really rely on their notes” (ID34, GU Nurse)

However, some physicians modified their enactment of Immediacy over time, because nurses would call throughout the day to obtain current information.

“You know when I first started with the hospitalists I think they tended to rely on their notes communicating to the staff. And because there was this tendency for them to write the note at the end of
THEIR 12 hour day and us not knowing what their plan was, we ended up calling them more frequently. So I think over the years they've gotten to the point where it's easier for them to update us in person before they leave the unit, or write their note quicker, or BOTH, than having to answer our 20 phone calls during the course of the day ... So what I see with the hospitalists now a lot is they will stand in front of our assignment board and look for the nurse that had the patients and then find them one by one, whereas in the past they would just come, see all the patients, leave, and we'd never know they were here on the unit ... I think everybody has their style, but generally most of them do seek out the nurse now.” (ID33, GU Nurse)

ICU and GU core teams experienced variations with how consultant physicians enacted the affordance for sharing information instantaneously in the EHR. Many consultant physicians transcribed notes, which were available in the EHR only two to three days after a patient visit, though some entered preliminary notes. An ICU resident emphasized the constraining effects of this enactment variation of Immediacy on shared goals (i.e., the plan) and shared knowledge (i.e., have they seen the patient) due to delayed communication.

"The problem is a lot of people dictate things and they don’t always write a brief note. So sometimes you don’t even know if they’ve seen the patient yet. The dictations take usually a day for it to at least come up so you can look. So yeah, it can really affect the plan. I mean they could put in their own orders, but then we're not sure what happened.” (ID20, ICU Resident)

Core team members in ICU and GU described similar constraining effects on shared knowledge through documentation delays of notes in the EHR.

"If they [consultants] do a procedure, generally they will talk to you and tell you the results of the procedure or what they think the results of the procedure would be. Sometimes the problem with consultants though is that they dictate their notes. And then in the computer when you go to look for the note under their name, it will say ‘note dictated’ [laughs]. So there’s not really an actual description of what happened. There might be two or three days down the line, but at the time that you might be looking for the written result it’s not there. So if you happen to miss them for some reason, you’re downstairs with a patient on another test or somewhere where you miss the consultant, you may not find a note that’s detailed to what happened or what the results were.” (ID28, ICU Nurse Afternoon)

"I know sometimes we have the private doctors that will still do that come in the unit see the patient and then leave and we will never know they came until the patient said, oh now they were here 4 hours ago, (laughs) and still there’s no notes. So depending on who you’re dealing with it can be difficult as far as having that right up to date communication.” (ID33, GU Nurse)

For ICU teams, the affordance for accessing information instantaneously in the EHR was also a central component to facilitate the creation of a plan for the patient in the multidisciplinary round. Because the team depended on up-to-date data in the discussion during rounds, enactment variations of Immediacy supported or inhibited shared knowledge and shared goals to the extent that timely communication occurred in the EHR. Because enactments of Immediacy by physicians who were consulted on the previous day were varied, physicians sometimes attempted to reach consultants for verbal recommendations during the round, as described by an ICU physician.
“If I say something ‘what did such and such say’, did they put a note in, I can see that and refer to it ... if it’s urgent then we’ll be calling right away” (ID40, ICU Physician)

Enactments of the affordance for accessing information instantaneously in the EHR were less varied and typically effective for timely communication of data like vital signs and lab results. The EHR facilitated timely communication in rounds by instantaneous access to current data that were not available before the round or that had changed since residents collected the data for presentation. For example, an ICU physician commented on the difference between timely communication of data before and after introduction of electronic medical records.

“With the ICU things change pretty quickly. It’s hourly data, at least the vital signs and of course the labs and everything else. So I mean it’s usually pretty up-to-date ... I mean if you sent something prior to rounds, and you didn’t have that information on your sheet before rounds, you can look it up in real time to know if the labs are back, if you have new information. You have all the up-to-date information, at least when it comes to labs, available at your fingertip. And that directly affects your medical decision-making at the time. Old school way of rounding was the resident gathers all the data from whatever nooks and crannies they need to gather the data from, get it together out in a written form and then has a verbal discussion with an Attending about each system and all the data at hand. That data by the time you sit down and talk about it might have been outdated.” (ID19, ICU Physician)

Example 2: Communication of Plan Changes and Time-Sensitive Recommendations with Notes

Communication of plan changes and time-sensitive recommendations in notes could affect timeliness of communication and therefore constrain shared knowledge and shared goals, because team members accessed notes during the shift only as their workload allowed. For example, a timely addendum to a progress note was not sufficient for timely communication between ICU residents and ICU nurses, because nurses did not check notes regularly for updates during the day. Many nurses used a paper goal sheet (‘the yellow sheet’), which they filled out during the round, as a guideline for shared goals during the day.

“I’ve seen some residents addend their note but not update the nurse. And they’re like ‘We’re going off the yellow sheet, why would I...’ because if I attend rounds, I don’t always go and read their notes, because we talked about it, right? So if I didn’t happen to be there when they [residents] came back and said ‘well no doctor so and so wants to do this instead’, I don’t know except for the orders. I don’t know, it might fall through.” (ID41, ICU Pharmacist)

Similarly, if consultant physicians shared time sensitive recommendations in notes without communicating to the team verbally, delayed communication was likely. For
example, an ICU nurse spoke about the challenges that nurses faced in making sure no gaps in patient care occurred due to delayed communication from consultant physicians.

“Well it affects the patient I think because of our structure that consultants very often go ahead and order a certain medication, order a certain procedure. So they leave it in the note and if the residents are not seeing the note in a timely manner, they don’t order that medication or they don’t order the test. And the nurses very often have to be sort of very good at reading the note and then say ‘the doctor recommended this drug or this procedure’. And when the nurses don’t see a result or they don’t see an order for that particular thing, they’re usually very good, we are, at going to the resident or the intensivist saying ‘well doctor so and so said it’d be best for the patient to have this drug, what do you think?’ And then they might say ‘oh ok, let’s order it’ ... So the dayshift nurse will very often say ‘The doctor or the consultant was here. He wrote in his note start aspirin or some such thing like that’, and then they’ll say ‘the resident hasn’t ordered the aspirin yet’. So the line of communication I think in my mind is broken there, because that nurse should have gone to the resident and said ‘well this consultant ...’. I mean some do, some don’t, it’s just the situation ... The consultants are supposed to talk verbally to the resident or talk to the nurse and say ‘this is my recommendation’. That line of communication is broken I think. It’s not always easy in the beginning of your day or through your day when you’re busy to actually read the notes until you have more of a relaxed time between medications or procedures or whatever you’re doing with the patient.” (ID28, ICU Nurse Afternoon)

Although patient care in the general unit did not face similar time constraints to the ICU in coordination with others, a GU physician was concerned about the same issue.

“‘If I have a consult I will call, explain what I want and then it’s really up to them to communicate back to me. Everyone will write a note, but it’s probably fifty-fifty that they will call me to verbally communicate as well as document in the chart. There can be gaps in care if there’s no communication. Especially sometimes consultants will write ‘would consider or would order x, y, or z’, and they expect the attending physician to put in those specific orders. So if I don’t look at that note or no one tells me that there’s a new note in, there may be a gap of however many hours before someone notices that there are some new recommendations. So you know I think it certainly can happen, yes.” (ID25, GU Hospitalist)

The constraining effects of these use variations on shared knowledge through delayed communication were reinforced by feature fit to the extent that the notes did not contain alerts and safeguards similar to the order feature, as described by a nurse manager.

“The idea is to put the right information in the right place so that the triggers are built in that section but not in the progress note. So the progress note is the most dangerous place to write stuff. It has no triggers.” (ID32, GU Nurse Manager)

Example 3: Communication of Orders and Order Status

When physicians communicated orders to team members, variations in how the affordance for sharing information instantaneously in the EHR was enacted were most important in regards to time-sensitive orders. ICU nurses checked for new orders in the EHR frequently, but patient care and other documentation requirements could delay their
awareness of new orders through communication in the EHR alone. Therefore the affordance for sharing information instantaneously in the EHR for physicians depended on use of the EHR by nurses.

Potential delays in when nurses could view orders in the EHR did not constrain coordination for non-urgent orders. However, clinicians agreed that time-sensitive orders required verbal communication to ensure timely communication for shared knowledge and shared goals between physicians and the nurses who could be busy with patient care at the bedside. An ICU nurse explained the importance of verbal communication for timely communication.

“I believe it’s important that they call me and let me know, because it’s a safety issue for the patient. I may not be looking at the orders every hour. How soon do you want it, you know, if you want it stat and I don’t see no order for two hours, you know I mean, I believe you have to communicate.” (ID22, ICU Nurse Night)

ICU physicians generally agreed on the importance of verbal communication to communicate at least urgent orders with a combination of EHR and verbal communication. For example, an ICU physician talked about ‘the personal touch’ to communicate urgency, while a resident spoke about the necessity for at least a phone call with the nurse.

“When it comes to ordering in Epic, it’s usually fine for something that’s not urgent. You put in the numbers in a miscellaneous order or CT scan of the abdomen. However, if there is an urgent or emergent thing that needs to be done immediately, you can’t just put it in the computer and walk away. You need to accompany that with a verbal order. So all orders should be through Epic, but if you want something to be done right away, it needs to be accompanied by the personal touch. You need to go and talk to the person to make sure it happens.” (ID19, ICU Physician)

“It depends on how fast you want the order done, if you think it’s urgent. If you’re not really concerned, and it’s just another order, then you don’t need to talk to anyone. But if it’s something ‘oh I need this kinda quick’, then that’s when you usually call the nurse and say ‘this one I want to order fast’.” (ID20, ICU Resident)

An ICU pharmacist also ensured timely communication of time-sensitive information by speaking to nurses before documenting in the EHR.

“I only talk to the nurse if something specific comes up. If I don’t see results and I think they might have already done something, I might go ask them. If I find something in the medications that makes me talk to the doctor before rounds, I’ll talk to the doctor, get my changes and then tell the nurse. If they’re about to hang anything, that they don’t hang.” (ID41, ICU Pharmacist)

An ICU physician similarly mentioned the role of verbal communication for timely communication and as a courtesy for nurses.

I usually put an order in and walk away to say ... part of it is kind of courtesy ‘by the way, I did dadadada’. The other small percentage of it is just me. It’s another way of putting an order in. So you
ICU nurses generally agreed that physicians were aware that they could not view new orders in the EHR immediately. For example, two ICU nurses commented that verbal communication from physicians was common.

"Sometimes the resident will actually come and let me know that they put in orders. But more typically the orders on my homepage, a red flag will say ‘unacknowledged orders’ or ‘new orders’ or something. I think the flags are very helpful. It’s a nice way to keep abreast of new orders. If it’s something that’s very urgent, they will typically come and tell me. You know the doctors will tell me ‘you need to do this or that’."

[ID8, ICU Nurse Day]

"Especially here. Usually the resident or intensivist will talk to you about something before they just order. Yeah, it’s almost always discussed."

[ID10, ICU Nurse Day]

In the ICU, the multidisciplinary round also reinforced Immediacy of information sharing, because orders were entered in the EHR during the discussion in the presence of nurses.

“Between myself and whoever is running the other COW, we can put in most of the orders that we talk about before rounds is done. Right, because it used to be: you made a plan and you made little checkboxes of what needed to get done, and then after rounds, somebody had to go write all the orders or somehow put all the orders in, so that the nurses would have it. But this way it’s all getting done real time.”

[ID41, ICU Pharmacist]

However, when physicians communicated time-sensitive orders in the EHR without speaking with the nurse, negative effects on relational coordination were apparent. These negative effects did not only relate to shared knowledge and shared goals in regards to gaps in patient care, but also to mutual respect between the professional groups. In the ICU, these situations were not common and could occur when new residents joined the ICU for one month during their rotations among different units. Several nurses described an adjustment period of coordinating with residents who had worked in non-ICU units.

"For example there's a stat order. I'd rather have them come and tell me 'ok there's a stat order'. Coz they think it's gonna flag, they don't need to talk to us. So you find out and you just do it. I think they were told when they came to the floor, by the intensivist, if there is an urgent order you need to go talk to them. But sometime they ... But most of the time, I feel like very frustrated, because they don't like talk to you. So like because we're ICU, so we into the habit that you check your [Epic] every so often.”

[ID7, ICU Nurse Day]

"The residents are different than our intensivists. It’s totally different, the way they talk about the plan of care and changes. They’ll go ‘Did you see I put that in?’ I’m like ‘No. You gotta tell me if you want something done’. I may never close Epic all day and the only reason I would know ... I might be in doc flowsheet for five hours because I’m so busy just documenting things. In the beginning it’s rough, and then it gets easier once they figure out it runs a little different.”

[ID10, ICU Nurse Day]
In the GU, communication of time-sensitive orders in the EHR also depended on the workload of nurses, who conducted patient care for five to six patients. When physicians expected immediate awareness of orders by nurses through the EHR, it was possible that timely communication did not occur. A GU nurse described how the expectation of Immediacy also constrained mutual respect between the professional groups in such a situation.

“I would like it if he would let me know I'm going to be putting in an order for this, because if I'm in another room and then I get called to another room and then get called to another room, and in the meantime patient 4 has an order put in for a stat something, and nobody, I didn't know... So I can be late, and then they get upset with me but nobody communicated to me that we needed this, and not necessarily stat order, but 'I needed this how come this wasn't, how come it's an hour gone by you haven't done this, why'. Well I didn't know it was, I haven't gone back to look at that patient yet, I've been with three other ones in that hour.” (ID34, GU Nurse)

Communication related to orders was also particularly important for coordination in the handoff process between nurses and in other professional groups that carried out orders (e.g., respiratory therapists). While ICU physicians conducted a verbal handoff that focused on ‘the big picture’ about a patient, incoming nurses had to make sure to receive the most up-to-date information on task status from outgoing nurses. Variations in how nurses enacted the affordance for sharing information instantaneously in the EHR were most important in regards to documentation delays. Due to the time constraints in the ICU, nurses of the previous shift did not always have time to document the most current task status in the EHR at the time of the verbal report.

Although rules and regulations do not specify how nurses should use the EHR in verbal handoff, the vast majority of nurses preferred concurrent verbal communication and EHR use to verbal communication and subsequent chart review. For example, an ICU nurse described the importance of using the EHR and verbal communication concurrently for timely communication.

"Usually when she gives report, I'm looking at the [Epic]. So say I look at the lab and say like 'ok, the potassium is low, did you replace?'. Or I do see that there's a new order. 'Have you had a chance to look at this order?' They just put it in at 6.55, and I'm coming on at 7. So like 'Oh did you have a chance to see that? If you didn't do it, then I will do it.'... So we not actually together look at [Epic], but either she's looking or I look at [Epic] and then, you know, we'll see what she didn't do or what she didn't replace and we can do that. Or like any kind of lab that just putting in or maybe procedure that she wasn't aware of.” (ID7, ICU Nurse)

Another ICU nurse commented on negative effects of documentation delays in the EHR on accurate communication and shared knowledge in the absence of a handoff that included concurrent use of verbal communication and the EHR. He explained that he could
not be certain if the status of the order in the EHR was current if the open order in the EHR had not been discussed during verbal report.

"Some people do get report without having Epic open, but I don’t find they get enough information. So I really do like to have the system open, and going through the chart, the computerized flow sheet and all that while I’m getting report, because inevitably people forget something or other. Some people actually take the report standing at the desk or at a table, where there isn’t a computer available for them. So they get totally verbal report from the nurse. But I’ve always found that if that happens, then I go back to the chart and open the chart and I see a red flag saying that someone hasn’t given a med, and I don’t know. So I usually prefer to have it right there open while I do it, so I can cross check information that they’re giving me." (ID8, ICU Nurse Day)

A respiratory therapist similarly explained the importance of using EHR and verbal communication at the same time to verify if information in the EHR was current (i.e., order status) and to clarify and resolve potential documentation delays.

“Because I can question any orders that don’t come up in the report or anything that I see during the report that doesn’t quite fit what I was being told. So for me it’s helpful to see and to kind of scan a little while I’m getting the report. I’m hoping that everybody charts, but sometimes you know people get so busy, they forget to document something that needs documenting. And then to go in [Epic] and not see it, I might miss or I might think it wasn’t done, but it was being done and not charted yet.” (ID37, ICU Respiratory Therapist)
6.2. Enactment Variations of Comprehensiveness and Interpretability within Groups and Relational Coordination Effects

The previous section showed that enactment variations of the IS affordance for Immediacy in groups affected relational coordination through timely or delayed communication, unless team members mitigated potential delays through verbal communication. In Chapter 5 we learned that enactments of the IS affordances for Comprehensiveness and Interpretability interacted with Immediacy. Effective enactments of the IS affordance for accessing information instantaneously (i.e., Immediacy) could not support shared knowledge and shared goals through timely communication, if the quality of the information provided in notes was not sufficient to move forward with patient care. In these cases, clinicians had to follow up and clarify the information.

Enactments of the Integration affordances for sharing and accessing information within a source that was clear and understandable (i.e., Interpretability) and that contained all necessary details for the care of a patient (i.e., Comprehensiveness) were essential for how team members experienced coordination with teams members. This section shows important enactment variations of the affordances for Comprehensiveness and Interpretability due to use of the EHR by others affected relational coordination.

Table 28 summarizes the enactment variations of Comprehensiveness and Interpretability and demonstrates when these use patterns could affect relational coordination with team members adversely.
<table>
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<tr>
<th>Process</th>
<th>Enactment Variation</th>
<th>RC Implication</th>
<th>Examples</th>
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</table>
| Notes   | Communication of thought processes, assessments, plans, recommendations and situations | Primary communication dimensions: Comprehensive, Accurate Communication, Problem-solving communication | • Individual variations in how clinicians wrote notes were common  
  • In addition, variations in how different professional groups wrote notes were common:  
    o Physician notes could consist of generic templates with many data or very short ‘one liners’ with differing elaborations of assessments in both types  
    o Resident notes consisted of templates that contained long reviews of each body system for teaching, but detailed assessments and plans, cosigned by attending  
    o Nursing notes consisted of generic templates that lacked specific detail, though some nurses added more descriptive information than others  
    o Physical therapist notes consisted of templates that contained many data and specific terminology |
|         | C&I of information sharing by others in EHR affected RC: Team members could not always understand assessments and/or not receive sufficient detail on pertinent information | Variations:  
  • Could constrain SG & SK when others did not clearly communicate pertinent information, unless team members clarified information through verbal communication  
  • Could constrain MR when selective communication was followed by challenging verbal communication  
  • Danger of passive or blaming communication when disagreements occur | Issues less common among core ICU team members, because of multidisciplinary round and proximity |
| Order   | Communication of orders | Primary communication dimension: Comprehensive communication | • ICU Physicians shared basic orders in the EHR and accompanied more complex orders by verbal communication  
  • Consultants sometimes entered orders without note or verbal communication, although this practice was strongly discouraged in the ICU because of potential conflicts in the overall plan  
  • ICU nurses and GU nurses called physician when an order was not clear or unexpected  
  • Variations in how ICU nurses used ‘acknowledge order’ feature in the EHR did not affect coordination, because physicians monitored order status in results review, MAR, and at the bedside |
|         | C&I of information access by others in EHR affected RC: Team members could not always understand the reasons for orders | Variations could constrain SG & SK when physicians did not clearly communicate the reasons for orders, nurses followed up with verbal communication.  
  In the ICU, verbal communication between physicians and nurses was common unless orders were basic. |
The overview table showed that enactment variations of the affordances for Comprehensiveness and Interpretability occurred in all core communicative processes. In communication with notes, comprehensiveness and interpretability of information access depended on how clearly clinicians describing their assessments and if they included all pertinent information for a team member reading the note. Variations in how team members wrote notes were based on individual differences and differences among professional groups. In the order process, nurses did not always understand why physicians entered certain orders in the EHR. In the handoff process, clinicians had to consider potential incomprehensive documentation in the EHR, because team members of the previous shift were not allowed to document all information in the patient chart as a legal document. During the round, Comprehensiveness and Interpretability of information access was similarly dependent on
how others documented information, such as consult notes, which ICU team members used as a basis for discussion.

Depending on the variations, shared knowledge and shared goals in day-to-day-practice could be constrained if comprehensive communication in the EHR did not occur. Insufficient enactments of Comprehensiveness and Interpretability could result in selective and inaccurate communication, unless team members incorporated verbal communication to alleviate documentation problems. For example, variations could be mitigated if consultant physicians talked to the ICU team beside filing a note, if physicians spoke to nurses about orders, when nurses conducted a verbal handoff that included informal information that was not in the EHR, and when the ICU team contacted consultants during round for clarifications of recommendations in their notes. Because of the proximity of ICU team members, verbal communication that alleviated potential issues associated with variations in Comprehensiveness and Interpretability was more common than in communicative processes with consultants or between physicians and nurses in the GU. When the quality of communication in the EHR and verbal communication were insufficient, instances of passive communication occurred, which could not only constrain shared knowledge and shared goals, but also mutual respect among team members.

The following section discusses enactment variations in communication with notes and their effects on relational coordination through comprehensive or selective communication in more detail.

**Example: Communication with Notes**

Critical enactment variations of the coordination affordances for Comprehensiveness and Interpretability were related to how clinicians wrote notes, because notes were important in communicating thoughts, assessments, recommendations and plans among team members.

Chapter 4 suggested that notes should be effective tools to support relational coordination in practice, because clinicians from all professional groups described creating notes with the goal of communicating the plan for a patient and their contributions to the care of that patient during the shift. However, Chapter 5 showed that enactments of the IS affordances for Comprehensiveness and Interpretability within groups depended on use of the
EHR by others, rules and regulations, and feature fit. While all three components were important for how Comprehensiveness and Interpretability were enacted in groups, the dominant source of variations was use by others, supported by rules and regulations and the notes feature that allowed for variations in how team members crafted notes and provided the ability to create templates and smart phrases.

From an information access perspective, clinicians described large variations in how other team members created notes and their usefulness to communicate the information they needed to continue their work.

**Variations among professional groups**

Clinicians described important variations in how different professional groups enacted the IS affordances for Interpretability and Comprehensiveness in communication with notes and how these variations could enable or constrain shared goals and shared knowledge through comprehensive or incomprehensive communication unless team members clarified information verbally. Variations among professional groups were related to practices in specialties. For example, resident notes contained more detailed information than most other physician specialties, while consultant physician notes differed depending on the practices of the specialty. An ICU physician described the usefulness of both types of notes for coordination.

