THE IDENTIFICATION AND MANAGEMENT OF PATIENT INFORMATION PROBLEMS BY COLLABORATIVE PATIENT-CARE TEAMS

A Dissertation in
Information Sciences and Technology
by
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ABSTRACT

Hospitals are highly collaborative, information-intensive environments where patient-care teams rely on the availability of accurate and complete information to provide safe and effective patient care. However, patient-care team members frequently encounter patient information problems (PIPs). These PIPs include any issues related to patient information that impact the patient-care team’s ability to perform their work (e.g., wrong, missing, outdated information). Although these PIPs have always existed in paper records, there is an increasing need to focus on PIPs in electronic records due to the tremendous growth in the use of health information technology (HIT).

Researchers in the Medical Informatics and Human-Computer Interaction communities are currently studying what causes these PIPs in hospitals, and the impacts that PIPs can have on the patient-care workflow. Additionally, Computer-Supported Cooperative Work researchers are exploring how the collaborative nature of hospital work affects the information management activities of patient-care teams. Yet, there is still limited research on how patient-care team members actually identify and then manage the PIPs that they encounter during their work. After all, if these PIPs are not identified and properly fixed, they can result in medical decisions being made on wrong or outdated information, or even result in the occurrence of medical errors that could harm patients.

In this dissertation study, I address this limitation in existing research by conducting an ethnographic field study in a hospital’s emergency department and in-patient ward. I used qualitative methods including observations, shadowing, semi-structured interviews, and artifact analysis to examine how patient-care teams identify and manage PIPs that they encounter. The contributions of my study include: (a) providing a conceptual understanding of the ways that patient-care teams identify and manage PIPs, including the development of a PIP taxonomy and
conceptual framework, and (b) developing socio-technical recommendations for how to improve the design of hospital policies and HIT design that will better support the identification and management of PIPs by collaborative patient-care teams.

The research motivation of this dissertation study highlights the importance of better understanding PIPs that occur in hospitals in order to prevent or mitigate any negative impacts that they can have on patient care. The contributions of this research extend the conceptual understanding of PIPs and provide tools and design recommendations that can better support collaborative patient-care teams in their identification and management of PIPs.
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1 Introduction

1.1 Problem Motivation

Hospitals are highly collaborative, information-rich environments where patient-care teams rely on the availability, accuracy, and completeness of information in order to make well-informed decisions about their patients. However, these teams frequently encounter patient information problems (PIPs). PIPs include any issues related to patient information that impact the patient-care team’s ability to perform their work. Examples of these PIPs can include wrong, missing, or outdated patient information. Although these PIPs have always existed in paper-based patient records (Ash, Berg, Coiera, 2004), there is an increasing need to focus on PIPs in electronic patient records because of the tremendous growth in hospitals implementing health information technologies (HITs) due to recent U.S. government incentives (US HHS Benefits of HIT, US HHS HITECH Act). HIT is a general term used to refer to any information systems used in hospitals to help manage patient information, such as electronic health record (EHR) systems and computerized provider order entry (CPOE) systems.

HIT has changed the work practices of patient-care teams, including how they document and retrieve patient information (Ash, Berg, Coiera, 2004). The use of HIT also impacts how PIPs are caused, identified, and managed. Researchers have extensively studied the causes of patient information problems (Abramson et al., 2012; Ash, Berg, Coiera, 2004; Embi et al., 2004; Siegler & Adelman, 2009). However, there is still a limited understanding about how these PIPs are identified and managed in hospital work. Therefore, there is a need to better understand the impact that HIT has on the identification and management of PIPs by collaborative patient-care teams given the pervasive implementation of HIT within U.S. hospitals.

Consider the following scenario, which is based on data from my study. The scenario illustrates the challenges that arise when patient-care team members encounter a PIP while performing their daily work:
An attending physician and her three residents are performing morning rounds in the hospital. They visit one of their patients in the Intensive Care Unit (ICU) and stand outside the room discussing the patient's condition. They review the patient's record in the electronic health record (EHR) system with the patient's nurse. The physician team and nurse enter the room to assess the patient. When the team exits the room, they discuss the patient's worsening condition and which tests they should run next. The physician team then continues to their next patient in the Surgical Intensive Care Unit (SICU) four floors down.

A pharmacist, who rounds with the physician team once a month as part of the hospital's interdisciplinary rounding initiative, arrives at the room to meet up with the physician team. The nurse tells her that the team just left. The pharmacist says, “I need to get a hold of them because I think there’s a concern with this patient’s medications.” The nurse says that the team doesn’t have a team phone, but she can page them. The nurse pulls up the paging system on her computer and sends the team a message. The pharmacist tells the nurse, "I was reviewing the patient's med list and saw that he’s been on Penicilliamine [medication used to treat patients with active rheumatoid arthritis]. Is this correct? Or should he be on Penicillin V [an oral antibiotic for bacterial infections] for his infection?" The nurse pulls up the patient’s medication list in the EHR and agrees with the pharmacist that the patient may be on the wrong medication. After a few minutes the team hasn’t called the nurse back yet, so the pharmacist says she will try to track down the team on their rounds. The nurse says she will hold off on any meds until she hears from the physician team.

The pharmacist is able to find the team in the SICU and explains her concerns about the ICU patient’s medication. The team pulls up the patient’s record and a resident comments, “This must have been carried over from the ED [emergency department], since he was admitted from there. Because I don’t think we ordered it, did we?” The attending replies, “No we didn’t. It must have carried over. We need to make sure we’re checking the patient’s meds when they arrive, but someone should have caught this in the ED. There’s no need for the patient to be on an anti-rheumatoid med.” The attending tells the resident to take it off, put in an order for the Penicillin V, and page the nurse to stop any administration of Penicilliamine. The resident opens the team laptop to change the medication order and says, “We just can’t trust the ED, their documentation is always bad.”

This scenario exemplifies the challenges that patient-care team members face when trying to collaboratively manage PIPs that they encounter in an HIT system. More specifically, three of these challenges include:

(a) Cascading effects of PIPs: Patient-care teams are highly collaborative and rely on each other to provide accurate and up-to-date information about the shared patient. HIT systems provide a centralized view of a patient’s history and current status, which creates a shared awareness of that patient across the team. However, this shared awareness can be impacted when PIPs persist in the patient’s record. In the above scenario, the physician team did not discover the
wrong medication was carried over from the ED until the pharmacist pointed out the issue. This resulted in the PIP persisting in the record for an extended period of time before it was identified, which is common for hospital staff who are responsible for a number of patients and a variety of urgent tasks (Ash, Berg, Coiera, 2004; Park, Lee, Chen, 2012). However, the persistent PIPs can have cascading effects on patients, other team members, and the patient-care workflow. The major cascading effect in this scenario was that the patient was receiving a medication that he did not need, and he was not receiving an antibiotic that he did need to treat his infection. The nurse’s work was also affected since she is responsible for administering medication to the patient. The nurse had to put her own patient-care tasks on hold until the physician team managed the PIP. The scenario also resulted in the resident viewing documentation from the ED as untrustworthy, which can have a negative cascading effect on the patient-care workflow by creating tension and communication issues between the two units.

(b) Accountability for managing PIPs in collaborative teams: Patient-care team members co-own and co-manage their patients’ records. This means that there is a shared responsibility for entering, updating, and maintaining the accuracy of the patient information. However, this shared responsibility can lead to members of a patient-care team having an unclear understanding and, at times, a conflicting opinion about who is responsible for managing the accuracy of the information. This can lead to the persistence of PIPs because the team members either assume or believe that someone else is responsible for managing information or fixing PIPs. In this scenario, the physicians, nurse, and pharmacist were all collaboratively managing the accuracy of the patient’s medication list. However, the attending raised an important point about who is responsible for reviewing the accuracy of the patient’s information during patient transfers from the ED to in-patient. Was the ED responsible for reviewing the accuracy of the patient’s medication list prior to the patient transfer? Or is it the
in-patient team’s responsibility to review all of the previously entered patient information in the EHR record? Determining accountability within these highly collaborative teams can be complicated and not always clear.

(c) HIT usability issues: The design of HIT systems can include restrictions that prevent certain roles from adding or editing parts of the patient’s record, such as medication orders. Although these restrictions are important to control who adds and edits the content of the patient record, it can also create challenges for team members who have limited user rights. In this scenario, the pharmacist and nurse encountered a PIP – wrong medication information. However, when they were trying to manage the problem, the design of the HIT restricted the pharmacist and nurse from changing the patient’s medication list. This then led to a workflow disruption where the nurse and pharmacist had to track down the physician team to verify the accuracy of the medication order and ask them to fix the issue. Additionally, the wrong medication was carried over from a previous unit, the emergency department. The physician team had to remember on their own if they were the team who prescribed the medication or if it was the ED’s prescription. This is because the HIT system did not indicate which medications on the active list were ordered by which unit or team member. This information about the original medication order can only be found by going into the pharmacy system, which is in a separate part of the overall EHR system.

Therefore, these challenges of cascading effects, accountability for managing PIPs, and HIT usability issues illustrate the importance of understanding how patient-care teams identify and manage PIPs so that these challenges can be better understood and properly addressed.
1.2 Research Motivation

Due to recent U.S. government legislation, there has been an acceleration in the transition from paper-based records to health information technologies (HIT), such as electronic health record (EHR) and computerized provider order entry (CPOE) systems (US HHS Benefits of HIT, US HHS HITECH Act). Although these HIT can provide a number of benefits (Ash, Berg, Coiera, 2004; Embi et al., 2004; Koppel et al., 2005; Turchin, Shubina, Goldberg, 2011), the use of HIT does not necessarily eliminate what I define as patient information problems (e.g., wrong, missing, incomplete, outdated information) (Abramson et al., 2012; Ash, Berg, Coiera, 2004; Dillion & Lending, 2010; Embi et al., 2004; Koppel et al., 2005; Park, Lee, Chen, 2012; Siegler & Adelman, 2009; Sittig & Singh, 2011; Turchin, Shubina, Goldberg, 2011; Zhou, Ackerman, Zheng, 2009). In some cases, HIT can actually introduce new causes of PIPs (Ash, Berg, Coiera, 2004; Embi et al., 2004), such as the unintentional selection of default values (Abramson et al., 2012) and the truncation of data entry fields resulting in the loss of patient data (Sittig & Singh, 2011). These PIPs in the HIT system can lead to issues among the patient-care team, including ambiguity about what treatments or procedures were done to a patient, medical decisions being made based on wrong or outdated information, and even the occurrence of medical errors that could harm patients (Ash, Berg, Coiera, 2004; Park, Lee, Chen, 2012). Therefore, it is important to understand how patient-care teams’ identify and manage PIPs during their collaborative work, and the impact that HIT design has on the identification and management of these PIPs.

Given the serious impact that PIPs can have on the patient-care process, researchers in the Medical Informatics (MI) and Human-Computer Interaction (HCI) communities are currently studying these patient information problems. A majority of this research describes the causes of PIPs in hospitals. Due to the overly structured and rule-based design of HIT, the design of the systems themselves can lead to PIPs. These design issues include the fragmented view of information (Ash, Berg, Coiera, 2004; Koppel et al., 2005; Sittig & Singh, 2011), the rigidness of
data entry mechanisms (e.g., standardized drop-downs, text restrictions) (Abramson et al., 2012; Koppel et al., 2005; Sittig & Singh, 2011), and the inability to enter important descriptive information about the patient (Dillion & Lending, 2010; Zhou, Ackerman, Zheng, 2009). The users themselves have also been the cause of PIPs. This includes data entry issues due to transcription errors or the use of copy-and-paste functionalities (Embi et al., 2004; Siegler & Adelman, 2009), delayed information entry that leads to HIT systems being outdated or incomplete for extended periods of time (Ash, Berg, Coiera, 2004; Park, Lee, Chen, 2012), and information discrepancies where information provided in the system’s structured fields (e.g., medication name, dosage) contradicts information found in the free-text field (Turchin, Shubina, Goldberg, 2011). Current MI and HCI research provides valuable insight into the causes of these problems (e.g., system design, user entry errors). This research can help inform hospital teams and HIT designers on how to proactively prevent some PIPs from occurring. But, these PIPs will still occur due to the constantly changing nature of patient information and due to human error. Therefore, it is also important to explore how these PIPs are being identified and managed by the patient-care teams when they do occur. My research motivation is to extend the current MI & HCI research in order to explore how patient-care teams identify and manage these PIPs.

Additionally, there is also limited research on how the collaborative nature of patient-care work affects the resolution of patient information problems. In the Computer-Supported Cooperative Work (CSCW) community, researchers have acknowledged the importance of understanding the collaborative nature of hospital work, including the effects of collaboration on patient coordination processes (Abraham & Reddy, 2008), information-seeking activities (Payne, Fletcher, & Labuguen, 2010; Reddy & Dourish, 2002; Reddy & Jansen, 2008), and the use of informal, transitional documentation (Cabitza et al., 2005; Campbell et al., 2006; Chen, 2010; Fitzpatrick, 2004; Hardey, Payne, Coleman, 2000; Hardstone et al., 2004). However, there is limited research on how collaboration impacts PIPs encountered by patient-care teams. For
instance, when electronic patient records are co-managed and simultaneously viewed by multiple patient-care team members at once, whose responsibility is it to communicate known PIPs to the team? Whose responsibility is it to fix the patient information problems? Also, how does a PIP caused by one individual affect the other team members who rely on that information to do their work? My research seeks to address this CSCW research limitation by describing how the collaborative nature of patient-care work impacts the identification and management of PIPs.

1.3 Research Objectives and Questions

To address these limitations in existing research, the objectives of this dissertation study are to: (a) provide a conceptual understanding of the ways that patient-care teams identify and manage PIPs, including the development of a PIP taxonomy and conceptual framework, and (b) develop socio-technical recommendations for how to improve the design of hospital policies and HIT systems in order to better support the identification and management of PIPs by collaborative patient-care teams.

Prior to beginning my main study, I identified two research questions that would help me address these research objectives. The research questions are based on limitations in previous research and based on the initial findings in my preliminary study (Table 1-1).
There is a limited understanding of how collaborative patient-care teams identify PIPs during their work.

**RQ1:** How do collaborative patient-care teams identify patient information problems?

- **RQ1a:** How does the EHR system help or hinder the identification of PIPs?
- **RQ1b:** How do work practices help or hinder the identification of PIPs?

There is a limited understanding of how collaborative patient-care teams manage PIPs during their work.

**RQ2:** How do collaborative patient-care teams manage patient information problems?

- **RQ2a:** How does the EHR system help or hinder the management of PIPs?
- **RQ2b:** How do work practices help or hinder the management of PIPs?

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<thead>
<tr>
<th>Research Gaps</th>
<th>Research Questions</th>
<th>Research Objectives</th>
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<tr>
<td>There is a limited understanding of how collaborative patient-care teams identify PIPs during their work.</td>
<td>RQ1: How do collaborative patient-care teams identify patient information problems?</td>
<td>Provide a better conceptual understanding of the ways that patient-care teams identify and manage PIPs, including the development of a PIP taxonomy and conceptual framework.</td>
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<td>Develop socio-technical recommendations for how to improve the design of hospital policies and HIT systems in order to better support the identification and management of PIPs by collaborative patient-care teams.</td>
</tr>
<tr>
<td>There is a limited understanding of how collaborative patient-care teams manage PIPs during their work.</td>
<td>RQ2: How do collaborative patient-care teams manage patient information problems?</td>
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Table 1-1: Research Gaps, Questions, and Objectives

As previously defined, PIPs are any issues related to patient information that impact the patient-care team’s ability to perform their work. The *identification* of PIPs occurs when patient-care team members realize or question the availability or integrity of the patient information that they are using in their work. The *management* of PIPs includes how patient-care team members respond to the patient information problems (e.g., fix the problem, work around the problem).

The sub-questions listed below each main research question reflect the socio-technical nature of this study, which includes a focus on both the technical systems (e.g., EHR system) and social systems (e.g., work practices, organizational policies, social norms) in the hospital. The technical system that I focused on in the main study was the electronic health record (EHR) system, which was identified as the primary HIT used by patient-care teams during my preliminary study. This system is further described in Chapter 4 Research Setting. I also wanted to observe the social systems of the hospital to describe how they helped or hindered the
identification and management of PIPs. Therefore, I also observed the participants’ “work practices,” which refers to the day-to-day patient-care activities performed by the participants, including any organizational policies or social norms that influenced the participants’ behaviors during their work. Additionally, these research questions include a focus on the collaborative nature of patient-care work, since my preliminary study highlighted how collaboration can create challenges in how the patient-care team members identified and managed PIPs (see Chapter 5 Preliminary Study). The next section describes my approach to answering these research questions.

1.4 Research Approach

To address the research gaps and answer my research questions, I used qualitative methods to identify the types of PIPs that the patient-care teams encountered during their work, and to describe how the team members identified and managed PIPs. Since I used a socio-technical perspective when conducting this study (Chapter 3), I focused on both the technical systems and the social systems of the hospital. This included observing how the design of the EHR system and the participants’ work practices helped or hindered their ability to identify and manage the PIPs.

I chose to focus my research on patient-care teams because of the highly collaborative nature of hospital work. In hospitals, information and tasks related to patient care are distributed across various members of the overall patient-care team. Collaboration and communication between these team members is essential in achieving a shared awareness and understanding of a patient’s condition (Payne, Fletcher, Labuguen, 2010). Therefore, I observed the various members of patient-care teams in order to collect data on how the collaborative nature of their work can affect the identification and management of PIPs. These patient-care teams were composed of different types of healthcare professionals (e.g., physicians, nurses, social workers,
care coordinators) who had to collaborate with each other to accomplish their patient-care tasks. All team members had their own information needs based on their role in the patient-care process, but they all relied on each other to provide accurate, complete, and up-to-date information about their shared patients. Although I studied the behaviors and perceptions of individual patient-care team members through observations and shadowing, my research also looked at the patient-care team as a whole in order to understand how team member’s behaviors and perceptions impacted other team members.

In order to understand how patient-care team members identified and managed PIPs, my main study included spending three months in the in-patient ward observing how the teams used various communication and documentation tools for gathering, sharing, and documenting information. These communication and documentation tools included any spoken discussions among the team, formal documentation in paper or electronic form (e.g., EHR system, paper records/forms), and informal transitional documentation (e.g., white boards, temporary notes). It was critical to understand the use of formal documentation in the EHR system since this is considered the official record that the teams use to communicate information about the patients’ history, medications, symptoms, test results, and diagnoses. I also studied informal methods of communication and documentation to provide me with important insight into how team members discuss and document information before it is entered into the formal, official EHR record (Chen, 2010).

By conducting this comprehensive field study, I was able to examine the types of PIPs that patient-care teams encountered in their daily work, and how the teams identified and managed the PIPs. This research approach also helped provide a socio-technical understanding of how both technical systems and collaborative work practices can impact the identification and management of PIPs.
1.5 Intellectual Contributions

This research makes two intellectual contributions. The first is a conceptual understanding of PIPs and how they are identified and managed within patient-care teams. The second is socio-technical recommendations for improving hospital policies and HIT system design to better support the identification and management of PIPs by collaborative patient-care teams. Table 1-2 summarizes the existing research on PIPs in the MI, HCI, and CSCW communities, and how my research objectives will contribute to these research communities.

<table>
<thead>
<tr>
<th>Research Community</th>
<th>Existing Research on PIPs in Hospitals</th>
<th>My Contributions to Existing Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI, HCI, CSCW</td>
<td>Provides descriptions of PIPs.</td>
<td>Develop a taxonomy of PIPs encountered during hospital work.</td>
</tr>
<tr>
<td>MI, HCI</td>
<td>Describes the causes of PIPs in hospitals.</td>
<td>Develop a conceptual framework for how collaborative patient-care teams identify and manage PIPs.</td>
</tr>
<tr>
<td>CSCW</td>
<td>Describes the collaborative challenges that patient-care teams face when managing information in hospitals.</td>
<td>Describes how these collaborative challenges can affect the identification and management of PIPs by patient-care teams.</td>
</tr>
<tr>
<td>MI, HCI, CSCW</td>
<td>Discusses the impact that HIT system design has on the causes of PIPs.</td>
<td>Provides socio-technical recommendations for hospital policies and HIT design in order to better support the collaborative management of PIPs by patient-care teams.</td>
</tr>
</tbody>
</table>

*Red boxes are improvements in conceptual understanding and the blue box is socio-technical recommendations*

Table 1-2: Contributions to Existing Research

The first contribution of this research is to develop a better conceptual understanding of the types of PIPs that occur and how they are identified and managed in hospitals. Although many MI, HCI, and CSCW studies describe the existence of PIPs in hospitals, there is currently no taxonomy or classification for the types of PIPs that occur. Therefore, my research will create a taxonomy that classifies PIPs into types and provides definitions and descriptive examples of how these PIPs occur within the context of patient-care work.
MI and HCI research also explores the causes of PIPs and the impacts that PIPs can have on the patient-care workflow when they are not properly managed (Abramson et al., 2012; Ash, Berg, Coiera, 2004; Dillion & Lending, 2010; Embi et al., 2004; Koppel et al., 2005; Park, Lee, Chen, 2012; Siegler & Adelman, 2009; Sittig & Singh, 2011; Turchin, Shubina, Goldberg, 2011; Zhou, Ackerman, Zheng, 2009). However, there is little understanding about what happens after team members identify what causes the PIPs, including how they identified them and how they managed them. Better understanding how PIPs are identified and properly managed can help to lessen the negative impacts that PIPs can have on the patients, team members, and patient-care workflow.

The final part of improving the conceptual understanding of PIPs includes observing how the nature of collaborative work can impact the team’s ability to identify and manage PIPs. This focus on collaboration will help extend research within the MI and HCI communities. Both of these communities study PIPs and how to improve the design of systems to minimize the cause of these PIPs. However, there a lack of research on how collaborative patient-care teams make each other aware of these PIPs, work together to manage the PIPs, and determine accountability for fixing the PIPs in an environment where multiple people co-manage the patient information. My research extends this current conceptual understanding of PIPs in MI and HCI research by focusing on the role of collaboration in the identification and management of patient information problems. Additionally, researchers in the CSCW community focus specifically on how collaboration impacts the communication, workflow, and information management activities of patient-care teams (Abraham & Reddy, 2008; Paul & Reddy, 2010). However, there is a lack of studies that seek to understand how the nature of collaborative hospital work impacts PIP identification and management. Therefore, my research also extends the CSCW community’s conceptual understanding of collaborative information management to include the identification and management of PIPs.
The second contribution of this research is providing socio-technical recommendations for improving hospital policy and HIT system design to better support the identification and management of PIPs by collaborative patient-care teams. MI, HCI, and CSCW researchers have identified a number of issues with HIT design including data fragmentation (Ash, Berg, Coiera, 2004; Koppel et al., 2005; Sittig & Singh, 2011) overly standardized data entry mechanisms (Abramson et al., 2012; Koppel et al., 2005; Sittig & Singh, 2011), and the inability to enter certain descriptive information about patients (Dillion & Lending, 2010; Zhou, Ackerman, Zheng, 2009). This prior research provides design implications for fixing data entry issues and minimizing the proliferation of PIPs within HIT systems. My research extends these findings to include HIT system design and policy recommendations that aim to better support the identification and management of PIPs. More specifically, this includes recommendations that will enhance users’ ability to make each other aware of PIPs and help the teams collaboratively manage PIPs. These socio-technical design recommendations are especially important at this time because of the accelerated implementation of EHRs and other HIT systems in U.S. hospitals (US HHS Benefits of HIT, US HHS HITECH Act).

1.6 Dissertation Overview

This dissertation has the following structure:

**Chapter 2 Background** summarizes MI and HCI research that explores the causes and impacts of PIPs in hospitals, as well as CSCW research that explores the challenges of collaborative hospital work that impact the communication and management of patient information.

**Chapter 3 Research Methodology** provides a summary of the participants and an overview of the qualitative research methods that I used for the data collection and analysis of both my preliminary study in the emergency department and my main study in the in-patient ward of the same hospital.
Chapter 4 Research Setting provides descriptive details of the hospital field site including an overview of hospital units and policies, sources of patient information, and the specific information management activities and workflows for both the emergency department and the inpatient units.

Chapter 5 Preliminary Study presents the findings of the preliminary field study that explored the use and perceptions of HIT in an emergency department. This chapter also includes how this preliminary study informed my main study.

Chapter 6 Main Findings provides a description of the main study’s findings including the types of PIPs that occur in hospitals, how those PIPs are identified and managed by the patient-care team members, and the challenges of collaborative work that impact PIP identification and management.

Chapter 7 Discussion presents a PIP taxonomy and framework that provide a better conceptual understanding of how patient-care team members identify and manage PIPs. I also discuss the specific challenges that patient-care teams face when trying to managing PIPs, and I offer socio-technical design recommendations to improve hospital policy, training, and HIT design in order to better support the identification and management of PIPs by patient-care teams.

Chapter 8 Conclusion includes a final summary of the contributions of this dissertation study and offers directions for future research in the area of patient information problems.
2 Background

This chapter summarizes the current research about patient information problems in hospitals from the Medical Informatics (MI) and Human-Computer Interaction (HCI) communities. Additionally, since this dissertation focuses on collaborative patient-care teams, I discuss research from the Computer-Supported Cooperative Work (CSCW) community, which provides insight into the challenges that patient-care teams encounter during their highly collaborative work.

2.1 Patient Information Problems in Hospitals

Studies show that HIT can provide benefits to users, such as: increasing visibility of patient records, improving legibility of providers’ orders and notes, tracking work processes, improving communication within healthcare teams, centralizing patient history information, and reminding providers of outstanding tasks and quality improvement suggestions (Ash, Berg, Coiera, 2004; Embi et al., 2004; Hippisley-Cox, Pringle, Cater, 2003; Koppel et al., 2005; Tang, LaRosa, Gorden, 1999; Turchin, Shubina, Goldberg, 2011). Although these studies have highlighted the benefits of HIT systems, other studies have discussed how the use of HIT can also introduce new patient information problems (Ash, Berg, Coiera, 2004; Embi et al., 2004; Koppel et al., 2005). This section will first discuss the types of PIPs that MI and HCI researchers describe in their research. Then I will discuss the predominant focus of patient information problems’ research for MI and HCI – the causes of PIPs.

2.1.1 Types of PIPs

In Chapter 1, I define PIPs as any issue with patient information that may interfere with the ability of the patient-care teams to do their work. The following Table 2-1 classifies and describes specific examples of PIPs that were described in MI and HCI research. This high-level classification with specific examples of PIPs provided me with a general understanding of what
these PIPs actually looked like prior to starting my main in-patient research. The types of PIPs that have been described in MI and HCI research include: wrong, outdated, conflicting, incomplete, missing, fragmented, and overly standardized information.

<table>
<thead>
<tr>
<th>PIP Type</th>
<th>Example</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong</td>
<td>System automatically selected default dosage resulting in an incorrect dosage for the patient.</td>
<td>Abramson et al., 2012; Koppel et al., 2005</td>
</tr>
<tr>
<td></td>
<td>System incorrectly merged data into wrong reports.</td>
<td>Sittig &amp; Singh, 2011</td>
</tr>
<tr>
<td></td>
<td>User ordered a wrong test for the patient.</td>
<td>Kinonen et al., 2012</td>
</tr>
<tr>
<td></td>
<td>User used the copy/paste function and carried over incorrect information from one record to another.</td>
<td>Ash, Berg, Coiera, 2004 Embi et al., 2004 Siegler &amp; Adelman, 2009</td>
</tr>
<tr>
<td></td>
<td>User entered patient information into the wrong patient record due to patient’s having the same name.</td>
<td>Sittig &amp; Singh, 2011</td>
</tr>
<tr>
<td>Outdated</td>
<td>User did not enter patient data until much later resulting in the patient’s record being outdated for a period of time.</td>
<td>Ash, Berg, Coiera, 2004 Chen, 2010</td>
</tr>
<tr>
<td></td>
<td>User used paper form instead of system leaving system with outdated information</td>
<td>Chen, 2010</td>
</tr>
<tr>
<td>Conflicting</td>
<td>System showed that demographic information in the system is different than a paper record.</td>
<td>Kinonen et al., 2012</td>
</tr>
<tr>
<td></td>
<td>User entered different medication information into a structured field and the free-text field.</td>
<td>Goldbert et al., 2010</td>
</tr>
<tr>
<td>Incomplete</td>
<td>User received a requisition with incomplete demographics</td>
<td>Kinonen et al., 2012</td>
</tr>
<tr>
<td></td>
<td>System’s fragmented patient data caused the record to look incomplete</td>
<td>Koppel et al., 2005 Sittig &amp; Singh, 2011</td>
</tr>
<tr>
<td></td>
<td>System truncated data entry fields resulting in lost patient data</td>
<td>Sittig &amp; Singh, 2011</td>
</tr>
<tr>
<td>Missing</td>
<td>System limited user from seeing another user’s notes, which affected the user from being fully informed about the patient</td>
<td>Ash, Berg, Coiera, 2004</td>
</tr>
<tr>
<td></td>
<td>System prevented user from entering data into the system</td>
<td>Dillon &amp; Lending, 2010 Zhou et al., 2009</td>
</tr>
<tr>
<td></td>
<td>Patient’s blood type was missing when nurse needed to perform a transfusion</td>
<td>Kobayashi et al., 2005</td>
</tr>
<tr>
<td>Segregated</td>
<td>The design of system screens separates the patient data onto multiple screens leaving the physician uncertain about the patient’s medication order</td>
<td>Koppel et al., 2005</td>
</tr>
<tr>
<td></td>
<td>Patient data is located on my different screens preventing users from seeing the complete patient record.</td>
<td>Sittig &amp; Singh, 2011</td>
</tr>
<tr>
<td>Overly Standardized</td>
<td>System with standard, boiler-plate text made it hard for user to find useful information</td>
<td>Ash, Berg, Coiera, 2004</td>
</tr>
</tbody>
</table>

Table 2-1: Types of PIPs in MI and HCI
2.1.2 Causes of PIPs

The causes of PIPs are extensively studied in MI due to the potential impact that they can have on medical errors in patient care. Additionally, the HCI community also has a strong interest in this research since HIT design is identified as one of the main causes of PIPs that can negatively impact the user. The causes of HIT-related PIPs can be divided into two areas: (a) PIPs caused by the design of HIT systems and (b) PIPs caused by the users of HIT systems.

2.1.2.1 PIPs Caused by HIT Design

It is a challenge to build information systems for the fast-paced and information-intensive environment of hospitals. Researchers describe how HIT systems tend to be overly structured and designed with rigid rules that encourage data standardization (e.g., drop-down menus, text entry restrictions), which can lead to information issues caused by the design of HIT (Ash, Berg, Coiera, 2004).

Current studies discuss how HIT design can cause PIPs with medication ordering. Koppel et al. (2005) observed a CPOE system that was used to order patient medication and identified 22 types of information issues associated with the design of the system. Some of these issues included fragmented displays that prevented a coherent view of patients’ medications, inflexible ordering formats that led to wrong orders, and separation of system functionality that resulted in double dosing or incompatible orders. Abramson et al. (2012) also described how a medication ordering system automatically selected the default dosing in the order forms. This led to some residents frequently accepting the default dosage without checking the accuracy or applicability of the dosage for the patient.

Additionally, researchers also identified PIPs associated with entering and accessing descriptive information about patients. Dillon & Lending (2010) found that a HIT system prevented users from entering descriptive data into a record and, instead, forced them to select
values from drop-down menus that were not considered intuitive to the user. Zhou et al. (2009) also discussed HIT systems that restrict the entry of descriptive information. In their study, the implementation of a HIT eliminated psycho-social information about patients, which nurses argued, “provided continuity of care...[and] a richer picture of the patient’s situation.” Examples of this psycho-social information include: “pt requesting to be woken up for pain meds,” “pt is a MD urologist,” “pt only speaks Russian,” “see social worker and my note to get the whole story” (p.2065). Furthermore, Ash et al. (2004) also found that HIT systems can limit access to other users’ notes and parts of patient records. This system limitation was described as, “severely hampering the professional’s ability to be optimally informed” (p.107).

Other researchers discuss how HIT design can lead to information fragmentation and cognitive overload for users. In one study, users described how entering and reviewing data across many different fields located on many different screens resulted in users losing a cohesive overview of the patient’s record and the ability to identify emerging problems with the patient. Physicians in this study also discussed an issue where the systems’ templates created overly standardized information: “There are so many standard phrases in the [electronic] reports, I don’t think that’s good...you have to really search for the usable information” (Ash, Berg, Coiera, 2004, p.107).

Furthermore, HIT researchers also describe system bugs that cause PIPs. This included HIT systems that truncate data entry fields resulting in lost patient data (Sittig & Singh, 2011). Other system bugs included problems with screen design that prevent users from seeing the complete patient record (e.g., missing patient name, date of birth, medical record number) and HIT systems where two buttons on a screen had the same label but different functionalities, which caused information problems within the system (Sittig & Singh, 2011). Therefore, these studies describe how HIT design can lead to PIPs for users. However, there are also times when PIPs are caused by the user.
2.1.2.2 PIPs Caused by Users

Users are the cause of certain PIPs within HIT systems. These problems can include information entry errors, delayed information entry, and discrepancies between multiple sources of information.

At times, users may cause a PIP by simply entering the wrong information into the system. Goldberg et al. (2010) conducted a study where the users who previously made an error in entering a patient’s weight were twice as likely to make another error. Additionally, other researchers have identified information entry errors due to users copying and pasting text in order to save time when entering standard text. Embi et al. (2004) studied computerized physician documentation and found that many users were concerned about the reliability of patient records due to users’ tendency to copy and paste. Study participants stated that copying and pasting from prior notes led to outdated or incorrect clinical information in the patient record, as well as the proliferation of misinformation throughout the record. Siegler & Adelman (2009) also discussed the PIPs resulting from copy/paste shortcuts. They found that copying and pasting led to, “reducing the credibility of the recorded findings, clouding clinical thinking, limiting proper coding, and robbing the chart of its narrative flow and function” (p.495). Ash et al. (2004) also encountered this PIP in their study. A participant discussed the issues associated with the use of copy/paste shortcuts:

“People have the tendency to cut and paste...and instead of taking the pertinent facts from a laboratory report or from another clinician’s progress note, they will cut and paste a whole laboratory report, cut and paste somebody else’s thinking process into their own note and sign it” (p.107).

Researchers also identify delayed information entry as a common problem caused by HIT users. Park, Lee, & Chen (2012) describe how some physicians met with multiple patients and put off their data entry until a later time so that they could focus on more urgent tasks. This resulted in patient records being outdated or incomplete for extended periods of time. The delayed
information entry prevented other healthcare providers (e.g., nurses, social workers) from seeing the most recent patient information, which they rely on to do their jobs. It also led to physicians entering information for multiple patients at once after much time had passed, which required the physicians to depend on their memory for context or details about each patient. This time lapse could cause PIPs in the patient record. Ash et al. (2004) also described how delayed information entry is more prone to errors because the documentation occurs away from the actual context where the patient was discussed. Their study described how some healthcare providers perform tasks in urgent situations (e.g., medication administration), so they may not document the task in the HIT system until a later time. However, the authors then explained that, due to the collaborative nature of healthcare, this delay could result in the patient being given the same medication twice by another member of the healthcare team who relies on an up-to-date patient record (Ash et al., 2004).

Furthermore, information discrepancies are another issue that can occur during the use of HIT systems. Turchin, Shubina, & Goldberg (2011) describe how HIT users encountered situations where medication information provided in the system’s structured fields (e.g., medication name, dosage) contradicted information found in the free-text description field. Therefore, the current MI and HCI literature describes a variety of PIPs that are caused by the HIT system design, as well as by the HIT users. The next section discusses the impacts that PIPs can have on the patient-care workflow.

2.1.3 Impacts of PIPs

Medical Informatics researchers have long studied the impacts that PIPs can have on the patient-care workflow. Some of these impacts include delayed procedures (Koppel et al., 2005), confusion about what treatments a patient received (Ash, Berg, Coiera, 2004), medical decisions being made based on wrong or outdated information (Park, Lee, Chen, 2012), and even the
occurrence of medical errors that could harm patients (Ash, Berg, Coiera, 2004; Koppel et al., 2005; Taib et al., 2011). The most critical impact that PIPs can have on patient-care is when they lead to medical errors that negatively affect the patient. In hospitals, a medical error is any mistake in administering or failing to administer patient care that may adversely affect the patient (Taib et al., 2011). There are many hospital-related taxonomies that classify the types of medical errors that occur in the hospital in order to better understand how they happen and how they can be prevented from occurring in the future (Harrison, Koppel, Bar-Lev, 2007; Koppel et al., 2005; Taib et al., 2011; Wright et al., 2007; Zhang et al., 2004). Many of these medical error taxonomies include types of patient information problems (e.g., wrong, missing, outdated information) that led to clinicians making a medical error.

Due to the pervasive implementation of HIT systems into hospitals, MI researchers began investigating how HIT systems played a role in contributing to medical errors. In 1999, a report by the Institute of Medicine even stated that medical errors are caused by “faulty systems, processes, and conditions that lead people to make mistakes or fail to prevent them” (Kohn, Corrigan, Donaldson, 1999). This report motivated MI researchers to take a closer look at how HIT systems could lead to medical errors. This resulted in the development of HIT-related medical error taxonomies that have allowed system designers and practitioners to anticipate the unintended consequences that system design can have on medical errors (Harrison, Koppel, Bar-Lev, 2007; Koppel et al., 2005; Sittig & Singh, 2011; Wright et al., 2007; Zhang et al., 2004). Once again, PIPs that exist in these HIT systems were listed as one of the reasons why medical errors occur according to these taxonomies. Additionally, Section 2.1.2 discusses how HIT systems were now causing new types of PIPs, which could also contribute to the cause of medical errors. Therefore, a critical motivator for studying PIPs in hospitals is to better understand how patient-care teams can identify and properly manage PIPs before they become the cause of
medical errors. The next section will explore CSCW literature and the challenges that patient-care teams encounter when working in such a highly collaborative setting.

2.2 Challenges of Collaborative Work in Hospitals

CSCW researchers have widely studied the complex hospital setting in order to understand the challenges of working in such a highly collaborative and multi-disciplinary environment. There are a few challenges that are prevalent in collaborative hospital work, which are important factors to consider when studying PIPs in hospitals. These challenges include: mobility work, temporal coordination, collaborative information-seeking, use of informal communications, and the use of workarounds.

2.2.1 Mobility Work

Bardram & Bossen (2005) discuss the importance of considering the spatial layout, or “mobility work,” when studying environments where participants are frequently moving throughout a physical space and among other people. Mobility is an inherent and necessary characteristic of hospital work due to the continuous need to access information, resources, people, and places (Bardram & Bossen, 2003; Moran et al., 2007). Additionally, patient-care teams must also manage the distributed nature of their work. This includes being aware of where patients, information, and resources are located in relation to the other members of the patient-care team, since distribution can impact communication and collaboration activities (Bossen, 2002). Although health information technologies can help facilitate communication while hospital staff members move throughout the hospital, the mobile nature of hospital work still presents collaborative challenges for patient-care teams (Patel, Kannampallil, Kaufman, 2015). These challenges can lead to communication breakdowns between team members and negative impacts to the quality of patient care (Chen, 2010; Ebright et al., 2004; Patel, Kannampallil, Kaufman, 2015).
2.2.2 Temporal Coordination

Similarly, where mobility of work considers the physical layout of the hospital, temporal rhythms considers the time coordination of work (Reddy & Dourish, 2002; Reddy, Dourish, Pratt, 2002). Within the busy, collaborative hospital setting, understanding the patterns of time can help staff stay productive and successfully coordinate patient-care activities. Additionally, understanding the temporal rhythms can also lead to more effective planning or scheduling of patients (Bardram, 2000; Munkvold & Ellingsen, 2007). This is especially important when coordinating critical patient-care tasks, such as scheduling operating rooms for surgeries. Chandra et al. (2013) discuss how a lack of sharing information and maintaining awareness of others’ schedules can lead to surgery delays and staff frustration.

Furthermore, hospitals are always open and require continuous patient-care coverage by hospital staff (Zerubavel, 1979). Therefore, being aware of temporal rhythms throughout the day can also help identify the best time to hand off patients between shifts to ensure continuity of care (Gandhi, 2006; Patterson et al., 2004; Riesenberg et al., 2010; Tang & Carpendale, 2007), and to determine sleeping schedules for staff who are working double shifts (Arora, 2006). Additionally, time plays an important role for patients that have to be transferred between units or facilities (Horwitz et al., 2009), especially if the patient is critically ill and requires specific support during the transport (Cohen, 2015).

2.2.3 Collaborative Information-Seeking

Hospitals are not only highly collaborative, but they also face the challenge of being very information-intensive. Patient-care teams are dependent on information in order to do their work and are continuously performing information-seeking activities (Reddy & Dourish, 2002; Reddy & Jansen, 2008). Within the hospital environment, information-seeking is considered a collaborative activity and is defined as, “activities that a group or team of people undertakes to
identify and resolve a shared information need” (Poltrock et al., 2003; Reddy & Spence, 2008). If done effectively, information-seeking plays an integral part in the patient-care team’s ability to meet their information needs, make decisions about patient care, and coordinate activities within the hospital. It also plays an important role in increasing the patient-care team’s awareness of one another’s activities (Reddy & Spence, 2008).

2.2.4 Use of Informal Communication

Since hospitals are very information-rich, there are a variety of information sources that patient-care teams must manage. Not only are patient-care team members responsible for updating formal patient documentation (e.g., EHRs), but they must also manage and be aware of other informal communications among the team. CSCW researchers highlight the importance of white boards for increasing awareness of activities and status updates (Bardram, 1998; Scupelli et al., 2010; Xiao et al., 2001; Xiao et al., 2007), locating people or information (Payne, Fletcher, Labuguen, 2010), and adding annotations to customize the board as needed (Bjørn & Rødje, 2008; Wilson, Galliers, Fone, 2006). Additionally, other researchers discuss the importance of understanding “transitional artifacts,” which are any informal documentation that stores information until it can be entered into the formal EHR system. These artifacts have also been called “working records” (Fitzpatrick, 2004), “provisional information” (Hardstone et al., 2004), or just simply “scraps” (Hardey, Payne, Coleman, 2000). These informal communication artifacts are important for researchers to evaluate because clinicians have stated that they prefer this quick, informal documentation instead of using the formal EHR system (Cabitza et al., 2005; Campbell et al., 2006; Chen, 2010; Fitzpatrick, 2004; Hardey, Payne, Coleman, 2000; Hardstone et al., 2004). Additionally, the use of these workarounds could have an effect on other members of the collaborative patient-care team. This leads into the last challenge that collaborative teams face – the use of workarounds.
2.2.5 Use of Workarounds

Many CSCW studies have explored how the collaborative patient-care team members adapt to the integration of new HIT into their demanding work environment. These studies have identified a few unintended, negative impacts that the HIT implementation had on the patient-care teams, including: interruptions to their workflow (Zhou, Ackerman, & Zheng, 2011), system-related medical errors (Ash & Bates, 2005; Ash, Berg, Coiera, 2004; Koppel et al., 2005), and increased documentation time (Poissant et al., 2005). In response to these negative impacts, many patient-care team members create workarounds to, “adapt to new work processes or to bypass the deficiencies of new technology” (Park & Chen, 2012). These workarounds typically include making notes on paper instead of in the system (Bossen, 2006; Fitzpatrick, 2004; Tang & Carpendale, 2007), which ties back into Chen’s (2010) discussion on transitional artifacts.

These workarounds create a challenge for collaborative patient-care teams because they can cause a breakdown in the shared understanding of the formal documentation. If team members are using their own workarounds to track information, then that information may not be getting to the other team members (Zhou, Ackerman, Zheng, 2011). This results in other team members working off of outdated or missing information for their own patient-care tasks.

Therefore, it is important to consider these challenges of working in a collaborative hospital setting. In my study where I explore PIPs, these challenges can negatively affect how the patient-care team identifies or manages the PIPs.

2.3 Chapter Summary

In conclusion, this chapter presented existing literature in the MI, HCI, and CSCW domains. MI and HCI researchers discussed the types of PIPs that occur in hospitals, as well as the causes of the PIPs. However, these studies did not explore how the patient-care team then identifies and manages the PIPs. Additionally, CSCW researchers described the various
challenges that patient-care teams must face within their highly collaborative hospital environment. I considered these challenges during my studies since they can affect the identification and management of PIPs by patient-care teams. The next chapter will outline the methodology for my preliminary ED study and my main in-patient study.
3 Research Methodology

In this chapter, I describe the research methodology for the preliminary and main studies. This includes explaining the rationale for choosing qualitative methods, providing an overview of the socio-technical theoretical perspective that guided my research, describing the data collection and analysis process for the studies, and discussing the validity and reliability of the studies.

3.1 Qualitative Research Approach

In this study, I used a qualitative approach for data collection and analysis including ethnographic methods, such as general observations, shadowing, interviews, and artifact analysis. Researchers in Medical Informatics (Abramson et al., 2012; Ash & Bates, 2005; Ash, Berg, Coiera, 2004; Embi et al., 2004; Fitzpatrick, 2004; Goldberg et al., 2010; Koppel et al., 2005), Human-Computer Interaction (Chen, 2010; Kobayashi et al., 2005; Park & Chen, 2012; Saleem et al., 2011; Scupelli, et al., 2010; Tang & Carpendale, 2007), and Computer-Supported Cooperative Work (Abraham & Reddy, 2008; Bardram & Bossen, 2005; Berg, 1999; Bjørn & Rødje, 2008; Bossen, 2006; Coiera, 2007; Munkvold & Ellingsen, 2007; Randell, 2004; Reddy & Dourish, 2002) have used qualitative methods for studying hospital teams because they allow the researcher to observe work practices within their natural environment (Lincoln & Guba, 1985).

This methodological approach is appropriate for my research for the following reasons:

(a) Concept development: The main contribution of my research is to improve and extend the conceptual understanding of how patient-care teams identify and manage PIPs. In order to do this, I observed the nuanced behaviors and collaborative interactions of the patient-care team and evaluated any additional factors that could impact PIP identification or management (e.g., EHR design, work practices). Qualitative methods allowed for a long-term immersion into a field site and the continuous evaluation of participants’ behaviors and interactions, which are situated within the context of the participants’ organizational setting and everyday work
practices (Maxwell, 2005). The data was continuously collected and analyzed in an iterative manner to progressively refine the conceptual understanding of the research objectives, which provides a rich understanding of the studied phenomenon (Maxwell, 2005).

(b) **Naturalistic setting:** Hospitals are highly dynamic and context-specific environments. A typical day for patient-care team members includes a continuous process of gathering, documenting, discussing, and searching for information, while also performing patient-care tasks. Additionally, team members are frequently interrupted during their work and have to quickly shift between tasks when other priorities unexpectedly arise. When studying how these teams identify and manage PIPs, the observations had to be embedded within the context of this busy, complex environment. Since this unique hospital environment cannot be adequately replicated in a controlled lab setting, this study was conducted within the hospital setting itself. Therefore, a qualitative approach is appropriate because it included a long-term immersion into the field site, which allowed me as the researcher to observe the naturalistic processes and behaviors of the participants (Lincoln & Guba, 1985).

(c) **Human-as-instrument:** In order to address my research objectives in the hospital setting, I had to be able to quickly respond to any environmental or interpersonal cues that I encountered (e.g., patient emergencies, private discussions between participants, new patient arrivals) and understand how those factors affected the study participants. I also had to be able to adapt my research collection approaches to address any restrictions or challenges of the hospital setting, including access issues (e.g., participants declining participation) or physical restrictions (e.g., not being allowed to enter certain areas of the hospital or patient rooms). Additionally, in order to ensure that I properly addressed my research objectives, I had to immediately process the data that I collected in the moment so that I could clarify any assumptions or questions that arose, and so that I could explore any atypical findings that I encountered. Lincoln & Guba (1985) describe how qualitative methods position the human researcher as
the instrument of data collection, and that this is beneficial to the “naturalistic inquiry” of the research. Table 3-1 describes the characteristics and benefits of the human-as-instrument qualitative approach (Lincoln & Guba, 1985, p. 193), which further supports that qualitative methods are appropriate for this research study.

<table>
<thead>
<tr>
<th>Human-as-Instrument Characteristic</th>
<th>Benefit</th>
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<tbody>
<tr>
<td>(1) Responsiveness</td>
<td>“The human-as-instrument can sense and respond to all personal and environmental cues that exist. By virtue of that responsiveness he or she can interact with the situation to sense its dimensions and make them explicit.”</td>
</tr>
<tr>
<td>(2) Adaptability</td>
<td>“The human instrument can collect information about multiple factors – and at multiple levels – simultaneously.”</td>
</tr>
<tr>
<td>(3) Holistic emphasis</td>
<td>“The world of any phenomenon and its surrounding context are ‘all of a piece,’ and the human instrument is the only one available capable of grasping all this buzzing confusion in one view.”</td>
</tr>
<tr>
<td>(4) Knowledge base expansion</td>
<td>“The human instrument is competent to function simultaneously in the domains of propositional and tacit knowledge. Extending awareness of a situation beyond mere propositional knowledge to the realm of the felt, to the silent sympathies, to the unconscious wishes, and to the daily unexamined usages will lend depth and richness to our understanding of social and organizational settings.”</td>
</tr>
<tr>
<td>(5) Processual immediacy</td>
<td>“Processual immediacy [is] the ability of the human instrument (and only the human instrument) to process data just as soon as they become available, to generate hypotheses on the spot, to test those hypotheses with respondents in the very situation in which they are created.”</td>
</tr>
<tr>
<td>(6) Opportunities for clarification and summarization</td>
<td>“The human instrument has the unique capability of summarizing data on the spot and feeding them back to a respondent for clarification, correction, or amplification.”</td>
</tr>
<tr>
<td>(7) Opportunity to explore atypical or idiosyncratic responses</td>
<td>“The human instrument can explore such [atypical and idiosyncratic] responses not only to test their validity but to achieve a higher level of understanding than might otherwise be possible”</td>
</tr>
</tbody>
</table>

Table 3-1: Lincoln & Guba’s Human-as-Instrument Characteristics and Benefits

3.2 Socio-Technical Systems Perspective

In this study, I used a socio-technical theoretical perspective when collecting and analyzing my data. This socio-technical perspective is “a view that the technical features of the
system and the social features of the work are fundamentally interrelated” (Reddy, Shabot, Bradner, 2008, p.480). The technical system in the hospital is the EHR. The social features of a hospital could be individual (e.g., knowledge, skills, attitudes, values, needs), organizational (e.g., management structure, internal policies, training requirements, social culture, collaboration norms), or external (e.g., governing regulations, external facilities) (Ash, Berg, Coiera, 2004). The primary concept of a socio-technical perspective is the view that the technical and social systems should be optimized to ensure that they “fit” with one another (Badham, Clegg, Wall, 2000; Reddy, Shabot, Bradner, 2008). Coiera (2007) states that there can be unintended consequences of not properly integrating technical systems with the social factors in a hospital environment, which can lead to issues that have negative impacts on patient care.

My research questions include sub-questions that explored how both the EHR system and the work practices of patient-care team members helped or hindered the identification and management of PIPs. These sub-questions reflect my socio-technical viewpoint that technical systems do not function alone and must be observed within the context of the interactions and activities of human actors (Geels, 2004). Baxter & Sommerville (2011) explain the importance of taking a socio-technical perspective when researching or developing technical systems in organizations because, although many systems will meet the technical requirements of the organization, they will ultimately fail to meet the expectations of the users if the system does not properly align with the work practices and culture of the organization.

The socio-technical perspective has been widely used in hospital research to better understand how different HIT systems influence clinical users and vice versa (Abraham & Reddy, 2008; Ash, Berg, Coiera, 2004; Bardram & Bossen, 2005; Coiera, 2007; Fitpatrick, 2004; Lawler, Hedge, & Pavlovic-Veselinovic, 2011; Park & Chen, 2012; Paul & Reddy, 2010; Reddy, Shabot, Bradner, 2008; Reddy & Spence, 2008; Tang & Carpendale, 2007). Lawler, et al. (2011) discuss how understanding both the social interactions and technical components of hospital work is
critical for HIT implementation because it helps develop more “*intuitive, user-friendly, and supportive user-machine interfaces*” while also ensuring that the HIT is properly integrated with hospital work processes. Additionally, Coiera (2007) used a socio-technical approach to discuss how HIT design neglects the collaborative nature of hospital work by focusing too narrowly on supporting the data entry of one individual instead of considering how the system could better support the collaborative discussions between clinicians. Therefore, I conducted my study using data collection and analysis methods that allowed me to observe the identification and management of PIPs from both a social (work practices) and technical (EHR) perspective.

### 3.3 Immersion in the Field

In order to address my research questions, I first immersed myself into the emergency department (ED) for my preliminary study. I then went into the in-patient ward of the same hospital for my main study. During my preliminary study in the ED, I experienced challenges during the field immersion and then developed strategies for overcoming these challenges in my main in-patient study. The following activities were critical for successfully immersing into the in-patient ward during my main study:

(a) *Gaining access:* The first stage of immersion is gaining access to the field site. This included identifying a gatekeeper, or point-of-contact, who granted me permission to study the site and who provided local support for my research (Creswell, 2007). My adviser helped me identify an in-patient attending physician who agreed to act as my gatekeeper. This gatekeeper was helpful in providing an overview of the site, people, and general workflow of the hospital units; helping me identify appropriate participants for the study; introducing me to participants; and performing member-checking throughout the research process to ensure that my assumptions about the site were accurate. I also learned that the gatekeeper is not always available to provide daily support because of her busy schedule. Consequently, I found that
obtaining a hospital identification badge provided visible verification that I was allowed to be in the hospital and helped participants accept my presence at their site, especially when the gatekeeper was not available to introduce me to participants. Gaining access to the hospital also included obtaining research approval from the hospital’s Institutional Review Board (IRB) and completing any required privacy and confidentiality training for the hospital. The IRB approval and required training were all completed before the beginning of my preliminary study.

(b) Site familiarity: When performing the field study in in-patient, it was important to become familiar with the specific areas of the hospital where my participants worked (e.g., resident workrooms, different in-patient units). A challenge I faced during my preliminary study was my lack of medical training and limited experience in hospitals. However, conducting the preliminary study helped me feel more comfortable and familiar with the hospital environment and patient-care workflow prior to entering the in-patient ward for my main study. I also did other activities to better educate myself on the hospital environment prior to conducting my main study. I read medical research papers that were situated in similar hospital units as my study, subscribed to health information technology blogs written by healthcare professionals, and took a Health Policy and Administration class at Penn State in order to gain a basic understanding of the hospital environment and the responsibilities and challenges that healthcare professionals encounter. I also took time at the beginning of the main study to perform general observations to gain a high-level understanding of the hospital units. This included learning about the different types of people who work in the unit, the general workflow and processes, the various sources of information and types of documentation, HIT used by the patient-care teams, and local terminology used throughout the units. I found my general observations in the preliminary ED study very helpful at quickly learning about the field site, so I made sure to do this in the main study as well.
(c) **Building rapport:** Another important aspect of field immersion is building rapport and trust with the participants. I found this particularly challenging during my preliminary study since the gatekeeper was not available to personally introduce me to participants and the participants were very busy in the ED. In order to overcome this challenge in my main study, I learned to identify staff members who oversaw others and asked them to introduce me to their group. This included approaching attending physicians who could introduce me to their team of residents, or talking to charge nurses who could introduce me to the other nurses in their unit. I found that after the attending physician or charge nurse accepted me being there to shadow the team, the other residents or nurses accepted me being there as well. Additionally, I found that consistently being onsite, always being friendly, bringing in snacks, helping out with minor tasks, and staying out of the way when things became very busy appeared to make the participants more comfortable with my presence in their team. I also conducted observations early in the morning, late at night, on weekends, and on holidays. Participants said that seeing me in the hospital during these non-standard times showed my commitment to my work. In addition, I learned that frequently talking to participants about their work or their opinions of the HIT systems helped to build trust since it conveyed a genuine interest in what they do and showed that I valued their opinions. They were also able to more specifically understand what I was studying through our informal discussions, which appeared to make them more comfortable with me taking notes on their activities. After spending a few days developing a rapport with the participants, they were friendlier and accepted me as a member of their team.

(d) **Maintaining scope:** Immersion into a busy and complex site can become overwhelming due to the significant amount of information that the researcher must absorb as the data collection instrument (Lincoln & Guba, 1985). I experienced this challenge during my preliminary and main studies when trying to balance the general, high-level observations that provided insight
into the overall workflow with the more focused and narrow observations that directly related to specific research questions. It can be easy to get distracted by other interesting observations that may not be in the scope of my research study. In order to address this challenge and maintain the scope of my main research objectives, I transcribed my field notes the same day that I conducted the observations, shadowing, or interviews and then spent time reflecting on what I had learned, what questions I still had, and if I was obtaining data that addressed my research scope. This continuous evaluation of my progress helped me stay focused on collecting data that was applicable to my study’s research objectives. When I had issues with data collection, I would discuss these issues with my adviser or other students who had conducted research in hospitals so that they could provide advice on how to adjust my data collection approach.

3.4 Data Collection

I conducted my preliminary and main studies at a large teaching hospital in northeastern United States. The preliminary study was conducted in the ED and the main study was conducted in the in-patient ward of the same hospital. The hospital is described in more detail in Chapter 4 Research Setting. This section describes the participants that I encountered in the studies and a summary of the specific data collection activities for both the preliminary study and the main study. Additionally, I describe the specific details of the four qualitative approaches used in the studies: general observations, shadowing, interviews, and artifact analysis.