“So one extreme is the note that you usually see from the Medical ICU resident cosigned by the attending physician, in which every single system is noted out in excruciating detail, and every single detail since the patient’s admission is all in that plan. And then the other extreme is a subspecialist note, there are a couple of physicians who are infamous for doing that [laughs]. But say ‘Continue Primaquen. Patient better’, and their name. So there needs to be something in between. So what you see right now are those two extremes more often than not, interspersed with the nursing notes, which may or may not be helpful, PT, case management, they’re always helpful, what other notes ... speech therapy and occupational therapy, and then the subspecialists.” (ID19, ICU Physician)

An ICU nurse and resident further commented on differences in the quality of notes for coordination based on practices in consultant physician specialties.

“Very different. I mean very different. Barebones. You really have no idea what their plan of care is or what they ... you know, they just have the most basic thing. They’re only focused on one thing. They’re not focused on the person as a person. They are looking at one system a lot of times. But then others are just like ours, you know our attendings, and they’ll be really complete. Actually the best guys are like the ID guys, because they put everything they have done, history, what happened, response. They’ve always been really similar [to ICU notes]. They’re really good. Or like the oncology is not so good.” (ID26, ICU Nurse Night)
“The notes are just different among different professional groups. Like a heart doctor, cardiologist, will have EKG, all the things that are important to the heart doctor auto populate on their note. That’s how they design. It’s more helpful for them actually. If I have a question for heart problem, at least they have everything that you need to know about the heart and its current state of health in one note. I think that makes it easier. Electronic medical record just makes it more convenient for us.” (ID39, ICU Resident)

One common practice across physician specialties was auto-populating data in notes. Because other professional groups looked for team members’ thinking, assessment and plan in notes, this enactment of Comprehensiveness made it more difficult and time consuming for others to review notes. This is an example of when enactments of Interpretability interacted with the affordance for accessing information instantaneously (i.e., Immediacy) in a conflicting way. For example, an ICU nurse manager described the lack of balance between pertinent and extraneous information for coordination in many notes.

“I think it depends on the consultant, because a lot of consultants use the APRN's to do their notes for them. Again, they're focused, on their particular system. You know the cardiologist or the nephrologist, there's some variability, there're some better notes than others, you can tell some people have worked on it. And then even their progress notes, some people pull in way too much stuff. Their progress notes are three pages, because they pulled in every lab and every test for the last thirty days. Well who cares? It’s a note from day to day. And then you can tell what they write in at the very end is two, not even two sentences.” (ID30, ICU Nurse Manager)

An ICU physician commented how extraneous information distracted from communication of assessments and thinking by other team members and constrained coordination through incomprehensive communication of pertinent information versus extraneous data.

“I tend not to incorporate all of the labs and stuff, only the relevant things. There are others, not just within our group but other consultants who just like to incorporate all the … you know there’s a way in Epic to bring in every single lab piece. It gets to be 6, 7 pages. You don’t really need it in the note. And not all that is necessary for the purpose of our notes. The content of the note can be a bunch of objective data, but it’s hard to pull together what the person’s thinking writing the note, and in that instance Epic gets sort of polluted ... I don’t think it’s what they intended. And so the notes become less useful in some ways, even though they’re chock full of data, I think note content could be streamlined a little bit, because Epic’s original intent is corrupted somewhat by this ability to incorporate tons of data, and the thinking, the process, gets lost.” (ID4, ICU Physician)

Another common practice related to Comprehensiveness and Interpretability was copying and pasting information from the previous note, which could affect comprehensive and accurate communication. The primary coordination issue was selective communication when team members would scroll through content that appeared not valuable and potentially missed pertinent information. For example, a consultant physician commented on potentially adverse effects on shared knowledge when notes contained information that others should be aware of ‘hidden in’ extraneous non-coordination content.
“I actually until fairly recently would put in bold text the key sentence that I want people to see, or things that have changed, because also you know there is a lot of cutting and pasting of the chart. I basically build today’s note off yesterday’s note. It’s the same diagnosis and it’s the same history, I’ll change what part of the exam and I change whatever part of my assessment and plan I need to change. But many notes look exactly the same day to day. Mine change, but many other ones don’t. And so no one’s gonna read through all that.” (ID23, Consultant Physician)

The secondary issue for coordination was potentially inaccurate communication, as described by an ICU resident.

“One thing about electronic medical records that is a little dangerous, but everyone does it, is the copy and paste function. So it can get bad because people don’t update information. But it’s also helpful because you don’t want to type the same thing every day when not much is changing. I think as residents we’re all guilty of taking our note from the day before, moving it forward and just updating it. Refreshing all the new data that comes in and then in each problem we change, if something happened then we try to change it. Sometimes we might forget to like take out one part of it, like continue this medication when we stopped it. Just because our notes are so long you might miss one line ... Attendings do it, too, more consultants because our attendings usually just addend our note. Sometimes it could be like ‘continue this’, but maybe we have stopped it a couple of days ago. Or minor things would be like, some attendings will write ‘I discussed this case with Doctor whoever’, when the attendings change ... Some people are better with it, some aren’t.” (ID20, ICU Resident)

The usefulness of nursing notes for other professional groups appeared to be limited by the practice to chart against nursing care plans. For example, an ICU physician discussed the generic character of notes, which did not communicate sufficient details about the care of a specific patient.

“They [nursing notes] all start to look alike, except for maybe one sentence at the bottom. I go through it to see what’s in it. And then I look at the title sometimes, it will say ‘hypoxemia something’. They have a note that looks very much the same for all hypoxemia things, but it doesn’t tell me in detail of anything going on. So then I’ll either call or walk over and ask. It is not as descriptive.” (ID40, ICU Physician)

ICU nurses also commented on how care plans affected the way they could enact the affordance for sharing interpretable information with nurses and other professional groups. For example, an ICU nurse explained the difference between ICU physician notes and nursing notes regarding clear communication of goals.

“The doctors are very good with it [goals], because always at the end of their notes they have plans as far as each body system, you know, they’ll put a plan. Or what might be the major problems with the patient, if it’s kidneys or lungs or whatever, and they’ll put the plan. The nurses don’t always do that. We have the care plans, but unfortunately they’re not always personalized. They’re more general, just for every patient kind of. So that’s not always, nursing wise, between nurses, a good way to get the plan. Verbally nurses are very good at doing that, but writing notes they’re not always very good with the plan.” (ID28, ICU Nurse Afternoon/Evening)

Another ICU nurse described how the inclusion of more specific goals in care plans would help nurses to create more specific notes that are more useful for communication.
“Specific clinical goals need to be modified, elaborated, added. I think all these things need to be added to the care plan in order for us to be more specific with our notes. For the most part it's functional. But it may not be exactly the one that you want.” (ID22, ICU Nurse Night)

On the other hand, the quality of physical therapy notes for coordination was limited by how the professional group enacted the affordance for sharing understandable information (i.e., Interpretability) due to the use of specific terminology. For example, an ICU nurse manager described team members’ frustrations with understanding physical therapy notes.

“I can't even understand them [Physical Therapist notes]. I cannot understand them at all. But that's their discipline. And if that's what they're required, that's fine, but I can't tell what is the patient doing. Are they sitting up at the side of the bed, are they taking two steps. I can't tell that from their notes because of all their jargon ... [It’s frustrating] For the team to know, well what's happening, where are we at here, and you can't tell. If I can't read the notes, or I don't understand the notes, then I just call the physical therapist myself. 'Help me understand what's going on with the patient. We need to be here, I can't tell where they're at'. 'Oh ok’.” (ID30, ICU Nurse Manager)

Individual variations

In communication with notes, individual variations in how clinicians across professional groups wrote notes appeared to be even more important for coordination in teams than variations across professional groups. Individual variations in how team members created notes occurred across professional groups. For example, an ICU resident and a GU physician explained that they experienced large variations in all specialties regarding descriptiveness and usefulness of notes.

“Specialties and people within a specialty it varies [how they write notes]. It’s probably just based on the individual. If they’re really descriptive, like what they’re thinking and what they’re doing and why, then it’s really helpful ... 40% of the time? 50? I don’t know, maybe 50-50. It really varies.” (ID20, ICU Resident)

“I think it’s mainly dependent on the provider, there are consultants that write really great notes, there are consultants who write really bad notes. There are surgeons who write great notes, there are surgeons who write bad notes. So that really is provider dependent I think.” (ID25, GU Physician)

Individual variations were particularly important for comprehensive / selective communication related to physician notes, because notes communicated plans and recommendations to the team. Issues with relational coordination due to enactments of Comprehensiveness and Interpretability did not occur in the ICU, because residents were required to create a detailed progress note that they also presented in the multidisciplinary round, which was addended and co-signed by attending physicians. An ICU pharmacist
highlighted the value of this approach for relational coordination and contrasted it to another ICU in the hospital.

“I think there’s a difference between professional groups. I haven’t worked in the SICU in a while, but when I had to cover over there, they have this templated note that requests a lot of data. And then they write a very bulleted plan, but there is no assessment. I have a hard time, I find that there is not an assessment of what’s wrong. Whereas in MICU they’ll have a lot of data, but then they’ll have the plan by system of ‘this is the problem and this is why, like acute hypoxic respiratory failure from whatever reason, and then this is what we’re doing’. So that’s much better. I find in the MICU, because of how we ask them to present in rounds, it’s more like that.” (ID41, ICU Pharmacist)

An ICU respiratory therapist explained the difference between ICU progress notes and consult notes for shared knowledge and shared goals through comprehensive or selective communication.

“Some people just dictate their notes and it gets typed up and you just read it as a little note. In the ICU they have a template that they fill out daily, with all the lab values, what happened, what the plan is.” (ID37, ICU Respiratory Therapist)

Individual enactment variations were more common among consultant physicians and physicians in the GU. An ICU resident and a consultant physician emphasized the role of Comprehensiveness in understanding the thought process of a consultant physician and highlighted potential adverse effects on shared goals through selective communication.

“Sometimes attendings will write too little and you don’t know really what they’re saying or why they’re doing it. They have a plan, but you don’t know why they’re doing it.” (ID20, ICU Resident)

“Well a lot of people really aren’t so transparent in what they’re thinking. They just say ‘this is the problem, this is the treatment’. And they might, sometimes the recommendation is just a list of drugs. So sometimes the assessment is just a list of problems, and the treatment is just a list of treatments, drugs, what have you. But it doesn’t say what do you think, what are the chances that these are gonna work.” (ID23, Consultant Physician)

A GU physician described the adverse effects of incomplete assessments and plans on shared goals between physicians.

“I think face to face is the best, but in lieu of that I think the notes are fine, or pretty good. But I do think there is variability in the way that people write their notes, and so you know that makes it difficult. So even within our own group I think there’s a huge variability in people’s documentation styles. So there are certain people in the group that I would not at all mind picking up a patient from because I can read their note and I know for certain what they’re thinking, what their plan is and where to go. And there are other people that you’re going to have to start from scratch.” (ID36, GU Physician)

Some individual variations were related to feature fit to the extent that individual clinicians were not comfortable with supporting tools in the notes feature, although interview participants in all professional groups agreed that creation of templates and smart phrases was not difficult. An ICU resident explained that some physicians created elaborate templates
while others used free text for every note, based on individual skills with the EHR system. A consultant physician added that individual variations related to computer skills were a generational issue.

“Every attending physician’s note is different. Part of it is their ability to use electronic medical record and they’re getting to know it. If you really want to get to know the system, then you can really design, they can design their own template. Some doctors do that … Sometimes they just come out in paragraph form. But then those are good too. The quality of the note is really like easy to follow.” (ID39, ICU Resident)

“I think the younger the people are, the more they’re writing [laughs]. Well unfortunately it’s more among the generations, like the old timers have a hard time typing sometimes I think. So the more you have grown up with computers, the easier I think it is. So for the older physicians, they tend to be very brief sometimes. I don’t know if it has to do with their computer skills or what it is.” (ID31, Consultant Physician)

However, the resident also emphasized that varying use of templates among individuals or professional groups did not determine the quality of assessments. A GU physician further commented that comprehensiveness of assessments and plans depended on the preferences of the individual physician rather than EHR skills.

“I think it’s a style, because what you can’t make a template is the assessment and plan. So the assessment really is you got to convey your thoughts, and some people want to do that, and some people feel like they should just keep it to a limited …” (ID36, GU Physician)

Individual variations in how team members enacted Comprehensiveness in the EHR were also important related to if physicians updated notes in additional to verbal communication in the case of plan changes. Verbal communication without documentation in the EHR resulted not just in selective communication, but also in inaccurate communication with team members who were not present for the verbal communication. For example, an ICU physician described coordination effects when residents did not update progress notes.

“If they [residents] don’t go back and fix their notes if their plan changed, their note might say one thing and what they ended up saying after discussion with either myself or the team, they might end up saying something else and it could be confusing … I think a lot of people don’t. They could just addend it and say ‘oh discussed with team and decided on x change over what was initially planned’. I guess the safest would be have your discussion and then change your note. Because otherwise there’s a confusion of ‘well they said to use imipenem but what they ordered was ertapenem’. Their note might have said ertapenem because that had been the plan. But then when they discussed ‘oh the patient’s sicker, maybe we need to broaden the coverage a little bit more’. But then you know if their note hasn’t changed, it could be … I don’t know which way do you want it. If they just put in an order, then everyone is like ‘where did this come from’.” (ID41, ICU Pharmacist)

An ICU nurse described how team members taking care of patients in the next shift relied on adequate enactments of Comprehensiveness in physicians’ progress notes and how they dealt with inconsistencies.
“Well the physician’s daily round written note captures everything. I go to that to find out what the plan of care is. And then from there I question ‘well why aren’t we doing what you have in the note’, and then ‘if we’re not, then why is it in the note’, and then ‘so when did it change’. And so if something’s changed, I want a note about it or I’ll write a note and this is ‘Ok, saw this in the note, this wasn’t being done. We’re doing this now.’ (ID26, ICU Nurse Night)

A related issue for comprehensive communication occurred when physicians entered orders without verbal communication or documentation in a note. While ICU physicians typically communicated verbally with nurses about orders, clinicians described some variations with new residents and consultant physicians. For example, two ICU nurses commented that verbal communication or an explanation in a note was necessary for nurses to understand the rationale of complex orders.

“I believe it’s important that they call me and let me know, because it’s a safety issue for the patient. It’s not just about seeing the orders. It’s about patient safety. You have to be able to communicate to the nurse why it is that you’re ordering it, because she may not necessarily understand it. And then what’s gonna happen is she may not understand why it’s being ordered, you want to clarify if it was a mistake or not or why am I giving this, I just am not getting it. Then you have to call him again. So it’s an extra step. And an extra piece or a step where you have to enter into Epic that you called the physician for this. Sometimes they don’t let me know because it’s something that is like not as important, like labs for the morning. I don’t need to be called for that sort of thing” (ID22, ICU Nurse Night)

“But then when you get orders without notes, you don’t really have anything backing that up, and sometimes you’ll have to call because, I’ll be like ‘do you mean to write an order for this patient, coz you don’t do anything to coordinate … ’why do you write this lasix order for this patient. It didn’t mention anything about urine output but I know you’re a nephrologist, but there’s nothing saying why’. ‘Oh yeah yeah, I thought that bla bla bla’. ‘Ok’.” (ID18, ICU Nurse)

However, these situations were not common in the ICU, because consultant physicians were strongly encouraged to speak with residents who coordinated all orders.

**Enactment Variations and Competing Demands on Clinicians**

In the literature review, I noted two recent studies, which had identified different affordances of HIT in the health care organizations that were not related to the goal of communication among team members (Strong et al., 2014; Goh et al., 2011). Examples included affordances for monitoring and standardizing operations and efficiency.

Variations related to enactments of Comprehensiveness and Interpretability across professional groups and across individuals could be traced to conflicting non-coordination affordances that were associated with competing demands on clinicians in daily work. An example of a non-coordination affordance that affected individual enactments of the
affordances for Comprehensiveness and Interpretability was efficiency. For example, an ICU physician explained why many clinicians created very short notes that did not contain the details necessary for effective coordination.

“I think that the communication via the notes is adequate at this point, but it can certainly get better. Well so, say an example, maybe the gen surgeon comes in and puts in three lines, or the nurse’s note says ‘Transported to CT. Patient back from CT and sicker’. So there is still some detective work involved sometimes to try to figure out exactly what the course of events was. Even though the document is there, you just have to decipher the course of events and put it together with the results tab, you know looking through what tests were done. That being said, because there are so many documentation requirements popping up, most of our time is spent in documentation. So how we decrease that burden and make documentation more efficient, but still tell the complete story, that’s a struggle.” (ID19, ICU Physician)

However, use variations were also often related to rules and regulations. For example, clinicians described that interpretability of notes differed with how professional groups incorporated and prioritized billing. A GU physician commented on the difference between physical therapy notes and social work notes due to focus on billing versus coordinating with others.

“It differs by provider. Physical therapy notes I think are also very billing oriented, so there’s a lot of stuff in there so that they can bill. And you have to sort of hunt through the nuggets to find. Whereas social worker, case management are not necessarily tied to billing. So they’re very straightforward in terms of just communicating what they think.” (ID25, GU Physician)

The GU physician further explained how he reconciled billing with enacting the coordination affordance for Interpretability effectively for other team members.

“There are different purposes of documentation. One is for billing, and the second is for communication. So I make sure that I document appropriately so that I can bill appropriately, so for the coders I use specific medical language that allows them to code the document appropriately. But on top of that I try to write it in such a way that someone reading it would understand. From their perspective what’s important, so if it’s a nurse what the plan of care for the day is, what the overall plan is, for social work discharge planning, for PT what I hope that the patient is mobilized for the day so that I try to address it for the multiple audiences that I think are important in my patients’ care.” (ID25, GU Physician)

A consultant physician described the conflicting interactions of the non-coordination affordances for billing and legal documentation with the coordination affordances for Comprehensiveness and Interpretability.

“We do have different audiences. Unfortunately the most practical thing is I’m writing for the billing and coding people. That’s ACTUALLY the most PRACTICAL thing, because I know not many people are going to be reading the note … The second is communication among the colleagues, and I know some people will be reading it and some people will be looking. They call us because things aren’t going well and they kind of want some help. So I know usually whoever consulted us the intensivist or whoever is gonna read the note and see what I’m thinking. But I’m gonna have already spoken with them anyway. But a lot of times, if I’m saying what everybody else is kind of thinking but I put it in the chart, that might help them to raise the issue of moving forward and say yeah I think so too. Now that I
see it written in black and white, that kind of makes sense and I kind of agree with that. So it is communication. It is just to put it out there in the public square. This is my assessment. This is what I think. Anybody agree, anybody disagree? And then the third is the medical legal, will a lawyer or a jury or a judge be looking at this ever? And that fortunately is a very rare thought that goes into my head when I’m writing my notes. It is really pretty much in that order. I mean the everyday humdrum note, I’m just doing the pain management piece. I want people to know what I’m doing, but it’s REALLY mostly documenting how much work I did and what is the value of this. So a hundred percent of the notes it’s about getting paid. And then a certain percent of the notes is about communicating important things. And you know there are some notes where there’s zero of that, but most notes there’s at least one thing I want people to know. Hey, I’m adjusting their bowel medicines today, just be aware. So don’t you do that because I’m already doing this.” (ID23, Consultant Physician)

Another example of a non-coordination affordance that affected how coordination affordances were enacted was evaluation for teaching. For example, an ICU physician and resident explained why residents enacted the Comprehensiveness and Interpretability differently from other physician specialties.

“Well, it’s the way that residents learn how to think about the patient in a system based manner. And present in a system based manner. So their verbal presentations are mirrored by their written presentation in the note” (ID19, ICU Physician)

“I think because people will evaluate our notes and see are we doing a good job writing it. But then we put a lot of information in there, so it gets really long and wordy and I don’t think people read the whole thing, because it would take forever. Our notes can get very long, like 5 pages. If we don’t do it in that detail, then we could get in trouble, or I don’t know if that affects billing. I’m not sure how that works. But usually residents’ notes are much longer. And so to look for the information you need might be a little more difficult. Whereas attending notes could be really short, but the plan’s like right there.” (ID20, ICU Resident)

Rules and Regulations were also the primary reason why team members could not receive all pertinent information in the EHR as a legal document. Clinicians were not allowed to include certain information in notes, which was essential for shared knowledge and effective patient care among clinicians of different shifts. Team members could only receive ‘informal information’ verbally from a nurse at the bedside or from a physician, which included subjective concerns, family issues, and patient behavioral issues. For example, an ICU physician explained that the outgoing physician could only verbally communicate details about family visits, which were important for the care of a critically ill ICU patient.

“He [the outgoing physician] may not leave notes to everything that may have happened. For instance family visit, they came in the middle of the night. Those are things that you can’t really necessarily put in notes. There are some verbal things that get passed on that’s essential, that should not make it into notes.” (ID40, ICU Physician)

An ICU nurse also spoke about family dynamics, behavioral information, or concerns of the patient that were essential for shared knowledge between nurses.

“Usually more psychosocial type things, so the family members and the patient. Maybe something that the patient relates to them that isn’t having to do with vital signs or medications. Things that are more
personal I guess, or personalized. That isn’t always gotten from the notes or from the flow sheets or that sort of thing.” (ID28, ICU Nurse Afternoon/Evening)

Because rules and regulations applied to all units in the trauma center, GU physicians and nurses described the same issues. A GU physician added that rules and regulations also required that all documentation had to be conducted in the patient chart.

“We used to do word document, which was just a tiny summary of what the patient was. But then I think for HIPAA reasons that was taken away and then there was a recommendation that we do a sign-out report, which is in Epic. The issue with that is that it’s an open document, so anybody in the medical record can read it. There are some things you might want to communicate that are inappropriate to be part of the medical record. And it would be nice if it would be just something that just the hospitalist group can see, you know. And then you could say what you wanted.” (ID36, GU Physician)

Of the professional groups I interviewed, only pharmacists and physical therapists had access to an informal section in the EHR, in which they could communicate information that was not part of the medical record and support shared knowledge in the absence of verbal handoff in these professional groups through comprehensive communication.

“The good thing for me that I think most therapists appreciate is we have our own quote unquote secret section that says internal communication. It’s where I get the heart of what I need to know. When I have to follow 12 patients a day, sometimes I know none. And so it’s so nice to see what the therapist before me said, [patient name] tends to talk too much and will swear at you and says he hates women. I mean put exactly, it doesn’t have to be in professional language. It’s nothing that the nurses, the doctors, or the patients will ever see. It’s not part of the medical record. You want to be able to warn your therapists especially from a Friday to a Saturday, but you don’t want to put like swears and hates women or anything that’s gonna stay forever. So I honestly feel like that internal communication makes the job so much easier.” (ID38, Consultant Physical Therapist)

**Enactment Variations and Responses by Team Members**

Team members dealing with variations in how the affordances for sharing comprehensive and understandable information were enacted by others took different strategies to obtain necessary information.