3.4.1 Study Participants

Patient-care teams are composed of a wide variety of healthcare professionals who each play a part in the patient-care process. Table 3-2 describes the specific team member roles who were included as participants in both the preliminary ED study and the main in-patient study.
<table>
<thead>
<tr>
<th>Participant Role</th>
<th>Description of Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attending Physician (“Attending”)</td>
<td>Attendings are medical doctors and are ultimately responsible for the patient-care activities, including the diagnosis and treatment of the patient. The attendings also oversee the clinical education of the residents and interns and lead the rounding activities. In the main study, I shadowed the Internal Medicine (IM) attendings and their team of residents and interns.</td>
</tr>
<tr>
<td>Resident</td>
<td>Residents are medical doctors who are currently in their first, second, or third year of residency (i.e., clinical training) within the hospital. The residents typically conducted pre-rounding activities, led the presentation of the patients during morning rounds, and created the patient-care plan with input from the attending.</td>
</tr>
<tr>
<td>Intern</td>
<td>Interns are medical students currently in medical school. The interns were included as part of the physician team and were responsible for leading the presentation of patients during rounds and offering suggestions to the patient-care plan. In the EHR system, the interns could view the patient records, but they could not order medication or add/edit information in patient records.</td>
</tr>
<tr>
<td>Nurse</td>
<td>Nurses are clinically trained (e.g., registered nurse, nurse practitioner, licensed practical nurse) and responsible for the daily care of patients. This care can include the collection of patient measurements (e.g., inputs and outputs, glucose levels, blood pressure), medication administration, and performing certain procedures (e.g., drawing blood, inserting IVs). The nurses were located within specific hospital units (further described in Table 4-1). They worked with the IM physician teams to provide updates on a patient’s status and discuss the patient’s care plan. In the hospital, there was always one nurse, the “charge nurse,” who oversaw the other nurses and managed the daily nursing tasks of that unit.</td>
</tr>
<tr>
<td>Consulting Physician</td>
<td>Consulting physicians are medical doctors (attending or resident) who are responsible for the prevention, diagnosis, and treatment of adult diseases for a specific therapeutic area. The IM physician team contacted the consulting physicians if a patient’s condition required an assessment or procedure by the consulting group. The consulting physicians observed in the in-patient study were part of the following clinical departments: Cardiology, Gastroenterology and Hepatology, Infectious Diseases, Nephrology, Neurology, Nutrition, Pain Management, and Respiratory.</td>
</tr>
<tr>
<td>Therapist</td>
<td>The therapists observed during this study were either Occupational Therapists (OT) or Physical Therapists (PT). OTs work with patients to improve their functional abilities that were impacted by an illness or procedure, including making sure they have any necessary assistive devices or tools to perform their daily activities (e.g., wheelchair, cane, shower rail). The OT participants said that their goal is to optimize the patient’s independence and ensure that the patient’s home and work place are suitable for the patient’s condition. The PTs evaluate and diagnose patients’ injuries or limitations due to recent procedures. The PTs then work to rehabilitate the patients by treating their injuries over time. During the study, OTs and PTs frequently worked with each other and with the care coordinator to create discharge plans for patients with physical injuries or limitations.</td>
</tr>
<tr>
<td>Participant Role</td>
<td>Description of Role</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Care Coordinator</td>
<td>Care coordinators are clinically trained (usually a registered nurse) and are responsible for providing patients with disease management training, financial assistance options, and coordination of discharge to external medical facilities (e.g., nursing homes, assisted living). In the main study, care coordinators rounded with the physician teams daily as part of an interdisciplinary rounding initiative.</td>
</tr>
<tr>
<td>Social Worker</td>
<td>Social workers are responsible for providing support and resources to patients with drug or alcohol abuse, physical or sexual abuse, and/or psychiatric concerns. The social workers worked with care coordinators to manage a patient’s discharge plan.</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>Pharmacists are responsible for reviewing and fulfilling medication prescriptions. In the main study, the pharmacists rounded with the physician teams once a month as part of an interdisciplinary rounding initiative. During rounds, the pharmacists advised physicians on appropriate medication forms, dosages, and drug interactions with other medications.</td>
</tr>
<tr>
<td>Registration Assistant</td>
<td>Registration assistants are responsible for generating the patient’s unique IDs upon arrival in the emergency department and recording the patients’ personal and insurance information into the EHR to assist in proper billing for the visit. The registration assistants were only observed in the ED.</td>
</tr>
<tr>
<td>Hospital Technician</td>
<td>Hospital Technicians are trained in performing diagnostic tests using specialized medical equipment. These technicians were only observed in the ED.</td>
</tr>
<tr>
<td>EMT</td>
<td>EMTs are trained in providing basic medical care to patients in emergency situations before and during the transportation of the patient to the ED. EMTs were only observed in the ED and were associated with patients who arrived via ambulance.</td>
</tr>
<tr>
<td>Patient Transporter</td>
<td>Transporters are responsible for physically lifting and moving patients throughout the hospital. This includes moving patients to other areas for tests or procedures, and for transfers from one unit to another.</td>
</tr>
<tr>
<td>Chaplain</td>
<td>Chaplains provide patients and families with spiritual support while making decisions about treatment or end-of-life options. Chaplains were only observed in the ED.</td>
</tr>
<tr>
<td>Facility Worker</td>
<td>Facility workers are responsible for maintaining, cleaning, and sterilizing hospital rooms prior to new patients entering the rooms. These participants were only observed in the ED where they played an important role in the quick turn-over of patient rooms.</td>
</tr>
<tr>
<td>Hospital Volunteer</td>
<td>Hospital volunteers perform various activities in the hospital without being paid for their services. These volunteers are typically not formally trained in medicine, but receive basic training in the hospital. Volunteers were only observed in the ED.</td>
</tr>
<tr>
<td>Food Services Staff</td>
<td>Food Services staff members are responsible for delivering food to patients’ rooms throughout the hospital.</td>
</tr>
</tbody>
</table>

Table 3-2: Description of Participant Roles
3.4.2 Preliminary Study Data Collection

I conducted the preliminary study in the ED and it consisted of 54 hours of general observations and eight formal semi-structured interviews with ED staff (Table 3-3).

<table>
<thead>
<tr>
<th>Method</th>
<th>Focus</th>
<th>Number</th>
<th>Transcribed Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations</td>
<td>ED workflow</td>
<td>54 hours</td>
<td>175 pages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>85 participants</td>
<td></td>
</tr>
<tr>
<td>Formal Semi-structured Interviews</td>
<td>ED staff</td>
<td>8 participants</td>
<td>30 pages</td>
</tr>
</tbody>
</table>

Table 3-3: Preliminary Study Data Collection

I conducted 54 hours of general observations in the ED for 2-5 hours at a time over a 3-month period. During the observations, I observed 85 participants (Table 3-4). I collected observational data by taking detailed field notes with a pen and notebook about the general workflow, communication, collaboration, and HIT used by the ED staff. The general observations also included informal member-checking discussions where I asked participants questions to verify any assumptions that I was making about my observations. The field notes were transcribed into an electronic document for analysis. These general observations helped to inform the formal semi-structured interviews and also provided me with appropriate contextual examples and local terminology for the interviews.

I then conducted eight semi-structured interviews with three registration assistants, one social worker, one care coordinator, one registered nurse, one physician, and one facility worker (Table 3-4). I identified interview participants based on recommendations by the hospital’s Chief Medical Information Officer (CMIO) and based on my own informal discussions with participants during the observations. The interview questions focused on understanding the participants’ daily work activities, their interactions with the EHR system, and whether the system supports their daily tasks. This interview data triangulated the observational data by providing additional insight into the perceptions and use of EHR systems by both clinical (e.g.,
physician, nurse) and non-clinical (e.g., registration assistant, social worker, care coordinator, facility worker) ED staff.

<table>
<thead>
<tr>
<th>ED Participants</th>
<th>Participants Observed</th>
<th>Participants Interviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nurses (including Charge Nurses)</td>
<td>18</td>
<td>1</td>
</tr>
<tr>
<td>Registration Assistants</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>Attending Physicians</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td>Residents</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Emergency Medical Technicians (EMTs)</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Facility Workers</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Hospital Technicians</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Patient Transporters</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Hospital Volunteers</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Chaplains</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Care Coordinators</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Social Workers</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Pharmacist</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>85</strong></td>
<td><strong>8</strong></td>
</tr>
</tbody>
</table>

Table 3-4: Preliminary Study Participants

More specific details of how I conducted the general observations and formal semi-structured interviews are further described in sections 3.4.4 and 3.4.5 of this chapter.

### 3.4.3 Main Study Data Collection

After I conducted my preliminary ED study and successfully defended my dissertation proposal, I then conducted my main study in the in-patient ward of the same hospital. The main field study consisted of 155 hours of general observations and shadowing of patient-care teams. I also reviewed 38 hospital policies to understand how the hospital trains patient-care team members on the management of patient information (Table 3-5).
For the main study, I shadowed five Internal Medicine (IM) physician teams during 29 morning rounds over a 3-month period resulting in 155 hours of observations. These IM physician teams were led by an attending physician (“attending”) and included medical residents and interns. The shadowing observations also encompassed the physician teams’ interactions with other members of the broader patient-care team, including nurses, consulting physicians (e.g., cardiology, neurology), therapists (e.g., occupational, physical), care coordinators, social workers, and pharmacists. A total of 116 participants were observed during the shadowing activities of the main study (Table 3-6).

<table>
<thead>
<tr>
<th>In-Patient Participants</th>
<th>Participants Observed</th>
</tr>
</thead>
<tbody>
<tr>
<td>IM Attendings</td>
<td>5</td>
</tr>
<tr>
<td>IM Residents</td>
<td>19</td>
</tr>
<tr>
<td>IM Interns</td>
<td>5</td>
</tr>
<tr>
<td>Nurses</td>
<td>60</td>
</tr>
<tr>
<td>Consulting Physicians</td>
<td>15</td>
</tr>
<tr>
<td>Therapists</td>
<td>4</td>
</tr>
<tr>
<td>Care Coordinators</td>
<td>3</td>
</tr>
<tr>
<td>Social Workers</td>
<td>3</td>
</tr>
<tr>
<td>Pharmacists</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>116</strong></td>
</tr>
</tbody>
</table>

Table 3-6: Main Study Participants

Although I initially proposed conducting interviews as part of the main study, I found that I had a significant amount of time with the participants during shadowing to ask them follow-
up questions, verify any assumptions that I had, and discuss the participants’ opinions and perspectives on topics that arose during rounds. After collecting, transcribing, and analyzing my field notes, I found that these shadowing discussions sufficiently answered the questions I would have asked during more formal semi-structured interviews. Therefore, I did not conduct any formal interviews during the main study.

I also performed artifact analysis during the main study by taking detailed notes about the participants’ use of the EHR system and reviewing 38 hospital policies that related to the management and privacy of patient information. I coded these policies for any information related to PIP identification or management, and policies related to accountability for information accuracy. The policies relevant to this study are summarized in Chapter 4 Research Setting. The specific details of the data collection methods for general observations, shadowing, and artifact analysis are further described in the following sections 3.4.4, 3.4.6, and 3.4.7.

**3.4.4 General Observations**

I used general observations in both the preliminary study and the main study. In order to gain site familiarity, I obtained an overview of the ED and in-patient units from the gatekeeper about the various roles, typical workflow, and sources of information that participants used (e.g., EHR system, paper forms or reports, white boards, mobile phone, pagers) prior to beginning the observations. I then walked through the hospital’s floors and units to become familiar with the physical layout of the ED and in-patient units, and observe how various roles move throughout the units while performing their daily tasks. In addition, I sat in busy, information-intensive areas to observe specific work practices for those areas. In the ED, these areas included nurses’ stations and the registration areas. In the in-patient ward, this included the resident workrooms where the physician teams met before rounds, completed their patient documentation, and had hand-off discussions between day and night shift; the 6th floor rotunda where the care coordinators, social
workers, and therapists met every weekday at 1:00pm to discuss patient status and discharge plans; and nurses’ stations where nurses collaborated on patient-care activities, updated patient documentation, and communicated with physicians about patient-care plans.

As part of these general observations, I was either introduced by the gatekeeper or I introduced myself to participants, informed them about my research, and asked for verbal consent to study their work practices (see Verbal Consent Form in Appendix A). In the preliminary study, these general observations helped me understand the general workflow of the ED environment, the use of the EHR by the participants, and the local terminology of the unit. In the main study, the observations helped me better understand where communication and documentation activities frequently occurred. They also helped me identify specific information-intensive activities where I could more closely shadow participants in order to observe the identification and management of PIPs, which helped me maintain the scope of my observations (as mentioned in Section 3.2). I took field notes of the general observations with a pen and notebook, which I found to be the most mobile and discreet way to record information in a hospital setting. I then transcribed the written field notes into an electronic format for analysis on the same day or within a few days of taking the notes. Transcribing the notes a soon as possible after conducting the observations helped to make sure I was accurately recalling specific details from my notes and immediately reflecting on my data collection process. This daily reflection helped me determine how to best focus my observations for the next day, and allowed me to make a list of any questions that I needed to ask the participants.

3.4.5 Formal Semi-Structured Interviews

I used semi-structured interviews in the preliminary ED study. After conducting general observations in the ED, I then conducted formal semi-structured interviews in order to better understand the ED staff’s perceptions of what I observed. I used the semi-structured interview
format to ensure that certain questions are asked consistently across all participants while still offering the flexibility to allow participants to discuss what they find most interesting and relevant about the topic (Creswell, 2007).

All interviews began with me explaining the study’s purpose, procedures, risks, and benefits, and letting the participants know that any information I collect will be kept confidential, that their participation is voluntary, and that they can choose to stop participation at any time. I then asked the participants for verbal consent to participate in the study and permission to audio-record or take notes on their interview answers. When possible, the interviews were conducted in a quiet, private office in the ED. However, most interviews occurred in more open areas of the emergency department. Many interview participants did not want to be audio-recorded due to the confidential nature of the ED environment. When this occurred, I took detailed notes in my field notebook and immediately transcribed the notes after the interview.

The interview questions were informed by the general observations and aimed to understand the participants’ professional background, their communication and documentation activities, and their information needs. Additionally, the interview questions asked participants about their perceptions of whether the EHR system did or did not support their daily tasks. The semi-structured interview protocol for the preliminary study is provided in Appendix B. During the interviews, participants provided stories about the types of patient information problems that they encountered during their work and how the PIPs affected the patient, themselves, or other members of the patient-care team. This finding from my preliminary study data is what motivated and informed my main study’s focus on patient information problems.

3.4.6 Shadowing

I used shadowing in the main study. After I completed a few hours of general observations by walking through the various in-patient units, I worked with the gatekeeper to identify five
attendings who agreed to let me shadow their teams during morning rounds. I requested to shadow the teams during morning rounds because this is when the team discusses each patient’s status, visits the patient room to evaluate the patient, and communicates with other members of the broader team as necessary (e.g., nurses, consulting physicians, therapists). Therefore, it is a primary time that the patient-care team identifies and manages any PIPs that they encounter. A care coordinator also rounded with the team every day and a pharmacist rounded with the team once a month as part of an interdisciplinary rounding initiative at the hospital.

Prior to beginning the shadowing activities, I introduced myself to the physician team members. I then summarized the Verbal Consent Form to explain my research’s purpose, procedures, risks, and benefits, and let them know that any information I collect will be kept confidential, that their participation is voluntary, and that they can choose to stop participation at any time (see the Verbal Consent Form in Appendix A).

The shadowing focused on the morning rounds, but also included other patient-care activities, such as: hand-off discussions between night and day shift, pre-rounds by the residents and interns, night-shift rounding, EHR documentation in the resident workroom, status meetings between care coordinators and social workers, and new in-patient admissions in the emergency department. I was included as a member of the IM physician team and was introduced to patients as a research student studying the hospital staff. During shadowing, I observed the teams’ activities in hallways, workrooms, patient rooms, and nurses’ stations. I took detailed field notes in a paper notebook about the participants’ workflow, communication, collaboration, documentation, and use of the EHR system. The primary focus of the shadowing was to identify the types of PIPs that the patient-care team encountered when reviewing and discussing patient information during rounds, and how the participants identified and managed those PIPs.
I also had many discussions with participants to clarify assumptions, obtain additional information about specific situations, and ask for the participants’ opinions and perceptions on a variety of different topics. These topics included:

(a) *Medical or hospital-specific terms:* Questions included asking about how the hospital is structured, the name and purpose of different units, the role and responsibility of various team members, what different acronyms stood for, and the meaning and importance of different medical terms that were used during the identification or management of specific PIPs.

(b) *Information management:* Questions included asking the participants about their formal and informal documentation practices, any issues that they encountered when trying to search for or document patient information, the different methods they used to communicate information to other team members, and their opinions on the differences in how the various units of the hospital manage and communicate information.

(c) *Accountability:* Questions included asking participants about who is responsible for which tasks, how work is delegated among the patient-care team members, and who is responsible for resolving specific PIPs when they occur.

(d) *Use of the EHR system:* Questions included asking participants what they like or dislike about the system, how they would change the system to better meet their needs, where they find specific information in the system, how they use paper documents to supplement the EHR system during rounds, and the pros and cons of accessing the EHR on different devices (i.e., workstation, laptop, or tablet).

I took detailed field notes with a pen and paper notebook. To protect the privacy of participants and patients, I did not record any personally identifiable information during the shadowing activities. I transcribed the field notes into an electronic format and reviewed them in a continuous, systematic way to ensure that I was capturing rich, descriptive data that addressed the study’s objectives. The shadowing provided a more in-depth understanding of the
participants’ communication and documentation behaviors, as well as specific examples of PIPs that I identified during the patient-care activities. Close shadowing of the team members also allowed me to visually observe how participants’ identified and managed the PIPs that they encountered.

### 3.4.7 Artifact Analysis

I analyzed artifacts in the main in-patient study. During shadowing, participants frequently interacted with certain physical artifacts, such as the EHR system and paper reports printed from the EHR. Since these artifacts were associated with the identification and management of PIPs, I took notes on the artifacts during shadowing by describing how the participants interacted with them, and, if the physical layout of the screen or report was relevant to the PIPs, I drew a picture of the layout of the screen or report in my field notes.

Additionally, there are a number of formal hospital policies on how staff should document patient information, how they should manage information problems, and who is accountable for the accuracy and completeness of the patient information. I reviewed 38 of these hospital policies as part of my data analysis. I also attended a resident training on “Good Documentation Practices,” which included policies and recommendations for best practices in how residents should document patient information in the EHR system. The artifact analysis helped me better understand the information management activities of the patient-care teams, and provided further insight into how the team members identified and managed PIPs. These artifacts are further described in Chapter 4 Research Setting.

### 3.5 Data Analysis

After data collection in both the preliminary study and the main study, I transcribed the paper-based field notes into an electronic document for analysis. During transcription, all participants were given a unique participant identifier to maintain the confidentiality of that
individual. The participant identifiers were based on the participant's role (e.g., A01 for attendings, R01 for residents, N01 for nurses) in order to analyze the data for individuals, and to analyze across the various roles that make up the patient-care team. I maintained a secure, electronic spreadsheet to keep track of the participant identifiers. This spreadsheet included the hours of observations for each day and which participants I observed on that day. This spreadsheet is password-protected and stored on a secure Penn State University server.

I then coded and analyzed the data using Braun & Clarke’s (2006) thematic analysis approach for both the preliminary study and the main study. This analytical approach facilitates the process of becoming familiar with the data, systematically identifying individual codes, grouping those codes into preliminary themes, defining and naming the final themes that commonly occurred across the entire data set, and then selecting examples from the data to accurately illustrate each theme (Table 3-7). I iteratively performed this analysis approach during my data collections so that the themes for each study were progressively refined as more data was collected throughout the studies.
<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Familiarizing ourselves with the data</td>
<td>Transcribe the notes taken during the observation/interview/analysis and read through the transcriptions to ensure a general understanding of the data.</td>
</tr>
<tr>
<td>(2) Generating of initial codes</td>
<td>Label segments of data in a systematic way across all of the data.</td>
</tr>
<tr>
<td>(3) Searching for themes</td>
<td>Review individual codes and identify preliminary themes.</td>
</tr>
<tr>
<td>(4) Reviewing themes</td>
<td>Review preliminary themes to ensure that they made sense across the entire data set.</td>
</tr>
<tr>
<td>(5) Defining and naming themes</td>
<td>Continuously refine each theme, identify a specific name for each theme, and define the boundaries of the theme.</td>
</tr>
<tr>
<td>(6) Producing the report</td>
<td>Present themes with interesting examples from the data that illustrate the individual themes.</td>
</tr>
</tbody>
</table>

Table 3-7: Six-Phase Thematic Analysis Approach

More specifically, in the main study, I created *individual codes* in the data any time there was a field note about a patient information problem being discussed by the team (e.g., the attending physician cannot find the assessment note from the consulting Cardiology physicians in the EHR). All of the individual codes were then grouped into *preliminary themes* based on prevalent similarities identified across all of the individual codes (e.g., missing information found in the EHR). The preliminary themes were then grouped into broader *final themes* that were named, defined, and bounded to be mutually exclusive (e.g., missing information) (Figure 3-1). This data analysis process was used for both the preliminary and main studies. They resulted in themes that are described in Chapter 5 Preliminary Study and Chapter 6 Main Study Findings.
3.6 Validity and Reliability

Maxwell (2005) defines the validity of qualitative research as “the correctness or credibility of a description, conclusion, explanation, or interpretation” (p.106). Research studies must demonstrate internal validity, external validity, and reliability in order to strengthen the integrity of the study’s findings. The following sections describe how I strengthen the validity and reliability of my studies during data collection and analysis.

3.6.1 Internal Validity

Internal validity ensures credibility of the data and findings within the study itself. I strengthened the internal validity of my preliminary and main studies by following these recommended guidelines (Maxwell, 2005):

(a) Intensive long-term involvement: I immersed myself in the field for three months in both the preliminary study and the main study. By conducting these long-term observations and
shadowing, I was able to identify patterns in the data and understand contextual nuances across the data sets. For the preliminary study, this helped me understand the hospital workflow and ED staff’s use of EHR systems. In the main study, this helped me understand the identification and management of PIPs by patient-care teams over the course of the three months.

(b) Rich, descriptive data: By taking detailed field notes during my long-term studies and analyzing hospital policies, I collected “data that are detailed and varied enough that they provide a full and revealing picture of what is going on” (Maxwell, 2005, p.110). This “thick description” provides support for any assumptions and conclusions that were drawn during data analysis.

(c) Triangulation: During my studies, I triangulated my data collection by gathering data using a variety of methods and from a variety of perspectives. More specifically, in the preliminary study, I conducted general observations and interviews. In the main study, I conducted general observations, shadowing, and artifact analysis. I collected data from my own perspective as a researcher during observations and shadowing. Then I collected data from a variety of participants’ perspectives during interviews or informal shadowing discussions with participants (e.g., attendings, residents, interns, consulting physicians, nurses, care coordinators, social workers, therapists, pharmacists).

(d) Member-checking: Additionally, I strengthened my internal validity by frequently performing member-checking with my participants and gatekeepers. This included asking for feedback from participants to ensure that I was correctly understanding the data, making valid assumptions, and drawing appropriate conclusions about the data.
3.6.2 External Validity

In addition, external validity ensures that a research study’s findings are generalizable to other settings (Maxwell, 2005). Lincoln & Guba (1985) refer to this as “transferability” in qualitative research. Since qualitative data collection focuses on gathering contextual and nuanced details of a phenomenon within a specific research site, it can be difficult to generalize the findings (Maxwell, 2005). However, external validity of a study can be strengthened by collecting “thick descriptions,” which allows an individual to verify the appropriateness, or transferability, of the study’s findings to other settings (Lincoln & Guba, 1985). Therefore, I gathered rich, detailed descriptions during my data collections in order to strengthen the external validity of my study. These descriptions are included in Chapter 5 Preliminary Study and Chapter 6 Main Study Findings. Additionally, I provide a clear description of the field site, participant roles, hospital policies, and patient-care activities in the Chapter 4 Research Setting so that readers of my research can determine the transferability of my findings to other settings.

3.6.3 Reliability

Furthermore, the reliability of research studies is evaluated based on the consistency and trustworthiness of the data and findings (Lincoln & Guba, 1985). I strengthened the consistency of my studies by closely analyzing my data using a systematic data analysis approach (Section 3.5) and triangulating the data by gathering it from a variety of sources using a variety of methods. For instance, during my main study, I compared my participants’ perceptions about a specific concept gathered during discussions (e.g., their perceptions of how they manage PIPs) with the data that I gathered during observations and shadowing about the same concept (e.g., how they actually managed PIPs during their work). Also, because I shadowed five different teams during the main study, I was able to compare the consistency of my findings across these different teams and participants.
In addition, I strengthened the reliability of my studies by increasing the trustworthiness of my research. I demonstrated this by providing a detailed and transparent description of my entire research process so that there is a clear understanding of how I conducted the study. I also increased trustworthiness by being aware of my researcher bias and putting in place strategies to document and control my bias (Maxwell, 2005). This included documenting personal reflections throughout my studies in order to identify and address any known biases, assumptions, or emotions that I experienced while conducting the research, which could interfere with the data collection or analysis process (Lincoln & Guba, 1985). An example of this is when residents would express frustration and tell me when other residents or units of the hospital were being unreliable or inconsistent with patient documentation. Although these are valid participant perceptions, I did not want their opinions to make me biased or lead to me making incorrect assumptions about the other participants or units. So, while transcribing my data after collection, I created personal memos to specifically highlight when participants vocalized a strong opinion that could influence my analysis or future observations. When possible, I followed up with the other participants to better understand their perspective of the situation.

3.7 Chapter Summary

This chapter described the methodological approach that I used during the preliminary ED study and the main in-patient study. This includes how I immersed myself into the hospital field site, collected and analyzed data for the preliminary and main studies, and strengthened the validity and reliability of my findings for both studies. The next chapter, Research Setting, provides an overview of the hospital where I conducted the field studies.
4 Research Setting

In this chapter, I provide an overview of the research site for both the preliminary study and the main study. Both studies took place in the same hospital, but the preliminary study was focused on general observations in the emergency department and the main study focused on shadowing physician teams in the in-patient ward. The purpose of this chapter is to provide a detailed description of the hospital units, sources of patient information, and relevant hospital policies, as well as provide a comprehensive overview of the information management activities and workflow processes for both the preliminary ED study and the main in-patient study.

4.1 Hospital Field Site

I conducted this study in a large teaching hospital located in central Pennsylvania. The hospital has 551 beds and admits more than 25,000 patients per year. The hospital’s emergency department includes a trauma center and has more than 47,000 emergency room visits per year. The medical campus also includes a cancer institute, children’s hospital, out-patient clinic, and medical college. However, the focus of this study was only in the emergency department and in-patient ward of the main hospital.

The patient-care teams at the hospital are composed of a number of healthcare professionals. The specific participants in the preliminary and main studies are described in detail in Chapter 3 Research Methods, Table 3-2. Additionally, the hospital field site is composed of different units and floors. In the preliminary study, I only observed and interviewed participants in the emergency department. In the main study, I shadowed the Internal Medicine (IM) physician teams, who were responsible for patients in a variety of different in-patient units throughout the hospital, including visiting the emergency department to transfer patients into an in-patient unit. Table 4-1 describes each of these units in more detail.
Hospital Unit | Description of Hospital Unit
---|---
Floor | The “floor” is for patients who are in stable condition and do not require close monitoring by the nurses. These patients can typically take care of themselves (e.g., use the bathroom, feed themselves) but still need to be in the hospital for recovery, treatment, or tests. At the hospital, there were 8 floors (ground and 1-7) that that participants referred to by their location (e.g., 4th Floor North) or by their clinical unit (e.g., Surgery).

Emergency Department (ED) | The ED is for critical patients with varying symptoms who need urgent attention. These patients enter the ED from an ambulance or as walk-ins. After patients are evaluated and/or treated in the ED, they are either discharged from the hospital (i.e., to go back home or to an external facility) or they are admitted into the one of the in-patient units of the hospital. The IM physician teams frequently visited the ED to participate in patient transfers from the ED to in-patient.

Medical Intensive Care Unit (MICU) | The MICU is for critically ill patients who need close monitoring by nurses. This can include patients with serious chronic conditions or acute illnesses (e.g., infections). The nurses in these units are trained in specific skills required to take care of the critically ill patients. During the study, patients were usually transferred from the MICU to the intermediate care unit (MIMCU) when their condition improved, and in one case a MIMCU patient was transferred back to the MICU when her condition worsened.

Medical Intermediate Care Unit (MIMCU) | The MIMCU is where patients are transferred when they no longer need intensive care, but are not yet ready for the standard floor status. The participants referred to the MIMCU as the “step-down” unit.

Surgical Intensive Care Unit (SICU) | The SICU is for critically ill patients who are in need of surgery or are recovering from surgical procedures. The IM physician team occasionally visited their patients in the SICU if they were going to be transferred from the SICU to the MIMCU or floor status.