In the **beginning of the shift**, clinicians typically combined the review of notes with verbal communication. For example, an ICU resident described variations in nurses’ notes and the role of verbal communication for his awareness of important events during the previous shift.

“Sometimes they’ll give things that weren’t documented or little other things. They know the patient a little bit better. They can explain exactly what happens overnight in more detail. Sometimes their progress notes will just be to the point.” (ID39, ICU Resident)
An ICU nurse talked about the necessity for verbal communication with the outgoing nurse to obtain additional information on the reasons for orders, which may not have been documented in notes, in addition to addressing potential documentation delays regarding orders (i.e., enactments of Immediacy).

“Sometimes they do verbally say that and they didn’t put it on Epic. They put it on the order as written and then they talk to them on the phone then close the communication loop. There is a patient summary, there is what the patient need or certain thing is pending. Certain thing WHY they didn’t do it or those kind is not in the computer and might not be on nurse note. So those kind is from the nurse we receiving.” (ID27, ICU Nurse Day)

While ICU team members alleviated variations and the lack of informal information in notes with verbal communication, shared knowledge could be constrained through incomprehensive communication between GU physicians in the absence of verbal handoff. GU physicians relied on receiving informal information from nurses, but not all communicated with nurses verbally in the beginning of the shift. For example, a GU physician commented on potential constraining effects on shared knowledge through selective communication based on individual variations in enactments of the IS affordance for Comprehensiveness in sign-out notes by GU physicians who cared for a large number of patients in different units, as well as based on the lack of informal information due to rules and regulations.

“Well we don’t really have a choice to get things from the chart. I think most of us have gotten used to documenting in Epic in a way that conveys a majority of the concerns, and that verbal communication is not essential. It does help sometimes, but it’s not essential … Unfortunately the way our system works, only a few physicians are covering a very large amount, so they often do things and don’t document it themselves or even remember doing something small on the patient 11 hours ago. So most of us rely on Epic, nursing notes and reviewing orders that were placed to kind of piece together what’s happened since we were in the hospital.” (ID25, GU Physician)

**During the round**, physicians viewed consult notes and decided whether to contact a consultant physician for clarifications. Two ICU physicians and a resident commented that verbal communication with consultant physicians during rounds could be necessary to progress patient care when recommendations in notes were not transparent.

“It’s a substitution that you just deal with. And if it’s that unclear then we make at the time the contact, or if it’s that urgent then we’ll be calling right away.” (ID40, ICU Physician)

“Yeah I mean depends upon how good their documentation is, right? And what the question is for that particular subspecialist. [If needed] Then you just get them paged during the rounds and talk to them.” (ID19, ICU Physician)

“For the most part the note is good enough, but sometimes you’ll still page them.” (ID20, ICU Resident)
During the shift, a common strategy was to seek the descriptive part of physician notes, which was typically located at the end of the note. For example, an ICU respiratory therapist described the typical behavior of team members to look for pertinent information in notes.

“There is a lot of stuff especially in the physicians’ notes, stuff that we can just kind of skip through ... I guess different units, docs, have different templates. And some of them have this lab work and all these things and then they finally do an assessment and then a plan. I guess they’re ok, you just got to understand how the template is set up to follow what’s going on.” (ID37, ICU Respiratory Therapist)

Another strategy was to only view notes of other professional groups to address a specific question.

“I don’t know if you’ve ever tried to read Physical Therapy notes, but it doesn’t really amount to much of anything. I just want the bottom line. I just want a one-liner saying what they did with the patient, what’s the ultimate goal. You know, it’s like this long [shows long note with her hands]. So I mean yeah, I’m gonna skip the physical therapy note for the day. Unless the physical therapy notes says ‘deferred seeing the patient because of x, y, and z’ and that’s it. Same thing with the nurses’ notes sometimes. A regular maintenance of care note can be really, really long, but it doesn’t mean much to me as a physician going in trying to figure out what happened overnight and what needs to be done today.” (ID19, ICU Physician)

This practice could constrain shared knowledge and goals among professional groups through selective communication especially with peripheral team members. For example, a physical therapist described selective interactions with physicians in the hospital (but did not specify a particular unit).

“Some physicians have walked in during treatment time after a month of patient being here. Oh I didn’t know that he can get up and out of bed. Well he’s walked 5 feet 3 days 4 days a week for the last 3 weeks. Like I said, it’s in the same format note, if they look at even one of them. So I don’t know if it was situational. But I feel like occasionally, it’s not just once or twice. There’s been frequent surprise, you know the physicians were ‘well I didn’t realize the patient got out already’.” (ID38, Consultant Physical Therapist)

If clinicians viewed notes and did not understand assessment and recommendations in a note, they typically communicated verbally for clarifications and details. For example, an ICU physician explained that verbal communication could clarify thought processes and enable shared goals.

“How they got to that decision becomes a little bit more clear [in verbal communication] and then what ends up being is that you have a common goal to get to.” (ID40, ICU Physician)

However, the necessity for verbal communication in such cases interacted with how the IS affordance for Immediacy supported relational coordination in practice with physicians. An ICU resident commented on delays in patient care when a consult note was not understandable.
"You rarely want to pick up the phone and call people, because that’s a whole other issue in itself [laughs]. It’s very hard to get in touch with some people. Consultants or just other doctors in general. Some are very easy. They’ll give you their cell number. And then some you page through like physicians exchange and they might not be available ... Yeah [the note is useful]. But then again if you’re confused by it, then you have to get in touch with them. It might take some time." (ID20, ICU Resident)

An ICU pharmacist commented on similar effects when new residents entered orders without informing nurses verbally, because ICU nurses relied on verbal follow-ups when the justification of orders were not clear.

"It could be that they got a call on their cell phone [from the consult] as they are leaving already, and they can still put in orders, but it would be more above and beyond to go and call the nurse then. But you could, or you could call your on-call person and say ‘hey doctor so and so said this, so we’re going to do that, could you please update the nurse’. You could do that. So it’s just, it’s always that communication thing, and [Epic] may not be enough, unless the order you put in is very specific. Because all you have to do for the drug orders is say ‘this is the dose, this is how I want you to give it and how often’. Right? But it doesn’t say ‘this is because doctor so and so wanted this’" (ID6, ICU Pharmacist)

While ICU nurses generally felt comfortable communicating verbally with consult physicians to clarify notes, in some cases the quality of notes and verbal response by physicians appeared to reflect and reinforce negative issues with mutual respect. For example, an ICU nurse described negative team dynamics with negative verbal responses consult physicians whose notes were not sufficient for coordination due to their enactments of the IS affordances for Comprehensiveness and Interpretability.

"Some of the physicians, they’re just not very friendly and you really don’t want to talk to them. Not that I avoid it, but ... if I don’t have to talk to them, that’s fine with me. Only some of them, because like I say I work at night. Some doctors, if you call them at night, they’re very grumpy. For no reason they’re yelling at you, because you’re trying to help the patient that they’re being paid to take care of [laughs]. If they would write a good note, you wouldn’t have to call them half the time." (ID26, ICU Nurse Night)

Another ICU nurse commented on how the EHR system helped her deal with such situations due to Immediacy of access to information in multiple sources (i.e., Simultaneity).

"When you go to a progress note, then it explains exactly why that particular medication was ordered for the patient. But you have to kind of like maybe go a little bit further to figure it out. Sometimes physicians can be a little defensive when you ask them ‘why are you doing that’. They might, not all of them, some are usually really good with communication. There are some physicians who are very defensive and they don’t really want to, they think they’re being challenged or something I guess [laughs]. But our physicians, the ones that we have here all the time, are very good about the verbal communication ... It might be a communication on the phone rather than they’re being there in person. I would say ‘well it says this in the note or the lab results say this’ and ‘I notice that you may have ordered this medication, but I’m not really sure what the purpose was of the medication’. And of course like I say some of them may be a little defensive, they don’t yell or whatever, they don’t get angry, but they always kind of maybe challenge you a little, then you can just say ‘well I see it in the lab results, but I don’t understand the connection’ or something. And then generally they’ll sort of, you know they give you the answer, but sometimes it’s like pulling teeth. But you have it in black and white."
you have seen it in the notes or in the lab results or in whatever. It’s right there for you. They can’t say ‘where did you get that’ or ‘how do you’. (ID28, ICU Nurse Afternoon/Evening)

However, in some cases enactment variations of Comprehensiveness and Interpretability in combination with avoidance of verbal communication resulted in passive communication, which constrained shared goals, shared knowledge, and reinforced issues with mutual respect. For example, the ICU nurse elaborated that ICU residents could also be hesitant to contact certain consultant physicians for verbal clarifications.

“Oh they avoid that, too. They’re just difficult to deal with. It’s like what are you here for? We’re all here for the same thing, you know? And everyone will be confused, including the patient. Or the patient will be saying, you know, this is what the plan is … It’s the politics, the doctor politics.” (ID26, ICU Nurse Night)

A consultant physician described her observation of negative effects on mutual respect through incomprehensive communication by consultant physicians.

“That’s one of the issues that I think with the ICU sometimes. If the consultant comes around, doesn’t talk with the team or the nurse, either does a procedure in the ICU or doesn’t leave a thorough note or doesn’t answer the questions that are needed from them, you know that always sets up those kind of little walls, and then I think it makes it very easy for people to say ‘well why didn’t he come do this’ or ‘why didn’t he do this’. I think it detracts from the collegial nature of the care, the lack of face-to-face communication.” (ID16, Consultant Physician)
6.3. Enactment Variations of Visibility within Groups and Relational Coordination Effects

In the previous section, we saw that enactment variations of the IS affordances for Comprehensiveness and Interpretability in groups affected relational coordination primarily through comprehensive or selective communication, unless team members mitigated potential problems with unclear or incomplete information through verbal communication. These enactments interacted with the affordance for Immediacy, because team members had to spend time following up to clarify information. The EHR could further reinforce issues with mutual respect through low-quality selective communication in the EHR.

In Chapter 5 we learned that enactments of the IS affordance for Visibility also interacted with Immediacy. How the EHR supported or inhibited relational coordination depended not only on when new information was entered and viewed in the EHR and how comprehensive and understandable information was. It was also essential that team members could notice pertinent information and emphasize information to others among multiple sources in the EHR.

The EHR offered the action potential for emphasizing and noticing pertinent information among multiple sources. This integration affordance was essential for leveraging the affordances for Simultaneity and Reviewability by enabling organization of the vast amount of information in the EHR, particularly for complex patients who had been in the hospital for a longer time.

Chapter 5 also showed that enactments of the IS affordance for Visibility within groups depended on use of the EHR by others, rules and regulations, and feature fit. However in contrast to the other essential foundational affordances, the dominant enactment component and source of variations for how team members could notice pertinent information and emphasize pertinent information to others in the EHR was feature fit, supported by the rules and regulations that governed the implementation of the EHR system in this hospital.

This section shows how important enactment variations of the affordance for Visibility based on feature fit and associated use patterns affected relational coordination. Table 29 summarizes the enactment variations of the affordance for Visibility and
summarizes when associated use patterns could affect relational coordination with team members adversely.

<table>
<thead>
<tr>
<th>Process</th>
<th>Enactment Variation</th>
<th>RC Implication</th>
<th>Examples</th>
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<tr>
<td>Notes</td>
<td>Communication of thinking, assessments, plans, recommendations and situations</td>
<td>Primary RC dimensions: Timely &amp; comprehensive communication</td>
<td>• Filtering tools and chronological order made it relatively easy to find a specific note, but helped less for finding pertinent information among multiple notes</td>
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<tr>
<td></td>
<td>• Features that FILTERED pertinent information</td>
<td></td>
<td>• Advanced filters (physician subspecialties) and highlighting tools could improve filtering</td>
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<tr>
<td></td>
<td>• No integrated view of plan, important chronological events</td>
<td>Not sufficient to enable SK &amp; SG in complex cases, unless combined with verbal communication</td>
<td>• Team members had to search through many notes to find pertinent information on shared goals in complex cases (i.e., long-term patients with multiple physician teams)</td>
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<tr>
<td></td>
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<td>Selective use patterns</td>
<td>• Selective patterns to find information more quickly could limit awareness of information by other team members</td>
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<tr>
<td>Order</td>
<td>Communication of orders</td>
<td>Primary RC dimensions: Timely, accurate &amp; comprehensive communication</td>
<td>• Order sets combined multiple sources based on best practices</td>
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<tr>
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<td>• Features that INTEGRATED pertinent information (order sets)</td>
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<td>• Physicians could flag orders as urgent</td>
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<td>• Features that HIGHLIGHTED pertinent information (order flags)</td>
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<td>Handoff</td>
<td>Communication of pertinent information in the end of the shift</td>
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<td>Clinicians used features that enhanced coordination by integrating multiple sources in handoff.</td>
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<tr>
<td></td>
<td>• Features that INTEGRATED pertinent information (patient summary, results review)</td>
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<td>However,</td>
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<td></td>
<td>• Features that HIGHLIGHTED pertinent information (order flags)</td>
<td></td>
<td>1) Still many fragmented sources of information</td>
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<td></td>
<td>• ICU Physicians focused their review of the EHR in the beginning of the shift with a verbal handoff</td>
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<td>2) Notes were important in handoff</td>
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<td>• Nurses mentioned pertinent notes to the incoming nurses during verbal handoff</td>
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<td></td>
<td></td>
<td></td>
<td>• Nurses pieced together important events</td>
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• Features that filtered pertinent information (notes)

sufficient to support SK & SG in urgent orders, unless combined with verbal communication

• The notes feature, which only enabled filtering pertinent information was not sufficient to enable shared knowledge in complex cases, unless combined with verbal communication.

of the last days during handoff by searching through the notes

<table>
<thead>
<tr>
<th>Round</th>
<th>Communication of current data and pertinent tasks during round</th>
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<tr>
<td></td>
<td>• Features that integrated pertinent information (rounding navigator, results review, order sets, patient summary)</td>
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<td></td>
<td>• Features that highlighted pertinent information (order flags)</td>
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<td>• Features that filtered pertinent information (notes)</td>
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<table>
<thead>
<tr>
<th>Round</th>
<th>Primary RC dimensions: Timely, accurate &amp; comprehensive communication</th>
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<tbody>
<tr>
<td></td>
<td>• Integrating features enhanced SK unless cases were very complex (volume of information)</td>
</tr>
<tr>
<td></td>
<td>• The notes feature, which only enabled filtering pertinent information was not sufficient to enable shared knowledge in complex cases, unless combined with verbal communication (e.g., with consultants not present during the round).</td>
</tr>
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</table>

• Rounding navigator combined multiple related actions
• Results review combined multiple data sources
• Certain data sources were not integrated in the summary report, but fragmented in multiple flowsheets
• It could take time to find pertinent notes during round
The overview table shows that enactment variations of the affordance for Visibility could be identified among the core communicative processes. In communication with notes, features that only enabled filtering information among multiple notes supported enactments of Visibility. In the order, handoff and round processes, features also enabled highlighting and integrating information from multiple sources.

Depending on the variations of feature fit, shared knowledge and shared goals in day-to-day-practice could be enhanced or constrained if comprehensive communication in the EHR did not occur. Insufficient enactments of Visibility in the notes feature could result in delayed and selective communication, unless team members incorporated verbal communication to alleviate problems with emphasizing or finding pertinent information among multiple notes particularly for complex patients. Because of the proximity of ICU team members, verbal communication that alleviated potential issues associated with variations in Visibility was more common than in communicative processes with consultants or between physicians and nurses in the GU.

In the following section, I compare enactments of Visibility supported by features that highlighted and integrated information with enactments of Visibility supported by features that enabled filtering of information. I then focus on how communication with notes affected relational coordination in the absence of features that enabled integration versus filtering.

Feature fit influenced how team members could share and notice pertinent information with features that integrated pertinent information (e.g., patient summary feature, order sets, rounding navigator), features that enabled highlighting important information (e.g., flagging urgent orders), and features that enabled selective use patterns (e.g., filters in the notes feature).

Enactments of the affordance for Visibility with the three feature types supported relational coordination to different extents.
Example 1: Communication in the Order Process and Round with Features that Integrated Multiple Sources

For example, clinicians described positive effects on relational coordination when they used features that increased Visibility of pertinent information by integrating multiple sources. For example, ICU team members designed order sets, which were available in the order feature, to combine best practices in specific medical situations. An ICU physician explained how order sets helped clinicians to notice all relevant information in a critical situation. This enactment of Visibility within groups contributed to timely, comprehensive, and accurate communication.

“Especially in the Medical ICU the order sets, like sepsis or diabetic ketoacidosis order sets. Order sets are really good at prioritizing best practices, or getting together best practices and making sure they’re actually implemented. Make sure that things don’t fall through the cracks. So at least it’s another safeguard. Standardization of particular things is good. Just like in the Medical ICU order set, it always asks you whether or not you’ve got the patient on [name] prophylaxis. If you’ve got a ventilated patient, it asks you to put in orders to make sure that the head of the bed is elevated greater 30 degrees aspiration precautions, oral care, whatever, whatever, whatever. So all these best practices, these recommendations, these evidence-based practice guidelines are incorporated into the order sets. So that’s excellent.” (ID19, ICU Physician)

An ICU resident also spoke about how order sets helped to ensure comprehensive, accurate and timely communication by integrating multiple sources in the admission and discharge processes.

“The order sets can be very useful, especially when you’re admitting a patient or transferring a patient or doing a big protocol like where it’s standardized. Like for example after a code blue, if you want to do a hypothermic protocol, then it’s so helpful when there’s so many labs that you have to order at a certain time, and the order set you can just click a box. You just click the box and that makes it a lot easier than putting in each individual order. Sometimes it’s good with the warnings that come up, because sometimes maybe you forget they have an allergy and other times it just makes you hesitant, because some random reaction will come up and you’re like ‘I don’t know if I should order this or not’, but you feel like really there’s not gonna be an interaction or it’s not significant, then you just overwrite it. If you’re not too sure, then you can either ask the pharmacist to help you or talk to your attending.” (ID20, ICU Resident)

During the multidisciplinary round, physicians enacted the affordance for noticing pertinent information by using the rounding navigator feature of the EHR, which integrated related information and actions as described by an ICU physician.

“All our documentation is in the “Notes”. I go directly to Notes if all I am doing is write a note and Orders/Order sets if I just want to put in an order. I will use Rounding, Discharge etcetera because they require multiple related actions and it is easier to have them together.” (ID21, ICU Physician)
Another ICU physician commented on how enactments of the IS affordance for Visibility through integration of multiple data sources in a unified presentation supported timely communication, compared to collecting information in a paper charting environment.

“It’s amazing. It’s so much better than it used to be. Like going to the bedside, collecting vital signs, blood sugars … it used to be a task to get together the data that you needed to get together from so many different sources, or up-to-date data I should even say, in order to take care of the patient. Right now you could just do it sitting in one spot, five different tabs and you’re done. So it’s great.” (ID19, ICU Physician)

An ICU pharmacist further highlighted the importance of integrating features with an example of how timely communication was challenging during the round when information was fragmented in multiple sources.

“I think the frustrating thing is their limitations based on what someone else thinks is important or the builders don’t have the time to get to it. Like we’re working on sedation. What would be really nice would be to have it all in our flow sheet report. Instead I have to go to the doc flow sheet where the nurses chart and go look for the separate components. If it would just be right there, it would be so much simpler, because the summary report we look at all the time while we’re rounding as a team - the physicians, the pharmacists, the nurses.” (ID6, ICU Pharmacist)

Example 2: Communication in the Order Process with Features that Highlighted Pertinent Information

Team members also described positive effects on relational coordination when they used features that increased Visibility of pertinent information by highlighting important information among multiple sources. For example, an ICU nurse explained how she could notice new orders among multiple sources in the EHR and among multiple orders.

“If a new order has arrived that I knew nothing about, it’s highlighted with a special yellow or tan kind of alert. There are several ways to know. First before you open the chart, on the ... I guess I call it the front of the chart ... it’s like a bar that you click on to open the chart. On that bar, the chart’s not even open, you can see a flag that says ‘new orders’. I don’t know what they are, but I know when I open this chart I see new orders inside. It’s similar to the old system where they had a plastic tab that would come out. You’d call flagging it. And this plastic tab would say ‘hey look here, there’s new orders inside’. So we have that on the front of the electronic chart. When you open the chart, then the new orders are highlighted at the top. Special attention is made.” (ID13, ICU Nurse)
Example 3: Communication with Notes with Features that Enabled Filtering for Pertinent Information

Further, clinicians described positive effects on relational coordination when they used features of the EHR that increased Visibility of pertinent information by enabling filtering information from multiple sources (such as multiple notes and results). Filtering and sorting tools were the primary way for team members to organize multiple notes in the notes feature. Filtering notes worked well for finding and noticing specific notes. For example, an ICU nurse explained how she could easily find specific notes through filters and representation in chronological order.

“I utilize the filters. So if I’m looking for a physician’s note, I’ll use the filter for just physicians’ notes instead of having all the nurses and RT’s and the OT, PT and all those notes all combined. Because the general note page has everything. But then it has a filter aspect that you can just click physicians’ notes and they’re the only notes that will be there. If you’re looking for respiratory therapists’ note, you can do the same thing. So you can filter out all those other miscellaneous notes that are in there. So that makes it very easy. It’s possible that some people don’t utilize that so it’s harder for them.” (ID28, ICU Nurse Day)

Another ICU nurse mentioned that enactments of the affordance for Visibility among multiple notes were effective when she knew the name of the team member who had filed the note.

“[You can easily find specific notes] As long as you know who the physician was for the person you’re looking for. I’m quite technically inclined, so I can find anything that I want, because I know how to work it [laughs]. Some people might not have as easy a time. I also use ascending and descending order, time, all the things like that.” (ID22, ICU Nurse Night)

However, the variation in how feature fit supported enactments of the affordance for Visibility by integrating information or by filtering information also resulted in different effects on relational coordination. In particular, selective use patterns enabled by filtering tools could constrain coordination. This distinction was important, because integrating and highlighting features supported enactments of Visibility for actions associated with orders, handoff and rounds, while filtering features supported enactments of Visibility associated with notes. Notes were an essential way for team members to obtain shared goals and shared knowledge with others regarding a patient.

While it was relatively easy to find specific notes, navigating the notes feature was more difficult when clinicians were browsing notes for pertinent, important information among multiple notes, such as the most important events of the last days. For example, an ICU resident spoke about the value of filters for finding a specific note, but added that
filtering tools were not as helpful in finding information among multiple notes particularly for complex patients.

“During the hospitalization, it’s just in sequential order. By the time you file ... or the time you start your note, it just gets followed by that time. So it’s in that order. So you just keep going back. If the patient has been here for three weeks, then it gets messy. Or there are so many notes that if you want to go back, you have to look, but then they have filters. If I’m just looking for a physician’s note, or if I’m looking for a consult’s note, then I just use the filters.” (ID20, ICU Resident)

An ICU physician mentioned that enactments of Visibility with the notes feature could constrain timely communication in rounds.

"The notes can be rather cumbersome, that is to say that you can have a note put in for anything, and it gets to be a really long list. And sort of finding what I need from notes can be a little bit challenging. There’s tabs across the top for original consultations or operative report, but the day to day stuff is all lumped in together. And so it can take a little while to find." (ID4, ICU Physician)

Another ICU physician considered the potential value of more advanced filters, such as physician subspecialties, to improve enactments of the affordance for Visibility in teams.

“It’s hard to decipher the notes. The best way to actually decipher the notes is by what service or what their identifying service is. So I tend to filter my notes by physician versus not. So that classification is super important. It’d be even better if the physician’s subspecialty came up. That would make things so much easier on Epic, I think you have to pay extra for that feature. At least that’s what I was told in my old institution. I’m like ‘ok, fine, whatever’. That was gonna be the next rollout. ... I think it’s very manageable. Yeah I mean the organization can always use work, but it’s not bad. It’s way better than it used to be.” (ID19, ICU Physician)

Filtering tools were not sufficient to support relational coordination particularly in complex cases. Negative effects on timely and comprehensive communication were associated with the lack of highlighting features and integrating features. For example, an ICU nurse considered how highlighting tools, similar to flags for time-sensitive orders, may help noticing pertinent information to support timely communication.

“It can be [tedious to find important notes]. Yes, and it would be kind of cool if you could put them in a ... the important ones like asterisk them or ... But then you wouldn’t want to do that either in a permanent way that would flag, you know what I mean? You want everything to be the same in a permanent record, but yet some notes are more helpful than other notes." (ID26, ICU Nurse Night)

The constraints of filtering tools for enactments of Visibility among notes were particularly important in the absence of a feature that integrated multiple sources into a comprehensive plan that contained shared goals and promoted shared knowledge across disciplines. For example, an ICU nurse manager explained that team members could not obtain a comprehensive picture of a patient unless they reviewed the notes of all involved disciplines.
“How do you integrate the notes and the plan and the daily goals and whether they’re meeting the goals. It’s really disciplines writing their notes. Can we all have input to one plan? Why does it have to be, you know, nurses have their care plans and PT has their care plans. It’s one patient. It’s like we’ve separated ourselves. I think it should all be integrated and I’m not sure what that looks like. You can read a physician’s note, a nurse’ note, a respiratory note, a rehab note, and they all write their own focused notes and you really don’t get an idea of what’s going on with the patient. It’s not integrated very well at all.” (ID30, ICU Nurse Manager)

An ICU nurse similarly described the fragmentation of information across notes of different disciplines and highlighted the necessity of verbal communication to ensure comprehensive communication among specialties.

“Doctors all just do their own note. And they may mention each other occasionally in the note. But I guess that’s what the overall goal of maybe a good care plan would be. Everyone could see what the same problems are. But that would be like a medical care plan. We have a nursing care plan, where it’s all like pain and risk for skin breakdown. It’s not like talking about how we’re going to manage their liver failure, or how we’re going to manage their heart failure. There’s nursing stuff, you know there’s like restricting fluids and monitoring eyes and nose and stuff. But as far as from a medical standpoint, I don’t think there is that one place where all the doctors can put their input besides just their random notes and verbal communication between themselves.” (ID18, ICU Nurse)

However, the constraining influence of feature fit on enactments of Visibility promoted delayed and incomprehensive communication particularly in complex cases of patients who had been in the hospital with many specialties are involved in the care. For example, a consultant physician described the situation of a long-term patient where it was not possible for him to find pertinent information among the notes. Verbal communication was necessary in order to reach shared knowledge and shared goals.

“I got consulted on somebody who’s been here 222 days. Do you know how long it would take me to look through every single note? I can’t. So I started with the social work notes and then I read the most recent intensivist notes and then I looked at the code status. I had to sort of GUESS where is the meat, you know where is the ... where was a family meeting, And I had called the social case. I couldn’t find the note where they talked about that ... It is a little bit of a needle in a haystack when you’re trying to figure out what really important conversations we had about goals and expectations ... How does somebody go back and find among all my notes that we talked about. There’s no way to talk about the goals of care, the plan of care. And I’m talking about people with life threatening illness, there’s no real way of just flagging that.” (ID23, Consultant Physician)

A consultant physician highlighted the constraining effect of this enactment of Visibility on timely communication in complex patient cases.

“There’s no particular page where it says Plan. It depends on the team, because sometimes for a patient there are multiple teams. There is internal medicine, there’s infectious disease and there’s the surgeons. So they all may have different plans. If it’s somebody with a very complicated disease that requires different teams that follow, it may be confusing to figure out exactly what’s happening, but USUALLY I can get the big picture just looking through everybody’s notes. But you have to spend some time looking.” (ID31, Consultant Physician, Lab)

An ICU resident further noted potential negative effects of Visibility regarding inaccurate communication for complex cases.
“I guess another downside would be because it’s so much information, the patients that come here very frequently, they have a lot of data and then you can get it all mixed up. Like ‘oh I saw this one’, but it might have been their last hospitalization, because I mean the dates, sometimes you just think it’s this hospital stay only, but sometimes it will include data from their last hospital stay.” (ID20, ICU Resident)

A related issue was the lack of a feature that integrated pertinent events in the care of a patient in the last days. Team members could only obtain shared knowledge of pertinent events by searching through notes. For example, an ICU nurse manager described how nurses pieced together important events of the last days during handoff by searching through the notes.

“It's the day to day events that it's really hard to pick out. You can't sift through pages and pages to figure out what happened, or pages and pages of flow sheets. I don't need to know every single detail and every single lab test, but just the significant ones. ... A lot of times when nurses are getting handoff, they repeat the history over and over again, and it would be nice to see the chronological events of what happened. Like they were intubated this day, they were weaned off their drips this day, you know kind of a sequence of events so you kind of know what happened. They went down for a CAT scan and this is what the results are. So chronological events of what happened with the patient. You can't get that. You have to piecemeal through notes and procedure notes and that. I want to see ok the patient was here for four days, what happened in that four days. You can't get that from [Epic] unless you read all the notes.” (ID30, ICU Nurse Manager)

An ICU nurse talked about how the EHR patient reminded him of the paper chart in terms of fragmentation of information regarding major events.

“It’s just a computerized version of a paper chart. Everything is still very fragmented. It doesn’t have this nice flow timeline like Facebook could design a chart. You know, like this is what’s happened. I think that would be ... it’s like an interim report. They’re so nice. Like this is what happened on this date, this is what happened on this date, this is what happened on this date.” (ID18, ICU Nurse)

Because the enactment of Visibility with notes interacted with the affordance for Immediacy particularly in complex cases with documentation from multiple providers over time (i.e., Simultaneity and Reviewability), team members utilized selective use patterns to find information quickly in a time-constrained environment. These use patterns increased Visibility of noticing anticipated pertinent information but also limited awareness of information in the EHR. For example, an ICU resident talked about how learned, selective use patterns constrained comprehensive communication and the reliance on verbal communication from team members for gaps in shared knowledge.

“The downside of Epic is because there’s so much information available, there’s so many buttons and tabs you can push that ... I don’t use all of them and I don’t know what they’re all for, so it can get just overwhelming with a lot of information presented to you, and it’s our job to filter out what we think is important and what’s not. And that maybe is a challenge because you just have more and more information. Especially in an ICU there’s even more data we look at. I just try to figure out what I think is the most important data and forget the rest. And if it’s something important, someone will
remind me about it, like the nurse or my attending. ‘Did you look at this’, ‘oh no I’m sorry’, and then I go look at it.” (ID20, ICU Resident)

Team members had to actively make an effort to integrate information themselves, or they could disregard information through selective use patterns supported by filters unless they sought information to resolve a specific question. For example, a consultant physician considered how selective use patterns promoted incomprehensive communication that could constrain shared knowledge by disregarding information from other team members.

“Pretty much all of the physician notes or most of the physician notes I’ll read, because I consulted them. The nurses’ notes to the most part, I mean that’s probably one of the disadvantages, when you work in a paper chart before, the nurse would kind of pop out at you, because you would have to scroll through the papers to get through. So you know depending on how good or how bad the handwriting was, sometimes you kind of read them just by default. And now you don’t. So unless I actually decide to look at a nurse’s note and open it up, I’m not gonna pay any attention to it. And it’s rare that I do that, for the most part. It’ll more be, if it’s like an issue I had with something, you know, what was going on over night, and did I miss something, but usually not. It’ll be rare that I actually go to a nurse’s progress note.” (ID16, Consultant Physician)

From an information sharing perspective, selective use patterns made it most challenging for peripheral team members to effectively share important information in the EHR alone unless another team member looked specifically for this note. For example, an ICU resident was confident that team members would read the daily progress note because ICU physicians’ progress notes were the main point of integration to communicate shared goals among team members.

“They at least read our note, the resident’s note or the attending’s note partially because we’re the ones coordinating care. We kind of synthesize everything for the patient.” (ID39, ICU Resident)

On the other hand, a consultant physician emphasized the necessity of verbal communication to ensure timely and comprehensive communication of important information due to enactments of Visibility.

“I think it works fine. But again, people will still have to click on my note to see why did I put a note. It’ll just say ... they have my name there. So I have to make sure I’m gonna say Pathology note or something that brings their attention to look. Obviously if for instance Dr. [name] has called me ‘can you come in for a biopsy’, he will look because he’s waiting for my note. But I am assuming, and I have to admit I’m assuming that people will just open my note because they’ll be curious why am I involved [laughs]. So yes unfortunately there’s no tag that says ‘please read’ or you know ... And part of it I’m ok with it because I know that I generate my pathology report, it will show on the results somewhere else. So they’ll eventually see it [in the Results Review], but if I want to make sure that someone gets the message, I’ll also call. So for documentation purposes it works fine, however I’m not sure if everybody’s reading it or not.” (ID31, Consultant Physician)

Feature fit constraints related to integration of shared goals and pertinent events, which shaped enactments of Visibility in groups, were closely related to rules and regulations of the institution implementing the system. For example, a consultant physician described a
solution in another institution and in his unit to improve enactments of the IS affordance for Visibility by integrating pertinent information for complex patients.

“I know at other institutions, they created like a problem list item, you know goals of care or something like that, and they can file the note under that, I think. This is frankly a reason that we created what’s called the post form physician notes for life sustaining treatment, which is an out of hospital DNR. It’s the goals of care that the patient filled out. And then when the patient comes back in the system they can bring it, and it says what they want and what they don’t want. And we wouldn’t need that if there were a real easy way for EVERYBODY in real time to access those conversations. But that’s not realistic. No system could really do that... We created a navigator, an advanced care planning navigator to document what was discussed and proposed. What was proposed, discussed, was it offered, was it completed, why wasn’t it completed. There are all these drop down menus, so that was an attempt to try to solve this situation so we can look in and say ‘oh look, that’s the decision maker, and they do have a living will, oh but look they changed...’. (ID23, Consultant Physician)

A GU physician described how other institutions attempted to improve Visibility by integrating pertinent information in shared documents among multiple providers.

“It [the EHR] is very, very customizable from a progress note standpoint. I have seen other institutions that create continuity of care documents where multiple providers will update the same document as things change. Epic is installed in different institutions and is used in different ways. So things like care coordination notes or rounding notes or problem based charting. I mean there’re all different kinds of ways to use the tool. So that’s what’s fascinating about this is because you know Epic is not Epic is not Epic depending on where you go. I’ve been to different sites and even their model systems, we don’t use it the way it’s necessarily designed to be used, but this is what [this hospital] has decided or it’s evolved seven or eight years to be what it is.” (ID25, GU Physician)

In the ICU, team members frequently incorporated verbal communication to alleviate issues associated with Visibility and ensure shared goals and shared knowledge through timely and comprehensive communication. For example, physicians focused their review of the EHR in the beginning of the shift with a verbal handoff. For example, an ICU physician described the role of verbal handoff and patient exam to as a guide to notice pertinent information in the EHR for timely and comprehensive communication.

“Talking to the outgoing physician is going to give you the bottom line. It’s highly efficient verbal communication. The primary issues that happened over night are brought up and the primary issues that need to be resolved during the day come up within 30 seconds to a minute of verbal communication. It’s key. As opposed to Epic, when you look at the vital signs of the patient, you look at the labs of the patient, you look at all the written communication of the patient. You’ve got a lot of data there, but putting it together usually happens in the context of the verbal report that you get from the outgoing physician. That provides the focus when it comes to your Epic review of the patient. Or what can also focus your Epic review of the patient would be standing there at the bedside trying to figure out what the most important issues are right now. And the way you get that is by either doing it yourself, which I think is ideal but I mean sometimes the unit is full of 20 patients, you’re not able to do that yourself before sitting down on Epic. Or the other way to do it would be what the outgoing physician tells you what’s going on with the patient. What are the key issues of the patient.” (ID19, ICU Physician)

An ICU nurse explained that she mentioned pertinent notes to the incoming nurse during verbal handoff in the end of her shift.
“It’s sometimes part of my report. Read this person’s note on this day. That’s the best note. And then I won’t say anything else about that just ‘you’ll understand if you read this’.” (ID26, ICU Nurse Night)

Another ICU nurse commented on the critical role of verbal communication for shared goal due to the lack of a feature that integrated pertinent information across multiple disciplines.

“I think that most of it is verbal. And that’s during the rounds. But when the doctors change daily, that can be difficult to coordinate, too. It feels like there should be a better, more permanent, official place for this kind of coordination. I think there must be a possibility ... if it’s anything like Cerner, which I didn’t care for, but it’s moldable by the entity that’s using it. You can make it do what you want to do. And I’m sure there’s a way or a place that you can make that information centralized for all the specialties.” (ID18, ICU Nurse)

Summary

Chapter 6 showed that enactment variations of the essential foundational IS affordances for Immediacy, Comprehensiveness and Interpretability within groups depended primarily on how team members used the EHR within the constraints of rules and regulations. Enactments of Visibility were primarily related to variations in feature fit depending on the availability of features that integrated and highlighted pertinent information compared to features that enabling filtering for pertinent information.

Effects of different enactments of the affordance for sharing and accessing information instantaneously (i.e., Immediacy) in groups on relational coordination were contextualized to what timely communication meant in a particular situation. Enactments of the affordances for Comprehensiveness, Interpretability and Visibility interacted with Immediacy and could affect timely communication when team members had to clarify information. If team members relied on the documentation in the EHR without following up with verbal communication, these enactment variations could also constrain the relational dimensions through incomprehensive and inaccurate communication.

Chapter 6 showed an emerging pattern and common theme that verbal communication played a critical role for how different enactments of IS affordances ultimately enabled or constrained effects on relational coordination. Communication challenges occurred when team members relied on communicating important information in the EHR that could not be viewed in time, easily noticed or interpreted. Verbal communication was not necessary if enactments of Immediacy and the interacting
affordances supported coordination in a situation, but this was often not the case. The importance of verbal communication was particularly apparent when I contrasted effects of enactments of the foundational affordances on relational coordination between the ICU and the GU and in interactions with consultant physicians, where clinicians were less likely to incorporate verbal communication due to the lack of proximity, weaker relationships and associated challenges among professional groups of different disciplines (including physician specialties) and status.

Chapter 7 will show that team members interacted in the core communicative processes by enacting the meta-level EHR affordances of Facilitation, Supplementation and Substitution of verbal communication. In situations with different requirements in terms of time constraints, interdependence and uncertainty, it was essential for effective relational coordination if team members adapted their use of the EHR system from substituting verbal communication to supplementing and reinforcing verbal communication or to facilitating verbal communication.
CHAPTER 7. THE ROLE OF META-LEVEL IS AFFORDANCES AND ADAPTIVE COORDINATION FOR RELATIONAL COORDINATION EFFECTS

The previous chapter showed that enactment variations of the essential foundational affordances could constrain relational coordination through delayed and selective communication.

This chapter shows the critical role of three meta-level affordances for how these variations ultimately affected relational coordination. How the EHR enhanced or disrupted communication in teams ultimately depended on how team members combined EHR use with verbal communication in different situations. I revisit some examples of Chapter 6 and show that enactment variations of the foundational affordances were compensated with adaptive enactments of the meta-level affordances for Facilitation, Supplementation and Substitution of verbal communication. In these cases, the EHR enhanced relational coordination through timely, accurate, comprehensive and problem-solving communication. In contrast, relational coordination breakdowns occurred when meta-level affordances were not enacted in line with the requirements of coordination situations. Non-adaptive enactments of the meta-level affordances constrained coordination through instances of delayed, inaccurate, selective and passive communication.

In section 7.1., I introduce the meta-level affordances and show how the EHR enhanced coordination with their appropriate use, despite potential enactment variations of the foundational affordances. In section 7.2., I contrast examples that demonstrate when the enactment variations of the foundational affordances did constrain coordination, because verbal communication was not incorporated appropriately.

7.1. Adaptive Enactments of Meta-Level IS Affordances and Enhanced Communication

The foundational coordination affordances of the EHR supported three meta-level affordances that addressed expertise coordination situations with different requirements for adaptive coordination. At the meta level, enactments of the IS affordances involved verbal discussions among team members while interacting with the system. In particular, the EHR
allowed clinicians to facilitate, supplement, and substitute verbal communication based on the foundational IS affordances for coordination.

Effects of different enactments of the foundational IS affordances on relational coordination depended on how teams enacted the meta-level affordances in situations with different time constraints and complexity, i.e., to what extent they incorporated verbal communication. When the meta-level affordances for Facilitation, Supplementation and Substitution of verbal communication were enacted as part of effective adaptive coordination, these adaptive enactments of the meta-level affordances enhanced coordination through effective communication. Figure 7 shows adaptive enactments of the meta-level IS affordances in ICU teams, GU teams and by consultants.

<table>
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<tr>
<th>META-LEVEL I.S. AFFORDANCES FOR COORDINATION</th>
<th>Facilitating Verbal Communication</th>
<th>Supplementing Verbal Communication</th>
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<td>Meta-level affordance for supporting verbal communication with concurrent access to information in the EHR</td>
<td>Meta-level affordance for reinforcing verbal communication with subsequent documentation in the EHR</td>
<td>Meta-level affordance for replacing verbal communication and representing the care provider by input in the EHR</td>
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<tr>
<td>• ICU Round</td>
<td>• Communication of ICU &amp; GU plan for the day (progress note)</td>
<td>• Minor plan changes and communication to peripheral team</td>
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<td>• Nursing Handoff</td>
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<td>• Ad-hoc verbal communication with SD</td>
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<td><strong>EHR enhanced RC</strong></td>
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<tr>
<td>• All communication dimensions</td>
<td>• Comprehensive and accurate communication</td>
<td>• Comprehensive, accurate, timely communication primarily in non-complex, non-urgent situations</td>
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<td>• Notably problem-solving communication in interactions with SD or disagreements</td>
<td>• Verbal communication was necessary for timely &amp; comprehensive communication</td>
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Figure 7: Adaptive Enactments of the Meta-Level Affordances and Relational Coordination Effects

In the following section, I demonstrate how these enactment variations enhanced relational coordination in teams with some examples from the three categories.
7.1.1. Meta-Level Affordance for Facilitation of Verbal Communication

Facilitation of verbal communication is a meta-level affordance for supporting verbal communication with concurrent access to information in the EHR. The EHR took a background facilitator role in coordination among team members. Concurrent use of verbal communication and the EHR enhanced coordination by supporting efficiency and joint sensemaking in discussions, and by providing evidence to support discussions across the hierarchy. For example, clinicians described positive effects on communication and the relational dimensions in nursing handoff, multidisciplinary rounds and ad-hoc discussions between clinicians.

Adaptive Enactment Example 1: Multidisciplinary ICU Round

The EHR enhanced communication when team members enacted the meta-level affordance for Facilitation of Verbal Communication to support the discussion that established a patient’s plan for the day in the multidisciplinary round. Residents presented pertinent information and proposed a plan for their patient, while the attending physician and other team members listened to the resident’s presentation and viewed the EHR concurrently to look for current results, enter orders and search for additional data. In this context, physicians emphasized a key advantage of the EHR as making discussions more efficient and providing detailed, current data that enabled timely, comprehensive and accurate communication. For example, an ICU resident and two ICU physicians explained how teams used the EHR to facilitate verbal communication, supported by Immediacy and the other foundational affordances.

“We have multiple residents and someone’s on the computer either putting in orders while someone else presents, or looking up labs if someone maybe missed a lab, or just checking things. And we have someone else that calls the nurse and then usually the on call person is taking notes while someone’s presenting.” (ID20, ICU Resident)

“It is a good resource that if somebody didn’t get all the information, you can stop and refer to it and come back. So we always have it on, everyone has some kind of device which is connected to [Epic], and then we carry on with rounds.” (ID40, ICU Physician)

“It’s not like Epic makes rounds better. Epic makes rounds more efficient, and you can look up things that you may not know by heart. Or you may not know all the numbers right off the bat, but I mean they’re all there.” (ID19, ICU Physician)
Enacting the meta-level affordance for Facilitation of verbal communication also supported problem-solving communication to the extent that it provided data evidence that team members across the hierarchy could use to support their points of view. For example, an ICU physician and an ICU resident discussed the role of the EHR in supporting joint sensemaking about a patient.

“We try to practice a thing called ‘evidence based medicine’. Whoever has the best evidence to be able to provide the best care in that setting. So we discuss it, we look things up always online, and we have a discussion on what would be the actual best way on how to get there ... the best PROVEN way to get there.” (ID14, ICU Physician)

“If you have the same idea it’s not good. If everyone sometimes see in the same way, that one have different, and that one may be useful for the patient. The main thing is good teamwork and respect for every idea. And we discuss in term of the reasoning and try to be positive. When we discuss, we look for the data, for the detail. We don’t look in imagination.” (ID17, ICU Resident)

An ICU respiratory therapist spoke about how using the EHR during the discussion helped to support accurate and problem-solving communication across the hierarchy.