Dialysis Unit | The Dialysis Unit is for patients who need a dialysis treatment (i.e., cleaning waste and excess water from the blood due to a decrease or loss of kidney functions). The IM physician team occasionally visited their patients in the Dialysis Unit if the patients were getting their treatment during rounds.

| **Table 4-1: Hospital Units** |

4.2 **Sources of Patient Information**

There were four primary sources of patient information used by the participants when communicating, documenting, and managing patient information in the hospital: the electronic health record (EHR) system, paper-based documents, verbal communication from other team members, and the electronic paging system.
(a) *The EHR system:* The EHR was considered the primary and preferred method for documenting patient data in the hospital. The system includes the patients’ medical records, laboratory ordering and results, clinical progress notes, and patient registration information. The EHR system also included the computerized provider order entry (CPOE) system, which facilitates the medication ordering process with the pharmacy department. CPOE systems are sometimes separate systems from the EHR at other facilities, but this hospital integrated the CPOE system into the EHR. The hospital’s imaging system (i.e., picture archiving and communication system (PACS)) generates and stores x-rays and other patient scans in a system separate from the EHR. However, the PACS images and associated clinical notes are integrated with the EHR system so that the users can seamlessly view the imaging information within the EHR interface. The participants frequently referred to the PACS imaging system as the “GE system” since the system’s vendor is General Electric. Additionally, registration assistants in the ED used an Admissions, Discharge, and Transfer (ADT) system. The ADT system was also a separate system, but it was integrated with the EHR interface to allow staff to document information when patients first arrived in the ED. This ADT system created the patients’ unique identification number and included their name, date of birth, social security number, zip code, and complaint (i.e. symptoms, why they were there). Therefore, the EHR system in this hospital was the source of all formally documented patient information, which is why the EHR is the specific HIT system that I focused on in this study. Participants accessed the EHR system using desktop computers at nurses’ stations and in workrooms, laptops carried during rounds, mobile devices (e.g, iPads, tablets), and the nurses’ computers-on-wheels (COWs) located in hallways.

(b) *Paper-based documents:* Participants frequently used “Patient Care Summary” reports printed from the EHR during rounds. According to hospital policy, this summary report is considered a static snapshot in time of the patient’s information and was used as a temporary source of
information during rounds. Residents who did not round with a laptop or tablet printed these reports and took handwritten notes on the report during rounds about changes in the patient’s status or tasks they needed to do for the patient. After rounds, any patient-related information was then documented in the EHR. In the ED, non-clinical participants (e.g., social workers, care coordinators, registration assistants) also printed a paper report from the EHR called a “face sheet.” This report was a shorter, higher-level version of the Patient Care Summary report that could be printed as one-page. Additionally, if a patient required heart monitor reports, they were printed on paper from the heart monitor machine in the patient’s room and stored in a drawer outside the room.

(c) Verbal communication from other team members: Participants had conversations about patient information either face-to-face or on the phone. The physician team is typically assigned one mobile phone for all members of the team. However, every day that I rounded with the physician teams, they did not have a team mobile phone. When I asked why there were no phones, they explained that either previous teams did not return them, or they “get lost or broken” and there are limited funds to replace them. Since there was no team phone, attendings and residents used desk phones located in their workroom, hallways, or at nurses’ stations. The care coordinators, social workers, therapists, and pharmacists all had their own mobile phone during rounds. Nurses used desk phones at the nurses’ stations or mobile phones that were clipped to their clothing.

(d) Electronic Paging System: Participants frequently used an electronic paging system to send short messages to one another. Physicians and nurses wore pager devices that clipped onto their clothes and the other participants who had mobile phones received pages on their phones. The participants sent these electronic messages to one another using a web-based system accessible through the hospital’s intranet where they could specify a recipient’s name and type a message. These electronic pages were either about logistical information (e.g., a
nurse paged a resident to ask him to call a specific phone extension, a resident paged the team to see where they were currently located during rounds) or patient information updates (e.g., a nurse paged a resident their patient’s current blood pressure after the resident asked the nurse to keep him updated, a resident paged a nurse to tell her to decrease the dosage on the patient’s next medication administration).

4.3 Hospital Policies

Hospital staff members are required to be regularly trained on organizational policies, including how to properly manage patient records in both electronic and paper form. The policies state that the patient record is the primary means of communication for all hospital staff and that every patient must have a documented patient record. The following points summarize the hospital policies that are relevant to this study:

(a) Documentation Management: Hospital policies state that the patient’s data should be documented as soon as it is collected by the person who collected it, and it should be documented in only one place when possible. All electronic and paper records must “be authenticated,” which requires the author’s signature, and the date and time of the data entry. The unique login credentials for each employee are considered the author’s electronic signature in the EHR system. The hospital’s EHR system is called the “gold copy” and is the primary and preferred method for documenting patient data. The policy states that EHR reports should never be printed and stored as part of the patient’s record except under specific circumstances, including: when the EHR system is down or inaccessible, and when the clinical teams print a Patient Care Summary from the system to be used as a Rounds Report. The policies also discourage the use of abbreviations, but if one is used, the staff should ensure it is one listed on the hospital’s list of approved abbreviations.
(b) **Documentation Modification**: All entries made to the EHR or paper medical records are never removed or deleted. However, if the data requires modification, a staff member can only modify his/her own data entry by making the modification and providing a reason for the modification. Clinicians may not modify other clinicians’ documentation unless they are authorized to do so (e.g., an attending may modify a resident’s progress note with proper annotations when co-signing the note).

(c) **Documentation Accountability**: According to the hospital policies, the attending physician of the patient is “ultimately” accountable for preparing a complete and accurate medical record for every patient in his/her care. The registered nurse assigned to the patient is also “ultimately” accountable for keeping an accurate and complete record of the patient’s activities, ongoing progress, and responses to care.

Although all hospital staff members are trained on these organizational policies, work practices can differ based on the different units of the hospital. Therefore, the next two sections will describe the specific information management activities and workflows of the emergency department (4.4 Preliminary ED study) and the in-patient units (4.5 Main In-Patient Study).

### 4.4 Preliminary ED Study

In the preliminary ED study, I conducted general observations and interviews with ED staff members. This section describes the details of the information management activities and workflow processes of the emergency department.

#### 4.4.1 ED Information Management

During the preliminary study in the ED, the participants used all of the main sources of information described in Section 4.2. More specifically, the ED staff communicated with each other and received patient information during face-to-face communication; while using cell phones, pagers, desktop computers, laptop computers, computers-on-wheels (COWs); and while
viewing paper documents, white boards, and mounted electronic screens (e.g., tracking board). Since the hospital policies state that the EHR is the primary source of patient information, the ED staff utilized computers to access the EHR. Desktop computers were found in patient rooms, nurses’ stations, registration desks, and private offices. Some hospital staff (e.g., physicians, residents) carried laptops with them throughout the ED and used them to access the EMR at the nurses’ stations and in private offices. Other ED staff members (e.g., social workers, care coordinators) frequently printed paper-based “face sheets” from the EHR. Those participants carried these paper copies into patient rooms, took handwritten notes on them, and returned to their office computers to enter their notes into the EHR. When I asked them why they did this, they responded that it was more convenient and faster than having to log into the computer in the patients’ rooms. They also stated that they preferred entering the patient information at their own computers to ensure that it was entered correctly into the EHR system.

### 4.4.2 ED Workflow

The primary focus of the preliminary study was to observe any information management activities that occurred in the main open areas of the ED. These areas included observations of the patient registration area (patient check-in and check-out), the nurses’ stations, and the ED hallways. The preliminary study did not include entering patient rooms or private ED offices. Figure 4-1 provides an illustration of the physical layout of the ED, where blue areas indicate the location of the general observations and red lines indicate controlled-access doors (see Appendix C for a larger version of the map).
The ED workflow was composed of the following activities:

(a) *Patient Admissions*: The ED workflow begins when patients enter the ED as either a walk-in patient or a trauma patient. The walk-ins enter through the registration check-in area where registration assistants enter the patient into the EHR system. The registration assistants collect the patient’s name, date of birth, social security number, zip code, and complaint (i.e., symptoms). This EHR data entry process generates a patient ID and alerts the charge nurse and attending physician of the new patient so that they can assign a patient-care team. Physicians are assigned to one of three areas in the ED and nurses are assigned to specific rooms. The triage nurses evaluate the patient, if needed, and then take them to an ED room.
Depending on the room and location of the room, specific ED physicians and nurses, along with the ancillary staff, form the patient-care team for that patient.

(b) Trauma Patients: If there is a trauma, the patient arrives through the ambulance entrance where a registration assistant assigns a patient ID in the EHR and collects as much information as possible depending on the patient’s state. The trauma patients are then immediately brought to one of the designated trauma rooms. The registration assistant also alerts the ED of the trauma by sending out a page to certain staff. The trauma page alerts the charge nurse and attending physician, who assign a patient-care team for the trauma. The trauma page also alerts the registration assistants in the check-out registration area, who post the trauma information on the EHR’s “tracking board” and compile a “trauma pack” depending on the type of trauma (e.g., dead-on-arrival, brain attack). An assigned nurse or ED technician pick-ups the trauma pack from registration and proceeds to the trauma room where the patient-care team is briefed on the patient’s status.

(c) Patient-Care Activities: Once the patient is in his/her ED room, the assigned physician and nurse(s) perform their patient care activities (e.g., evaluation, tests, medication, treatment). Registration assistants also visit the patient rooms to gather additional registration information, including demographic, insurance, and contact information. The registration assistants collect this information on a paper report and then enter the information into the EHR back at their desk. A care coordinator is assigned to help the patient with financial assistance options, patient training, and external facility coordination (e.g., rehabilitation, assisted living). If the patient has any issues with drug or alcohol abuse, physical or sexual abuse, or psychiatric concerns then a social worker is assigned. Additionally, if the patient requests spiritual support, a chaplain is assigned as well. All members of the patient-care team log their activities in the EHR’s “interdisciplinary narrative.” This narrative is a real-time, chronological list of short updates about the patient’s lab results, medication
administration, and general assessments by the patient-care team. The physician and nurse also enter the patient’s medical information into the EMR throughout their patient-care activities. When patient-care team members need to discuss the patient, they frequently have the discussion at the main nurses’ station that is centrally located in the ED.

(d) Patient Visitors: If a patient receives visitors during their stay, the visitors arrive through the check-out registration area. The registration assistants provide the visitors with access to the ED. If the visitors are family members and the patient’s registration information is not complete, then the registration assistants may ask the family members if they know the missing registration information (e.g., insurance, date of birth, address, phone number). The registration assistants then give the visitor the patient’s room number and directions to the room. Visitors enter and exit through the access-controlled doors of the registration area.

(e) Patient Discharge: When a patient is ready to be discharged, the patient-care team creates a discharge plan based on whether the patient will be admitted to the hospital, discharged to an external facility, or allowed to go home. The care coordinator typically arranges any plans if the patient is discharged to an external facility or if the patient needs transportation from the hospital. The clinical team of physicians and nurses are responsible for ensuring the accuracy and completeness of the clinical information in the discharge plan (e.g., diagnosis, treatments, medications). Once the patient is discharged, the registration assistants check the patient out of the ED by logging his/her exit in the EHR and requesting any incomplete registration information before departure.

4.5 Main In-Patient Study

I conducted my main study in the in-patient ward of the hospital by shadowing IM physician teams during morning rounds. This section describes the details of the specific information management activities and workflow processes of the in-patient ward.
4.5.1 In-Patient Information Management

During the main study in the in-patient ward, I shadowed the Internal Medicine physician teams during their primary activity, morning rounds. During rounds, four of the five attendings carried paper reports with handwritten notes and one attending carried a laptop. On occasion, the attendings without a laptop would access the EHR by using nurses’ computers-on-wheels (COWs) in the hallways outside patient rooms or desktop computers at nurses’ stations. The residents and interns carried paper reports with handwritten notes and also shared one team laptop that they would pass to each other throughout rounds. A few residents (2 of 19) and interns (3 of 5) also carried an iPad or tablet device to access the EHR system and make digital notes. The care coordinators rounding with the team carried paper reports with handwritten notes, and the two pharmacists rounding with the team carried their own laptops as well as paper reports with handwritten notes about the patients’ medications.

4.5.2 In-Patient Workflow

The primary focus of the main study was on any information management activities that occurred during the morning rounds of the Internal Medicine (IM) physician teams. In order to observe this, I shadowed the IM physician teams as they moved throughout the in-patient ward of the hospital throughout the day. This included observing the teams in the resident workrooms, patient’s rooms, nurses’ stations, hallways, elevators, stairs wells, and in the ED during patient transfer activities. The hospital included 8 floors (ground and 1-7), but the IM teams spent a majority of their time on the sixth floor. This is because the resident workrooms and attending offices are located on this floor. Additionally, a majority of their patients were located in the MIMCU and MICU units, which were also located on the sixth floor. Figure 4-2 provides an illustration of the physical layout of the hospital’s sixth floor. The other floors had a similar
layout. The blue areas indicate where I observed the participants and red lines indicate controlled-access doors (see Appendix D for a larger version of the map).

*Blue areas indicate the location of the observations and red lines indicate controlled-access doors*

**Figure 4-2: Map of In-Patient Shadowing Observations**

The IM physician teams that I shadowed were responsible for patients in the in-patient area of the hospital and focused on the prevention, diagnosis, and treatment of adult diseases. The IM teams frequently requested consultations from other clinical departments (e.g., Cardiology, Neurology) when a patient’s condition needed a specialized assessment. Since the hospital site was a teaching hospital, intern students and residents were a part of the patient-care team and were managed by an attending physician. The daily rounds typically included teaching activities (e.g., each resident and intern listening to a patient’s breathing to understand how to describe the
respiratory status) and teaching discussions (e.g., the residents and interns discuss the positives and negatives of proceeding with a specific plan of care).

In Internal Medicine, there were three attending physicians during the day-shift who were responsible for their team of residents/interns, and for the care of 12-14 patients each. I shadowed one night-shift attending who had a team of five residents and was the only IM attending in the hospital. The attendings and their team of residents/interns worked for two consecutive weeks and each of the patients was assigned to one of the residents or interns. The following is an overview of a typical day for the IM physician team, including: hand-off discussions between shifts, pre-round work, morning rounds with the IM physician team, and post-round work.

(a) **Hand-off Discussions:** A typical day started with the residents arriving between 4:00-6:00am to discuss patient hand-off with the night shift. During the hand-off discussion, the night-shift resident went through the Patient Care Summary report (either a printed copy or in the EHR) with the new resident and they discussed any important or immediate concerns for each patient. The night-shift attendings also created a high-level patient summary report that they stored on a shared, secure network drive. The day-shift attending would review the report prior to morning rounds, but the attendings did not meet in person to hand-off patients. The same hand-off activities also occurred between day and night-shift between the hours of 4:00-6:00pm.

(b) **Pre-Rounds Work:** After the hand-off discussion, the residents and interns would visit their assigned patients’ rooms to wake-up and physically assess the patients, and to talk to the nurses about night-time activities. The residents/interns would then return to the resident workroom to perform any tasks carried over from night-shift (e.g., order tests or consults) and prepare for rounds with the attending. This preparation for rounds included reviewing their patients’ records in the EHR, printing or generating a Patient Care Summary from the EHR system for each of their patients, and taking any notes to help during the presentation of their
patients. The care coordinator rounding with the team would also meet with the residents/interns responsible for patients who were close to being discharged in order to get an update on that patient’s status. This helped the care coordinator gather the proper documentation required for discharge, including any scripts (e.g., medication, oxygen), transportation needs, insurance forms for Medicare or Medicaid, and approvals for patients going to external facilities (e.g., nursing home).

(c) **Morning Rounds:** The residents, interns, attending physician, and care coordinator met in the resident workroom at approximately 8:00am to discuss any critical patient issues and decide on the order of seeing their patients. The team typically prioritized seeing patients who needed immediate evaluations and patients that were ready for discharge. Otherwise, the order was determined based on where the patients were located in the hospital. Then the team walked to each patient room and the assigned resident/intern presented the patient outside of the patient’s room or at a nearby nurses’ station. This presentation included giving a brief overview of the patient’s demographic information (e.g., 43 year old woman), relevant medical history, chief complaint (i.e., why the patient came to the hospital and how he/she described their pain and discomfort), all relevant biometric measurements (e.g., blood pressure, inputs and outputs), lab results, and symptoms. The team then discussed what they needed to do to properly diagnosis and treat the patient, including how to physically assess the patient and if they needed to order a test, medication, procedure, or consult. Then, the team entered the patient’s room to talk to the patient and perform a physical assessment. The patient’s nurse usually joined the team during the resident/intern presentation or in the room. Once the team spoke to and assessed the patient, they gathered outside the room to decide on the patient-care plan. If the next steps included ordering medication, tests, procedures, or consults, the residents would sometimes perform those tasks in the EHR system while walking to the next patient room. The care coordinator frequently asked questions about
patients who were close to discharge so she could prepare documentation and approvals for the patient. When the pharmacist rounded with the team, she would review the patient medication list to provide suggestions to the team. These suggestions included recommendations for changing dosages, adjusting times of medication administration, questioning why patients were on certain medications, or removing medications from the patients’ lists. Occasionally, a new patient would be assigned to the team from the ED. When this happened, one of the residents would go to the ED to document the patient’s history and perform a physical assessment, called an “H&P” (history and physical).

(d) Post-Round Work: Morning rounds lasted between 2-5 hours, then the residents/interns returned to their workroom and the attending returned to his/her office. Each resident/intern worked on updating patient documentation, creating their daily patient progress report, and following-up on any tasks decided on during rounds. Residents would occasionally return to their patients’ rooms if additional discussions or assessments were necessary. Between 4:00-6:00pm, the night-shift residents would begin work and the day-shift would then perform patient hand-off activities.

4.6 Chapter Summary

This chapter described the research setting where I conducted my field study. This includes a description of the hospital site and units, the primary sources of patient information used by participants during their work, the hospital policies that relate to information management and accountability, and specific details about the information management activities and general workflow processes of the ED (preliminary study) and the in-patient ward (main study). The next chapter discusses the details of my preliminary field study conducted in the emergency department. This preliminary ED study informed the focus of my main study conducted in the in-patient area of the same hospital.
5 Preliminary Field Study

The findings from the preliminary ED study are presented in four sections. I will first describe the types of PIPs that were observed or discussed by the ED staff. I will then describe how the ED staff identified and then managed PIPs that they encountered during their daily work. Then, I will describe the role of collaboration within patient-care teams and how it affected the identification and management of PIPs. I will conclude by discussing how these findings helped to inform the focus of my main study.

5.1 Types of PIPs in the ED

Data from the preliminary field study illustrate how PIPs frequently occur in hospital environments. Multiple participants discussed the importance of accurate information in the EHR and that they are even evaluated on their data entry accuracy. As one registration assistant said, "You have to be careful because we're graded, we're audited on the information we enter. We have to be within 90% accurate."

Even though participants discussed the importance of ensuring information accuracy in their work, they also expressed that certain problems, such as data entry errors or incompleteness, were inherent in the highly dynamic hospital environment. A social worker described this: "There's always the possibility of errors, that's just the nature of entering information. And you only know what you know. Sometimes you don't have the whole story." The PIPs that were observed or discussed in this preliminary study included wrong, outdated, conflicting, and incomplete information. The following sections further discuss these PIP types.

5.1.1 Wrong Information

There were a variety of reasons why information was incorrectly entered into a patient’s record. One of the primary reasons that was observed and discussed by participants was data entry errors. During observations of the registration area, a few registration assistants (RA) had
trouble locating a patient in the EHR system. After searching, checking with other RAs, and asking a visiting family member questions about the patient, they discovered that the patient’s first name was listed in the last name field, and his last name was listed in the first name field. Although this data entry error did not affect the patient’s medical care, it did cause confusion and additional work for the team to identify and fix the issue. Additionally, in another instance, it was observed that an RA made data entry errors when she took notes on a paper copy of the patient’s registration, called a “face sheet,” then transcribed the paper notes into the EHR system. She stated that she could not read her handwriting and ended up entering the wrong information into the system. The error was only identified after another RA questioned her about the patient’s information because it “did not look right.”

The EHR system also included data fields in the form of checkboxes, so that the hospital staff could ask patients questions and check the yes/no response in the system. A social worker recalled a time when a nurse incorrectly checked the wrong box:

“The other problem with the system is people checking the wrong information. So the nurses will ask patients questions, like “has anyone ever forced you to have sex against your will?” If the nurse checks the wrong box, which happened, then I am called in to talk to the patient about it. When I address them about the sensitive topic, a patient once became irate saying that they never said that and demanding that their record be changed. And the issue with the system is that the person who entered it has to change it, so I couldn’t even fix the error myself.” [social worker interview]

Additionally, data entry errors also included times when ED staff entered the right information into the wrong area of the system. One physician described this:

“For example, if you put allergies in the wrong spot, they’re put in the problems list instead of the allergies list – this tends to happen, [and it led to] another physician making patient care decisions off of the wrong information.” [attending physician interview]

Another cause of wrong information being entered into the EHR system was inaccurate recollection of information. During observations, the hospital staff members in the ED were constantly multi-tasking and frequently interrupted while they were working. The participants
even acknowledged this during interviews. One nurse stated, “we are always interrupted, it’s just part of the job.” A registration assistant also described the nature of her work: “This job requires a lot of multi-tasking...you have to be social, handle a lot at once, and deal with all kinds of people all the time.” The multi-tasking and constant interruptions typically led to staff recording information after some time had passed and so they had to rely on their memory to recall the information. This was observed at the registration desk when a RA was entering information into the EHR system and said out loud to herself, “Oh shoot, what time did they say the accident occurred?” This was also observed when one nurse exited a patient’s room and said to another nurse who was working at her computer behind the nurses’ station, “Room 30, INR is 3.5.” The nurse at the computer responded with “okay.” Then approximately 30 seconds later, the nurse at the computer said out loud to herself, “Wait, what was the INR again? I think she said 3.5, hmm.” [observation field notes]. These examples show instances when ED staff had difficulty recalling information that could result in wrong information being entered into the EHR system.

5.1.2 Outdated Information

Another PIP identified during the field study was outdated patient information. The EHR system used in the ED was designed to display the most recent information in the system. However, the system does not show the user when the information was last updated. A social worker described this aspect of the EHR system:

“That’s the problem, the system doesn’t show when the information was last updated. So if a patient was here before, that information is still in the system and you can’t tell that it’s old information... [the outdated information] can be more dangerous than having no information in there.” [social worker interview]

The social worker recalled a few times when patients’ contact information was outdated and it led to emotional or stressful situations for the patients:

“I had a patient and the record showed that her husband was her contact and I asked her about calling her husband, but her husband had died since the last visit so she was a widow. It made her very upset. Now I have an emotional and crying
patient because the information was not updated. That’s something that could have been avoided if someone had asked for updated emergency contact information when she arrived.” [social worker interview]

In addition, the social worker also recalled another time when outdated information was an issue:

“Another time we had a patient who was in here because of abuse injuries and the boyfriend was listed as the emergency contact from a previous visit. The boyfriend was called, but the boyfriend was the abuser. So this created a potentially dangerous situation for the patient and the hospital because the information was not updated.” [social worker interview]

Although these situations did not involve clinical information that could affect the patient’s medical care, the outdated information did affect the patient’s experience in the ED, which is an important part of the patient-care process.

Outdated information was also observed at the registration desk. A registration assistant was discussing with another RA that the EHR system showed that a patient was, “listed as being in isolation, but I just walked by his room and spoke with him. I guess that must have been from a previous visit” [observation field notes]. Although I did not directly observe if the outdated “isolation” status of the patient impacted his care, this type of outdated information stating that the patient was in isolation could have affected how that patient was treated, which provider was assigned to the patient, or other aspects of the patient’s medical treatment.

5.1.3 Conflicting Information

There were also situations where information in the EHR system conflicted with other sources of information outside the EHR system. Prior research describes instances when there is an internal discrepancy between two information fields within the EHR system. For example, Turchin, Shubina, and Goldberg (2011) discuss an instance when the “strength and form” of a medication selected in a structured drop-down menu (“500mg capsule, take 1”) conflicted with the data entered by the physician into a free-text field (“take two tablets three times a day”). Although I did not directly observe this type of internal system discrepancy in the ED, I did
observe and discuss with participants instances when there were discrepancies between
information in the EHR system and other external information sources, such as ED employees,
patients, or visitors. This conflicting information created confusion and additional work for the
ED team to determine which information was correct.

For instance, a care coordinator described a time when she was talking to a patient and
noticed a discrepancy between a patient’s pill color and the dosage listed in the system:

“I had a patient who was elderly that had an INR of 16 and it should have been 3.5
at most. I went in to talk to the patient and she said, “the color changed” in
reference to her pills. So I looked in the records and found that the drug she was
taking was 5 times the amount she should have been taking. So the record in the
system helped me identify that there was an issue.” [care coordinator interview]

The care coordinator recalled another time when the EHR system record did not
accurately reflect a patient’s condition. The system said she was using a glucometer, but after
talking with the patient, she said she had not been using the device:

“I had a diabetes patient whose numbers were off...so I talked to the patient and
she said, ‘I had a glucometer but my son stepped on it’ so she wasn’t using one at
home, even though her record said she was [using the glucometer].” [care
coordinator interview]

An observation from the check-out area also exemplifies a time when the patient’s
physical attributes did not match his information in the EHR system, which led to the patient
finding out that his insurance had been stolen:

In the check-out area, a physician tells the small group of ED staff in the waiting room
that his patient’s insurance had been stolen. He recalls the story of how he scanned the
patient’s registration information and realized something was wrong because the
record said the patient’s race was listed as African American and the man was
Caucasian. The patient then confirmed that the [EHR] record did not have his correct
social security number. [observation field notes]

Additionally, the RAs experienced a few situations where there were discrepancies
between the EHR record and what visitors were saying about the ED patients. In one situation, a
patient’s mother was told that her son was being admitted to the hospital, but the system showed
that patient was about to be released:
A visitor enters the registration area looking for son. The RA asks for the patient’s name and insurance information. The visitor provides the information and the RA enters the insurance information into the system. The RA says that the patient has been discharged. The mother says she is confused because they told her that her son was being admitted. The RA says, “There’s a blue dot next to his name, a blue dot means he’s leaving.” [observation field notes]

Therefore, although the participants did not discuss any conflicting information between internal fields within the EHR system, the ED staff did experience conflicting information between the information in the EHR system and other external sources, such as ED employees, patients, or visitors.

### 5.1.4 Incomplete Information

The final type of PIP observed in the preliminary study is incomplete information. Hospital staff have identified incomplete information as a major concern with moving from paper-based records to electronic records. Zhou, Ackerman, and Zheng (2009) discuss how transitioning to EHR systems led to incomplete patient records due to the loss of psycho-social information that provided, “continuity of care...[and] a richer picture of the patient’s situation” (p.6). This psycho-social information included short notes between the staff that provide a better understanding of the patient across the patient-care team and across shifts.

Similarly, during the field study, the participants discussed times when they did not or could not enter all of their information into the EHR system. A social worker stated that, due to her limited editing rights and the available fields in the EHR system, she could not enter all of her notes about the patient:

“Some of my information about my patient does not get into the patient’s record because I can’t edit. And there’s no place for me to put some of my notes about the patient, which could help others, I guess not really the doctors, but it would help the next [social worker] shift. So I usually just write it on the [paper] face sheet or the next shift takes notes during our hand-off.” [social worker interview]

In addition, the RAs also discussed the use of a general “comments” field in the EHR system to communicate information about whether the patient can have visitors. However,
because the field is not consistently used or not always complete, it can cause confusion and additional work for the RAs to verify a patient’s status:

"[When a visitor checks in] I first check the comments in [the EHR system] to see if I can let the visitor go back. There might be a note that says something about the patient, like when visitors are not allowed in the room. So I just ask the visitor to wait until I can check with the nurse to bring them back, or wait for a chaplain to bring them back. But not everyone uses the comments area, so it gets confusing, or you don't get the full story. Sometimes you have to just call someone to check instead." [registration assistant interview]

Therefore, these findings describe how the design of the EHR can lead to incomplete patient records, which can cause confusion and a lack of knowledge transfer among the ED team.

This section provided descriptive examples of the four types of PIPs observed or discussed during the field study: wrong, outdated, conflicting, and incomplete information. The next two sections will discuss how these PIPs were identified and then managed by the ED staff during the preliminary study.

5.2 Identification of PIPs in the ED

ED staff only recognized PIPs when they interfered with their ability to do work, and then they consequently identified it as a PIP. Any of the PIPs discussed in the previous section could have persisted within the EHR if no one identified the information as being wrong, outdated, conflicting, or incomplete. Therefore, the identification of PIPs emerged as a theme within the preliminary data because the PIP is first identified before it can be managed or fixed. The ED staff identified PIPs in two ways: when comparing the EHR system’s information to other information sources, or when they were trying to make sense of information that did not look right.