"I go to whatever patient we’re discussing and bring up their flowsheet. And I have it right there. And if they have something wrong on the respiratory portion, I say ‘No, that’s not right. Here’s what’s been charted, and here’s what’s going on’. And that’s the hard information. You know, sometimes you talk to somebody and get some information, but you find out they’re not charting that, they’re charting something else. So you’re getting the charted information and they can tell me ‘oh this patient has gotten this’ and I can say ‘no they haven’t, they’ve done this, here’s the charting right here’. So I find it very useful that way.” (ID5, ICU Respiratory Therapist)

However, the extent to which the EHR ultimately enabled problem-solving communication also depended on group dynamics associated with the attending physician. For example, an ICU physician described how the affordance for Immediacy (and the interacting affordances) enabled a focus on joint decision-making due to the efficiency of data access.

“Now rounds aren’t just about reporting most up-to-date data to me. I can look at the computer and I know that data instantaneously. Which is what I do while the resident’s presenting to me. The focus has shifted purely towards decision making about that data. So the emphasis on data collection has actually decreased significantly.” (ID19, ICU Physician)

On the other hand, an ICU physician and an ICU resident commented that the dynamics of a round were primarily dependent on the attending physician.

“Everybody shares the same goal pretty much, whether we have the same idea of how to get there. Does Epic help [in the discussion for goals]? It’s hard dude, it’s hard, because there’s so much religion in quotation marks in patient care. A lot of it is style, practice style, how you were trained. But again the physician is sort of the captain of the ship, and so Epic in terms of providing data and stuff, but a lot of the plan and how things are done is depending on who’s working that day. I won’t kid you. Welcome to medicine.” (ID4, ICU Physician)
“It’s very attending dependent. I think that that’s regardless of whether it’s paper chart or different electronic medical records versus Epic. I think it just depends on the attending what is presented. Some people like it short in assessment and plan. Some people like to hear about everything.” (ID39, ICU Resident)

Physicians discussed two concerns of how enactments of the foundational affordances could affect creation of shared knowledge during discussions. For example, two ICU physicians shared the concern that team members may not actively process or be aware of detailed data about a patient because of instantaneous access.

“They don’t take care to have memorized things, which is a cultural change. It’s a general change, because when I was a resident, you had to have memorized everything or written down. We didn’t have computers with patient files that went back years. So you had to have known these things already. And if you didn’t, then you had to go find out … In fact when I was a second year resident, when I had a computer for rounds, I was reprimanded for having a computer. And now you can’t have rounds without them.” (ID40, ICU Physician)

Because that emphasis on data collection has shifted significantly, there’s also less awareness … well it shouldn’t be this way, but sometimes there’s also less awareness of the residents … Before they knew the numbers on their patients [snaps her fingers] flat, you know, because you didn’t have a computer sitting beside you. So now they know the general trends, and I mean honestly that’s the case with me, it’s just less clutter in my brain and I’m more focused towards overall big picture and plan. (ID19, ICU Physician)

A GU physician described challenges for shared goals and shared knowledge in discussions with residents in the absence of a multidisciplinary round where several team members assisted presenting residents in searching for additional data.

“The nurses are hardly ever looking directly at the computer when we talk to them, because when they’re on their COW generally they’ll just stop and you have an actual conversation. The residents sometimes can be involved in just kind of continually looking at the computer, but that is hard because they’re distracted and you’re not having a real conversation. It’s a little bit disjointed sometimes.” (ID36, GU Physician)

Another concern was that the EHR could disrupt creation of shared knowledge when team members enacted the IS affordance of Immediacy to conduct alternative tasks during the round. For example, an ICU physician described a situation where team members may enact the IS affordance of Immediacy not as a coordination affordance, but as a non-coordination affordance of efficiency.

“You’re supposed to have gathered all the information, participate in rounds, formulate the plan, then input everything back into Epic. It serves as a distractor when used during. Because person A, who may not necessarily be involved with person B on this other patient, he might be doing some other work already, which is the case a lot. He’s not paying attention at all. It’s a big distractor.” (ID40, ICU Physician)

A consultant physician shared this concern thinking about rounds with his specialty team.
“It can be a double edged sword, because people involved with Epic could actually be looking at other patients than what we’re discussing right now. They could be saying ‘oh we’re not really talking about my patient and I don’t need to be involved. I want to look at little more deeply into what’s going on with another patient, so when we come to discuss that patient, I’ll have more to contribute.” (ID23, Consultant Physician)

On the other hand, this concern appeared to be not uniquely associated with the presence of the EHR during round, but rather a reflection of how team members interacted in less complex expertise coordination situations versus dialogic coordination situations. For example, an ICU pharmacist commented that residents were more active in the discussion when they utilized the EHR.

“For the other people sitting around, and especially if they’re not on call, they’re more engaged if they’re on the computer helping. Helping look up the information, helping put in orders. Because otherwise they’re just kind of sitting and maybe they’re daydreaming because they’re not on call, they don’t have to really know this information until they’re on call. You know, but they should be, we want them to pay attention because they’re all their patients.” (ID41, ICU Pharmacist)

Another ICU resident described how the active involvement of residents in the discussion differed in expertise and dialogic coordination situations.

“I think if we come to a roadblock where as a group maybe we need to think of something, like ‘oh what is going on’, then at that point people will start shooting off labs like ‘oh I have this, I got these labs, I don’t know what it means’, and then we’ll have a discussion about well what does everyone think is going on. And then from there we’ll come up with a plan as a group. But if it’s other things that are just straightforward like ‘oh I looked at their labs, they all looked normal except for this, I want to do this’, then no one really pays attention unless you’re on call and you have to look that up later.” (ID20, ICU Resident)

**Adaptive Enactment Example 2: Nursing Handoff**

In handoff, nurses who used the EHR to facilitate verbal communication enhanced timely, comprehensive and accurate communication of every important aspect of their beginning shift. For example, an ICU nurse described how she typically used the EHR to obtain shared knowledge and shared goals with the outgoing nurse.

“We meet face to face, and we usually sit near or in front of a computer. I’d say 90% of the time we sit near or in front of a computer, and we look together at the basics of the computer. The nurse is telling me the general plan for the patient, including the history, the reason that they’re there, and then most specifically the events of the prior shift, and anything outstanding that needs to be carried on and taken care of through that ongoing shift, and or issues that are just going to be continually addressed. So he and I or she and I sit down, and we go through the patient, and we go system by system, meaning body system by body system ... And then a lot of times we use Epic, or the computer, for looking at specific lab results, medication times, results, you know referencing when certain things happened, when a patient left the room, returned to the room, when they received a medicine, when labs were done, that kind of thing. Sometimes we’ll go through the notes, specific notes that are pertinent to what we’re
discussing, like from a consultant. If he or she made a note that’s specific to our issue, we’ll do that together, but not always.” (ID13, ICU Nurse)

Adaptive Enactment Example 3: Ad-Hoc Discussions with Status Differences

The EHR further enhanced communication when team members enacted the meta-level affordance for Facilitation of Verbal Communication to support the support ad hoc verbal discussion in the presence of status differences outside of the round. For example, ICU and GU nurses used the EHR to support arguments and recommendations in face-to-face or phone conversations with physicians. An ICU nurse described how she used the EHR in discussions with ICU physicians during the night shift.

“I’ll look at lab results, I’ll look at trends of vitals, I’ll look at whatever I’m thinking about. I might have the note from the attending from the daily rounds and say ‘hey I thought we were doing … can we start to work’, you know.” (ID26, ICU Nurse Night)

Two ICU nurses spoke about how the affordance for accessing information instantaneously (supported by the other foundational affordances) helped support arguments and promoted problem-solving communication.

“When it’s there black and white, maybe they believe me more, I don’t know [laughs]. People tend to believe data as opposed to… So sometimes if there are questions, I can always go back. That is helpful. Because if you have [Epic] and you have a flow of information, you can say ‘this result was here, then two hours later it was this, then two hours later …’. So you can show a flow of information, which is helpful.” (ID8, ICU Nurse)

“It can’t make people change their mind if they’re set on a certain way, but if you have documentation, you can use that data. It’s just a data collector. You can show the data of ‘this is what happened when we did this three days ago, two days ago, 1 hour ago’. It’s a good tool for data collection, because no one could remember all that.” (ID13, ICU Nurse)

Another ICU nurse considered the more important role of the EHR in facilitating verbal communication across the hierarchy with new residents compared to intensivists due to different working relationships.

"When you go ask for something or suggest something, it’s usually face to face. And it’s not necessarily Epic. But maybe with residents more so than with intensivists, the newer physicians, they might be more about the data than listening to you, because that’s the way they talk on the floor, regular med/surg floor. Whereas here the intensivists, you know, you communicate. You say ‘this is what’s going on with my patient, what do you think about x, y, and z’, and they say ‘yes, no’. Whereas on the floor, the nurse is charting all day and then the doctor comes and sees what they charted. (ID10, ICU Nurse)

A GU nurse described a similar role of the EHR for facilitating communication with physicians in the General Unit.
“Sometimes in the results review you can highlight certain things and pull up actual charts, graphs and I can show them this is the trend. I mean did you notice this, or we going do anything about it? And they’re like oh, yeah, good thing you showed me that, and they may change your plan. I certainly use the data to back up whatever I’m requesting from the physician, so if I’m seeing trends in the patients’ labs or whatever, and that’s correlating to whatever symptoms they may or may not be having then I can talk to them based on that, using Epic.” (ID33, GU Nurse)

Enactments of the meta-level affordance for Facilitation of Verbal Communication also enabled problem-solving communication when nurses contacted physicians for clarification when they did not understand or receive sufficient details with notes and orders.

“And of course like I say some of them may be a little defensive, they don’t yell or whatever, they don’t get angry, but they always kind of maybe challenge you a little, then you can just say ‘well I see it in the lab results, but I don’t understand the connection’ or something. And then generally they’ll sort of, you know they give you the answer, but sometimes it’s like pulling teeth. But you have it in black and white, you have seen it in the notes or in the computer or in the lab results or in whatever. It’s right there for you. They can’t say ‘where did you get that’ or ‘how do you.” (ID28, ICU Nurse Afternoon/Evening)

7.1.2. Meta-Level Affordance for Supplementation of Verbal Communication

Supplementation of verbal communication is a meta-level affordance for reinforcing verbal communication by subsequently documenting assessments and plan changes in the EHR. When team members enacted this meta-level affordance, the EHR took a reinforcing role in the coordination among team members who participated in verbal communication and a replacement role in the coordination with other team members who were also involved in the care of the patient. Supplementation of verbal communication in the EHR enhanced coordination by supporting timely and comprehensive communication of information that was essential for shared goals and shared knowledge between team members. For example, clinicians described positive effects on communication and the relational dimensions when others communicated plans, major plan changes, time-sensitive orders and recommendations verbally and also in the EHR.

Adaptive Enactment Example 1: Plan and Plan Changes

ICU teams enacted the meta-level affordance for Supplementation of verbal communication when they established daily plans for patients in the multidisciplinary round and subsequently documented their analyses, assessments and plans in progress notes after the round. The EHR enhanced coordination by reinforcing comprehensive communication
for team members who participated in the round. For example, an ICU resident described the role of progress notes for comprehensive communication with team members after the round.

“I don’t think people sit by the computer and wait for our notes to come out. And during our rounds, we actually call the nurses there. So they listen to us present the patient, so they kind of get an idea of the plan as well. So they know the plan... the big picture of the plans, and then you know they can look at our notes later.” (ID20, ICU Resident)

Moreover, an ICU nurse commented how reviewing physician notes after the verbal handoff enhanced shared knowledge by improving her understanding of the situation.

“Sometimes verbal communication can be difficult. Everyone sort of uses their own slang or terms and sometimes I don’t understand exactly what they meant until I actually look at the physician’s daily note to see the patient’s entire assessment and this is an event that had occurred either during the day or during the night sort of thing. So I think sometimes the notes are actually BETTER, especially when you’re talking about physician assessment and transcription. I believe that that is actually better than verbal report. Just because sometimes handwritten things tend to be more concise, precise versus you know just a regular verbal handoff. I think both have equal importance. It’s just that the interpretation sometimes on the verbal side of it is sometimes just a bit difficult to kind of really understand, grasp. I think their notes are a good thing, because it actually gives me the foresight that I know their thinking. So I may be told one thing in report, but when I’m reading the note there’s actually way more that you find answers to, you know? And it’s the way that you’re supposed to be sort of thinking.” (ID22, ICU Nurse Night)

A consultant social worker described how the combination of verbal communication within her team in the multidisciplinary meeting and the note provided comprehensive communication.

“Because the template is so comprehensive, you have everything here that’s essential, so it provides a lot of helpful information. [Verbal] helps me to hone in on who this patient is, what they’re wanting me to do. And then when I get the information, it just kind of reinforces ‘oh ok, well we talked about some of the issues and ok it’s stating right here that these are the issues. So it just solidifies it.” (ID24, Consultant Social Worker)

Another primary advantage of well written notes was their helpfulness in communicating shared goals and shared knowledge, given the time constraints that frequently applied to verbal conversations outside of rounds. In particular, notes from different professional groups promoted comprehensive and accurate communication by improving understanding and clarify uncertainties after short verbal conversations. For example, an ICU pharmacist described how availability of consultant physician notes in the EHR could enable comprehensive communication, depending on the quality of the note (i.e., enactment variations of the foundational IS affordances for Comprehensiveness and Interpretability).

“If it’s outside of rounds though, depends on the doc. They might be more rushed and not give you the time to ask everything you want to ask or find out everything you want to find out. So then it’s easier to read their note if their note is any good.” (ID41, ICU Pharmacist)
An ICU resident described how nursing notes could enhance shared knowledge by providing more details for comprehensive communication on complex cases.

“I always talk to the nurse. That’s just my habit. And I think most people should as long as the nurse is there. But for more detail, if it’s a long story, the nurse’s notes are really good too. And I usually use them.” (ID39, ICU Resident)

An ICU respiratory therapist explained that EHR documentation could reinforce comprehensive and accurate communication after verbal conversations with team members.

“I think the verbal communication is important. The written in the chart is also important, you know sometimes if you miss things, you can catch it on the written part.” (ID37, ICU Respiratory Therapist)

Similarly, a GU physician considered the role of notes for comprehensive and accurate communication after phone conversations with consultant physicians.

“Sometimes it’s nice to see their recommendation in black and white. Versus when you’re talking to someone on the phone, there can be some miscommunication in terms of who is supposed to do what or exactly what order you need to do. It’s just more black and white when it’s written down rather when it’s just a conversation there can be some more back and forth about it.” (ID25, GU Physician)

In the case of plan changes and critical events, notes documented verbal communication with the primary physician and provided comprehensive and timely communication to other team members who were not directly involved in the care for this particular event.

“If it was a situation where the patient was decompensating or there was a real problem for me to be addressed right away, I would communicate verbally with the physician. Then I would do the note and I would expect that afterwards follow up other people would see the note.” (ID28, ICU Nurse Afternoon/Evening)

Adaptive Enactment Example 2: ICU Physician Handoff

Physicians enacted the meta-level affordance for Supplementation of Verbal Communication in the beginning of the shift by conducting a verbal handoff before a chart review in the EHR to address time constraints and uncertainty of medical situations in intensive care. The verbal signout provided ‘the big picture’ and focused the EHR review, while the EHR took a reinforcing role in the coordination and primarily ensured shared knowledge through comprehensive communication. For example, an ICU physician and an ICU resident explained how the EHR enhanced coordination by providing additional details to verbal communication and patient exam.
“He [outgoing physician] has to leave and I’m just fresh coming on, so we do that first and he goes away. And then I’d walk by the room or go see the patient next. That gives me a sense of what the patient looks like, if I have to deal with anything right away. And then the Epic thing is all the information I can sit there as long as I want to, as long as no emergency happens.” (ID40, ICU Physician)

“Either I go to the computer and start reading notes or I will look for whoever was on call and then just ask them ‘hey did anything major happen with my patient overnight’. After that I would again look at notes on Epic first, get all the information I think I need. Then I’ll go talk to the nurse. And then see the patient. Looking at Epic, you can look at the notes from yesterday, because we might leave before a consult drops their note. So we can read what they thought of yesterday. We can read the nurse’s note from yesterday and the nightshift.” (ID20, ICU Resident)

An ICU nurse added how a more complete EHR review after verbal handoff reinforced shared knowledge and shared goals through comprehensive communication.

“You get what you need in report, but then you also need to kind of read through the notes and understand where the patient’s coming from. So I mean what the doctors are thinking they’re going to do for the patient and their assessment. I look at it during report. And if no time during report, then afterwards.” (ID22, ICU Nurse Night)

**Adaptive Enactment Example 3: Time-Sensitive Orders and Recommendations**

When team members enacted the meta-level affordance of Supplementation of verbal communication to communicate time-sensitive orders (from physicians to nurses) and recommendations (from consultant physicians to ICU or GU physicians), the EHR supported shared knowledge and shared goals primarily through reinforcing comprehensive communication rather than timely communication. Verbal contact was necessary to ensure timely communication because of enactment variations of the affordance for accessing information instantaneously in the EHR (i.e., nurses may not have time to check the patient chart for new orders). For example, a consultant physician noted the important role of documentation in the EHR in addition to verbal communication for comprehensive communication of time-sensitive recommendations.

“I may do both, to make sure that they get the message, because sometimes you don’t get to read other people’s notes until the end of the day. So verbally makes sure they know, especially if it’s something that needs to be done right away. But I like the writing on it for documentation purposes. I think it’s important to document what you do. So I will do both, but if I need something for people to know immediately, I’ll call or tell the nurse to tell somebody.” (ID31, Consultant Physician, Lab)

A physical therapist also mentioned the appropriate role of notes in the EHR for supporting comprehensive rather than timely communication in urgent situations.
I think most importantly it’s being able to talk to somebody. Coz you can write something down, but if something’s happening ... if you’re concerned about something, I’m not gonna just chart it. I’m gonna go tell somebody, you know? Coz that’s more important.” (ID11, Consultant Physical Therapist)

Enacting the meta-level affordance for Supplementation of verbal communication further fostered mutual respect by ensuring timely and comprehensive communication for time-sensitive and complex orders. For example, an ICU nurse described the positive effects on mutual respect when physicians made an effort to combine verbal and EHR communication.

“The residents are fairly well trained. They might call you or just if they see you in the hall they’ll say that they ordered it. But some of them don’t, but they’re very busy, too, so it’s understandable. We have some very good intensivists here, Dr. [name] who will always ... well I won’t say always, that’s too generalized, but the majority of the time will call you and say ‘I ordered this’. He’s very good about that. Yes, it’s a very good working relationship with him.” (ID28, ICU Nurse Afternoon/Evening)

An ICU physician spoke about the role of courtesy in addition to his awareness of enactment variations of Immediacy in communicating orders to nurses.

“I usually put an order in and walk away to say ... part of it is kind of courtesy ‘by the way, I did dadadada’. The other small percentage of it is just me. It’s another way of putting an order in. So you kind of double-check yourself to make sure it went in, because I don’t necessarily trust the system all the time I suppose. Because if you put something in, it’ll get ignored. Or something may get skipped over or something like that, so.” (ID40, ICU Physician)

7.1.3. Meta-Level Affordance of Substitution of Verbal Communication

Substitution of verbal communication is a meta-level affordance for replacing verbal communication and representing a care provider by the contribution in the EHR. When team members enacted the meta-level affordance for Substitution of verbal communication, the EHR took a foreground replacement role in coordination among team members. Using the EHR without verbal communication enhanced routine coordination by supporting timely communication in situations that allowed for flexible timing of information sharing and access and when a team member was not available for verbal communication. However, support of relational coordination was also conditional on the quality of communication in the EHR (i.e., see Chapter 6.2., ‘Enactment Variations of Comprehensiveness and Interpretability and Relational Coordination Effects’).

For example, clinicians described positive effects on the relational dimensions through timely communication when team members had questions that could be more
quickly resolved with the EHR in time constrained situations, when others communicated basic orders, minor plan changes and recommendations that were not time sensitive.

**Adaptive Enactment Example 1: Quick Information Access in the EHR when Verbal Communication was not possible**

Clinicians enacted the meta-level affordance for Substitution of verbal communication to gain shared knowledge through timely communication when they needed quick access to information when other team members were busy. Verbal communication was common due to the close proximity of team members in the ICU, however it was not always possible given the characteristics of critical care situations. For example, an ICU nurse described the benefit of the IS affordance for Immediacy supported by the affordance for Visibility for timely communication.

“I think it’s a form of communication that’s quick, you know, it’s very fast. Especially if you can’t find somebody and you need to maybe get an answer or try to find an answer, it’s a very quick way to do it. And the Epic form itself gives you a lot of pathways to try to find the results or read the notes and find the results of what you might be looking for. And it does give a good background on various things that you are looking for. Especially when you’re looking for history or when you’re looking for what you did about certain lab results or something like that, the person’s not present or they’re busy with something else, it’s easier.” (ID28, Nurse Day)

An ICU respiratory therapist also mentioned the value of progress notes when physicians were not available or when he was not available for verbal communication due to critical patient care situations.

“I’m busy a lot during the day, and I always don’t get to go to all the rounds, so I may not know the complete plan. I know the respiratory plan, you know, wean, extubate or hold or. They give me their parameters and I may not know the complete, you know, need to go to MRI, or is on the transplant list, or something like that. And it’s real easy to pick all that up through the progress notes. Also they will write their goals in the Epic, and I know where they write the goals. So if they’re too busy to talk to me, I know where to look and see what their goals are.” (ID5, ICU Respiratory Therapist)

An ICU nurse discussed the value of the EHR for daily coordination with the large peripheral team that are involved in the complex care of many ICU patients.

“It’s most helpful for numbers such as lab results, laboratory review, vital signs, the exact time when certain vital signs happened, and also notes from consultants, the input from all the different care providers. Because there is no possible way to talk to every single person, so you can just read their note and know what their particular plan of care is.” (ID13, ICU Nurse)
Adaptive Enactment Example 2: Situations that allowed for flexible timing

Situations that allowed for flexible timing included communication of minor plan changes, as well as non-urgent and basic orders, and recommendations by consultants. For example, two ICU nurses described communication with notes as an effective way to provide timely awareness of plan changes to the broader team. Although no immediate awareness by ‘non-critical’ team members was required, the EHR supported shared knowledge through timely and comprehensive communication.