5.2.1 Comparing Information Sources

The ED staff frequently identified PIPs when they were comparing the EHR system information to other sources of information. These other sources included other ED staff
members, the patients themselves, or visitors. For example, when an RA identified that a patient’s first and last names were switched in the system, she was talking with a visitor who requested to see the patient. The RA was comparing the EHR system to the information that the visitor was verbally providing about the patient when she identified this as a PIP. Additionally, the social worker identified that a nurse had incorrectly checked a box in a patient’s record stating that the patient was “forced to have sex against her will” only when she went into the patient’s room to discuss the sensitive topic with the patient. The social worker identified the PIP when comparing the information in the EHR system to the patient’s statement.

The participants also identified PIPs when comparing the EHR system information to something they were physically seeing. For instance, the physician identified that his patient’s insurance had been compromised when he saw that the EHR system listed the patient’s race as African American, but he could physically see that the patient was Caucasian. Additionally, the care coordinator identified a PIP when she noticed that the patient’s pill color was not the same color that the patient normally received. After physically comparing the dosage of the pill to the dosage listed in the EHR system, the care coordinator identified the PIP.

These examples illustrate how the ED staff identified PIPs when they compared information within in the EHR system to information external to the system. The ED staff also identified PIPs when they were making sense of information that did not look right.

5.2.2 Making Sense of the Information

Participants also described identifying PIPs when they encountered information that did not look right, which then caused them to think about why that information did not look right – or to make sense of the information. Participants did not explicitly state how they made sense of patient information, which is because making sense of information is a cognitive activity that the participants may not have realized they were doing. However, when the participants tried to make
sense of information that did not look right, they were frequently questioning the accuracy of information based on their previous experiences, medical knowledge, or other training or skills that they have. The participants described this as a “gut instinct” or simply that the information just “didn’t look right.” For example, the care coordinator described a time when the EHR system showed that the diabetes patient was using a glucometer, but noticed that her “[glucose] numbers were off.” The care coordinator stated: “A lot of times I have a gut instinct, you know? It didn’t look right. So I talked to the patient and she said, ‘I had a glucometer but my son stepped on it’ so she wasn’t using one at home, even though her record said she was [using a glucometer]” [care coordinator interview].

Additionally, there was the observation when a RA questioned another RA about something she had entered into the EHR system. The first RA said she could not read her handwriting so the information may be wrong. The other RA said: “Yeah, it just didn’t look right. So I had to check with you” [observation field notes]. In both of these examples, the social worker and the RA identified the PIP by making sense of the information and discussing it with a patient or other ED staff member.

Therefore, hospital staff identify PIPs by comparing the EHR information to other sources or by making sense of the information based on previous experiences, medical knowledge, or other training or skills. Once the ED staff identified the PIPs, then they could managed or fix the patient information problem.

5.3 Management of PIPs in the ED

After hospital staff members identify PIPs, they must then respond to the patient information problem. Not all of the participants’ responses to PIPs were observed or discussed during the field study. However, when the responses were observed or discussed, the participants
managed PIPs by fixing the problem themselves, finding the right person to fix the problem, or finding a way to work around the problem.

5.3.1 Fixing the Problem Themselves

When the participants identified a PIP and knew how to correct the problem, they typically just fixed the issue in the EHR system themselves. For example, when the physician identified that his patient’s insurance had been compromised, he said he then asked the patient for his correct information and entered it into the EHR system so that the patient “could be billed correctly for the visit” [observation field notes]. Additionally, when the RA identified the PIP related to a patient’s first and last name being switched in the system, she verified the patient’s identity with the visitor and other RAs. Once the other sources confirmed the patient’s name and she realized the data entry error, the RA simply fixed the information error in the system.

5.3.2 Finding Someone to Fix the Problem

There were other times during the field study that the participant who identified the PIP did not have the knowledge or did not have the editing rights to fix the problem in the EHR system. For instance, when the social worker realized that a nurse had checked the wrong box in the EHR system and the patient verified that the system was incorrect, the social worker had to track down the nurse to fix the issue because she did not have editing rights in the system to fix the problem herself. Additionally, the social worker also described a time when the patient’s contact information was outdated and she needed to find someone who could fix the problem:

“Since I can’t update it as a social worker, I try to call others to update it. I call the registration in the ED or the bed control in in-patient...But they sometimes say that it’s someone else’s responsibility. I talk to registration, but they may say that it’s the nurse’s responsibility, but when I talk to the nurse, they say it’s not their responsibility.” [social worker interview]

This exemplifies how the participant managed the PIP by finding someone who could fix the problem since the EHR system restricted her from being able to fix it. The example also
illustrates the challenge of determining accountability for managing PIPs when there are multiple individuals who are responsible for co-managing the patient’s record.

5.3.3 Working Around the Problem

The participants also found ways to work around the PIP so that they could continue with their task without having to fix the problem in the EHR system. The RA discussed how she would read the “comments” field before letting a visitor back to see a patient. However, she also mentioned that other ED staff did not consistently use the field, so she usually had to call the nurse to verify if the patient could have visitors. By calling the nurse, the RA found a way to work around the incomplete and unreliable “comments” field in order to continue with her task of directing visitors to patient rooms. In addition, the social worker described how the EHR does not allow her to enter all of her notes about the patient, so she described using a paper-based workaround: “So I usually just write it on the [paper] face sheet or the next shift takes notes during our hand-off” [social worker interview]. Therefore, these workarounds allowed the ED staff to continue with their work, even though it did not fix the PIP in the system.

This section described various ways in which ED staff managed PIPs by fixing the problem, finding someone to fix the problem, or working around the problem. The next section will describe how collaboration was frequently observed or discussed by participants during the management of PIPs.

5.4 Collaboration in the ED

Collaboration is an essential aspect of hospital work, especially in a busy and fast-paced environment like the ED. In the preliminary field study, members of the ED staff collaboratively worked together to provide patient care and to gather accurate information for the patients’ records. Therefore, this section will describe the different types of collaboration identified during the study and the challenges that arose due to the collaborative nature of hospital work.
5.4.1 Types of Collaboration

During interviews, I asked the participants if they collaborated with others to do their work. All of them said yes, including a registrar who said “yes, definitely,” a social worker who responded “all the time,” and a registered nurse who said “[we are] extremely collaborative.” Based on the observations and interviews, I identified three different types of collaboration activities for the ED staff: within-role (with others in the same role), internal (with others in the ED), and external (with others outside the ED). Understanding the different types of collaboration within the hospital can help to identify the different information needs of the staff members, including which roles are impacted if there are PIPs within the EHR. Additionally, understanding different types of collaboration can provide insight into how the EHR design does or does not support the various types of collaborative activities.

5.4.1.1 Within-Role Collaboration

The within-role collaboration included any ED staff member who worked directly with other members of the same role (e.g., physician, nurse, RA) to complete their work. The RAs primarily described within-role collaboration when they had to work with other RAs to obtain patient registration information. This was frequently observed when RAs would work together to gather or enter patient information into the EHR system, or when they had to collaborate during traumas by gathering the “trauma pack” information for the clinical team and posting the trauma to the EHR system’s “tracking board” to make other ED staff aware of the event.

The registered nurse also explained how she collaborates with other nurses:

“I work with other nurses during shift change to hand-off information or clarify the status of the patient, or we work together if we need help with something, like lifting a patient or questions about administering medication or other procedures to the patient.” [registered nurse interview]

Additionally, physicians were observed collaborating with other physicians or residents:
A physician and four residents exit a patient’s room. They gather around the main nurses’ station counter and the physician summarizes the patient’s condition based on the examination. He also mentions the patient’s current medications. The residents take notes in their notebooks. The physician then asks them what tests they think should be run on the patient. The residents offer their opinions and the physician discusses the recommended tests with the residents. [observation field notes]

On the other hand, both the care coordinator and social worker did not have much within-role collaboration, primarily because there was only one of them on shift at a time and the only communication that occurred within their individual roles was during shift changes. A care coordinator described this specific lack of collaboration with other care coordinators: “We don't really share our information [with each other]. We all have our own resources” [care coordinator interview]. The social worker similarly stated: “I don’t work with other social workers when dealing directly with the patients because it’s just me on shift” [social worker interview].

5.4.1.2 Internal Collaboration

There was also internal collaboration between different roles within the ED. The RAs discussed internal collaboration with other ED staff to perform tasks. During trauma cases, the RAs worked with physicians, nurses, and technicians within the ED to gather the necessary paperwork for the trauma and to alert these roles about the status of the trauma. It was also observed and stated in interviews that the RAs were the primary point-of-contact with the chaplains (spiritual advisors) when they were needed to provide spiritual support to the patients and their families. The RAs provided the chaplains with updates on the status of the patients through text-messaging and alerted them when families arrived in the registration area.

A registered nurse also discussed the collaboration with other internal ED staff members:

“We have to talk to doctors for different patient orders, the secretaries for transporting patients throughout the hospital. We might work with social workers or coordinators if they need to talk to us about the patient.” [registered nurse interview]
The social worker and care coordinator discussed their internal collaboration with others in the ED including physicians, nurses, and ED technicians. This included discussing patients’ history, tests, diagnoses, and treatments in order to have a comprehensive understanding of the patient. This patient overview is necessary for the social worker and care coordinator to provide appropriate training and resources to the patient and to develop a discharge plan.

5.4.1.3 External Collaboration

The social worker and care coordinator’s external collaboration included calling other areas of the hospital outside of the ED for specific patient resources. For example, the care coordinator discussed how she had to collaborate with a hospice representative and “shared information back and forth” [care coordinator interview] to arrange the patient’s transfer to hospice. She also mentioned collaborating with external assisted living, nursing home, and rehabilitation facilities to coordinate care for when the patient was discharged. Similarly, the social worker described collaborating with staff members external to the ED when performing her work:

“I also talk to other areas of the hospital, like if I have a cancer patient and I need resources for them, which I’m not as familiar with, I can call someone over in the Cancer Center to get information on medication or work with them on other opportunities for the patient.” [social worker interview]

External collaboration was not directly observed or mentioned by the physicians, nurses, or RAs within the preliminary study. Therefore, this description of the types of collaboration within the hospital can help to identify the different information needs of the participants, including which roles are impacted if there are PIPs within the EHR system.

5.4.2 Challenges of a Collaborative Environment

All of the interview participants described their collaborative activities with hospital staff both inside and outside of the ED. In addition, the participants also described various challenges that arose during collaboration with others, including the workflow effects of PIPs, the ambiguity
around who is accountable for fixing PIPs, and EHR design limitations that interfered with their ability to do their work.

5.4.2.1 Workflow Effects of PIPs

The participants described how the EHR system provides a shared, centralized, collaborative document of the patients’ histories, which is used by many different ED staff members. The system actions of one user (e.g., add, edit, delete) can affect the workflow of the other users who rely on the accuracy and completeness of the patients’ information. The social worker specifically talked about this challenge of managing PIPs in a highly collaborative setting:

“There is also patient history that we look at [in the EHR system]...If it’s wrong or outdated, it’s more dangerous than having no information in there. When people don’t verify the information in there and don’t update it, it affects all of us” [social worker interview]

A physician also explained how a patient’s allergies were once put into the “problems list” section of the EHR instead of the “allergies list” section of the system. The physician stated, “...this tends to happen, [and it led to] another physician making patient care decisions off of the wrong information” [physician interview]. Therefore, this illustrates how the actions of one team member can affect the workflow of other team members who rely on that information.

5.4.2.2 Ambiguous Accountability

Due to the highly collaborative nature of the ED, many different people within the patient-care team are responsible for co-managing patients’ records in the EHR system. Based on the field study, this can include physicians, nurses, social workers, care coordinators, and registration assistants. However, because there are multiple people responsible for the information, this can lead to ambiguity around who is actually accountable for ensuring that the patient information is accurate, complete, and up-to-date. Additionally, there is ambiguity around who is responsible for fixing the PIPs after they are identified within the system.
A social worker recalled an instance when trying to fix a PIP in the system:

“Since I cannot update it as a social worker, I try to call others to update it. But they say that it’s someone else’s responsibility. I talk to registration, but they say that it’s the nurse’s responsibility, but when I talk to the nurse, they say it’s not their responsibility.” [social worker interview]

When I asked if it was unclear whose responsibility it was to fix the problem, the social worker responded: “Well, it’s clear to them that it’s **not** their responsibility [laughs]! But it’s not clear whose responsibility it is” [social worker interview].

Therefore, collaboration within a hospital setting can create certain challenges including limitations of the EHR design, workflow effects of PIPs across the entire patient-care team, and ambiguity around who is accountable for the accuracy and completeness of patient information in an environment where information is co-managed by multiple people.

**5.4.2.3 EHR Design Limitations**

At times the EHR design made it more difficult to collaborate with others. A care coordinator explained how the ED has a different EHR user interface than other areas of the hospital and that this can make it challenging to communicate and collaborate with others outside of the ED:

“It’s cumbersome to go upstairs and work with people up there [in the in-patient area of the hospital] because it’s a different system! I get confused because it’s all different” [care coordinator interview].

The social worker also described how system limitations made it time-consuming to collaborate with external medical facilities when trying to find a placement for a patient at a rehabilitation facility:

“I can’t send things electronically [in the EHR system]. So I have to print and fax information for each individual site, which just adds time. It might sound like a silly and insignificant request to want to send to multiple sites at once, but it adds lots of time to that task and time is important...in the ED we’re talking in minutes, not days.” [social worker interview]
5.5 Discussion of Preliminary Findings

The preliminary findings describe the types of PIPs encountered by ED staff, how the PIPs were identified and managed by ED staff, and the collaboration challenges encountered by patient-care teams in the ED. This section will discuss three challenges that the ED staff faced when identifying and managing PIPs, including: (a) the effects of using workarounds when managing PIPs, (b) the effects that persistent PIPs have on collaborative patient-care teams, and (c) the impact that EHR design has on PIPs. The section will conclude with how these preliminary findings motivated and informed my main study in the in-patient ward.

5.5.1 Use of Workarounds in Collaborative Teams

The preliminary findings describe how ED staff used workarounds as one way to manage PIPs that they encountered during their work. Researchers have also described how clinicians frequently perform workarounds as a way to adapt processes or technologies to minimize the disruptions to their work (Abramson et al., 2012; Kobayashi et al., 2005; Koppel et al., 2005; Poissant et al., 2005; Saleem et al., 2011; Sittig & Singh, 2011; Vogelsmeier, Halbesleben, Scott-Cawiezell, 2008; Zhou, Ackerman, Zheng, 2011). However, these workarounds do not fix the PIP (Kobayashi et al., 2005), which will then remain in the EHR until the PIP is properly managed. This presents an issue when ED staff workaround PIPs within the highly collaborative environment of the hospital because the effects of workarounds can directly impact other members of the patient-care team. This is especially true if other members of the patient-care team are not made aware of the PIP in the EHR.

Kobayashi et al. (2005) discuss the “cascading effects” of workarounds where working around one issue can lead to the need for other workarounds. The authors’ discussion of cascading effects describes the impact that one person’s workaround can have on other team members’ work. However, the researchers did not discuss the effects of allowing a PIP to persist
in the system and not making others aware of that problem. As Saleem et al. (2011) state, the use of EHR workarounds, “introduces the potential for gaps in documentation as well as the unintentional propagation of errors” (p.662). Therefore, this persistent PIP and lack of awareness can affect the next team member who uses that information for her own work. For example, the preliminary findings discuss how the system restricted a social worker from editing the patient’s record, so she created a workaround by writing her patient notes on a printed patient report. Although the workaround allowed the social worker to record patient notes for herself, it also prevented any of the other team members from being able to see her notes in the EHR system. Her notes could help provide a more comprehensive view of the patient’s condition to other members of the clinical team, as seen in prior studies (Zhou, Ackerman, Zheng, 2009).

Therefore, this observation of PIP workarounds in the ED informed my main study. When shadowing patient-care teams in the in-patient ward I included observations about how and why patient-care team members worked around PIPs.

5.5.2 Persistent PIPs in Collaborative Teams

Patient information problems can persist in EHRs if they are not identified and fixed in a timely manner. These persistent PIPs are common for hospital staff because the staff are responsible for a number of patients and a variety of urgent tasks, which can delay or deprioritize their ability to fix the PIPs (Ash, Berg, Coiera, 2004; Park, Lee, Chen, 2012). However, a delay in fixing PIPs in a collaborative environment can directly affect the rest of the patient-care team who rely on the accuracy of that information. This raises a few questions about how collaborative teams manage PIPs, including: (a) Who is responsible for fixing PIPs that are identified within a team that co-manages the patient data? (b) How do hospital policies about managing PIPs align with the actual work practices of the team members?
These concepts of shared responsibility and policy versus practice are common characteristics of a collaborative work environment that could influence the persistence of PIPs in the following ways:

(a) *Shared responsibility*: In hospitals, there is a shared responsibility by all members of the patient-care team to enter and update patient information in the EHR. However, as seen in the preliminary findings, members of a team may have an ambiguous understanding and, at times, a conflicting opinion about who is responsible for managing the information. This can lead to the persistence of PIPs because the team member either assumes or believes that someone else is responsible for fixing the issue. This occurred in the ED when the social worker needed to find someone to fix wrong information in a patient’s record and registration told her it was the nurses’ responsibility, but the nurses told her it was registration’s responsibility. This finding also informed the focus of my main study. As part of my main study objectives, I observed the work practices of the patient-care teams. These work practices included how team members determined who was responsible for managing PIPs, and how the formal hospital policies informed their behaviors when determining who was responsible for managing PIPs. I also asked participants about their perceptions of accountability within such a collaborative work environment.

(b) *Formal policies versus work practices*: Hospitals create formal policies to outline accountability and provide guidelines for how hospital staff should handle a variety of situations (Murphy, Reddy, Xu, 2014). However, while some of the formal policies include very specific instructions, others are more general or vague in order to account for variances across different areas of the organization. The issue with these general policies is that the staff may have different interpretations of the policies when conducting their daily work. This can lead to an ambiguous understanding or a conflicting opinion about responsibilities, as discussed in the previous section. In order to study this in my main study, I created a plan to
analyze the hospital policies to understand who was legally accountable for the accuracy of patient records and how the hospital advised staff on managing PIPs. I then observed participants and asked for their opinions on how well the formal policies aligned with their everyday work practices.

5.5.3 Impact of EHR Design on PIPs

As hospitals transition from paper records to EHR systems, it is important to consider the impact that the system design has on the patient-care team’s ability to identify and manage patient information problems. Although PIPs have always existed in paper-based patient records (Weir, et al, 2011), the transition of these paper records into electronic systems has changed the way that hospital staff enter, view, and share the information that they need to do their work (Ash, Berg, Coiera, 2004). Therefore, it is important to first understand the differences between paper and electronic health records, and then explore how these differences may impact the identification and management of PIPs.

A primary difference between paper and electronic records is that the electronic records are constantly updated and viewed by multiple members of the patient-care team from distributed locations (e.g., their own computers, laptops, mobile devices). Electronic records are also typically updated and viewed away from the physical proximity of the patient’s room (Ash, Berg, Coiera, 2004; Park, Lee, Chen, 2012). This differs from the use of paper-based records, where there is one physical copy of a patient’s record that is typically viewed, updated, and stored either inside or right outside the patient’s room. Viewing or updating patient records within close physical proximity to the patient’s room, versus at a later time and away from the context of the patient encounter, has been shown to increase the recollection and accuracy of physicians’ notes (Ash, Berg, Coiera, 2004; Park, Lee, Chen, 2012). Therefore, this paper-versus-electronic
comparison illustrates the importance of considering the impact that the physical proximity of patient records to the location of the patient room has on PIPs.

Another difference between paper and electronic records is that EHRs are designed to dynamically display the most recent patient information without always showing who last updated the record and when it was updated. This can lead to users assuming that the system is displaying the most recent and accurate information, as seen in the findings and in prior studies (Ash, Berg, Coiera, 2004; Embi et al., 2004). The dynamic display of information in EHR differs from paper-based records. Paper records typically include visual cues to indicate who updated the record (e.g., signature, initials, handwriting) and when it was updated (e.g., date, change in ink, new sheet of paper) (Weir et al., 2011). Similarly, an attending physician in the study described this difference between paper and electronic records as well: “Paper records are a static representation of the patient’s condition at that moment in time, but computerized records tell a dynamic story of the patient’s condition. They are constantly updated and changing.” Because there are differences in how information is entered, viewed, and shared in paper versus electronic records, it is important to evaluate how the transition from paper to electronic systems can impact PIPs encountered by patient-care teams. For example, the loss of visual cues that are typically found in paper records (Weir et al., 2011), can make it more difficult for hospital staff to identify PIPs in EHR systems.

Therefore, the transition from paper records to EHR systems could affect how patient-care teams identify and manage PIPs. This discussion about the differences between paper and electronic records informed my main study by including observations that focused on how the EHR helped or hindered the team’s ability to identify and manage PIPs. This finding also motivated my main study by proposing design recommendations for how to improve the EHR design in order to better support the identification and management of PIPs by collaborative patient-care teams.
5.5.4 Transitioning to the Main In-Patient Study

This preliminary ED study informed and motivated my main in-patient study by providing me with field work experience, introducing me to the concept of PIPs, and raising various socio-technical questions about PIPs.

(a) Field work experience: This ED study provided me with experience in how to conduct observations and interviews in the busy, complex hospital environment. This included helping me understand the nature of hospital work, which made me feel more comfortable when shadowing teams and talking to participants during the main study. Additionally, the preliminary ED study also taught me how to most effectively develop rapport with my participants, take detailed field notes, and ask questions that would directly address my research objectives.

(b) Preliminary insights into PIPs: Although I was studying the challenges of managing information in collaborative environments during my preliminary study, the concept of PIPs was not an original focus of the study. I became interested in the concept while interviewing and observing participants in the ED. Analyzing the ED field study data helped provide preliminary insights into the types of PIPs that exist in hospitals, the ways that ED staff identified and managed those PIPs, and the impacts that PIPs can have on other ED staff members due to the collaborative nature of patient-care work.

(c) Socio-technical questions about PIPs: The preliminary study also raised questions about various socio-technical factors that could impact the identification and management of PIPs by the collaborative patient-care teams. These socio-technical factors include: how team members who co-manage patient data determine responsibility for managing PIPs, how well hospital policies about PIP management align with the team members’ actual work practices, and how the design of the EHR helped or hindered the identification and management of
PIPs. Each of these socio-technical factors were observed and analyzed during my main in-patient study.

After deciding to focus on the concept of PIPs for my dissertation, I chose to move my main study into the in-patient ward of the hospital, instead of conducting a second study in the ED. I chose to do this for the following reasons:

(a) *Gatekeeper availability:* There was an attending physician in the in-patient ward who agreed to give me access to the site, introduce me to clinical teams that I could shadow during rounds, and provide support for my research activities.

(b) *Longer patient stays:* Patients in the in-patient ward stay at the hospital for longer periods of time than in other units, such as the ED. In the ED there is a quick patient-turnover and the staff are even evaluated on how quickly they can discharge patients to avoid extended stays. On the other hand, the in-patient ward keeps patients for days or even weeks. This results in larger amounts of patient data that accrues over time, and a longer period of time when patient-care teams can identify and manage PIPs that arise within the patients’ data. These characteristics of the in-patient ward afforded me more opportunities to observe the identification and management of PIPs by the patient-care teams.

(c) *Routine schedule:* Although all hospital work can be urgent and complex, the patient-care teams in the in-patient ward have a slower and more routine schedule than in the fast-paced ED. This routine schedule created a better opportunity to more closely shadow participants, which was necessary to collect rich, detailed descriptions of the types of PIPs that team members encountered and how the team members identified and managed the PIPs.
5.6 Chapter Summary

This chapter summarizes the preliminary ED study. This includes a description of the four main themes: types of PIPs, identification of PIPs, management of PIPs, and challenges of managing PIPs in collaborative teams. The chapter concludes with a discussion about how these preliminary findings motivated and informed my main in-patient study. The next chapter will present the findings of the main in-patient study.
6 Main Study Findings

The main study findings are presented in four sections. I will first define the types of PIPs that were observed or discussed by the patient-care team members. Then I will describe how the team members first identified the PIPs that they encountered during their work and then how they managed the PIPs. Finally, I will describe how members of the patient-care team determined who was accountable for managing the PIPs that emerged during their work.

6.1 Defining Patient Information Problems

In this study, patient information problems are defined as any issues related to patient information that impact the patient-care team’s ability to perform their work. These impacts can include preventing or delaying patient-care decisions or activities until the PIP is managed. During the main study in the in-patient ward, I identified 120 discrete PIPs and classified them into seven types (Table 6.1 and Appendix E).

The 120 PIPs occurred during one of three different information management activities: viewing the EHR system (69%), verbally communicating with others face-to-face or on the phone (25%), and referencing paper-based notes (6%). The hospital policies state that the EHR system is the official source of patient data. Therefore, the EHR was the primary source of patient information for the participants and where a majority of PIPs were identified by the participants. However, when participants are busy and unable to immediately enter information into the EHR, they verbally communicated with other team members to get the most recent information and used paper-based notes to temporarily document information until they were able to enter it into the EHR system. This is why some PIPs were identified during these other information management activities outside of the EHR system.
<table>
<thead>
<tr>
<th>PIP Type</th>
<th>Frequency of PIP</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong</td>
<td>26</td>
<td>Information is not accurate.</td>
</tr>
<tr>
<td>Missing</td>
<td>32</td>
<td>Information is expected to be there, but all of the information is not there.</td>
</tr>
<tr>
<td>Incomplete</td>
<td>24</td>
<td>Information is expected to be there but only part of the information is provided, which can result in participants believing they have all of the information when they do not.</td>
</tr>
<tr>
<td>Questionable Accuracy</td>
<td>17</td>
<td>There is uncertainty about the correctness of the information and there is no way to verify if the original information is correct or not.</td>
</tr>
<tr>
<td>Unclear Meaning</td>
<td>5</td>
<td>There is uncertainty about the meaning of the information.</td>
</tr>
<tr>
<td>Outdated</td>
<td>8</td>
<td>Information that frequently changes is no longer accurate and has not been updated.</td>
</tr>
<tr>
<td>Segregated</td>
<td>8</td>
<td>Multiple pieces of related information are stored in different locations and are not easily viewed together.</td>
</tr>
<tr>
<td>Total</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

Table 6-1: Types of PIPs

Additionally, a variety of roles were responsible for helping to identify PIPs. These roles included: residents or interns, attending physicians, nurses, patients, patients’ family members, pharmacists, and care coordinators (Table 6-2).
<table>
<thead>
<tr>
<th>PIP Type</th>
<th>Resident /Intern</th>
<th>Attending</th>
<th>Nurse</th>
<th>Patient</th>
<th>Patient’s Family</th>
<th>Pharmacist</th>
<th>Care Coordinator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong</td>
<td>6</td>
<td>8</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Missing</td>
<td>14</td>
<td>11</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Incomplete</td>
<td>11</td>
<td>11</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Questionable Accuracy</td>
<td>10</td>
<td>9</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unclear Meaning</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Outdated</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Segregated</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>53</strong></td>
<td><strong>44</strong></td>
<td><strong>18</strong></td>
<td><strong>4</strong></td>
<td><strong>4</strong></td>
<td><strong>3</strong></td>
<td><strong>2</strong></td>
</tr>
</tbody>
</table>

n = 128*

*Sometimes multiple roles helped to identify one PIP, which is why there are 128 people identifying 120 PIPs.

Table 6-2: Identification of PIPs by Role

Since the teams primarily consisted of physicians, it is understandable that a majority of the roles who identified PIPs were the medical residents/interns and attendings. However, the nurses, pharmacists, care coordinators, and even the patients and patients’ families also helped to identify PIPs. More specifically, these results highlight the critical role that nurses can play in PIP identification. For instance, they identified the same amount of wrong information as the residents/interns. Additionally, there were numerous times that nurses followed-up with the physicians in the team about a PIP. This highlights the importance of patient-care team members double-checking and communicating concerns about information to one another. This collaborative effort to manage PIPs can prevent the PIPs from persisting in the documentation, and, more importantly, it can prevent any negative impacts to the patients. The next seven subsections describe each PIP type in more detail.
6.1.1 Wrong Information

Wrong information in patient records is a serious problem that can negatively impact the patient-care process and potentially cause harm to patients (Ash, Berg, Coiera, 2004; Park, Lee, Chen, 2012). There were a variety of reasons why information was not accurate in the patient’s record. The main reasons included wrong information being carried over into the system from other units or previous visits, and wrong information due to data entry errors.

Wrong information was occasionally carried over from other units or from historical records. In the following example, the patient-care team went into an ICU patient’s room and I stayed in the hallway talking to a pharmacist who was rounding with the team. The pharmacist showed me how she typically reviews the patient’s medication list to see if all of the medications are appropriate for the patient’s current condition. She then identified one medication that did not make sense to her. When the team exited the patient room, she asked the team about the medication:

The rounding pharmacist tells the team that the patient is on the medication “Penicillamine” and asks if this is correct, or if it is supposed to be the very similar sounding medication “Penicillin V” instead. After reviewing the medication list and patient history in the EHR system, the team realizes that the wrong medication was carried over in the system from the patient’s ED admission. The patient was supposed to be on Penicillin V. [shadowing field notes]

Additionally, when a new patient was admitted into in-patient, the patient-care team frequently checked the system to see if the patient already had an existing record from a previous visit so they could understand the patient’s history. An attending told the team about how one of her patients had an error in her record from a previous hospital visit that carried over into her new History & Physical (H&P) section of the current medical record:

The attending tells the team about an error she had found in a previous patient’s H&P. The historical H&P report appeared in her current view of the patient record and in the H&P summary it stated that the patient recently had a mastectomy due to breast cancer. The attending started talking to the patient about the mastectomy and the patient looked confused. The patient said she never
had breast cancer or a mastectomy. The attending then spoke about how hard it is to change previous records because they are “locked down” and “all you can do is put a note in the bottom addendum area, but, because the H&P is usually a longer note, no one really reads the addendum. So now this historical H&P is misinforming anyone who reads it. It’s really an issue.” [shadowing field notes]

Both of these examples show how previous records from other units or prior visits can result in wrong information being carried into the patient’s current record. This can cause the current patient-care team to be misinformed about the patient’s treatment or condition, and can even lead to the continuation of an inappropriate medication or treatment that could adversely affect the patient. Although the participants stated that the current team should always be responsible for the accuracy of the patient’s current record, the proliferation of wrong information can cause negative impacts if the errors are not caught by the current team.

Additionally, wrong information can also occur when there is a data entry error in the EHR system. These data entry errors did not just affect the immediate physician team, but also affected any other member of the patient-care team who relies on the accuracy of the EHR record to do their work. In the following example, a nurse asks the residents about why a patient still has his foley (i.e. bladder catheter) when she was told that the foley had already been removed:

A nurse approaches the residents and asks when they are going to remove the patient’s foley. The residents appear confused and one of them says that the night shift already put in the order and had the foley removed. The nurse says, “Nope, it’s still in. I just checked.” The residents pull up the patient’s record in the EHR and the patient’s progress note from night shift says that the foley was removed. When they check the order history, they see that the order was never placed. One resident tells the nurse, “They must have planned on doing it, but forgot to put in the order before leaving, even though it’s in their notes that it was removed. I’ll put the order in right now.” [shadowing field notes]

Similar to the above scenario, the nurses frequently contacted the physician team when they believed that there was a data or order entry error. The following two scenarios exemplify this common practice of nurses following-up with physicians to correct wrong information:
A nurse approaches and asks a resident if she wants her to administer the patient’s Vancomycin [type of medication] as they had discussed earlier. The resident says, “Yes, I already added it in the system.” The nurse replies, "It's actually not in the system. So if you want me to give it, can you add it?" The resident says, "Oh, I didn't realize that. Yes, I will add it now." [shadowing field notes]

A nurse catches the team before we leave the MIMCU unit and tells the team that the patient they just saw cannot take the potassium pill they just prescribed. The attending clarifies, “Because of the size of the pill and the issues the patient has with swallowing?” The nurse says yes. The resident who entered the order says, “Oh I thought I put in for the liquid form. I’ll change that.” The resident opens the team laptop, goes into the system, and changes the order to adjust the potassium form. [shadowing field notes]

As these examples describe, wrong patient information can lead to negative impacts on the patient-care treatment plan, unless they are properly identified and managed.

6.1.2 Missing Information

The participants also encountered missing information during their patient-care activities. This occurred when they were expecting to find information in the EHR system, but it was not there. The reasons for missing information in the EHR included: a delay or lack of data entry by team members, missing documentation from other units or facilities, and usability issues with the EHR system.

The patient-care team members frequently encountered times when other members of the team did not enter patient information that they said they would. This frequently occurred when the IM physician team called in consulting physicians to evaluate the patients. The IM team relied on the consulting physicians to enter notes into the EHR system that summarized their assessment and provided the recommended treatment or proposed diagnosis. However, the consulting physicians frequently delayed the entry of these notes, which impacted the IM team’s ability to proceed with their patient-care tasks. The following two scenarios exemplify this common PIP:

The IM team is standing outside a patient’s room discussing how to proceed with the patient’s treatment. The attending mentions that they can’t really make any decisions without talking to Cardiology about their assessment first. A resident says that he spoke to someone from the Cardiology team before leaving the
previous day and the Cardio consult said that they were on their way to see the patient and would enter notes right after. The attending pulls up the EHR record to look for the Cardio note. She says, “There’s no note. This always happens. You’ll have to follow-up with them, because we really can’t go from here without their input.” [shadowing field notes]

During pre-rounds, I follow a resident to each patient’s room to get an update on their overnight status. The resident tells me that they are waiting on Gastroenterology (GI) to perform a procedure on one patient, but they haven’t yet. When they arrive at the patient’s room, the resident talks to the nurse. The nurse tells him that GI did perform the procedure the night before. The resident is confused and says, “Really? They never notified us or wrote a note about the patient getting the procedure.” The nurse says she only knew about it because the overnight nurse told her that she saw the patient leave for the procedure and return afterwards. The resident says “Alright, I’m going to have to follow-up with them to make sure. Why can’t they just put the note in?” The nurse responds, “I have no idea. That seems to happen a lot.” [shadowing field notes]

Another common cause of missing information in the EHR system occurred when the IM team expected to see patient records from other hospital units (e.g., ED) or facilities (e.g., other hospitals, nursing home), but the records were not there. In the following scenario, a resident comments on their ED not recording a patient’s fluid output levels in the EHR:

A resident is presenting a newly admitted patient from the ED. The resident tells the team that, “the ED did not record the outputs in the system, which is not surprising [laughs, and the rest of the team smiles and nods their heads], so we need to start monitoring that.” [shadowing field notes]

These missing records that other units and facilities were supposed to provide but did not resulted in the team being frustrated and having to do extra work to piece together information that was already gathered at the other unit or facility. An attending explained this during rounds when the team encountered another patient who had missing records from the previous hospital:

During a team discussion about diagnosing a patient who was just transferred from another hospital, the attending says "It's so hard because the records from the other hospital are missing, so it's a black box. The patient's electrolytes are a mess, but I have no idea what fluids they had at the other hospital and it's not fair because then I get the brunt of frustration from the patients and family. We only know what we know, and we run new tests to put the pieces together, but there's always things missing about previous care. We end up responsible for everything that has happened up until now, even though we weren't involved." [shadowing field notes]
Lastly, usability issues with the EHR system also resulted in missing information when participants tried to find information that they needed and it was not there. As described in Section 4.2, the EHR system continuously synchronizes with the imaging system (“GE system”) to seamlessly integrate medical scans and their associated notes into the EHR system for the patient-care teams. However, there is sometimes a delay between when the GE system is updated and when it appears in the EHR system. The following example describes this usability issue:

A resident presents the patient’s status to the team. He explains that a consulting physician told him that he saw the patient the previous night and that the scan and consultant notes were in the system. However, when the resident opens the EHR on the team laptop, there are no consult notes. The resident opens the paging system on the laptop and sends a page to the consulting team. The IM team continues with their rounding activities. Approximately 20 minutes later, someone from the consulting team pages the resident. The resident goes to a nurses’ station and calls the consulting physician. The consulting physician explains that they put their note in the GE system with the patient’s scan, and that there is usually a delay before they appear in the EHR system. The resident asks the consulting physician about any major issues and says he’ll read the note when it syncs with the EHR. [shadowing field notes]

Additionally, the residents also discovered that the EHR system responds differently when accessed from a computer versus a mobile device. In the following example, a resident is trying to find patient documentation that the intern entered a few hours ago, but it is missing from the patient’s record due to an EHR usability issue:

The resident is getting ready to discharge a patient and opens the patient’s record to confirm that the documentation is complete, but she cannot find the information that the intern entered that morning in the workroom. The resident finds the intern and asks about the documentation. The intern says that she did enter it that morning. After checking again, the resident confirms that it is still not there and asks the intern if maybe she entered it in another patient record by accident. While the resident and intern try to figure out what happened, another resident arrives and they tell him what happened. He asks the intern if she entered it on her iPad. She says yes. The resident explains the issue: “I think that’s the problem. When you do it on the mobile devices, you have to save the information before switching tabs, otherwise it only saves the information for the tab that you have open when you hit the ‘save’ button.” They discuss how this is different from when they do it on a desktop or laptop, which allows the user to navigate between tabs and just save at the end. The intern is frustrated and says, “That’s really annoying. Ok, I’ll enter it all again so we can do the discharge.” [shadowing field notes]
6.1.3 Incomplete Information

Another PIP that the participants encountered was incomplete information. This is when the information is expected to be in the EHR system, but only part of the information is provided. Although this PIP is similar to missing information in that certain information is not found in the system, the important difference is that missing information was easily spotted by the participants. If a consult note was completely missing in the system, it was very obvious to the team members that it was missing. However, when a consult note was only partially complete, it resulted in some team members believing that they had all of the information when they did not.

Incomplete patient information was frequently identified in the following patient documentation: notes from consulting physicians, orders put in by other shifts or teams, and discharge reports.

The following scenarios illustrate incomplete information in consult notes:

*The IM team is discussing a patient who had been seen by a Urology consulting team earlier that day. The attending asks the resident, “What does Urology want to do?” The resident says that the Urology consults left a procedure note but there are no details or recommendations for how the IM team should proceed. The resident pulls up the consult note in the system and says, “They placed the stent, but when I talked to them on the phone they said they also removed gritty stones too, which is not in here.” The attending says, “Oh I didn’t know that. The removal of gritty stones is good for us to know about and it should be included in their notes.” She tells the resident to follow up with the Urology consults again to confirm the details of their procedure. [shadowing field notes]*

*The resident presents a patient to the IM team who had oral surgery to extract a number of teeth the day before. A second resident asks the first resident how many teeth were extracted. The resident searches for the consult note in the EHR and says, “I don’t know. No one seems to know, she [the patient] doesn’t even know, and it’s not in the note.” The nurse sitting at her computer nearby says, “Someone said 8 [teeth were extracted] last night, but I’m not sure. That’s the number I thought I heard.” After the assessment of the patient, the team talks outside the room about the treatment plan. The second resident asks, “Does the dentist think the patient needs antibiotics?” The first resident responds, “I don’t know. I just checked [the note] again and they didn’t say anything about an antibiotic. They haven’t called either. They usually call the attending but they didn’t.” The second resident recommends that he call the dentist for an update. [shadowing field notes]*
Each time the participants identified an incomplete note, one of the team members had to perform additional work to follow-up with the consulting teams. This typically took time away from other patient-care tasks and resulted in delayed patient-care decisions. Additionally, incomplete information was also frequently identified when the team was discussing orders put into the system by other shifts or consulting teams. Although the order itself was always clear (e.g., medication name, dosage, form), it was not always clear why the order was placed for the patient or who placed the order. This led to the team members having to follow-up with other members of team, which was sometimes difficult if the team members were no longer on shift.

The following scenarios exemplify incomplete information in orders from other shifts or consulting teams:

*The IM team reviews the patient’s record at the nursing station before entering the room. The attending asks, “Why did the night flow give Vitamin K last night?” The resident says, “They typically give Vitamin K if the INR is greater than 9 and not bleeding, or if the INR is less than 9 and bleeding.” The team discusses how they do not agree that giving Vitamin K was necessary for the patient given the other information in the record. The attending says, “For some reason the other team thought the patient needed it, but we don’t know why. Try to find out why.” [shadowing field notes]*

*During rounds, an attending asks a resident, “Is your patient on Mag-Ox for stool softening or for being low in magnesium?” The resident reviews the previous shift’s progress notes and says, “I’m not sure, it doesn’t say. It’s from the night flow, so we can’t follow-up.” The attending recommends, “Maybe ask the nurse? See if she knows something about it.” [shadowing field notes]*

Lastly, incomplete information was also discussed when the IM team was getting the patients ready for discharge and completing their documentation. The attendings and care coordinators, who helped with discharge activities, frequently commented on the incompleteness of the discharge reports. Attendings were ultimately responsible for approving and co-signing the discharge report that the residents completed. Frequently, the attendings would tell the residents that the patients’ medication lists were incomplete and that they needed to complete them before approval:
An attending enters the workroom where the residents are working on EHR documentation. The attending goes to one of the residents and says, “The meds for [patient’s last name] didn’t look complete in the H&P. I won’t sign off until they're complete.” The resident says, "Ok, I'll look them over again." [shadowing field notes]

The intern tells the attending that the discharge documentation for a patient is ready for her review. The attending pulls up the patient’s records on her laptop and reviews the medication list. The attending says, “The patient's home meds are not on the H&P. We have to list those as well, not just the hospital meds. So you’ll need to add that before discharge.” The intern says “Ok” and returns to the workroom to update the patient’s medication list. [shadowing field notes]

Additionally, the care coordinators also compiled documentation for the patients’ discharges to ensure that patients could be properly reimbursed for medications or other scripts. A care coordinator explained this to me and described an incomplete progress note that she had to follow-up on:

The care coordinator tells me that the patient was given a script for 2 liters of oxygen after discharge but the EHR progress notes that were approved by the attending do not reflect the patient’s need for the oxygen when leaving the hospital. She explains that this means that the patient's Medicare will not reimburse for the oxygen script if it’s not listed as necessary for discharge in the progress notes. She says this tends to happen with physicians who don't realize what information is needed for reimbursement. So she tells me that she will follow up with the attending who approved the progress note so that the missing information is added in the final progress notes. [shadowing field notes]

### 6.1.4 Questionable Accuracy

The accuracy of patient information is critical to patient-care teams to ensure that they are making decisions about diagnosis and treatment based on correct information. However, there are times when team members come across patient information and they question the accuracy of the information. Sometimes that questionable information can be verified as either being correct, or being wrong or outdated. However, with the questionable accuracy PIP type, the team cannot verify if the information is correct or not. There were two times that the patient-care team members encountered this type of PIP: (a) when the information was subjective, two team members disagreed with each other, and there was no definitive right or wrong answer; and (b)
when the team members questioned the accuracy of an instrument used to gather patient data, but they could not go back in time to re-test the patient in the exact same condition as when the instrument was used to perform the original test.

When patient-care team members assess a patient’s condition, their assessments are subjective. There were times during this study when multiple team members disagreed on their assessment of the same patient’s condition. The following two scenarios illustrate the differences in subjective assessments and how this can lead the to team members questioning the accuracy of the information:

Two residents enter the patient’s room while the attending talks to someone in the hallway. One resident assesses the patient’s shin infection and comments, “Oh that’s good, it looks less red than my last examination.” The nurse enters the room and says, “Actually, I think it looks more red than earlier today. I was going to ask you about what we should do because I was concerned that it’s more red.” The resident reassesses the shin again and says, “No I think it looks less red.” The attending enters the room, and the resident updates the attending on the patient’s status saying that the infection appears less red, which is a good sign. The nurse shakes her head and leaves the room. [shadowing field notes]

The IM team is in a patient’s room using their stethoscopes to assess the patient’s heart murmur. The attending informs me that the heart murmur is graded on a scale of 1-6. The intern listens first and says she would grade it “a 3 or 4.” One of the residents takes her turn listening and says, “Whoa, I would actually say a 2.” The other resident listens and says he would also say a 2. The attending listens last. She laughs and says, “I would actually say a 1. But I’m old and my hearing is not so good, so I wouldn’t necessarily take my number.” The intern then went back to listen again, but she said she still heard a 3 or 4. The team discusses how assessments like this can be very subjective and can’t always be figured out because different people hear different sounds. The attending agrees and says this is why it is so important to be as detailed as possible in progress notes and try to get second opinions on subjective numbers like this. [shadowing field notes]

Additionally, team members also questioned the accuracy of information that came from medical instruments or lab testing. In the following two scenarios, the teams questioned the accuracy glucose tests for multiple patients in the same unit and the lab results for a patient’s hemoglobin levels:
The team visits 3 patients in the MIMCU and all 3 patients have lower than expected blood sugar levels. The attending says, “This patient seems low, the other guy seems low, they all seem lower than they should be. I’m seeing a trend, maybe something is up?” They look for the nurse and ask her to do the blood sugar tests again. [shadowing field notes]

The resident is presenting a patient and pulls up the patient’s most recent lab results. He says, “the hemoglobin went from 9.3 to 7.4. That seems like a quick drop. Let’s see if it’s real.” The attending comments, “I’m beginning to wonder if it’s our lab. Why don’t we run that test again to be sure.” [shadowing field notes]

In both of these scenarios, the team cannot go back in time to re-test the patient in the exact same condition as when the glucose or lab tests were originally run. Therefore, when they encounter this type of PIP they typically responded by watching the numbers more closely and having the patients re-tested to see their current status.

### 6.1.5 Unclear Meaning

Another type of PIP that the participants encountered was unclear meaning. This occurred when team members were uncertain about the meaning of information found in a patient’s record. This specifically happened when certain team members used acronyms or terms that were unknown or unclear to other team members. The following scenarios illustrate this type of PIP:

The team is reviewing surgery notes and the attending says, “There’s a recommendation for ‘CLD’? What does ‘CLD’ mean? I’ll go into the surgery note.” The two medical residents do not know. All of the team members start looking on their laptops or mobile devices for an answer. One resident looks it up on her iPhone and after a few minutes says, “Oh I think it means ‘clear liquid diet’? I’ve never seen that used as an acronym before.” The others agree that they’ve never seen that acronym before and discuss how they are confused about why surgery still wants the patient on a clear liquid diet. The attending says, “I don’t see why she still needs to be on a ‘CLD’ as they call it, if that’s what ‘CLD’ actually means. We should follow-up with them to figure out what’s going on and if that’s really what it means.” [shadowing field notes]

The attending asks one of the residents why the patient’s lab results are not in. The resident checks the system and sees that the patient’s specimen wasn’t delivered to the lab. The resident finds the nurse and asks why she didn’t deliver the specimen to the lab. The nurse says that she thought the resident was doing it
because they are in the Surgical ICU, and all orders are the “clinician to collect” status. The resident is confused and says, “Oh, other units have that, but the nurses always do it anyway.” He asks the nurse if she can do it. The nurse says, “No, it’s floor policy that the clinician has to collect and deliver the specimen.” The resident says, “Ok, I’ll take care of it.” After the nurse leaves, the resident asks the rest of the team if “clinician to collect” means that in all areas of the hospital. The other residents say that they are not sure. The attending says that it may depend on the nurses in the unit, but that the resident should follow the SICU floor policy and do it himself.

This PIP typically led to team members having to follow-up with other members of the team to clarify the acronyms or terms, and sometimes it led to delays in patient-care decisions or treatments. It also led to frustration or tension between roles if there were differences in opinion about what the acronym or term meant. Consider the following scenario where the term “PRN” is identified as a PIP because the nurse and resident have a conflicting understanding of what the term means. The PIP results in an unclear understanding about who is supposed to decide if the patient needs a procedure (PRN is a medical acronym derived from the Latin phrase pro re nata, meaning as needed):

The resident asks the nurse why the patient did not receive a suppository procedure that morning. The nurse says, “It wasn’t on the list.” The resident looks confused, opens the system, and says, “Yes it’s scheduled daily.” The nurse goes to her system in the hallway. I follow her and ask if I can see her list. She looks up the order, and shows me, “See, it’s listed as PRN.” I ask what this means to her: “It means it’s as needed or as requested. So if the doctors want it done, then they tell me and I do it.” The nurse goes back and tells the resident, “It’s not scheduled daily, it’s listed as PRN. But I can do it, if that’s what you want.” The resident says “Yes, please do it if the patient needs it.” We exit the room and I ask the resident what “PRN” means to him: “It means as needed, so they should just do it if the patient is stopped up. It’s obvious that the patient needed it done...She doesn’t need us to tell her to do it.” [shadowing field notes]

In this scenario, the nurse believes that PRN means that the physicians will tell her when to do the procedure. Whereas, the resident believes that PRN means that the nurse should just use her best judgment for when to give the procedure to the patient. Through the discussion of this PIP, the nurse and resident agree that the nurse will be responsible for deciding if the patient needs the procedure moving forward.
6.1.6 Outdated Information

Patient records are frequently updated throughout the course of a hospital stay due to the patient’s constantly changing condition. As the patient-care team collects new information about the patient, they update the records in the EHR system. However, sometimes the team members become busy or forget to update patient records with the new information. This is primarily due to the team’s constant shifting between patient-care activities. Therefore, patient records sometimes become outdated, where the information is no longer accurate and has not yet been updated. In this study, the outdated information occurred when (a) nurses did not update the system with the patients’ most recent information and (b) when residents or interns printed reports from the system before rounds, which did not reflect any new updates made during their morning rounds. The following scenario illustrates when the system had outdated numbers for the patient’s inputs and outputs because the nurse was unable to update the system before rounds.

This type of scenario occurred five times during the study.

During morning rounds, a resident presents the patient and says, “The patient has 3 liters intake at 5pm and 0.5 output. But that was for last night. I’m not sure what it is this morning.” The team looks around and asks a nearby nurse if she is the patient’s nurse. She provides the team with the current input & output numbers from a piece of paper in her pocket. She says, “I’ve been running around, but I’ll update the system with these new numbers now.” [shadowing field notes]

Additionally, residents and interns frequently printed patient summary reports from the system to use during rounds. However, sometimes the information in the system was updated after they printed the report, leading to the team discussing outdated information during rounds.

An intern presents the patient outside the room and provides the team with the patient’s hemoglobin levels from his printed summary report. “The patient was at 12.6, but now she’s down to 6.2, which is not good.” The attending says, “Yeah, that’s not good. She’s anemic. So what’s your suggestion?” The team begins to discuss patient-care plans. A few minutes later, the nurse enters the hallway and the attending says, “So she dropped? [pointing towards the patient room].” The nurse looks confused and says, “Um, she’s back up at 13.2, so, I think she’s actually doing ok.” The team seems surprised, and the nurse says the
labs were just posted with new numbers. The team checks their systems and sees the new numbers. [shadowing field notes]

6.1.7 Segregated Information

The last type of PIP is segregated information. This occurred when multiple pieces of related information were stored in different locations in the EHR and they were not easily viewed together. Although all of the information could eventually be found in the system, it delayed the team’s ability to make decisions or proceed with their plans of care until all of the information could be viewed together. An example of this is when previous progress notes contained vague information about medications or procedures, and the current team had to go through the ordering system to obtain the details:

The IM team is at the nurses’ station discussing a patient who was put on an anti-coagulant during the night. The attending asks, “Which medication did the night shift prescribe?” The resident opens the progress note and spends 1-2 minutes reading through the text. She then says, “They don't specify which anti-coagulant the patient was given. They say they put her on one, but they don’t say which one.” The attending tells the resident that she can look it up in the pharmacy system. The resident says "Yes, but it's such a pain, why can't they just write it in the notes." [shadowing field notes]

The segregated information also caused a problem when the team had to access older, archived documents from a patient’s previous visit. In the following scenario, a resident had ordered a “GI Morbidity Study” for her patient without realizing that the patient already had one five years before.

The IM team is outside a patient’s room and the attending asks why someone ordered a “GI Morbidity Study” for the patient. The resident says “I ordered it because yesterday we talked about her needing one.” The attending says, “I had said to order one if she didn’t have one yet. But her records show that she had one done back in 2009.” The resident responds, “2009? That’s too many records to look through! Where do I even find records from 2009?” The team discusses how it’s hard to find some of the historical records and where they are located in the system. [shadowing field notes]
Therefore, these findings about segregated information describe how the design of the EHR system can lead to additional work for the team, or it can lead to the team ordering unnecessary tests for the patient.

This section provided descriptive examples of the seven types of PIPs that were observed or discussed during the main study. The next two sections will describe how these PIPs were identified and then managed by the patient-care teams.

6.2 Identifying Patient Information Problems

The PIPs described in the previous section will continue to persist in the patients’ records until someone clearly identifies them as being a PIP. In the main study, patient-care team members identified PIPs when they were performing one of four different activities: not finding needed information, encountering conflicting information, making sense of information, and generalizing unreliable sources of information (Table 6-3).

<table>
<thead>
<tr>
<th>PIP Identification Activity</th>
<th>Frequency</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not finding needed information</td>
<td>50</td>
<td>When participants were searching for specific patient information and were unable to find it.</td>
</tr>
<tr>
<td>Encountering conflicting information</td>
<td>38</td>
<td>When participants identified a discrepancy between two different sources of patient information.</td>
</tr>
<tr>
<td>Making sense of information</td>
<td>27</td>
<td>When participants questioned the accuracy of patient information based on their medical training, experience, and knowledge of the patients’ conditions.</td>
</tr>
<tr>
<td>Generalizing unreliable sources of information</td>
<td>5</td>
<td>When participants associated certain hospital units or external facilities as having a reputation for being unreliable sources of patient information.</td>
</tr>
<tr>
<td>TOTAL</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>

Table 6-3: Identification of PIPs
Additionally, Table 6-4 displays the number of each PIP type that was identified during each of the four PIP identification activities.

<table>
<thead>
<tr>
<th>PIP Type</th>
<th>Not Finding Needed Information</th>
<th>Encountering Conflicting Information</th>
<th>Making Sense of Information</th>
<th>Generalizing Unreliable Sources of Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong</td>
<td>0</td>
<td>16</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Missing</td>
<td>24</td>
<td>6</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Incomplete</td>
<td>18</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Questionable Accuracy</td>
<td>0</td>
<td>9</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Unclear Meaning</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Outdated</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Segregated</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>50 (42%)</strong></td>
<td><strong>38 (32%)</strong></td>
<td><strong>27 (22%)</strong></td>
<td><strong>5 (4%)</strong></td>
</tr>
<tr>
<td><strong>n = 120</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6-4: Identification of PIPs by PIP Type

Participants identified 42% of the PIPs when they came across missing, incomplete, and segregated information when they were unable to find information that they needed. All of the these scenarios included patient-care team members who knew the exact information that they were looking for, but it was either not there, only partially there, or it was located in multiple places in the EHR system. One example of this was when an attending was looking up the medication list for a patient admitted from the ED and she could not find it in the EHR. This was because the ED staff did not have time to enter the medications into the system before the patient was transferred to in-patient, so the attending had to ask the patient for his medications again.

Participants identified 32% of the PIPs when they encountered conflicting information. Approximately half of these scenarios included identifying wrong information. In one scenario, a
patient’s intake status was listed as “NPO except meds” in the system, but the nurse said that a resident told her that morning that the patient could have liquids. However, that resident forgot to update the status in the system. Therefore, this PIP was not identified until the patient-care team realized that the nurse and the EHR were presenting conflicting information.

The teams also identified 22% of the PIPs when they were making sense of the information based on their medical training, experience, and knowledge of the patient. This most frequently helped them to identify wrong and unclear information. There were a few times when this included trying to make sense of the meaning of an acronym that was used in the patient’s record. The process of making sense of the acronyms helped the team to identify these PIPs.

Participants also identified 4% of the PIPs by associating certain hospital units with poor documentation practices, including inaccurate, incomplete, and unclear information. Although this is a small percentage of individually identified PIPs, the act of generalizing units or external facilities as unreliable sources of information resulted in a noticeable frustration and distrust between different units and facilities.

The following sub-sections further describe each of the four activities that the patient-care team members were performing when they identified the PIPs: not finding needed information, encountering conflicting information, making sense of the information, and generalizing unreliable sources of information.

### 6.2.1 Not Finding Needed Information

During morning rounds and daily patient-care activities, the team members were continuously searching for patient information to fully understand their patients’ conditions in order to make decisions on their treatments and diagnoses. They frequently experienced times when they were looking for specific patient information and they could not find it. This resulted in the identification of a PIP.
The most common time that participants were unable to find information that they needed occurred when the team was looking for information to explain why a previous team member put the patient on a medication or ordered a test, but they could not find the information in the EHR. For instance, one morning the IM team could not find a reason for why the night-shift ordered an echocardiogram (“echo”) test for a patient:

The team is at the MIMCU nurses’ station talking about the next patient. One of the residents is looking at the patient’s record in the EHR and says to the team, “He has an echo ordered. But I’m really not sure why, or who ordered it. I’ve looked through the progress note and the reason isn’t there.” The attending is reading over the patient’s record on her laptop and responds, “It looks like it’s probably because they were concerned about the walls of the patient’s heart, but I’m not sure.” She then tells the resident to follow-up with the nurse to see if she knows anything, and says, “Then we can look at his numbers to see if it’s needed while he’s here or if he could just do a follow-up appointment after discharge.” The resident leaves to find the nurse. [shadowing field notes]

Additionally, there were times during a patient’s transfer from another hospital unit or external facility when the team members needed to know specific information about a patient, but it was not in the patient’s record from the previous unit or facility. In one scenario, an attending was looking for the medication list of a patient admitted to in-patient from the hospital’s emergency department and she could not find the medication list:

The attending describes how she could not find the med list in the EHR for a patient admitted from the ED. So, she went to talk to the ED nurse because they typically ask for current meds when the patient arrives. The ED nurse told the attending that she wrote the med list on paper when talking to the patient, but it was never put into the system because the nurse didn’t have the time to do it before the patient was admitted into in-patient. When the attending asked the nurse for the paper list, she said she had thrown it out [in the locked disposal bin]. So the attending said she had to re-create the list in the system and had to ask the patient for the current meds all over again. The team discussed how this often happens and how frustrating it is because they think it’s the ED’s responsibility to enter the information before the patient is discharged, but the ED does not think it is their responsibility once the patient is transferred. [shadowing field notes]
6.2.2 Encountering Conflicting Information

Participants also identified PIPs when they encountered conflicting information. In the preliminary study, conflicting information was originally classified as a type of PIP. However, after further data collection and analysis in the main in-patient study, I realized that conflicting information was really a way in which the team members were identifying a discrepancy between two sources of the same information where one source was correct and one source was wrong or outdated. Therefore, encountering conflicting information became an activity used to identify PIPs instead of being a PIP type.