“Yeah sooner than later [I put in a note when something happens], so you can capture the moment and what happened. So everyone is on the same page if they happen to look in the chart.” (ID26, ICU Nurse Night)

“If it was a situation where the patient was decompensating or there was a real problem for me to be addressed right away, I would communicate verbally with the physician. Then I would do the note and I would expect that afterwards follow up other people would see the note.” (ID28, ICU Nurse Day)

ICU team members also experienced positive coordination effects using the EHR in situations of limited urgency and complexity. For example, an ICU physician explained the different roles of the EHR in urgent and non-urgent situations with the examples of ICU versus outpatient communication.

“I view it as a log. It’s more of a record of what’s happened. But as a go back and forth communication tool, a good majority just happens face to face I think, especially in a hospital setting. My outpatient is excellent. My outpatient communication with my nurses downstairs is excellent. If that was my office downstairs in my outpatient setting, and they were getting phone calls there, they would just tell me, and I’ll say ok, I’ll be there to take the phone call. And because I’m not there all the time, this serves as a tool for us to communicate. But again, that kind of communication lags like a day at a time. They called yesterday, I do the prescription today. These are not so emergent things.” (ID40, ICU Physician)

Core ICU teams considered daily consult notes without verbal communication as adaptive to coordination requirements and supportive of relational coordination when consultants did not diagnose a change in an active issue. For example, an ICU physician explained that she viewed consultants’ assessments and recommendations when possible during the day and when she had a specific question (i.e., Substitution of verbal communication), but she expected a phone call when there was a change (i.e., Supplementation of verbal communication).

“If there is an active issue, but nothing has changed when it comes to the urgency of the issue, then the written communication [from the consultant physician] is enough. Whether it’d be a two liner or something more extensive. But if the patient is going down the tubes, then the written communication isn’t enough.” (ID19, ICU Physician)
A consultant physician added that enactment of the affordance for Supplementation of verbal communication would not enhance communication but rather decrease efficiency of communication in routine situations.

[In a situation where nothing has changed, do you reach out in addition to your daily consult note?] “Yeah I mean I’m not gonna waste, I mean everyone is really busy. So usually if it’s a new consult, ok ...” (ID23, Consultant Physician)
7.2. Non-Adaptive Enactments of Meta-Level IS Affordances and Relational Coordination Breakdowns

Effects of enactment variations of the foundational IS affordances on relational coordination depended on how teams enacted the meta-level IS affordances in situations with different time constraints and complexity, i.e., to what extent they incorporated verbal communication.

When adaptive coordination occurred with the EHR regarding meta-level affordances, enactment variations of the foundational IS affordances (whether due to time constraints or non-coordination affordances based on individual variations or rules and regulations) did not constrain relational coordination. In these cases, verbal communication ensured timely communication, while the EHR enhanced coordination by supporting comprehensive and accurate communication with the core team and timely communication with the broader team. However, when non-adaptive coordination occurred with the EHR regarding meta-level affordances, enactment variations of the foundational IS affordances did constrain relational coordination. In these situations, use of the EHR constrained coordination through delayed, inaccurate, selective and sometimes passive communication.

Serious challenges occurred when team members enacted the meta-level affordance for Substitution of verbal communication when coordination situations required use of the EHR for Supplementation or Facilitation of verbal communication for effective relational coordination.

Figure 8 visualizes when different relational coordination effects occurred as results of adaptive or non-adaptive enactments of meta-level IS affordances.
Table 30 contrasts examples of enactment variations of the foundational IS affordances from Chapter 6 in the context of adaptive or non-adaptive enactments of the meta-level affordances and compares effects on the relational coordination communication dimensions. For each coordination situation listed in the table, two contrasting examples demonstrate enabling or constraining effects on relational coordination when team members enacted the appropriate or inappropriate meta-level affordance of the EHR to address the complexity and time constraints of the situation.
Table 30: Contrasting Adaptive and Non-Adaptive Enactments of Meta-Level Affordances and Effects on Relational Coordination Communication Dimensions

<table>
<thead>
<tr>
<th>META-LEVEL AFFORDANCE</th>
<th>SUPPLEMENTATION OF VERBAL</th>
<th>SUBSTITUTION OF VERBAL</th>
<th>PRIMARY RC Communication Dimensions (Examples)</th>
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<tr>
<td>Coordination Situation</td>
<td>Adaptive Enactment Examples</td>
<td>Non-Adaptive Enactment Examples</td>
<td>EHR enhanced RC through comprehensive communication</td>
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<tr>
<td>Communication of Plan</td>
<td>“I don’t think people sit by the computer and wait for our notes to come out. And during our rounds, we actually call the nurses there. So they listen to us present the patient, so they kind of get an idea of the plan as well. So they know the plan ... the big picture of the plans, and then you know they can look at our notes later.” (ID20, ICU Resident)</td>
<td>“Very few of them [talk to me], and that's frustrating... But otherwise they'll come, they'll see the patient, do their charting and they're gone, and I may be in another room and I never saw them even come to the floor ... I really rely on their notes” (ID34, GU Nurse)</td>
<td>Versus EHR constrained RC through delayed &amp; selective communication</td>
</tr>
<tr>
<td>Communication of major plan changes</td>
<td>“I think most of the time people look at it once a day, and then if you know it was in at the time when they were looking at it, they would notice it. Otherwise they would look at it the day after. And then what happens is in this system, everybody expects a phone call of some sort. If it was important enough to change something.” (ID40, ICU Physician)</td>
<td>“I’ve seen some residents addend their note but not update the nurse. And they’re like ‘We’re going off the yellow sheet, why would I...’ because if I attend rounds, I don’t always go and read their notes, because we talked about it, right? So if I didn’t happen to be there when they [residents] came back and said ‘well no doctor so and so wants to do this instead’, I don’t know except for the orders. I don’t know, it might fall through.” (ID41, ICU Pharmacist)</td>
<td>EHR enhanced RC through comprehensive communication (Timely communication requires verbal) Versus EHR constrained RC through delayed communication</td>
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<tr>
<td>Time-sensitive / complex orders</td>
<td>“I believe it’s important that they call me and let me know, because it’s a safety issue for the patient. I may not be looking at the orders every hour. How soon do you want it, you know, if you want it stat and I don’t see no order for two hours, you know I mean, I believe you have to communicate. It’s not just about seeing the orders. It’s about patient safety. You have to be able to communicate to the nurse why it is that...” (ID10, ICU Nurse Day)</td>
<td>“The residents are different than our intensivists. It’s totally different, the way they talk about the plan of care and changes. They’ll go ‘Did you see I put that in?’ I’m like ‘No, You gotta tell me if you want something done’. I may never close Epic all day and the only reason I would know ... I might be in doc flowsheet for five hours because I’m so busy just documenting things. In the beginning it’s rough, and then it gets easier once they figure out it runs a little different.” (ID10, ICU Nurse Day)</td>
<td>EHR enhanced RC through comprehensive communication (Timely communication requires verbal) Versus EHR constrained RC through delayed communication</td>
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<tr>
<td>Initial Consult ICU</td>
<td>Time-sensitive consult recommendations</td>
<td>Physician Handoff</td>
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<td>“If they [consultants] do a procedure, generally they will talk to you and tell you the results of the procedure or what they think the results of the procedure would be ... If you happen to miss them for some reason, you’re downstairs with a patient on another test or somewhere where you miss the consultant, you may not find a note that’s detailed to what happened or what the results were.” (ID28, ICU Nurse Afternoon)</td>
<td>“I may do both, to make sure that they get the message. Because sometimes you don’t get to read other people’s notes until the end of the day. So verbally makes sure they know. Especially if it’s something that needs to be done right away. But I like the writing on it for documentation purposes. I think it’s important to document what you do. So I will do both, but if I need something for people to know immediately. I’ll call or tell the nurse to tell somebody.” (ID31, Consultant Physician, Lab)</td>
<td>“He [outgoing physician] has to leave and I’m just fresh coming on, so we do that first and he goes away. And then I’ll walk by the room or go see the patient next. That gives me a sense of what the patient looks like, if I”</td>
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<td>“The problem is a lot of people dictate things and they don’t always write a brief note. So sometimes you don’t even know if they’ve seen the patient yet. The dictations take usually a day for it to at least come up so you can look. So yeah, it can really affect the plan. I mean they could put in their own orders, but then we’re not sure what happened.” (ID20, ICU Resident)</td>
<td>“There can be gaps in care if there’s no communication. Especially sometimes consultants will write ‘would consider or would order x, y, or z’, and they expect the attending physician to put in those specific orders. So if I don’t look at that note or no one tells me that there’s a new note in, there may be a gap of however many hours before someone notices that there are some new recommendations. So you know I think it certainly can happen, yes.” (ID25, GU Hospitalist)</td>
<td>“Well we don’t really have a choice to get things from the chart. I think most of us have gotten used to documenting in Epic in a way that conveys a majority of the concerns, and that verbal communication is not essential. It does help sometimes, but it’s not essential … Unfortunately the”</td>
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<tr>
<td>EHR enhanced RC through comprehensive communication (Timely communication requires verbal)</td>
<td>Versus</td>
<td>EHR enhanced RC through contribution to comprehensive communication (Comprehensive communication also requires verbal)</td>
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have to deal with anything right away. And then the Epic thing is all the information I can sit there as long as I want to, as long as no emergency happens.” (ID40, ICU Physician)

and way our system works, only a few physicians are covering a very large amount, so they often do things and don’t document it themselves or even remember doing something small on the patient 11 hours ago.” (ID25, GU Physician)

Complex Recommendations

“If I don’t understand why, or I want to know the reasons why they make this recommendation. They might not leave that in their note. But if I talk to them, they can explain it to me in a way that I can understand. So I would be more likely to follow it... Generally I call them. I don’t know why you’re recommending this, let me call you. It’s better.” (ID36, GU Physician)

“Oh they avoid that, too. [calling a consult physician specialty for clarification on notes] They’re just difficult to deal with. It’s like what are you here for? We’re all here for the same thing, you know? And everyone will be confused, including the patient. Or the patient will be saying, you know, this is what the plan is... It’s the politics, the doctor politics.” (ID26, ICU Nurse Night)

EHR constrained RC through selective communication

EHR enhanced RC through contribution to comprehensive communication (Comprehensive communication also requires verbal)

Versus

EHR constrained RC through passive & selective communication

META-LEVEL AFFORDANCE FACILITATION OF VERBAL SUPPLEMENTATION OF VERBAL

Coordination Situation Adaptive Enactment Examples Non-Adaptive Enactment Examples Primary RC Communication Dimensions (Examples)

Nursing Handoff "When I’m getting report, that’s when I sign on to Epic. I look at the diagnosis, I look at how long the patient’s been here, all the orders, the meds. And as I’m getting a history of the patient, I look at the doctors’ notes and see if what the nurse is telling me and what doctors had written coincide. Not all nurses have another computer next to them. Some, you know, don’t use a computer. But I always have a computer. I’m always looking.” (ID9, ICU Nurse Night)

"Some people actually take the report standing at the desk or at a table, where there isn’t a computer available for them. So they get totally verbal report from the nurse, But I’ve always found that if that happens, then I go back to the chart and open the chart and I see a red flag saying that someone hasn’t given a med, and I don’t know. So I usually prefer to have it right there open while I do it, so I can cross check information that they’re giving me." (ID8, ICU Nurse Day)

EHR enhanced RC through contribution to comprehensive & accurate communication

Versus

EHR could constrain RC untimely & inaccurate communication (documentation delays may not be noticed)

Relational coordination breakdowns were not common among the ICU core team members even in the presence of status differences, due to the close proximity of team members. However, ICU team members discussed instances of non-adaptive enactments of
meta-level affordances and negative effects on relational coordination related to communication with selected consultant physicians and with residents who were new to the unit. In the following section, I discuss two examples that highlight negative relational coordination effects that occurred with non-adaptive enactments of the meta-level affordance for Substitution of verbal communication.

Non-Adaptive Enactment Example 1: Passive Communication in Complex Situations

Enactments of the meta-level affordance for Substitution of verbal communication were common among team members that did not work together in close proximity. When situations were not complex and did not require verbal discussions, Substitution of verbal communication did not necessarily constrain shared knowledge and shared goals, but could enable passive communication that reinforced challenges related to mutual respect. For example, a GU physician described the team dynamics with consultant physicians who would respond with a note, rather than with a note and a phone call, to a consult request by the primary physician.

“It’s more common that they just leave a note, but it might be maybe 40 percent of the time that you talk to them ... I guess if somebody just comes in and leaves a note and they don’t call you and talk about it, theoretically they’re supposed to be advising you, and you’re supposed to say ‘yes I agree with that, thank you for your advice, I’m gonna do that’ or ‘thank you, I’m gonna do something else’. So I don’t know, it’s kind of a weird dynamic if they just leave a note and you can’t have access to talk to them about it.” (ID36, GU Hospitalist)

Further, a physical therapist explained that it was possible to obtain shared knowledge and shared goals by reading notes even in the case of passive communication.

“I don’t think it really increases the communication. It might make it less, because then oh if I don’t really like you, I don’t have to talk to you. I can just look to see what the patient did earlier that day, right? Like if I don’t like another therapist, I can just say ‘oh I don’t need to talk to you, I’m just gonna look at the chart’, right? And you don’t have to say ‘I can’t read your writing, what does it say’. You just kind of read it and ‘alright I’m done, I can go do this’.” (ID11, Consultant PT)

However, serious challenges occurred when complex situations required joint sensemaking and discussions of different opinions. For example, when primary and consulting physicians enacted the meta-level affordance for Substitution of verbal communication in complex situations that required discussions for consensus and could include disagreements among specialties, communication that was not focused on problem solving (i.e., passive communication) constrained shared goals, shared knowledge and mutual
respect. In this context, physicians enacted passive communication that was not openly blaming or finger pointing but also not focused on problem solving. For example, two physicians described how using the EHR without verbal communication in complex situations could constrain shared goals, shared knowledge and mutual respect through passive communication.

“You can be pretty passive. And I think the electronic medical record enables that. Not only just passive, but passive-aggressive. Like chart wars. People have a conflict in medical opinion. They won’t pick up the phone and talk to each other about it, but for five days they’re going to be cancelling each other’s orders and putting in their notes, putting in the opposing plans.” (ID19, ICU Physician)

“Now if I want to know what somebody’s thoughts are, I just read their note in the chart or vice versa. I think it’s easy to kind of, and I know I’ve been guilty of this myself, you’re reading a note and then you make some comment like ‘well why doesn’t he want to operate’ or ‘why they’re waiting four days’. You know, you make a comment to yourself that you wouldn’t make if that person was there. You would just ask them, you know. ‘why wait for 4 days?’ or ‘don’t you think it might be better’. It’s a lot more passive-aggressive communication to a certain degree. So you have a disagreement, which you may just only air to nobody or to yourself, or in your own mind, or to the team that you’re rounding with, but don’t broach with the person that you’re having a disagreement with.” (ID16, Consultant Physician)

The consultant physician further explained how passive communication was closely related to selective communication when enactment variations of the foundational IS affordances of Comprehensiveness and Interpretability were not alleviated with verbal communication (i.e., Supplementation of verbal communication).

“I think it’s always to a certain degree siloing the professions. I think the more you have kind of interactive discourse, the more people can come to mutual agreement on things. But having things written down, especially with the writing you don’t get the nuances and what they’re trying to say. And sometimes it won’t be as elaborate in their explanations. You may think, well this person just doesn’t get what I’m asking them to do or what the issue is”

Passive communication could also constrain mutual respect across the hierarchy. For example, an ICU nurse and a GU nurse described how the use of the EHR constrained relationships when physicians enacted the meta-level affordance for Substitution of verbal communication in communicating complex or time-sensitive orders.

“We do what the doctor tells us to do through the computer, because I’ll have orders magically appear in my computer without any verbal mention from the doctor. And there may not even be a note written. I’ll just have the order there. And then you’re expected to do it. But I have to call a doctor and tell him what’s going on. He wouldn’t be able to just read my note. But he could be like looking through all the assessments and just make orders. Now whether he’s doing those orders from ... I won’t be able to assume that he will read a note and then make an order from that situation without me verbally informing him.” (ID18, ICU Nurse Day)

“I would like to know ‘oh I’m putting in an order for this’, it's just like communication, we're working on this patient together you know, for the better of this patient... but otherwise I'll see it pop up and it's like ok.” (ID34, GU Nurse)
Non-Adaptive Enactment Example 2: Time-Sensitive Consult Recommendations

Enactments of the affordance for Visibility associated with notes in groups often required verbal communication (i.e., Supplementation of verbal communication) to ensure shared goals and shared knowledge among team members through timely and comprehensive communication of time-sensitive and important information. When a team member other than the primary physician shared important information in notes, Immediacy of information sharing was not only dependent on when others accessed the EHR, but also if team members utilized selective use patterns with filters.

Another example of a communication breakdown due to inappropriate enactments of the meta-level affordance for Substitution of verbal communication arose when consultant physicians either included time-sensitive recommendations in consult notes or in orders without verbally informing the ICU core team. When a time-sensitive recommendation was incorporated in a note, gaps in care were likely due to delayed communication, because time constraints of patient care situations determined when and how often ICU physicians could view notes by consultants (i.e., enactment variations of Immediacy). When consultant physicians entered orders without speaking to the core team, constraints due to delayed communications were less severe because nurses were notified of orders in the EHR. Instead, the greater challenges were potential passive communication and inaccurate communication in the context of the integrated plan for the patient, which constrained the relational dimensions. In these situations, the ICU team mitigated potential constraining effects by initiating verbal communication. For example, an ICU physician, an ICU respiratory therapist, and an ICU nurse described how non-adaptive enactments of the meta-level affordance for Substitution of verbal communication by consultant physicians could constrain shared goals and shared knowledge among physicians and influenced mutual respect.

“As an Intensivist I’m supposed to coordinate care among whatever five consultants are on the case. And sometimes two consultants may have a conflict in what they want to get accomplished. However, you have to weigh one versus the other. So sometimes what happens is, each one of those two consultants is putting in their orders, and those are contrary paths of action. Technically all they should do is give suggestions as opposed to just going and doing whatever the heck they want to do. Yes and that still happens.” (ID19, ICU Physician)

“See, you know the consultants here as far as they communicate with me, I can put an order in for the physician. But then there’s also the ICU team who’s actually in charge of managing the patient. So when the consultant is called in, what is supposed to happen is they call the consultant. Then he comes and sees the patient and talks to the team and says ‘this is what I think they should do’. And then the team will ultimately put in the final orders. But we’ve had consultants come in, you know, basically do the consult and they put in an order and leave and not say anything to anybody. That’s something that
needs to be addressed I guess between physicians [laughs]. But when that happens, it’s kind of frustrating for the other physicians because you know there’s no communication I guess.” (ID37, ICU Respiratory Therapist)

“Consults can be a little more frustrating, because you’re not discussing what their expectations are. Whereas in rounds, or our physicians that are here all the time, we discuss expectations for the plan of care for the patient. So sometimes you’ll just see orders pop up from the consult and maybe you might even not see them for two hours. And it’s totally different than what your plan is with the MICU team. So that can be a period of frustration. Usually then I’ll call the consult and ask them or the resident will call to let them know what our plan is and how it’s different from the plan that the consult has.” (ID10, ICU Nurse)

Two ICU residents similarly emphasized the importance of adaptive enactments of the meta-level affordance for Supplementation of verbal communication for orders from consultant physicians in the ICU.

“If it’s a big order, I think most specialists will get in touch with us, the staff. But I think that’s just communication in general. I think our specialist and people coordinating care should be in good communication. It’s just that if we’re on the same page and everybody knows what people want for the day, I think it’s just better for patient care. Sometimes it takes more effort out of one person versus the others. But ideally if everyone kind of makes the effort to stay in touch with someone, foster good communication, I think it will be very helpful for the patient.” (ID39, ICU Resident)

“I mean they could put in their own orders, but then we’re not sure what happened. It’s very dependent on the consultant. I mean in some cases it’s very helpful, because they order things that we’re not used to ordering or that we’re not comfortable ordering. So it helps at those times. But then again, sometimes they put in things and we’re not really aware of it. Then at that time you probably will call the consultant and be like ‘oh, we need to talk about this’, because I think technically since this is a teaching hospital, residents are supposed to be putting in most if not all of the orders.” (ID20, ICU Resident)

The Role of Frequent Communication enabled by the Meta-Level Affordance for Substitution of Verbal Communication for Relational Coordination

When we consider the examples of adaptive and non-adaptive enactments of the meta-level affordance for Substitution of verbal communication, it is clear that verbal communication is critical for enabling or constraining effects on the relational coordination in many situations.

The EHR promoted frequent communication by providing anytime/anywhere access to information from other team members, as described by an ICU nurse.

“The data is accessible to everyone at all times. So I don’t have to be responsible for … I mean, I still retain responsibility for transmitting data to physicians when it needs to get moved that way. However, I am not the sole conduit of the information. They have access to Epic, so they can follow as frequently or more frequently than I am, if they’re needing that information sooner. There’s no middleman or woman if you will to push the information one way or the other.” (ID13, ICU Nurse)
However, this type of frequent communication in the EHR appeared to be much less important for effective coordination than timely and comprehensive communication, which required adaptive enactments of the meta-level affordances due to enactment variations of the foundational IS affordances. For example, a consultant physician compared frequent communication in the EHR with verbal communication in the context of comprehensive and problem-solving communication, which were essential for reinforcing the relational dimensions.

"Well, what kind of communication? Certainly I think in terms of the written communication it’s gonna be obviously more. And also because we can see every communication on every patient everywhere, versus back in the paper chart days, when you wanted to see a communication written on the patient, you had to go to that patient and look at their chart. So it’s been a huge advance on that, because I can be in one spot and see what everybody has to say about all my patients. But having that written chart has vastly decreased the amount of verbal communication certainly ... I think the more you have kind of interactive discourse, the more people can come to mutual agreement on things. But having things written down, especially with the writing you don’t get the nuances and, you know, what they’re trying to say. And sometimes it won’t be as elaborate in their explanations. You may think, well this person just doesn’t get what I’m asking them to do or what the issue is.” (ID16, Consultant Physician)

An ICU nurse summarized the limited role of the meta-affordance for Substitution of verbal communication in enhancing relational coordination, compared to Supplementation and Facilitation of verbal communication.