In the main in-patient study, conflicting information occurred when participants were comparing two sources of patient information that were in conflict with one another. This typically occurred when (a) the EHR system was accurate but someone’s verbal conversation or handwritten notes were wrong or outdated, (b) the system was inaccurate and one of the team members knew the accurate patient information, or (c) there was a discrepancy between two fields within the system.

In the first case, the EHR system displayed accurate patient information, but the team members spoke or referenced inaccurate written information, which then conflicted with the EHR information. In the following scenario, the physician team makes a decision about a patient’s oxygen levels based on outdated written notes. A nurse then refers the EHR information and corrects the team.

A resident presents the patient in the hallway and references some handwritten notes on his paper-based report. He says that the patient is currently on 2 liters of oxygen and it should probably be increased because of breathing difficulties reported by the night-shift. The team discusses the situation and decides that the patient could go up to 4 liters. After a few minutes a nurse joins the conversation, so the resident updates the nurse and says, “We are going to add 2 liters of oxygen.” The nurse looks confused and says, “You’re putting him on 6 liters?” The resident responds, “No, he’s on 2. We’re putting him on 4.” The nurse shakes her head, goes to her computer, points at the screen and says, “No it was already increased to 4 overnight. So he’s already on 4.” The resident and team
look in the system, and the resident says, “Oh ok. I didn’t know that. Four liters is good then.” [shadowing field notes]

In other cases, the EHR system was not accurate and one of the team members had the correct patient information. For instance, wrong information about a patient’s intake status was not identified until the patient-care team realized that the nurse and the EHR record were presenting conflicting information about the NPO status of a patient (NPO is a medical acronym derived from the Latin phrase nil per os, meaning nothing by mouth):

*The attending asks a nurse why the patient is getting liquids when the system says “NPO except meds.” The nurse says that a resident told her earlier that morning that the patient could drink liquids. A new resident arrives and joins the discussion. The new resident confirms that he did tell the nurse that the patient could have liquids but then realizes that he never changed the status in the system. The resident then goes into the system and changes the patient’s NPO status to “liquids only.”* [shadowing field notes]

Finally, the third way that team members identified a PIP due to conflicting information occurred when two EHR fields related to the same patient information were in conflict with one another. Consider the following example where the free-text progress note about a patient states that the patient’s status is “no support,” but the system lists the patient as “full support”:

*The attending says that the patient's status is listed as "no support" in the progress note, but the chart in the EHR says "full support." The attending asks 2 of the residents who are in the patient's room if any of them changed it, and they both say no. The attending then goes to find the nurse in the hallway and asks her if she changed it. The nurse said that she did not change it, but that she saw the change come through in the system and wanted to ask the team about it. The final resident catches up with the team and, overhearing the discussion, says that she put in for the request to "change to full support." The resident says that she wasn't aware that the patient was still supposed to be "no support." The resident says she will go into the system and change it.* [shadowing field notes]

All of these scenarios describe how PIPs were identified due to conflicting information. They also exemplify the critical role that nurses play in verifying the accuracy of a patient’s constantly changing condition. Since nurses are in continuous contact with patients throughout the day, they usually have the most recent information about the patients. The residents usually print a paper report from the EHR before rounds and share one laptop during rounding. Since
Rounding can take up to 4 hours, this can result in the residents being outdated on a patient’s status, unless the team continuously checks the EHR during rounds. This can explain why nurses have the most recent information about patients and frequently provide updated information to the residents during rounds.

6.2.3 Making Sense of the Information

Participants also identified PIPs while making sense of the information based on their medical training, experience, and knowledge of the patient. This occurred when (a) a lab result, test order, or medication prescription did not look right for the patient’s condition, or (b) when there was a term or acronym that had multiple meanings or an unknown meaning.

The following example illustrates how a care coordinator, who is also trained as a registered nurse, identified a mistake in one of the resident’s orders based on her own medical training and knowledge of the patient’s condition:

The care coordinator tells me about how she identified an issue with a patient’s order earlier in the week. She said she was reviewing the patient’s record to prepare any necessary scripts for discharge when she noticed an order that didn’t make sense. The care coordinator said, “The resident ordered a stool softener, instead of an ear drop that the patient needed for an ear infection. And I [based on my nursing background] was familiar with the prescription names, and knew he must have ordered the wrong one.” She said she found the resident in the workroom and told him that she noticed the order and asked if the patient needed stool softener, or if he selected the wrong medication for ear drops. She said the resident realized that he selected the wrong med and thanked her for letting him know. [shadowing field notes]

Another example of identifying PIPs while making sense of patient information was when a pharmacist rounded with the IM team and noticed that a patient should be on an antibiotic for her infection, so she asked the team about it:

The pharmacist rounding with the team listens to a resident present the patient, then asks a question: “Doesn’t this patient have a UTI [urinary tract infection]? I thought I saw that in her labs?” The resident says yes. The pharmacist then asks, “But she has no antibiotic on her med list. Shouldn’t she be on one?” Two of the residents responsible for the patient look at each other, and go back and forth about how each of them thought the other one had ordered it before rounds.
The resident who presented the patient said he will go into the system and order the antibiotic. I speak with the pharmacist when we walk to the next room and she says, “Rounding with the teams really helps point out issues related to the med lists directly with the team during the patient rounds, instead of just follow-up phone calls at random times during the day. So I think it raises awareness about how important it is for them to review med lists when they’re rounding and ensure that they’re up to date each time they round.” [shadowing field notes]

Additionally, there were a number of times when an acronym or term was used in the patient’s record that was either unknown or had a different meaning to multiple participants, so participants had to make sense of the term within the context of their work. Consider the following scenario where a patient’s “d-dimer” result was very high, until the team realized that it was measured on a different scale than the one they use at their hospital (d-dimer is a blood test that helps physicians determine if a patient has a blood-clotting issue):

A new patient was just transferred from another hospital and a resident is presenting the patient at the nurses’ station. The resident reviews the patient’s transferred files and says, “The d-dimer was 7000.” The attending immediately says, “What? That’s really high!” The team members each scan through their own laptop or paper records to review the patient’s record, and then one of the residents says, “I don’t think they use the same scale.” The attending says, “I hope not. That would be a problem. Let’s assess her and then see if we should run another test.” I follow-up with the resident afterwards and ask about the different scales for a d-dimer test. He tells me, “Other hospitals can use different scales to measure d-dimer in the labs. It’s kind of like using inches versus centimeters.” [shadowing field notes]

6.2.4 Generalizing Unreliable Sources of Information

The final way that participants identified PIPs was by associating a lack of information accuracy and completeness with specific hospital units or external facilities. This act of generalizing units or facilities as unreliable sources of information resulted in a noticeable frustration and distrust between the units or external facilities. More specifically, the participants considered any documentation from the emergency department and surgery ward of the hospital to be unreliable. An attending explains the reputation of these units:

An attending describes the progress notes and discharge reports from the surgery ward: “They are just horrible, so is anything from the ED. There’s so much missing, or doesn’t make sense, so you have to follow-up.” The attending
also states that good documentation practices in the surgery ward or ED, “are just not as emphasized, it’s focused on procedure only. But the purpose of the progress notes is to help understand the thought process. That’s more helpful than just numbers, which is what they give us.” [shadowing field notes]

The next two examples illustrate scenarios from the field study where the IM physician team makes comments about the reputation of the emergency department’s documentation:

A resident is presenting a newly admitted patient from the ED. The resident tells the team that, “the ED did not record the outputs in the system, which is not surprising [laughs, and the rest of the team smiles and nods their heads], so we need to start monitoring that.” [shadowing field notes]

One of the residents presents the patient who is newly admitted from the ED. The resident explains that the patient has a diabetic foot ulcer and summarizes the ED notes: “She was admitted to the ED for sepsis, supposedly” [mannerisms and tone of voice seem to imply doubt about the ED’s sepsis diagnosis]. The attending responds, “Yeah, we’ll have to double-check that.” I talk to the resident afterwards about the comment, and he says, “The ED documentation is just so rushed sometimes, so we can’t always believe what it says. We have to do our own assessments.” [shadowing field notes]

The participants also commented on issues with information that was included as part of patient transfers from external facilities, such as a Veteran’s Affairs (VA) hospital. In the following scenario, the attending comments on a patient’s outdated medication list from the VA hospital he was transferred from:

The team enters the room and it’s crowded, so I stay in the hallway listening to their conversation. The attending is looking over a printed medication list that came with the patient from the VA hospital. The attending calls me into the room to look at the 5-page paper report that is printed and has handwritten updates: “Look at this. This is what I’m talking about. This is what I have to work with. It’s outdated and never updated, so it carries through into our systems, and it’s really not good. We’re making decisions based on bad med lists.” She points to one of the medications on the active med list and says that the patient has not been on that medication in over 4 years. After leaving the room, I ask the attending who is responsible for the accuracy of the med list, and she says: “Well, the VA should be giving us an accurate list [laughs]. But in reality, they are usually always outdated or incomplete, so we end up having to do it or at least double-check it because we just don’t trust it. But it can be hard when patients have huge lists, and the patients don’t even know what they’re on most of the time.” [shadowing field notes]
This section provided descriptive examples of the four activities that were being performed when the patient-care team members identified the PIPs. The next section describes how the patient-care teams managed the PIPs after they were identified.

6.3 Managing Patient Information Problems

After participants identified PIPs, they then responded by managing them in a way that helped them continue with their work. I identified five ways in which participants managed the PIPs: find more information about the PIP, fix the PIP themselves, find someone to fix the PIP, ignore the PIP, and work around the PIP (Table 6-5).

<table>
<thead>
<tr>
<th>Management of PIP</th>
<th>Frequency</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Find more information about the PIP</td>
<td>40</td>
<td>When participants sought out other individuals or systems that could provide them with more information about the PIP.</td>
</tr>
<tr>
<td>Fix the PIP themselves</td>
<td>36</td>
<td>When participants had the knowledge and system access rights to fix the PIP.</td>
</tr>
<tr>
<td>Find someone to fix the PIP</td>
<td>32</td>
<td>When participants could not fix the PIP themselves due to lack of knowledge or system access rights, so they had to find the person(s) who could fix the PIP.</td>
</tr>
<tr>
<td>Ignore the PIP</td>
<td>8</td>
<td>When participants did not need the information to accomplish any immediate tasks, so they just continued with their work and did not attempt to fix the PIP.</td>
</tr>
<tr>
<td>Work around the PIP</td>
<td>4</td>
<td>When participants still needed to accomplish an immediate task, so they found a way to continue their work without the information and did not attempt to fix the PIP.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>120</strong></td>
<td></td>
</tr>
</tbody>
</table>

Table 6-5: Management of PIPs

When participants encountered PIPs, the majority of the time they had to collaborate with others in order to find more information about the patient information problem. Researchers have discussed how hospital teams are highly collaborative and dependent on each other to perform
patient-care tasks (Ash, Berg, Coiera, 2004; Bardram & Hansen, 2010; Reddy, Shabot, Bradner, 2008). Our findings further support this point by highlighting how patient-care teams are also highly collaborative and dependent on each other to properly manage PIPs as well. The following sub-sections further describe each of the five ways that the patient-care team managed PIPs.

6.3.1 Find More Information about the PIP

Participants often had to find more information in order to manage the PIPs that they encountered. When participants had to find more information, this typically included: (a) following up with other members of the team to provide updates or clarifications on the patient information, (b) searching through different areas of the EHR to piece together segregated information, and (c) running additional tests or re-assessing the patient to address information that had questionable accuracy.

Consider the following example of a resident who encountered conflicting information about a patient’s overnight status. He had to follow up with the nurse and search through the EHR to find more information to properly manage the PIP:

_The resident tells the team that the patient’s husband said the patient had bad diarrhea and a high fever the night before, but that, “the note in the system says nothing about diarrhea, nothing about fever. Is this guy crazy or something?” The attending says that this is why they double-check everything and recommends that the resident go back and re-read the night-shift’s progress note and ask the nurse about the patient’s overnight status. [shadowing field notes]_

Managing the PIP required the resident to perform additional work to better understand the overnight status of his patient. Finding more information to manage PIPs can also result in the need for patient-care teams to run additional tests or re-assess the patient. This occurred in previous examples when the IM team questioned the accuracy of three patients’ glucose levels that were tested by the same nurse, so they asked the nurse to take the glucose levels again. Another time, the IM team questioned the accuracy of a patient’s hemoglobin results in a lab test,
resulting in the team ordering more tests. The following scenario also illustrates the management of a PIP by re-assessing the patient to collect more information:

The attending stops by the resident workroom to ask one of the residents about a patient’s blood pressure. The resident says, “Her numbers were 120/90 sitting and 140/90 standing. I’m not sure why there was that big of a drop, maybe it was an error. I will go back and take it again.” [shadowing field notes]

6.3.2 Fix the PIP Themselves

When patient-care team members encountered PIPs, many times they could directly fix the PIP if they had the knowledge and system access rights to fix the problem. This was frequently the case when residents identified missing or incorrect information or orders during morning rounds. The following examples illustrate how participants managed the PIP by simply fixing the information themselves:

The attending is on her laptop and asks if they received the patient’s lab results: “Did we receive the albumin yet?” One resident says, “I’m not sure, I don’t see it [in the system]” and then turns to the second resident and says, “I thought you were going to do that?” The second resident replies, “Oh, I think I thought you were going to do it.” The first resident responds, “Why don’t you add it now since you’re in that area [of the system].” The second resident confirms this: “Ok, I’ll take care of it now.” [shadowing field notes]

A resident is presenting the patient’s status outside the room and says, “The oxygen level is at 1.5 liters but I’m not sure of the percentage. It’s not listed in the system, which is strange.” The patient’s nurse standing at the nearby workstation says, “It’s 90%.” The resident says, "Do you want to put that in the system or should I?" The nurse replies, "I can do it. I have the record up right here." [shadowing field notes]

6.3.3 Find Someone to Fix the PIP

Additionally, participants were not always able to fix the PIP themselves and had to find someone to fix it. This PIP management method is exemplified in the following scenario when a nurse identified an issue with a patient’s medication order and had to track down the IM team to check on the order:

The attending gets a page to call a nurse. The attending calls the nurse from a nurses’ station phone to discuss a question about a patient’s Vancomycin order. The nurse says the med is ordered for tomorrow, but the patient is being
discharged today. The nurse said the order didn’t make sense and she wanted to check with the team to see if they wanted her to administer the antibiotic before discharge today. The attending relays this information to the team and the resident responsible for the patient seemed confused and said, “I thought I ordered it for today. Let me check.” He asks to borrow the team laptop from the other resident and pulls up the patient record in the EHR. The resident says, “Yeah, she’s right. It’s ordered for tomorrow. That’s strange. I swear I ordered it for today.” The team discusses how sometimes if you put the medication order into the system in the morning, its default setting is to order the medication for the following day and maybe that’s what happened. The resident confirms that it is supposed to be administered today before discharge, and he will go into the system to make the change. The attending conveys the plan to the nurse on the phone. [shadowing field notes]

There were also times when participants had to find someone to fix the PIP but it was not always clear who the right person was to fix the PIP. Consider the following example of when a nurse was trying to find missing information about why a patient’s chest tube was removed and she was sent back and forth between the IM team and the consulting Cardiology team:

During morning rounds, a nurse approaches the attending and asks why a patient’s chest tube was taken out. The attending says she does not know because her team was just assigned to the patient and they were not responsible for him when he was first admitted. The nurse asked if anyone on the team has read the patient’s notes or if they have external records so she can better understand the patient’s condition. The attending tells the nurse that, unfortunately, they do not know a lot about the patient yet and she should “ask the CT [cardiothoracic] doctors.” The nurse states that she already tried to contact them, and they said to talk to the IM attending since the CT team just came onto their new shift and did not personally remove the chest tube. The attending asks the residents if they know anything, and they shake their heads “no.” The attending tells the nurse that they do not have any information to provide at this time. The nurse appears frustrated and walks away. The attending also appears frustrated and says to the team, “What, am I supposed to be a CT surgeon too?” [shadowing field notes]

The above example highlights the complexity of co-managing patient information in a highly collaborative team where there can be unclear or conflicting views on who is responsible for providing accurate patient information or fixing PIPs. This can lead to frustration and additional work for members of the patient-care team.
6.3.4 Ignore the PIP

In a few observed scenarios, the PIP did not directly impede the participants’ work, so they just ignored the PIP. This resulted in the PIP not being resolved. In one example, a patient’s historical records state that he was on a steroid inhaler, but the patient denies being on the inhaler:

*The resident says that the patient’s records state that he was prescribed a steroid inhaler, but when he asked the patient about it, the patient said he was never on a steroid inhaler. The resident says, “There’s really no way to confirm it. Either he was prescribed the inhaler, but never used it, or he doesn’t remember using it, or maybe the records are wrong, who knows?”* [shadowing field notes]

In this example, the resident cannot confirm the conflicting information, so he ignores it and continues on with his work. Additionally, sometimes the PIP was related to the team questioning the accuracy of subjective patient information. The following scenario exemplifies how subjective information cannot always be agreed upon by multiple team members, so they just ignore the PIP and continue with their work:

*The IM team is in a patient’s room using their stethoscopes to assess the patient’s heart murmur. The attending informs me that the heart murmur is graded on a scale of 1-6. The intern listens first and says she would grade it “a 3 or 4.” One of the residents takes her turn listening and says, “Whoa, I would actually say a 2.” The other resident listens and says he would also say a 2. The attending listens last. She laughs and says, “I would actually say a 1. But I’m old and my hearing is not so good, so I wouldn’t necessarily take my number.” The intern then went back to listen again, but she said she still heard a 3 or 4. The team discusses how assessments like this can be very subjective and can’t always be figured out because different people hear different sounds.* [shadowing field notes]

6.3.5 Work Around the PIP

The final way that participants managed PIPs was that they worked around the PIP. This occurred when the PIP could prevent them from doing their work, but they found a way to continue with their tasks without fixing the PIP. For example, this scenario describes how a participant worked around an alert message in order to continue with a patient’s medication order:

*The attending tells the team about how the system kept displaying a message saying that the medication they were trying to prescribe is “Contraindicated with Wellbutrin” but the patient isn’t on Wellbutrin anymore and hasn’t been for a*
while. The attending explains that this was a past medication so, “it’s a useless alert because it’s wrong. I just found a way to close it out, so that we could prescribe the medication anyway.” When I asked the attending if she notified the IT group of the incorrect notification issue, she said, “I probably could have, but I just don’t have time for that and wouldn’t even know who to tell.” [shadowing field notes]

The above example highlights an attending’s frustration with an EHR alert message, which she believed was displaying wrong information. The attending found a way to dismiss the message and order the medication, but she did not attempt to find someone to fix the system’s alert that she believed was displaying an incorrect message.

PIPs are an important challenge for patient-care teams to identify and manage. As described in this section, there are a variety of PIPs and the management of these PIPs can range from team members who identified the PIPs and fixed it themselves to team members who did not fix the PIP and allowed it to persist in the system. One issue that arose for participants when they were managing PIPs was determining who was accountable for managing the PIPs within the collaborative team who all collectively co-managed the patient data. Therefore, the next section will provide findings about the challenges involved with trying to identify who is responsible for fixing PIPs.

6.4 Determining Accountability for PIP Management

If the team members decided to manage the PIPs that they encountered during their work, they either managed the PIPs themselves, or they had to find someone else to manage the PIPs. This included identifying who they thought was responsible for fixing the patient information. In this section, I describe findings that illustrate the challenges that participants encountered when trying to determine who was accountable for managing PIPs.
6.4.1 Hospital Policies versus Work Practices

During this study I reviewed hospital policies about patient information management, which stated that the attending physician and registered nurse were ultimately accountable for the accuracy and completeness of their patients’ records (Section 4.3). However, when observing the work practices of the participants, other members of the team were responsible for the actual tasks required to ensure the accuracy and completeness of the records. These tasks included the continuous gathering and documenting of the patient information throughout the patient’s stay.

The following scenario exemplifies this difference between accountability for patient information according to hospital policy versus the daily responsibilities of managing the patients’ information. In this example, the attending was responsible for approving the resident’s progress report about a patient because she is ultimately accountable for the patient’s record. However, the attending clearly delegated the responsibility for creating a complete and accurate medication list to her resident:

An attending physician enters the workroom, approaches one of her residents, and says, “I looked at your report and the meds didn’t look complete in the H&P [section of report that summarizes the patient’s “History and Physical”]. I won’t sign off until they're complete.” The resident says he will look at the meds again and make sure the list is complete. [shadowing field notes]

Within the IM physician teams, it was common for the attendings to delegate the daily patient information management responsibilities to their team of residents and interns. This included making the residents and interns responsible for managing any PIPs that they encountered in their own patient documentation. However, the responsibility for managing PIPs became more complex when the PIP was related to information from another shift or from a consulting team. In the following scenario, an attending and her interns discuss a PIP related to information from the night-shift team. Although managing the PIP is more complex because it includes documentation from the night-shift team members who are no longer in the hospital, the attending makes it clear that their current team is now responsible for managing the PIP:
The attending reads from the EHR that aspirin was resumed for the patient, and says "I don't know where that came from - Who resumed the aspirin?" The two interns say that they don't know. One intern says, “Maybe it was the night shift?” The attending responds, "Well, it's your patient now, so you need to find out why it was resumed, or assess the patient and decide if she still needs aspirin."

Additionally, PIPs related to patient information that was entered by consulting teams also made it more complex to determine who was accountable for managing the PIPs for their shared patient. Consider the following scenario where the consulting Cardiology team prescribed a medication to the IM team’s patient, but they could not tell the team why they prescribed the medication:

The IM team is discussing why their patient was put on Lasix by the Cardiology team who is consulting on the patient. The IM attending sees the Cardiology team down the hallway and walks to talk to them. The IM attending asks them why the patient was put on Lasix. The Cardio attending says, "I signed it, but don’t know who put it in and why, I’m just the signer." The Cardio residents confirm that they do not know why the medication was prescribed and that it might have been done by one of the residents who is with another one of their patients at that time. The Cardio team says they will look into it and follow-up with the IM team. [shadowing field notes]

In this observation, the Cardiology attending stated that he was “just the signer.” This highlights how hospital policies may designate the attending as ultimately accountable for approving the patient information (including medication prescriptions), but the specific work practices and decisions that went into ordering that medication were delegated to other members of his team.

Therefore, hospital policies designate who is ultimately accountable for the accuracy and completeness of patient information, typically through formal approvals. However, when that accountability is delegated to other team members as part of their work practices and across different shifts, it can become more complex when trying to determine who is actually responsible for performing the activities that fix the PIPs. The next two sections discuss how
determining who was accountable for managing PIPs was either clear or unclear to the patient-care team members.

6.4.2 Clear Accountability

When participants encountered a PIP, it was sometimes immediately clear who was accountable for managing that PIP. Accountability was clear when there was one person or role responsible for the patient information or task. For instance, as seen in a previous section, wrong information about a patient’s intake status was identified when the patient-care team realized that the nurse and the EHR were presenting conflicting information about the NPO status of a patient:

*The attending asks a nurse why the patient is getting liquids when the system says “NPO except meds.” The nurse says that a resident told her earlier that morning that the patient could drink liquids. A new resident arrives and joins the team discussion. The new resident agrees that he was the one who said the patient could have liquids but then realizes he never changed the status in the system. The resident says he’ll go into the system and change the patient’s NPO status to “liquids only.” [shadowing field notes]*

In this case, it was immediately clear to the resident that he was responsible for updating the patient’s status in the EHR system since he was the one who verbally told the nurse that the patient could have liquids. Additionally, sometimes members of the patient-care team identified PIPs that had to be fixed by another member of the team. When this happened, they followed-up with the person who they thought was accountable for managing the PIP. In the following example, a nurse noticed that a resident ordered the wrong medication form for their patient, so it was clear to her that the resident who ordered the medication was the one who must fix the PIP:

*A nurse approaches a resident on the IM team and says that the patient cannot take the potassium pill that the resident just ordered because the patient has issues swallowing and the size of the pill is too big. The resident who ordered the pill says, “Oh right, I forgot about that when I put in for the pill form.” The nurse says, “So you’ll change that then?” and the resident says, “Yes, I’ll change it now.” The resident uses the team laptop to revise the potassium order from a pill form to a liquid form. [shadowing field notes]*
Additionally, care coordinators are accountable for managing a patient’s discharge from the hospital, including ensuring that the patient has all of their necessary scripts before they leave. In this example, a care coordinator identified a PIP in the progress note signed by the attending, and it was clear to her that she must follow-up with the attending to fix the PIP:

The care coordinator tells me that the patient was given a script for 2 liters of oxygen after discharge but the EHR progress notes approved by the attending do not reflect the patient’s need for the oxygen when leaving the hospital. She explains that this means that the patient's Medicare will not reimburse for the oxygen script if it’s not listed as necessary for discharge in the progress notes. She says this tends to happen with physicians who don't realize what information is needed for reimbursement. So she states that she will follow up with the attending who approved the progress note so that the missing information is added in the final progress notes. [shadowing field notes]

In each of these situations, it was clear who was accountable when trying to identify which team member was responsible for fixing the PIPs. However, determining who is accountable for fixing PIPs is not always so clear to the team members when there are overlapping responsibilities.

### 6.4.3 Ambiguous Accountability

Sometimes team members encountered a PIP that could be the responsibility of multiple team members because of shared and overlapping responsibilities. This made it difficult to determine who is accountable for fixing PIPs. Participants who encountered ambiguous accountability because of an overlapping responsibility responded in one of two ways: they either negotiated accountability by discussing and deciding who would fix the PIP, or the accountability remained unresolved when the participants could not agree on who should manage the PIP.

### 6.4.3.1 Negotiated Accountability

Within a patient-care team, multiple team members can be jointly responsible for documenting information or performing patient-care tasks, which can sometimes make it difficult to determine who is accountable for fixing PIPs that arise during work. Participants who
encountered this ambiguous accountability would discuss the PIP then clearly identify who would be responsible for fixing the PIP. In this case, two residents thought that the other one had ordered a lab test for a shared patient. However, neither of them ended up ordering it. This example shows how the residents discussed the missing lab order and decided who would be accountable for fixing it:

*The attending is on her laptop and asks if they received the patient’s lab results: “Did we receive the albumin yet?” One resident says, “I’m not sure, I don’t see it [in the system]” and then turns to the second resident and says, “I thought you were going to do that?” The second resident replies, “Oh, I think I thought you were going to do it.” The first resident responds, “Why don’t you add it now since you’re in that area [of the system].” The second resident confirms this: “Ok, I’ll take care of it now.” [shadowing field notes]*

Therefore, the negotiated accountability occurred when the two residents jointly responsible for ordering the patient’s labs discussed the PIP and decided who would fix it. This can also occur when there is an overlapping responsibility between a nurse and a physician who are taking care of the same patient:

*A resident is presenting the patient’s status outside the room and says, “The oxygen level is at 1.5 liters but I’m not sure of the percentage. It’s not listed in the system, which is strange.” The patient’s nurse standing at the nearby workstation says, “It’s 90%.” The resident says, “Do you want to put that in the system or should I?” The nurse replies, “I can do it. I have the record up right here.” [shadowing field notes]*

Participants can also encounter ambiguous accountability when there is an unclear and conflicting understanding of what a term means between two team members who have shared responsibilities. Consider the previously discussed scenario about the term “PRN.” The unclear meaning behind this term resulted in the nurse and resident have a conflicting understanding of who is supposed to decide if the patient needs a procedure:

*The resident asks the nurse why the patient did not receive a suppository procedure that morning. The nurse says, “It wasn’t on the list.” The resident looks confused, opens the system, and says, “Yes it’s scheduled daily.” The nurse goes to her system in the hallway and I follow. She looks up the order, and shows me, “See, it’s listed as PRN.” I ask what this means to her: “It means it’s as needed or as requested. So if the doctors want it done, then they tell me and I do*
it.” The nurse goes back and tells the resident, “It’s not scheduled daily, it’s listed as PRN. But I can do it, if that’s what you want.” The resident says “Yes, please do it if the patient needs it.” We exit the room and I ask the resident what “PRN” means to him: “It means as needed, so they should do it if the patient is stopped up. It’s obvious that the patient needed it done...She doesn’t need us to tell her to do it.” [shadowing field notes]

In this scenario, the nurse believes that PRN means that the physicians will tell her when to do the procedure. Whereas, the resident believes that PRN means the nurse should just use her best judgment for when to give the procedure to the patient. Through the discussion of this PIP, the nurse and resident determine that the nurse will be responsible for deciding if the patient needs the procedure moving forward. In all of these cases, the team members discussed the PIP and explicitly decided who would be accountable for updating the documentation or performing the task necessary to fix the PIP.