"I think any communication that is replaced by our use of Epic is not important communication. It’s like data seeking. So Epic takes care of that data seeking. So now the communicating that’s important can still continue.” (ID13, ICU Nurse)
CHAPTER 8. DISCUSSION AND IMPLICATIONS

8.1. Summary and Model Building

In Chapter 4, I discussed that relationships among core ICU team members were stronger than relationships between ICU team members and consultants and among GU team members. ICU team members emphasized how working in close proximity and meeting in daily multidisciplinary rounds helped develop a strong mutual understanding regarding how to achieve shared goals and how every team member contributed to goals, as well as positive perceptions of respect among professional groups for the work with patients. In contrast, ICU team members noted that strong relationships did not exist with many consultants or between physicians and nurses in general units because of the lack of proximity.

In Chapter 5, I identified a distinct set of foundational IS affordances for relational coordination. The EHR system provided users with a set of affordances for Accessibility and Integration, which were associated the group-level goal of coordination. In particular, the EHR provided users with Accessibility affordances for sharing and accessing information instantaneously (i.e., Immediacy), across multiple sources and concurrently with others (i.e., Simultaneity), across time (i.e., Reviewability) and across locations (i.e., Mobility). Further, the EHR provided users with Integration affordances for emphasizing and noticing pertinent information among multiple sources (i.e., Visibility), as well as sharing and accessing information within a source that was understandable (i.e., Interpretability), contained all necessary aspects for coordination (i.e., Comprehensiveness), was readable independent of handwriting (i.e., Legibility) and accurate (i.e., Accuracy).

Four IS affordance types and their enactments within groups were particularly important for team members’ experiences with relational coordination when using the EHR. In order to coordinate effectively with others in a time-constrained environment, clinicians depended on being able to access up-to-date information from others instantaneously (i.e., Immediacy), receiving information that was clear (i.e., Interpretability) and contained all necessary details to move forward with the care of the patient (i.e., Comprehensiveness), and quickly noticing pertinent information within the wealth of sources in the EHR (i.e., Visibility). Enactments of the IS affordance types for Visibility, Comprehensiveness and Interpretability interacted with the IS affordance for Immediacy in reinforcing or conflicting
ways. For example, the role of instantaneous access for coordination was diminished when clinicians had to follow up verbally to clarify information in the EHR. Enactments of IS affordances within groups depended on feature fit as defined in the technology affordance literature, but importantly also on use of the EHR by others and rules and regulations.

In Chapter 6, I showed how enactment variations of the four essential foundational IS affordance types enabled or constrained relational coordination on a day-to-day practice level in the different core communicative processes. Enabling or constraining effects of the affordances for Immediacy, and Comprehensiveness and Interpretability on relational coordination were primarily associated with use of the EHR by other team members, while effects of the affordance for Visibility were strongly dependent on variations of feature fit.

Variations in when clinicians shared and accessed information in the EHR (i.e., Immediacy) were common due to time constraints in the high velocity environment. Variations in how comprehensively and clearly clinicians communicated assessments, recommendations and pertinent situations in notes (i.e., Comprehensiveness and Interpretability) were common due to different practices among professional groups and individual variations. Enactments that limited the value of notes for coordination were associated with conflicting non-coordination affordances, such as individual efficiency, billing, and legal documentation. Variations in when clinicians shared or accessed information and how comprehensively and clearly they communicated pertinent information in notes enabled the relational dimensions primarily through timely and comprehensive communication, while variations could also constrain the relational dimensions through delayed and selective communication unless verbal communication was incorporated.

In contrast, variations in how team members could emphasize and notice pertinent information in the EHR (i.e., Visibility) were primarily related to differences in feature fit, supported by the rules and regulations that governed the implementation of the EHR system. While the EHR system supported relational coordination through timely, comprehensive, and accurate communication with features that integrated, highlighted and filtered pertinent information, filtering tools also enabled selective use patterns that could constrain timely and comprehensive communication. The notes feature only offered filtering tools that attempted to enhance Visibility, yet no options to integrate multiple sources into a comprehensive plan and a summary of pertinent events that promoted shared goals and shared knowledge in day-to-day practice across disciplines. The importance of notes for communication, in
combination with fragmentation of information and selective use patterns enabled by filtering tools, necessitated verbal communication to ensure comprehensive and timely communication among specialties particularly in complex cases.

Variations in enactments of Immediacy, Comprehensiveness, Interpretability and Visibility were least likely to affect shared goals and shared knowledge among core team members in the ICU (compared to communication between physicians and nurses in the GU and communication with consultant physicians) through delayed communication or selective communication, because ICU teams ensured timely and comprehensive communication by establishing a shared awareness in multidisciplinary rounds and verbal handoffs and by communicating frequently verbally throughout the shift due to close proximity. The analysis of the data presented in Chapter 6 showed an emerging pattern and common theme that verbal communication played a critical role for how different enactments of IS affordances ultimately enabled or constrained effects on relational coordination. Communication challenges occurred when team members relied on communicating important information in the EHR that could not be shared or viewed in time, easily emphasized or noticed, or interpreted. Verbal communication was not necessary if all enactment variations of Immediacy and the interacting affordances supported coordination in a situation, but this was often not the case.

In Chapter 7, I showed that the EHR ultimately enhanced or disrupted communication in teams depending on how team members combined EHR use with verbal communication in different situations with enactments of the meta-level affordances for Facilitation, Supplementation or Substitution of verbal communication. Synthesizing examples of enactment variations in the context of the meta-level affordances, it became apparent that adaptive enactments of the meta-level affordances enhanced coordination through timely, accurate, comprehensive and problem-solving communication. On the other hand, relational coordination breakdowns occurred when meta-level affordances were not enacted in line with the requirements of the coordination situation. Most importantly, non-adaptive enactments of the meta-level affordance of Substitution of verbal communication could constrain shared goals, shared knowledge, and mutual respect in day-to-day practice through variations of delayed, selective, inaccurate and passive communication. The importance of the meta-level affordances was particularly visible when I contrasted effects of variations in enactments of
the foundational affordances on relational coordination within ICU teams, GU teams and particularly with consultant physicians.

Table 31 summarizes the key findings and presents selected example quotes.

<table>
<thead>
<tr>
<th>Table 31: Overview of Findings</th>
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<tr>
<td><strong>Key Finding</strong></td>
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<td><strong>Chapter 4</strong></td>
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| 1. Core ICU team members had developed the strongest relationships due to proximity | Mutual Respect: ICU core team versus Consultant Physicians  
"It is a great collaboration, especially in the ICU. I think here it’s different. I think in the ICU people feel very comfortable talking to the doctors. Consults it’s different maybe. The consults that come in ... the surgeons." (ICU Nurse)  
Shared Goals: ICU versus GU  
“We are actually involved in the plan of care, we facilitate the plan of care. I feel like regular med/surg nurses, they do what’s stated on Epic, it’s their bible. Whereas we really talk and figure out as a team what you’re gonna do. It’s a lot different than just ‘oh I see an order to give a foley catheder. I’m just gonna put it in’, whereas we’ll be like ‘why do you need it’. We would have a discussion.” (ICU Nurse) |
| **Chapter 5.1** | |
| 2. EHR offered nine foundational IS affordance types for coordination, of which four were essential for how team members experienced RC in the high-velocity context | Immediacy Potential:  
“Today I oriented the new residents and I told them 'you know Epic's great, you can just put the order in and the nurse gets it automatically'. So this is much more immediate.” (ICU Pharmacist)  
Interpretability Potential:  
“For example, when a consultant comes in and makes a plan, they may not be able to verbalize their plan to everyone involved in the care, but they've made a note, so everyone who wants to know what that consultant's plan is can read the note. And then the plan is clear. Should be [laughs].” (ICU Nurse)  
Comprehensiveness Potential:  
“In the progress notes you can elaborate on what the situation was. You could really review all the data that was pertinent, what the discussion was, what the follow up was. You know, you can just really elaborate on the care that was provided.” (ICU Nurse)  
Visibility Potential:  
“In Epic versus handwritten, it does [help with timeliness of communication]. You can sort things better. Because if I only want to see the physical therapy notes, I can filter it. So I only see the physical therapy notes. So yeah, it's totally helpful in that sense.” (Consultant Physical Therapist)  
The Role of Simultaneity and enactments of Immediacy:  
“You can see trends, you can see labs, the patient’s whole history is there. But Epic is only as good as the information that I put in. If the nurse is busy and like nothing’s been put in for five hours, then you have nothing. You don’t know what’s going on. So it’s only as good as the user that’s using it at that moment.” (ICU Nurse) |
Chapter 5.2

3. Enactments of IS affordances within groups depended on feature fit, use of the EHR by others and rules and regulations.

- Enactments of the essential integration affordances (Comprehensiveness, Interpretability, and Visibility) interacted with the affordance for Immediacy

| Example Immediacy: |
| Use by others |
| "There’s often a delay. I know for myself, we have to get through rounds before I do my notes. So it might be noon before I’m putting my thoughts on paper in Epic, whereas we saw that patient three hours ago. Same with the consultant physician who comes by. May have seen the patient, may have dictated their note, but the note won’t be transcribed and actually signed for hours, maybe a day or two." (ICU Physician) |

| Rules and Regulations |
| "The charting is required. But you don’t have to put it in that second. Like I can do my assessment and then go back and put it in hours later. It’s only as good as the person that’s using it." (ICU Nurse) |

| Feature Fit |
| "Sometimes it can be frustrating when the computer is a little bit slow and you have to wait as you click through screens and navigate through screens. It can be frustrating to wait, even a few seconds can seem like a long wait when you’re wanting to look at the data." (ICU Nurse) |

| Interaction of enactments of the affordance for Visibility with Immediacy: |
| "The notes can be rather cumbersome, that is to say that you can have a note put in for anything, and it gets to be a really long list. And sort of finding what I need from notes can be a little bit challenging. There’s tabs across the top for original consultations or operative report, but the day to day stuff is all lumped in together. And so it can take a little while to find." (ICU Physician) |

Chapter 6

4. Variations in how team members enacted the four essential foundational IS affordance types enabled or constrained RC on a day-to-day practice level in all core communicative processes

Example: In the communication of plans and assessments, enactment variations of Immediacy could constrain shared knowledge and shared goals through delayed communication unless physicians also communicated verbally.

In contrast to GU and communication with consultants, enactment variations in the ICU did not constrain timely communication because of the multidisciplinary round and proximity:

| ICU: |
| "I don’t think people sit by the computer and wait for our notes to come out. And during our rounds, we actually call the nurses there. So they listen to us present the patient, so they kind of get an idea of the plan as well. So they know the plan … the big picture of the plans, and then you know they can look at our notes later." (ICU Resident) |

| GU: |
| "You know when I first started with the hospitalists I think they tended to rely on their notes communicating to the staff. And because there was this tendency for them to write the note at the end of THEIR 12 hour day and us not knowing what their plan was, we ended up calling them more frequently. So I think over the years they’ve gotten to the point where it’s easier for them to update us in person before they leave the unit, or write their note quicker, or BOTH, than having to answer our 20 phone calls during the course of the day.” (GU Nurse) |

| Consultant physicians: |
| "The problem is a lot of people dictate things and they don’t always write a brief note. So sometimes you don’t even know if they’ve seen the patient yet. The dictations take usually a day for it to at least come up so you can look. So
yeah, it can really affect the plan. I mean they could put in their own orders, but then we’re not sure what happened.” (ICU Resident)

### Chapter 7

5. **Ultimately effects on RC** depended on how team members combined EHR use with verbal communication through **three meta-level affordances for coordination**
   - **Facilitation**, **Supplementation** and **Substitution of Verbal Communication**

- **Adaptive enactments of the meta-level affordances mitigated variations** and enhanced RC through timely, accurate, comprehensive and/or problem-solving communication
- **Non-adaptive enactments** constrained RC in day-to-day practice through delayed, selective, inaccurate and/or passive communication
- **Non-adaptive enactments** were most likely when relationships were not strong (with new ICU residents, with consultants, among GU physicians and nurses)

Adaptive Enactments of Facilitation of Verbal Communication:
(EHR enhanced RC through all communication dimensions, notably problem-solving communication in interactions with status differences or disagreements)

“I go to whatever patient we’re discussing and bring up their flowsheet. And I have it right there. And if they have something wrong on the respiratory portion, I say ‘No, that’s not right. Here’s what’s been charted, and here’s what’s going on’.” (ICU Respiratory Therapist)

Adaptive Enactments of Supplementation of Verbal Communication:
(EHR enhanced RC through comprehensive and accurate communication. Verbal communication was also necessary for timely and comprehensive communication)

“If it’s outside of rounds, they might be more rushed and not give you the time to ask everything you want to ask or find out everything you want to find out. So then it’s easier to read their note if their note is any good.” (ICU Pharmacist)

Adaptive Enactments of Substitution of Verbal Communication:
(EHR enhanced RC through comprehensive, accurate and timely communication primarily in non-complex, non-urgent situations.)

“If there is an active issue, but nothing has changed when it comes to the urgency of the issue, then the written communication [from the consultant physician] is enough. Whether it’d be a two liner or something more extensive. But if the patient is going down the tubes, then the written communication isn’t enough.” (ICU Physician)

Example: Communication of major plan changes (shared goals on a day-to-day practice level)

Adaptive enactment of the meta-level affordance for Supplementation of verbal communication:
(EHR enhances RC through **comprehensive** communication, timely communication requires verbal communication)

“I think most of the time people look at it once a day, and then if you know it was in at the time when they were looking at it, they would notice it. Otherwise they would look at it the day after. And then what happens is in this system, everybody expects a phone call of some sort. If it was important enough to change something.” (ICU Physician)

Versus

Non-adaptive enactment of the meta-level affordance for Substitution of verbal communication:
(EHR constrains RC through delayed communication)

“I’ve seen some residents addend their note but not update the nurse. And they’re like ‘We’re going off the yellow sheet, why would I...’ because if I attend rounds, I don’t always go and read their notes, because we talked about it, right? I don’t know, it might fall through.” (ICU Pharmacist)

### Chapters 5 - 7

6. **Comprehensive/Selective Communication is a new RC**

Example: If the consult note was not detailed and clear and the team members did not discuss the recommendation verbally, selective communication could constrain shared knowledge, shared goals and possibly mutual respect when the
Having discussed all components, I integrate them into a conceptual model. Figure 8 depicts the conceptual model that shows how information systems affordances for coordination enable or constrain relational coordination in a high velocity health care environment.

Figure 9: Research Synopsis: A Model of Information Systems Affordances for Relational Coordination
8.2. Discussion

Based on this study, I developed a classification of foundational IS affordances for coordination, which were related to Accessibility and Integration of information.

This classification reinforces the value of identifying specific affordances of information systems in different organizational contexts to examine information systems effects (Volkoff & Strong, 2013; Majchrzak et al., 2013; Treem & Leonardi, 2012). To my knowledge, this is the first focused, comprehensive classification of IS affordances for coordination for multi-disciplinary work groups in high velocity, high reliability health care organizations.

Among the many potential affordances of information systems for health care professionals, I focused on identifying affordance types directly related to coordination as a group-level goal. The focus on identifying and studying specific affordances in the context of relational coordination supports the suggestion by recent research on IS affordances to anchor the affordances lens in the specific context of interest, such as online knowledge sharing (Majchrzak et al., 2013). This approach allows researchers to go beyond a generic use of the term affordance and focus on specific potentials that provide ways for users to engage with the IT-enabled context, along with mechanisms for productive and inhibitive patterns.

Some foundational IS affordance types align with specific IS affordances identified in other organizational contexts. For example, recent IS research identified integrating affordances and visibility affordances of enterprise systems (Volkoff & Strong, 2013). Further, IS research identified affordances for visibility and persistence, among others, related to social media (Treem & Leonardi, 2012). These similarities suggest that the IS affordance types identified in this dissertation are applicable to study effects of information systems in different organizational settings where employees have to communicate in work groups.

This study further showed that four foundational affordance types were most important for effective relational coordination in this high velocity health care environment. Relational coordination challenges using the EHR primarily occurred when these IS affordances were not enacted effectively in groups.
With Research Question 1, my goal was to understand how different IS affordance types affect relational coordination. I expected that IS affordance types have distinct effects on the relational coordination dimensions. The data analysis showed some IS affordance types were more important than others in this empirical setting for enabling or constraining relational coordination in day-to-day practice (i.e., Immediacy, Comprehensiveness and Interpretability, Visibility), while other affordance types were necessary but not sufficient to support effective coordination. Their role for coordination depended on enactment variations of the four essential IS affordances within groups. The importance of the essential foundational affordance types aligns with the coordination characteristics of intensive care units or trauma units (e.g., Faraj & Xiao, 2006). In high velocity patient care, the primary concern for clinicians in day-to-day coordination with others is to quickly get and share the information they need to do their jobs. In order to do their jobs quickly and effectively in interdependent processes, they need to know others’ assessments and the plan of the day for a patient (shared goals), and the roles of all involved team members and their work with the patient (shared knowledge), effectively communicated across the hierarchy (mutual respect).

In the context of Research Question 1, I further expected that reinforcing or inhibiting interactions among IS affordance types may influence effects on relational coordination. The data analysis shows that how the EHR supported or inhibited relational coordination depended on how the IS affordance for Immediacy was enacted in groups, and how enactments of the affordances for Comprehensiveness, Interpretability and Visibility interacted with Immediacy.

**Enactments of non-coordination affordances of the EHR system interacted with the essential foundational affordances.**

Explaining enactment variations of the coordination affordances in groups also led to the consideration of other EHR affordances, which were not related to the goal of coordination but interacted with enactments of coordination affordances in potentially conflicting ways (e.g., billing, legal documentation, individual efficiency). In previous research, I developed an initial categorization of IS affordances of accountability, compliance, decision support, and communication (Sebastian & Bui, 2012). Other research on IS affordances in health care environments also identified different non-coordination affordances, such as billing, compliance, accountability or teaching (Goh et al., 2011; Strong et al., 2014). This study reinforces the suggestion that we must understand the nature of the
relationships among multiple affordances that are associated with an information system or even with a single feature in order to understand how they are enacted (Volkoff & Strong, 2013). This is particularly important for HIT like EHR systems, which were not designed with a priority for communication but have evolved to essential communication tools for clinicians.

Enactment variations of IS affordances within groups depended on use by others, rules and regulations, and feature fit.

With Research Question 2, my goal was to understand the role of enactments of IS affordances within groups for potential effects on relational coordination. I expected that enactments of IS affordances in health care teams play a critical role for enabling or constraining effects on relational coordination (Volkoff & Strong, 2013). Enactments of the IS affordances in groups were part of coordinating with others. Variations reflect the practice perspective of coordination, which views coordination mechanisms not as standards and rules, but as dynamic social practices that are under continuous construction (Jarzabkoswki et al., 2012).

The data analysis showed that enactments of IS affordances within groups were indeed critical for effects on relational coordination. In particular, the study showed that enactments of IS affordances depended on use by others, rules and regulations, and feature fit, which played roles of varying importance for different affordance types. Enactment variations of the affordances for Immediacy and Comprehensiveness and Interpretability were primarily associated with use of the EHR by other team members, while enactment variations of the affordance for Visibility were strongly dependent on feature fit.

This study offers specific reasons for why it is difficult to actualize basic affordances in organizations beyond challenges with feature fit.

Recent research observed that it is difficult to actualize basic affordances in organizations because information systems are complex (Volkoff & Strong, 2013). In this study, variations in use of the information system by others due to time constraints and non-coordination affordances were also important or more important for difficulties in how team members could enact affordances effectively. The importance of enactment variations related to use by others and rules and regulations raises the issue of potential extensions to the IS affordance definition in the context of multidisciplinary teams. Enactments of affordances
depended on how feature fit related to goals, as proposed by definitions in the IS field 
(Volkoff & Strong, 2013; Markus & Silver, 2008). However, when feature fit was suitable 
for goals, effective enactments or actualizations of affordances were still strongly dependent 
on other factors, in particular other users when people work together using an information 
system.

**Ultimately the EHR enhanced or disrupted communication in teams depending 
on how team members combined EHR use with verbal communication in different 
situations by enacting the meta-level affordances for Facilitation, Supplementation or 
Substitution of verbal communication.**

Based on this study, I propose an additional meta level of IS affordances, which are 
action potentials to enhance communication when team members enacted the foundational 
affordances and incorporated verbal communication in ways that supported adaptive 
coordination in different situations (Faraj & Xiao, 2006; Argote, 1982; Yun et al., 2005; 
Klein et al., 2006). I call it ‘meta level’, because this level also involved verbal 
communication among team members while interacting with the EHR system. Further, the 
meta-level affordances encompass the different foundational affordances when clinicians use 
the EHR system and incorporate verbal communication to achieve coordination goals in 
practices. Based on enacting the various foundational affordances, the EHR system allowed 
clinicians to facilitate, supplement, or substitute verbal communication. This finding is 
somewhat related to but different from the idea of basic and advanced affordances, in which 
actualization of advanced affordances depends on actualization of basic affordances (Volkoff 
& Strong, 2013).

This study showed that effects of enactment variations of the foundational IS 
affordances on relational coordination depended on how teams enacted the meta-level 
affordances in situations with different time constraints and complexity, i.e., to what extent 
they incorporated verbal communication. This means that common enactment variations of 
the foundational IS affordances (whether due to time constraints or non-coordination 
affordances based on individual variations or rules and regulations) were not problematic for 
relational coordination when the meta-level affordances were enacted as part of effective 
adaptive coordination. In these cases, verbal communication ensured timely communication, 
while the EHR enhanced coordination by supporting comprehensive and accurate 
communication with the core team and timely communication with the broader team.
However, enactment variations of the foundational affordances resulted in communication breakdowns if team members enacted the meta-level affordances out of line with the requirements of a coordination situation.

Adaptive enactments of meta-level affordances were critical because of the essential role of adaptive coordination in high velocity, high reliability environments (e.g., Argote, 1982, Faraj & Xiao, 2006). Facilitation, Supplementation and Substitution of verbal communication addressed the different roles of the EHR in adaptive coordination. While I expect the foundational IS affordances to be generalizable to communication in work groups using enterprise systems, adaptive enactments of meta-level affordances could be more specific to high velocity, high reliability organizational contexts.

Non-Adaptive Enactments of the meta-level Affordance for Substitution of verbal communication were most challenging for relational coordination, because they often reflected negative relationships between professional groups and status.

The EHR acted as a boundary object that enhanced knowledge sharing when team members enacted the meta-level affordance for Facilitation of verbal communication to support verbal discussions in the presence of differences between professional groups and status (Carlile, 2004). However, non-adaptive enactments of the meta-level affordance for Substitution of verbal communication reflected and reinforced the negative role relationships, which coordination scholars have observed in communication across the hierarchy in health care organizations (Bunderson & Reagans, 2011; Gittell, 2002).

ICU clinicians often enacted the meta-level affordance for Supplementation rather than Substitution of verbal communication because they talked to each other while working in close proximity in the same unit. The importance of proximity for developing strong relationships among team members is noted in the organizational literature. For example, recent research compared relationships among team members who worked with hospitalist physicians versus private practice physicians who visited the hospital when needed. The study found that clinicians of different functional specializations built stronger relationships when they worked together in close proximity at the same location and stage of care (Gittell et al., 2008). A study of distributed teams in multinational organizations found that the situated coworker familiarity, which distributed team members developed at site visits, was critical in building strong relationships that prevailed over time (Hinds & Cramton, 2014).
On the other hand, clinicians described that non-adaptive enactment variations of the IS affordances for Comprehensiveness and Interpretability by consultant physicians could result in selective and passive communication, which also reinforced negative issues with mutual respect. From an information sharing perspective, the meta-level affordance for Substitution of verbal communication was dangerous particularly for sharing information in notes in non-collaborative settings, because other team members could filter notes without an integrated picture of multidisciplinary information. The recognition of stronger or weaker general relationships among team members is important, because this study has shown that ICU core team members tended to enact the EHR affordances for coordination in ways that enhanced communication, while challenges were more likely to occur with peripheral team members or among team members in the GU. For example, the most challenging communication occurred when consultant physicians used the EHR to communicate time sensitive or complex recommendations or when disagreements were communicated passively in the EHR. In these situations, shared goals and shared knowledge on a day-to-day practice level were constrained by delayed, selective and passive communication. This was the case because physicians enacted the meta-level affordance of Substitution of verbal communication instead of Supplementation or Facilitation of verbal communication, which were typically used in teams that work together in close proximity and have built strong relationships.

Therefore this study has shown that existing role relations and status differences influenced how team members enacted IS affordances. Use of the EHR system in teams did not mitigate negative team dynamics. Instead, it reinforced positive or negative team dynamics because team members enacted coordination affordances differently (Oborn et al., 2011). This is in line with the argument that the relational dimensions on a general level are relatively resilient and difficult to change (Gittell et al., 2011). Recent research has argued that there is a limited understanding in the organizational literature on how coworkers develop strong relationships, despite consensus of the importance of strong relationships (Hinds and Cramton, 2014). This study has supported the importance of proximity and highlighted the limitations of the EHR in developing strong relationships.

Adaptive enactments of the meta-level IS affordances for coordination are particularly important for the role of HIT in supporting performance in high velocity health care organizations, because the importance of relational coordination for performance increases in
situations that are characterized by greater time constraints, uncertainty and interdependence (Gittell, 2002). The limited suitability of the meta-level affordance for Substitution of verbal communication for effective coordination in many high velocity situations (i.e., in situations that allowed for flexible timing of information sharing and access and when verbal communication was not possible), combined with differences in team dynamics and the temptation to leverage this meta-level affordance in many situations to increase individual efficiency, may explain some of the equivocal results regarding performance effects of health IT (Agarwal et al., 2010).

The relational coordination communication dimensions timely and comprehensive communication were particularly important for how enactment variations of IS affordances affected shared knowledge, shared goals and mutual respect on a day-to-day practice level.

The relational coordination research community examines effects on relational coordination primarily from the perspective of how structural interventions improve the relational dimensions. High or low levels of the relational dimensions reinforce the quality of communication among professional groups (e.g., Gittell et al., 2010). This study has focused on examining effects on relational coordination from the perspective of the communication dimensions, which support or constrain the relational dimensions in the mutually constitutive cycle described by Relational Coordination Theory.

Frequent communication enabled by instantaneous information access in the EHR was much less important for effective coordination than timely and comprehensive communication, which required adaptive enactments of the meta-level affordances due to enactment variations of the foundational IS affordances. Relational Coordination Theory argues that coordination through frequent, high-quality communication enhances the ability of organizations to achieve desired outcomes (Gittell, 2006). This study reinforces the importance of high-quality communication with the EHR, which is in this case study critically represented by the communication dimensions of timely and comprehensive communication.

Achieving timely and comprehensive communication was more difficult in processes in which clinicians of different professional groups and/or status interacted in combination with lack of proximity (i.e., communication with consultant physicians, and between GU
physicians and nurses). Relational coordination breakdowns were more likely to occur because of non-adaptive enactments of meta-level affordances. Effective communication required adaptive coordination, which meant that enactments of the meta-level affordances had to be adjusted to the communication requirements of a situation. For example, when clinicians relied solely on communicating in the EHR (i.e., meta-level affordance for Substitution of verbal communication) in time-sensitive situations, timely communication could not be achieved. These situations required verbal communication (i.e., meta-level affordance for Supplementation of verbal communication), because enactments of the affordance for sharing information instantaneously (i.e., Immediacy) in groups depended on other team members who had multiple work responsibilities beyond checking a patient chart in the EHR system. When clinicians relied solely on communicating in the EHR system despite uncertainty about a recommendation, selective and passive communication could constrain shared knowledge, shared goals, and mutual respect. In this context, the EHR enabled passive communication when team members disagree on an issue but do not resolve disagreements in verbal communication. Passive communication was an important, unique instantiation of problem-solving / blaming communication dimensions, which constrained the relational dimensions.

8.3. Implications for Theory

In this dissertation, I developed a theoretically informed and analytically induced conceptual model of the effects of information systems affordances for relational coordination in high velocity, high reliability organizations. I draw on the literature on information systems affordances, Relational Coordination Theory and adaptive coordination, and IS literature on the implications of HIT on work practices.

Literature on Information Systems Affordances

This study extends existing research on IS affordances by contributing a contextualized discussion of how IS affordances are enacted in groups and how variations affect outcomes (Strong et al., 2014). In particular, this study extends the literature on IS affordances by showing that feature fit is only one important component for enactment of IS affordances in groups. For example, this study showed that feature fit
dominated enactments of the IS affordance for Visibility when it was not suitable to support complex coordination. Feature fit supported the IS affordances for Immediacy, Comprehensiveness and Interpretability. However, enactment variations based on use patterns that were related to individual variations, practices in professional groups and conflicting organizational demands were essential for effective relational coordination.

This study contributes to the literature on IS affordances by proposing a set of foundational affordances for coordination, which were critical for relational coordination in a high velocity, high reliability setting. I further proposed a meta level of affordances, which contextualized enabling or constraining effects of the foundational affordances by mitigating enactment variations. I expect both foundational and meta-level affordances to be relevant in different organizational environments, where team members communicate utilizing with enterprise systems, though their importance may differ depending on the necessity of high velocity coordination. By showing the unique effects and interactions of IS affordance types, this study further demonstrates the value of identifying specific IS affordance types to study IS effects (Strong et al., 2014; Volkoff & Strong, 2013; Majchrzak et al., 2013). To study the effects of information systems, we have to identify the specific IS affordance types, their interactions and dominant enactment variations in a context.

Literature on HIT and Implications for Practices and Relationships

This study contributes to the discussion of HIT as boundary objects in multidisciplinary, hierarchical groups (Carlile, 2004) versus disciplinary practices according to functional roles and status (Oborn et al., 2011).

In particular, I extend existing research by showing how enactments of affordances reflected collaborative relationships and reinforced rather than mitigated potentially negative relationships among professional groups (Oborn et al., 2011). This was particularly visible in the adaptive enactments of the meta-level affordance of Supplementation for verbal communication versus non-adaptive enactments of the meta-level affordance for Substitution of verbal communication among team members of different professional groups that had or had not developed strong working relationships. By demonstrating these dynamics, this study contributes to a better understanding of equivocal results regarding performance effects of
health IT (Agarwal et al., 2010). When we consider the lens of IS affordances and enactment variations, it is not surprising that performance effects of HIT differ when the collaborative nature of hospitals and even units within hospitals can differ substantially.

**Literature on Relational Coordination Theory**

This research extends the relational coordination literature by contributing the most nuanced study of information technology and relational coordination to date, and by proposing the new communication dimension ‘comprehensive / selective communication’, which captured an additional aspect of communication among team members that was critical for shared knowledge and shared goals in day-to-day practice. This aspect of communication was particularly affected by enactment variations of the foundational IS affordances for Comprehensiveness and Interpretability, which were essential in the communication of plans, assessments, recommendations, plan changes and pertinent events with notes in the EHR. For example, insufficient quality of notes constrained shared knowledge and shared goals unless team members contacted others in order to achieve a better and more detailed understanding of information in notes. Although selective communication in a note could be accurate and timely, team members could only align goals and create a shared awareness of each other’s contributions when they achieved comprehensive communication.

I define the proposed communication dimension 'comprehensive communication' as 'communication that contains all necessary detail that a team member needs to progress patient care in a situation'. For example, when team members use progress notes to communicate, progress notes should clearly state recommendations, but also thought processes, assessments that explain recommendations (e.g., 'recommend medication x', including why and what is the likely result). According to this definition, effective communication provides the relevant context and is mindful of the coordination needs of the information recipient. If this condition is not met, a progress note can contain a lot of information (for example information that is relevant for billing) but be selective for the coordination situation.

The communication dimension ‘comprehensive communication’ is unique and different from the existing communication dimension ‘problem solving communication’. ‘Problem-solving/blaming communication' applies to situations when a problem or error
occurs, such as in coordination situations that require dialogic coordination practices (Faraj & Xiao, 2006). Team members can respond effectively to the problem by focusing on solving it together. Alternatively, they can communicate passively without resolving disagreements, or they can blame each other for the problem. In contrast, the dimension 'comprehensive/ selective communication' applies to situations where people engage in expertise coordination. For example, attending physicians requested input from a specialty physician before deciding on the next steps for a patient. If the resulting consult note was not clear and the two physicians did not follow up verbally to discuss, selective communication could constrain shared knowledge, shared goals and possibly mutual respect when the recipient was frustrated about the quality of the note. When disagreements based on the recommendation were not discussed, passive communication could occur in addition to selective communication, which could further constrain the relational dimensions. This study proposes that the dimension ‘comprehensive communication’ captures an additional aspect of communication in relational coordination, which should receive particular consideration in environments where information systems are used to substitute for verbal communication.

The relational coordination research community focuses on how structural interventions affect relational coordination (e.g., Gittell et al., 2010). This study extends existing research (e.g., Romanow, 2013) and equivocal results on the role of HIT on the relational dimensions by demonstrating that specifying questions for the relational dimensions to a day-to-day practice level is valuable for examining effects of HIT on relational coordination. This approach is consistent with Relational Coordination Theory, as the relational coordination survey can be applied broadly or specifically (Gittell, 2011b).

Finally, this study contributes to the literature on adaptive coordination and expertise coordination practices by providing a more contextualized perspective of expertise coordination situations, which comprise most coordination situations in high velocity, high reliability organizations (Faraj & Xiao, 2006). A nuanced view of expertise coordination situations and the challenges in communicating with the EHR is important. Faraj and Xiao (2006) found that consistency of knowledge sharing was the most difficult practice in expertise coordination situations. This research shows that adaptive coordination is not only necessary when expertise coordination situations change to dialogic situations (e.g., in emergency situations or when errors occur), but also within expertise coordination situations
with different situational requirements regarding time constraints, uncertainty and interdependence.

8.4. Implications for Practice

Manage Enactment Variations of IS affordances to Improve the EHR for Coordination

HIT has enhanced coordination compared to paper charting (e.g., Oborn et al., 2011), however the critical question is how we can improve it further. I sought to capture the complex dynamics of the health care context and HIT implementations for a better understanding of potential effects on work practices and performance. HIT can make an important contribution to performance, but there is much evidence that this is difficult to accomplish. Therefore, we must understand when and why HIT supports effective work practices in different current health care settings. I believe that the application of the IS affordances concept in the context of relational coordination offers great value in this process.

A key contribution of this research is the recognition that enactment variations of IS affordances for coordination must be managed in order to achieve effective coordination when teams utilize the EHR system. Management of enactment variations is necessary to translate the potential of IS affordances into a beneficial outcome.

In the empirical setting of this study, management of enactment variations was most important in regards to the essential foundational IS affordances of Immediacy, Comprehensiveness and Interpretability, and Visibility. Based on the dominant enactment components in this study, management of enactment variations of the IS affordances of Immediacy and Comprehensiveness and Interpretability should be targeted to work practices (i.e., how team members use the EHR and the surrounding rules and regulations), while management of enactment variations of the IS affordances of Visibility should be targeted to suitability of features to emphasize and notice pertinent information (i.e., HER design and surrounding rules and regulations).

One focus area of managing enactment variations related to use of the EHR by team members is to improve the quality of notes to make them more effective for Substitution of verbal communication in suitable situations. Verbal communication that only served to
clarify confusions related to how team members communicated in notes is comparable to non-essential verbal communication that was necessary to clarify legibility in paper charts.

One focus area of managing enactment variations related to feature fit in this particular case setting is to improve how team members can enact the affordance for Visibility by designing notes features that not only filter, but also integrate pertinent information in multi-disciplinary plans and summaries of chronological events. Moreover, some enactment variations of the other essential foundation affordances were related to competing demands on work practices, such as time constraints and requirements to address billing or documentation in the EHR as a legal document. A question for practitioners is how an EHR system would be designed that is focused on relational coordination in a high velocity health care environment, rather than addressing multiple competing demands and audiences.

Recognizing that these competing demands are difficult to change with how health care organizations currently incorporate EHR systems in work practices, this research proposes a primary focus on fostering adaptive enactments of the meta-level affordances as a first step to mitigate variations. This study showed that moving from non-adaptive to adaptive enactments of the meta-level affordances in teams is primarily an issue of managing and strengthening relationships of team members who did not work in close proximity and conducted regular multidisciplinary meetings like the core ICU team members.

Develop a Diagnostic Survey for Use in Organizations

There is an increasing awareness among high reliability organizations of relational coordination measures. Organizations already use relational coordination as a diagnostic survey and are interested in assessing how the use of IT in their teams influences relationships. This research is the basis for the design a diagnostic survey that uses the idea of affordances for use within organizations (i.e., what distinct foundational and meta-level affordances does an Information System offer, how are these affordances enacted in adaptive or non-adaptive ways for coordination in terms of use, design and rules and regulations). The survey could be applicable when structured technology is introduced to any setting in which work depends on how people manage their relationships. Applications of this conceptual
model could allow us to examine when and how IT is disruptive by asking about the identified affordances and how they play out. Focus is not only on design, but also on how practices (use in the group and governing rules and regulations) should be adjusted to make it work.

8.5. Limitations and Future Research

This study has several limitations to answer the question how information systems affordances affect coordination in high velocity, high reliability organizations. First, the study focused on one unit, with additional interviews in a second unit, in one organization. Further, the study focused on expertise coordination situations, while teams must also deal with dialogic situations (e.g., emergency situations) in day-to-day practice.

In the context of this case study, the four affordance types of Immediacy, Comprehensiveness and Interpretability, and Visibility emerged as essential among the foundational IS affordance types. In this particular empirical setting, other affordances like Accuracy and associated enactment variations were not perceived as problematic by clinicians. Because this empirical setting is an intensive care unit with high stakes of errors, much attention is placed on correct data entry. Highly skilled nurses monitor one to two patients closely at the bedside, with the EHR system in the patient room. I recognize that in other empirical settings, other foundational affordances may emerge as particularly essential. For example, enactment variations of the affordance for Accuracy may be essential in emergency rooms because information sources for the EHR system are more varied. Future research should therefore examine the role of the essential foundational affordances in other high velocity, high reliability organizations, which could include any organizations that deal with time constraints, uncertainty and interdependence. Future research could also extend existing research on multi-organizational coordination of time critical services with shared information systems by applying the model of IS affordances for coordination and enactment variations (Schooley et al., 2010).

Second, this study focused only on coordination affordances of the EHR system, which support the ability to do work in conjunction with others. Other types of HIT affordances were identified in the literature (e.g., affordances for problem solving,
accountability, compliance), but this was not within the scope of this research (Goh et al., Strong et al., 2014). The issue of non-coordination affordances was only considered marginally in the context of competing demands on work practices and EHR design, which were not related to coordination but interacted with enactments of the coordination affordances in teams. While this study suggests that an HIT system can be overburdened with competing affordances (e.g., enacting billing affordances interacts with how team members can enact the coordination affordances for Comprehensiveness and Interpretability when creating notes), I have not focused on how these competing affordances conflict with coordination. An important part of future research is to extend this research, create a network of non-coordination affordances and examine in more detail how realizing non-coordination affordance constrains how team members can realize coordination affordances. One goal of such research should be a better understanding what a system would look like that is only designed to enhance coordinate in a high velocity environment.

Further, the discussion of this research focuses strictly on coordination, understanding that the findings could be interpreted from the perspectives of different research streams from HCI to system theory.

Lastly, a limitation of this study is the focus on semi-structured interviews without leveraging additional qualitative methodologies such as observation, which was not permitted in this empirical setting.
### APPENDIX A: LIST OF CODES

<table>
<thead>
<tr>
<th>Code Types (Miles and Huberman, 1994; Saldaña, 2009)</th>
<th>Affordances</th>
<th>Definitions</th>
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<tbody>
<tr>
<td>A-priori</td>
<td>Affordance</td>
<td>AFF</td>
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<tr>
<td>Emerging (first set of interviews, first round of coding)</td>
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<td>AFF-IMM</td>
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<tr>
<td>Mobility</td>
<td>AFF-MOB</td>
<td>Ch.5, p.50</td>
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<tr>
<td>Reviewability</td>
<td>AFF-REV</td>
<td>Ch.5, p.51</td>
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<td>Simultaneity</td>
<td>AFF-SIM</td>
<td>Ch.5, p.52</td>
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<tr>
<td>Visibility</td>
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<td>Ch.5, p.54</td>
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<td>AFF-COM</td>
<td>Ch.5, p.56</td>
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<td>Ch.5, p.57</td>
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<td>Ch.5, p.58</td>
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<td>AFF-ACC</td>
<td>Ch.5, p.59</td>
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<td>Supplementation of Verbal Communication</td>
<td>AFF-META.SUP</td>
<td>Ch7., p.125</td>
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<td>Rules &amp; Regulations</td>
<td>ENACT-R&amp;R</td>
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Pattern codes
APPENDIX B: INTERVIEW GUIDES

General Questions:
- What is your job title?
- How many years of clinical experience do you have in intensive care?
- How long have you been in this hospital and the ICU?

Data Collection Phase 1

Please describe what you do in a typical shift and how you use Epic:

| Handoff: Describe what you do in the beginning of a shift and how you use Epic. | Do other physicians use Epic in similar ways? |
| Rounds: Which steps do you go through when you participate in a round? How do you use EPIC in this process? | How do nurses and other professional groups use Epic in this process? |
| Orders: Which steps do you go through when you deal with an order? How do you use EPIC in this process? | For which activities and immediate goals is Epic helpful? (Think about your work with others) |
| Consults: Describe how you deal with consults and how you use Epic. | When is Epic not helpful? |
| Emergencies: Which steps do you go through when there is a critical situation? How do you use Epic in this process? | |

Progress notes:
- Describe how you create your own progress notes during a shift.
- What is the main purpose of (your professional group’s) notes?
- How do you use notes of others during a shift?

The next questions focus on how Epic helps you, or makes it more difficult, to coordinate with others in the ICU:

Think about the different professional groups working together in a shift and how well they know what everybody does.
- How much do other professional groups know about the work you do with patients?
- Does Epic help how much others are aware of what you work on during a shift?

Generally, do you think people in the unit have the same goals for the care of patients?
- What are some goals that other professional groups share with you discuss with you during your shift?
- Which goals are unique to physicians/nurses/other professional groups?
- Does EPIC help how you work together on these shared goals?

How much do other professional groups respect you and the work you do with patients?
- Do doctors ask for the input of team members that belong to other professional groups?
- How do team members deal with different opinions among team members?
- Do you think Epic plays a role in how much professional groups ‘listen to each other’?

- Does Epic help with frequent communication with other professional groups about the status of patients?
- Does Epic help with how timely other professional groups communicate with about the status of patients
- Does Epic help with how accurately other professional groups communicate with you about the status of patients?
• Does Epic help with how people work with you to solve problems as a team?

Data Collection Phase 2: Physicians (interview guide adapted for each professional group)

NOTES
• When do you typically file your progress notes during the day?
• If the plan for a patient changes after the round, do you usually update the progress note right away? / Who updates the plan through notes?
• When do you think others in the care team are looking at your progress note or addendum?
• How much do you think the unit relies on progress notes to communicate plan changes quickly?
• When you write a progress note, what do you hope to communicate to physicians, to nurses? What do they need to get from your note? How does using Epic make it better or more difficult to achieve that?
• Thinking about nuances of patient care, how does reading somebody’s thoughts in the note compare to talking?
• Does a consultant note usually follow verbal communication with you? When do you follow up?
• Does reading a note versus talking to the person affect the impact of their recommendation, if and how you solve the problem together?
• If you read somebody’s note and disagree with a suggestion (e.g., a procedure, when it will be done), what are your next steps to come to a decision (how do you come to a mutual understanding)?
• Do you generally read notes by other professional groups? Do these notes help you monitor progress towards patient goals, or is verbal communication better? Why?
• How do you find specific notes in Epic?
• How do you find an integrated plan for a patient?

HANDOFF
• In which sequence do you talk to others/look at the patient/use Epic in the beginning of the shift? Why is this combination most useful?
• Which information do you get from the physician, the nurse at the bedside, patient examination that is difficult to get from Epic?
• What are your goals in reviewing Epic in the beginning of the shift?
• In the beginning of the shift, is Epic or verbal communication more useful for you to know what others are doing/have done, to review goals, to connect with others and be aware of suggestions? (Why?)

ROUND
• What is Epic most useful for you during rounds?
• If someone who is involved in the patient’s care is not present in the round, is information in Epic a sufficient replacement?
• How does using Epic during the round - referring to it, entering data - affect how the discussion of the patient takes place?
• Does using Epic during the round ever make things harder?

ORDER
• What is most helpful about Epic to you in the order process?
• When is it sufficient to enter an order in Epic versus also talking to a team member?
• How important is Epic versus talking at the bedside to monitor progress with orders?
• Does Epic give you more confidence in data entry by others?
• Do you find dose suggestions, alerts and standardized protocols like order sets useful?
REFERENCES