6.4.3.2 Unresolved Accountability

Patients are frequently transferred between different units (e.g., from the ED into in-patient) or between different facilities (e.g., from a nursing home to the hospital). These different units and facilities have overlapping responsibilities for patient documentation based on when the patient was in their care. However, it is not always clear which unit/facility is accountable for managing PIPs that arise in the patients’ records. Furthermore, team members from the different units/facilities may discuss who is responsible for managing the PIPs, but these discussions do not always lead to both parties agreeing on who should be responsible for managing the PIP.

During rounds, the participants frequently discussed their frustration with the lack of documentation from the emergency department staff when a patient was transferred from the ED to in-patient. The following example illustrates this issue:

The attending describes how she could not find the med list in the EHR for a patient admitted from the ED. So, she went to talk to the ED nurse because they typically ask for current meds when the patient arrives. The ED nurse told the attending that she wrote the med list on paper when talking to the patient, but it was never put into the system because the nurse didn’t have the time to do it
before the patient was admitted into in-patient. When the attending asked the nurse for the paper list, she said she had thrown it out [in the locked disposal bin]. So the attending said she had to re-create the list in the system and had to ask the patient for the current meds all over again. The team discussed how this often happens and how frustrating it is because they think it’s the ED’s responsibility to enter the information before the patient is discharged, but the ED does not think it is their responsibility once the patient is transferred. [shadowing field notes]

In this example, the in-patient attending believes that the ED nurse was responsible for documenting the patient’s medication list for the transferred patient. However, when the attending discussed this with the ED nurse, the nurse suggested that it was not her responsibility once the patient was discharged from her care. This discussion about the PIP remained unresolved because both team members had conflicting opinions about who was responsible for the completeness and accuracy of the patient’s information. A resident also expressed her experience with unresolved accountability when patients are transferred from the ED:

A resident tells me that, in her experience, the ED frequently receives patient records if they’re coming from an external facility, like a nursing home. These records contain medication lists, code statuses, and patient history, “…which are really valuable to us in in-patient. But they just drop them in the bin and don’t give them to us when the patient is admitted. It’s so frustrating…like last night we had 8 ED patients admitted and it took over 4 hours of work to recreate the history record for each one, even though the ED had those records, but got rid of them. It could have saved us so much time if they’d just hand them over." I ask if the resident explicitly asks for the records each time, and she responds: “Every time.” [shadowing field notes]

Participants also encountered unresolved accountability when patients were moved between facilities, such as this example where an attending describes what happened when a patient was transferred from another hospital without any records:

The team is discussing the diagnosis of a patient who was transferred from another hospital without any records. The attending, who knows that I am collecting data on problems with patient information, explains to me: "It's so hard because the records from the other hospital are missing, so it's a black box. The patient's electrolytes are a mess, but I have no idea what fluids they have had at the other hospital, or what meds, and it's not fair because then I get the brunt of frustration from the patient and the family. We only know what we know, and we run new tests to put the pieces together, but there's always things missing about previous care, which is crazy because the information is there, we just
don’t have it. So, we end up responsible for everything that has happened up until now, even though we weren't involved when it happened or responsible for that documentation. But then we become responsible because they’re our patient now. It’s just not right." [observation field notes]

The attending expresses her frustration for being responsible for managing the PIPs that she believes are the other hospital’s responsibility. However, as she stated, the attending’s team has to now take accountability for managing the PIP because the patient is now in their care. However, she still believes that the other hospital should have provided them with complete and accurate records during the patient transfer.

Therefore, managing PIPs and determining accountability for PIPs can be challenging for patient-care teams. As described in this section, there are a variety of PIPs that occur, but it is not always clear who is responsible for managing the PIPs. In some cases, there is clear accountability, and in other cases, there is ambiguous accountability. These findings highlight a set of issues that should be considered when designing policies and systems that support the identification and management of PIPs by collaborative teams.

6.5 Chapter Summary

This chapter summarizes the findings of the main study conducted in the in-patient ward. This includes a description of the seven types of PIPs that occur in hospitals, and an overview of the how participants identified and managed PIPs that they encountered in their work. This findings chapter ends with a summary of how participants determined accountability for managing the PIPs within the collaborative patient-care teams.

The next chapter will present a conceptual framework that describes how patient-care teams identify and manage PIPs. It will also discuss the challenges that collaborative patient-care teams face when trying to manage PIPs, including cascading effects of PIPs and a more in-depth discussion on determining accountability for managing PIPs within and across hospital
departments. Chapter 7 will also present socio-technical design recommendations for hospital policies, training, and HIT system design.
7 Discussion

In this chapter, I discuss how this study addresses my research objectives of developing a better conceptual understanding of PIPs and providing socio-technical recommendations to help collaborative patient-care teams better identify and manage PIPs. I first present a conceptual framework that illustrates how patient-care teams identify and manage PIPs in hospitals, including the socio-technical factors that can influence how they identify and manage the PIPs. I then provide a more comprehensive discussion about the specific challenges that patient-care teams face when managing PIPs. The chapter concludes with socio-technical recommendations for how to improve hospital policy and training, as well as suggestions for HIT design features that can better support the identification and management of PIPs by patient-care teams.

7.1 PIP Taxonomy and Conceptual Framework

In order to provide a better conceptual understanding of PIPs, I developed a PIP taxonomy to classify, define, and describe the seven PIPs identified in this study. This taxonomy was presented in Chapter 6 Main Study Findings Table 6-1 and also found in Appendix E. I also developed a conceptual framework of how patient-care teams identified and managed PIPs, including the socio-technical factors in a hospital environment that can influence the PIPs. This section explains how this taxonomy and framework can offer a foundation for better understanding PIPs in hospitals.

7.1.1 Framework for PIP Identification and Management

Based on my findings, I developed a conceptual framework to illustrate how patient-care teams identify and manage these PIPs in hospitals (Figure 7-1). This framework highlights two key findings of my research: (a) the PIP identification and management activities performed by patient-care teams, and (b) the socio-technical factors that can influence PIPs in a hospital. It is important to note that this is a preliminary framework based on the findings in this dissertation.
study. This framework is not predictive and it does not intend to define the only types of PIPs that can occur or the only ways that patient-care teams can identify and manage PIPs. Its purpose is to draw together the PIP concepts that I identified in this study’s findings and provide a foundation for future PIP research (Jabareen, 2009). I built this framework using a bottom-up, inductive approach based on interpretations grounded in my data (Braun & Clark, 2006). A larger version of this framework is found in Appendix F.

![Figure 7-1: Framework of PIP Identification and Management in Hospitals](image)

Figure 7-1 first presents red boxes that represent the activities that patient-care teams performed when they identified and managed PIPs. I also included the causes of PIPs in this framework. Although studying the causes of PIPs was outside the scope of my research questions, I included the causes of PIPs in order to show the temporal process of how a PIP is first caused, then identified, and then managed in hospitals. The causes of PIPs were described in previous MI and HCI research (Chapter 2) and were also observed in my own study’s findings.
Additionally, the framework includes blue boxes for the socio-technical factors internal to the hospital that can influence the cause, identification, and management of PIPs. The internal social factors that I observed in this study were the patient-care team members’ work practices, hospital policies that influenced how hospital staff identified and managed information, and the collaborative nature of hospital work that could impact PIPs. These factors are further discussed in Section 7.2 of this chapter. The internal technical factor that I focused on in this study was the EHR, which is a type of HIT system (see Section 4.2). I included bi-directional arrows between the social and technical factors because of the interrelated nature of socio-technical systems, as described in Section 3.2.

I also included bi-directional arrows between the internal socio-technical factors and the causes, identification, and management of PIPs. These arrows indicate that socio-technical factors can influence how the PIPs are caused, identified, and managed. Additionally, understanding how PIPs are caused, identified, and managed can also influence how technical systems are designed, and can influence team members’ work practices, hospital policies, and the nature of collaborative work performed within the hospital.

Lastly, the framework includes external factors that exist outside of the hospital that can also influence PIPs. The two external factors observed during this study were government regulations and external facilities. My background literature describes how government regulations can influence the implementation of HIT systems and require hospitals to create new internal policies and training related to the electronic management of patient information. Additionally, there were many times that the participants identified PIPs due to missing, incomplete, or outdated patient records from external facilities (e.g., VA hospital, nursing homes), so external facilities were included as external factors as well.

This framework begins to provide a conceptual view of how patient-care teams identify and manage PIPs within the collaborative hospital environment. The next section will describe
how the PIP taxonomy and this conceptual framework can be used to better understand PIPs and work towards preventing or mitigating PIPs in hospital work

7.1.2 Use of the PIP Taxonomy and Framework

The PIP taxonomy and conceptual framework can be used as a tool to help researchers, hospital staff, and HIT designers better understand existing PIPs and more effectively anticipate future PIPs. The benefits of using this PIP taxonomy and framework include: (a) increasing the conceptual awareness of PIPs in research communities, (b) increasing PIP awareness for hospital staff, and (c) informing the design of HIT systems to better support the identification and management of PIPs. The following sub-sections highlight these benefits and provide a specific example of how I used the PIP taxonomy and framework in this study to achieve these benefits.

7.1.2.1 Improved Conceptual Awareness for Research Communities

The taxonomy and framework contribute to the MI, HCI, and CSCW communities by addressing a limitation in the existing research. These conceptual contributions highlight PIPs as an understudied problem space that researchers should further explore. Although researchers have studied the causes and impacts of PIPs, the conceptual framework also begins to unpack how patient-care teams identify and manage the PIPs. This helps to provide a more complete overview of PIPs within hospitals and encourages researchers to continue to explore this PIP problem space.

Consider the following example of how the PIP taxonomy and framework can provide an improved conceptual awareness for research communities. Table 6-2 quantified the types of PIPs that occurred and listed them according to the roles who helped identify each type of PIP (Chapter 6). The data in this table shows that nurses identified the same amount of wrong information as the residents and interns. This finding highlights the critical role that nurses play in PIP identification, especially in the identification of one of the most critical types of PIP – wrong
information. Using the PIP taxonomy, researchers can collect more data on which roles identify PIPs to provide insight into who plays a key role in identifying specific types of PIPs. This analysis could also be used to compare other hospital characteristics to the PIP taxonomy, including: hospital unit (e.g., MICU, MIMCU, SICU), department (e.g., emergency department), external facility (e.g., VA hospital, nursing home), type of patient information, cause of PIP, impact of PIP, and so on.

7.1.2.2 Improved Awareness for Hospital Staff

The taxonomy provides a classification for PIPs, which can increase hospital staff’s awareness about the existence of these PIPs and what they actually look like within the context of their own work. The framework can also guide the patient-care teams on how to identify and properly manage these PIPs. For instance, the framework illustrates how certain PIP identification and management activities lead to the PIP being resolved before it impacts the patient-care process. When hospital staff better understand how to successfully identify and manage PIPs, it can prevent PIPs from becoming potential medical errors. Additionally, the framework can also make hospital administrators more aware of socio-technical factors that can influence the teams’ abilities to identify and manage the PIPs. This can result in improvements to hospital policies, training, and processes.

For example, the findings in this study identified that certain units have a reputation for poor documentation. One activity that patient-care teams used to identify PIPs was generalizing sources of unreliable information, such as when team members realized that a patient was just transferred from the ED and a resident made a comment about not trusting the information that was transferred with the patient because ED documentation is unreliable. The types of PIPs identified while generalizing other units as unreliable were questionable accuracy, incomplete,
and unclear information. Additionally, the three most common sources of these PIPs were the ED, surgical ward, and local VA hospital.

Analyzing the data using the PIP taxonomy and framework helped to identify the specific sources of unreliable information for these specific types of PIP. Looking at patterns like this could help hospitals create targeted training or policies that aim to improve documentation practices in units or facilities that frequently cause PIPs. However, since the reputation and work practices of specific units or facilities might be difficult to change, this PIP analysis could also result in developing HIT system features that color-code or clearly indicate which unit provided the patient information in the EHR system. This could at least make team members visually aware of who provided the patient information and denote if it is a unit or facility who is known for having poor documentation.

7.1.2.3 Informing the Design of HIT Systems

Additionally, HIT designers and HCI researchers can use the taxonomy and framework to look for patterns across the PIP types that provide insight into how the current HIT design helps or hinders the identification and management of PIPs. This can lead to the development of new technical mechanisms for the HIT systems that could help prevent or mitigate certain types of PIPs. For instance, the findings reveal that 60% of wrong information was identified when participants encountered conflicting information (Table 6-4). Some of this conflicting information included discrepancies within the system itself. One example in the findings describes how a free-text progress note stated that a patient was listed as “no support” but the standardized field in the EHR chart listed the patient as “full support.” Identifying that two fields in the EHR system are presenting conflicting information can help highlight opportunities to improve the system’s design to proactively prevent PIPs from occurring. In this case, HIT designers could create mechanisms that cross-reference fields that frequently contain conflicting information in order to
notify the patient-care team of a potential PIP. The system design could even evolve to prompt
the user entering the information of any conflicts at the time of data entry, as current EHR
systems do when cross-referencing new medication orders with the patient’s existing allergies
and current medications, which notifies the physician of any contraindications (Kuperman et al.,
2007). Some additional examples of how the taxonomy and framework informed HIT system
design recommendations are further described in Section 7.3.2.

These are just a few examples of how the PIP taxonomy and framework can increase
awareness about PIPs, which can lead to the development of socio-technical interventions that
help team members identify and manage PIPs. Additional examples of how the conceptual model
informed recommendations for hospital policy and HIT design are further described in Section
7.3. The next section provides a more comprehensive discussion about the challenges that teams
encountered during the management of PIPs.

7.2 Challenges of Managing PIPs in Collaborative Patient-Care Teams

It is important to consider how the collaborative nature of hospital work impacts the
management of PIPs. Previous CSCW researchers have studied the socio-technical challenges
that arise during the collaborative work of patient-care teams (Chapter 2). However, these CSCW
studies do not discuss how these challenges can impact how PIPs are identified and managed by
patient-care teams. The collaboration challenges in this study, which were highlighted in Chapter
1’s motivating scenario, include: (a) the cascading effects of managing PIPs, (b) issues with
determining who is accountable for managing PIPs in collaborative teams, and (c) socio-
technical design issues that occur when identifying or managing PIPs while using HIT systems,
such as EHRs. Cascading effects and accountability issues are discussed in this Section 7.2.
Socio-technical design issues are further discussed in Section 7.3.
7.2.1 Cascading Effects of Managing PIPs

Hospital teams are jointly responsible for patient-care activities and maintaining accurate patient records. This means that team members rely on each other to provide accurate and up-to-date information about their shared patients. The EHR system can provide a centralized view of a patient’s history and current status, which creates a shared awareness of that patient across the entire patient-care team, even when team members are physically dispersed throughout the hospital. However, when a team member encounters a PIP, it does not just affect the one team member who identifies the problem. It can also affect the entire patient-care team who relies on the accuracy and completeness of that information to do their work. Therefore, the way in which team members manage PIPs can impact the entire team’s shared understanding of a patient. In this study, when there was a problem with the patient information, the team members who identified the PIP either fixed the PIP, or they found a way to work around or ignore the PIP. Both of these responses led to cascading effects on the collaborative work of the patient-care team. These cascading effects included: delayed work, persistent errors, and impacts to patient-care.

7.2.1.1 Delayed Work

If team members take on the responsibility of managing PIPs that they identify, it typically leads to additional work. When team members have the necessary information and the system-access rights to fix the problem themselves, then they can fix it immediately. However, sometimes team members do not have sufficient information or system-access rights to fix the PIP immediately. This can lead to them having to perform additional work, including taking the time to track down other people to fix the problem or seeking out other sources of information needed to fix the PIP themselves (e.g., paper notes, other systems, other team members). I observed this when nurses had to find the appropriate team member to fix PIPs, or when the
physicians had to follow-up with other team members to find or verify patient information needed to fix PIPs. This additional work has a negative cascading effect on the patient-care workflow because it requires team members to put their own work on hold while they track down the needed information or person to fix the PIP. Although managing PIPs is an inherent part of hospital work, it creates a disruption to the patient-care workflow. This disruption can have downstream effects on any other team member who is waiting to proceed with their own tasks, and it can lead to delays in patients receiving tests, procedures, medication administration, or discharge.

7.2.1.2 Persistent Errors

If team members plan to fix a PIP but cannot fix it in the system until a later time, it results in the PIP persisting in the EHR until it is fixed. In this study, this frequently occurred when the physician teams encountered PIPs during morning rounds. Since the teams visited up to 14 patient rooms, they did not always stop their rounding activities to follow-up with other team members or consult other sources of information to immediately fix PIPs that they encountered. Although they did intend on managing the PIPs, they waited to do it until they returned to the workroom, which could be up to four hours after they identified the PIPs. Delaying certain tasks is a common work practice for hospital staff because they are responsible for multiple patients at one time and they have a variety of urgent tasks that must be continuously prioritized (Dillon & Lending, 2010; Park, Lee, Chen, 2012). However, the delay in managing PIPs until later in the day can create an issue for any other team members who use that information in their own patient-care tasks and decisions. This is especially true if those who identified the PIPs do not make other team members aware of the known PIPs before they are fixed.

Additionally, team members may choose to work around or ignore PIPs and not fix them. The decision to not manage the PIPs can be due to team members believing that it is not their
responsibility to fix the problem. The next section will discuss the accountability issues that can arise when determining who should manage PIPs within collaborative teams. However, other times team members may just want to continue with their work, so they perform a workaround to prevent the PIP from impacting their immediate task. These workarounds are temporary solutions that allow users to adapt technologies or processes in order to minimize interruptions (Vogelsmeier, Halbesleben, Scott-Cawiezell, 2008). Researchers have described how clinicians frequently perform workarounds when the EHR design interferes with their work (Poissant et al., 2005; Saleem, et al., 2011; Zhou, Ackerman, Zheng, 2011) or when there is a problem with the information in the system (e.g., missing, incomplete, outdated) (Abramson et al., 2012; Kobayashi et al., 2005; Koppel et al., 2005; Sittig & Singh, 2011). Since the primary concern of patient-care teams is to take care of patients, some team members will find ways to work around PIPs that interfere with their work. Although there may be perfectly valid reasons for these team members to enact workarounds (Abramson et al., 2012; Kobayashi et al., 2005; Koppel et al., 2005; Poissant et al., 2005; Saleem, et al., 2011; Sittig & Singh, 2011; Zhou, Ackerman, Zheng, 2011), the workarounds can lead to persistent errors in the EHR system.

The negative impacts of persistent errors identified in this study included multiple people doing the same work, multiple teams ordering the same test, confusion about treatment decisions, patients receiving the wrong medication, and frustration and tension between units or team members. Other researchers also describe how persistent PIPs can lead to incorrect assumptions about the accuracy of patient information, which results in team members making decisions based on wrong, outdated, missing, or incomplete information (Park, Lee, Chen, 2012). Persistent errors can also lead to PIPs being copy-and-pasted into other areas of the patient’s record or carried over into other HIT systems (Kobayashi et al., 2005).
7.2.1.3 **Impacts on Patient-Care**

The most serious cascading effect of managing or not managing PIPs is when it directly affects the care of patients. This can include delays in patients receiving necessary tests, procedures, or treatments. Additionally, not properly fixing PIPs can also lead to potential medical errors. This includes outdated medication information leading to a patient receiving the same medication twice (Ash, Berg, Coiera, 2004), or as seen in this study, a patient receiving the wrong medication due to an error that was carried over from his ED admission.

Therefore, cascading effects can occur whether a team member chooses to manage or not manage a PIP. These effects include downstream impacts to the patient-care workflow, other team members, and even the patient themselves.

7.2.2 **Accountability for Managing PIPs**

Patient information is co-owned and co-managed by multiple members of the patient-care team, which means there is a shared responsibility for entering, updating, and maintaining the accuracy of the information. However, this shared responsibility can lead to members of a patient-care team having an ambiguous understanding or a conflicting opinion about who is responsible for managing the PIPs that arise during their work. This ambiguous or conflicting understanding about accountability for managing PIPs leads to the persistence of PIPs in patient records because team members either assumed or believed that someone else was responsible for fixing the PIPs.

As discussed in the previous section on cascading effects, patient-care team members occasionally work around or ignore PIPs because they do not believe it is their responsibility to fix the PIPs. Additionally, the findings also describe how team members were unclear or had conflicting opinions about who was responsible for fixing PIPs in the EHR. Therefore, these issues about determining accountability highlight an important challenge that patient-care team
members face when managing PIPs. This section discusses the challenge of determining accountability for managing PIPs in two different ways: (a) accountability according to organizational policies versus day-to-day work practices and (b) the differences between intra-departmental accountability versus inter-departmental accountability.

### 7.2.2.1 Policy versus Practice

Highly collaborative organizations frequently enact formal policies to clearly designate accountability for specific tasks or responsibilities. Hospitals create these formal policies to outline guidelines for how staff should handle a variety of situations, such as managing PIPs. All hospital staff members are required to complete training on these policies and comply with the policies during their daily work. However, while some of the formal policies include very specific instructions, others are more general or vague in order to account for variances across different areas of the organization (Murphy, Reddy, Xu, 2014; Turner & Dasgupta, 2003). The issue with these general policies is that the staff may have different interpretations of the policies when conducting their daily work. This can lead to an unclear understanding or a conflicting opinion about responsibilities for specific tasks, as discussed in the study’s findings (Chapter 6).

Researchers have described how individuals interpret formal policies in their everyday work practices can vary from person-to-person, which causes conflict or tension within highly collaborative teams (Bartsch, 2011; Bauer et al., 2009; Choi et al., 2006; Coiera & Clarke, 2004; Heckle, Lutters, & Gurzick, 2008; Lovis, et al., 2007; Murphy, Reddy, Xu, 2014). Therefore, understanding how well-aligned the formal hospital policies are to the everyday work practices of patient-care teams can provide insight into the challenges that these teams face when managing PIPs.

A hospital’s organizational policies may clearly designate a specific role as ultimately and legally accountable for the managing patient information. In this study, the hospital
designated the patient’s attending physician and registered nurse as ultimately and legally accountable for the accuracy and completeness of the patient’s record (see Chapter 4). However, the person who is designated formally accountable for the patient’s record according to hospital policy is not always the person who does the actual work to ensure that the patient’s record is complete and accurate. For instance, in this study, the attending physician frequently delegated responsibilities for gathering and updating patient information to her group of residents. This can sometimes lead to each of the residents believing that the other resident took care of a PIP, resulting in the PIP not being properly managed and persisting in the system. One example provided in the findings was when an attending asked the residents why the patient’s albumin levels were missing from the lab results. The residents went back and forth stating that each one thought the other one had taken care of the order. Although it eventually became clear which resident would manage the PIP and order the lab test, the original confusion caused a delay in making a decision on the patient’s plan of care due to the missing albumin level.

Additionally, responsibility for maintaining accurate and complete patient documentation is also transferred to others when team members hand-off patients to the next shift and when patients are transferred between departments (e.g., a patient from the ED is admitted into in-patient). Sometimes this transfer of responsibility for the patient’s information leads to unclear or conflicting assumptions, which is what I refer to as ambiguous accountability in this study. For instance, one example of ambiguous accountability is when an attending could not find the medication list for a patient that was just transferred from the ED, so she went to talk to the ED nurse who had just cared for the patient. The nurse told the attending that she wrote the patient’s medications on paper, but then disposed of the paper once the patient was transferred to in-patient. The attending was frustrated by this because she believed that the nurse should have entered the patient’s medication into the system prior to the patient transfer. Whereas the nurse
believed that it was no longer her responsibility to provide the patient’s medication list since the patient was no longer in her care.

Therefore, these examples illustrate how hospitals can create formal policies that designate who are accountable for the accuracy and completeness of a patient’s record. However, the team members’ actual work practices include delegating and transferring that responsibility to others, which can lead to unclear and conflicting opinions about who is responsible for the tasks that ensure a complete and accurate patient record. This also includes who is responsible for managing PIPs in the patients’ records. The next section will describe how patient-care teams responded to ambiguous accountability when it occurred within the same department versus when it occurred across different departments or facilities.

7.2.2.2 Intra versus Inter-Departmental Accountability

Ambiguous accountability can negatively affect the management of PIPs both within the same department’s team (intra-departmental), as well as between different hospital departments or facilities (inter-departmental). However, in this study, there was a noticeable difference in how the patient-care team handled accountability issues when it occurred within a department versus when it occurred between departments or facilities.

**Intra-Departmental:** When ambiguous accountability emerged among team members within the same department, it resulted in the team members directly discussing who should manage the PIP. This included clear communication about who would take responsibility for the tasks required to fix the PIP. This clear and direct communication between intra-departmental team members is most likely due to their continuous, daily interactions during the patient-care process. These daily interactions can result in a comfortableness and familiarity between team members. Additionally, team members who frequently work with each other may be more willing to volunteer to fix the PIP in order to develop a positive rapport with their colleagues. This relates
to Kobayashi et al.’s (2005) research, which describes how hospital teams frequently use a “favors” system where colleagues help each other out during one task in order to ask for favors later on. By volunteering to do work in one situation, they could then “call on [others] for a favor” at a later point and develop a reputation for being someone “who can be counted on.”

Furthermore, team members within a department are jointly responsible for the patients that are in their care at that time. So, if they do not make it clear who should fix the PIPs, then the PIPs would persist in the system and continue to directly impact the work related to their shared patient.

**Inter-Departmental Accountability:** Inter-departmental patient transfers are a complex process that requires careful coordination and clear communication between the sending and receiving departments or facilities (Abraham & Reddy, 2013; Dunn, Gwinnutt, Gray, 2007; Symon, Long, Ellis, 1996). Additionally, during inter-departmental transfers, it is not only the patient who is being transferred, but also the patient’s information. However, when it is not clear which department/facility is accountable for the accuracy of patient information (including fixing PIPs), then there can be an unclear and possibly conflicting perception of who is responsible for managing any PIPs that are transferred with the patient. This is especially challenging during patient transfers because it is not always clear at what point the responsibility for information management shifts from the sending department/facility to the receiving department/facility.

In this study, I observed a re-occurring frustration among participants when they were managing PIPs that occurred during patient transfers from the emergency department or from external facilities. One example described in the findings was when a patient was put on the wrong medication in the ED, and then the patient and the wrong medication were transferred over to in-patient. The PIP persisted in the patient’s record until the pharmacist identified the wrong medication as a PIP and notified the in-patient physician team so that they could fix it. Additionally, participants frequently described how frustrated they were with the lack of
documentation or the quality of documentation during transfers because they believed that the other departments or facilities were responsible for providing accurate, complete information during the transfer. Whereas, the sending department/facility either did not send any information or they sent the information they had without checking the accuracy or completeness of it. Although the receiving department ultimately became accountable for the accuracy and completeness of their patients’ information as per hospital policy, they still believed that the sending department/facility was responsible for the transfer of accurate and complete information. Therefore, identifying who was actually accountable for fixing PIPs in patient records remained unresolved because the different departments/facilities had conflicting opinions about whether PIPs should be managed before or after the patient transfer.

One reason why accountability for managing PIPs can be challenging during inter-departmental patient transfers is because the interactions between the different departments/facilities are much more formalized than the day-to-day interactions of team members within the same unit. This can lead to team members’ behaviors being more influenced by the formal, organizational policies than by the day-to-day casual interactions of intra-departmental team members. Therefore, the ED or external facilities may just assume that the in-patient department will be responsible for the completeness and accuracy of the patient record because that is what is stated in the hospital policy. Furthermore, once the patient transfer is complete, the sending department/facility is no longer dependent on the accuracy and completeness of the patient record to do their work because the patient is no longer in their immediate care. Therefore, properly managing the PIP is not a priority to the sending department/facility because it does not directly affect their work.

Therefore, patient-care teams must learn how to effectively manage PIPs in order to avoid negative cascading effects and the challenges associated with ambiguous accountability. The next section provides recommendations for how to improve the design of hospital policies,
training, and HIT systems in order to help patient-care teams more effectively identify and manage PIPs.

7.3 Socio-Technical Design Recommendations

As discussed earlier in this chapter, the PIP taxonomy and framework can help identify patterns in how patient-care teams identify and manage PIPs. This insight can lead to the development of interventions that can help better support the identification and management of PIPs. These interventions could include improving policies and training, or suggesting changes to HIT system design to help prevent PIPs from impacting the patient or the patient-care workflow.

This section provides recommendations for changes in policy, training, and HIT design to better support patient-care teams’ abilities to identify and manage PIPs.

7.3.1 Organizational Policies and Training

In order to help patient-care teams better identify and manage PIPs, I propose two recommendations for improving hospitals’ policies and training. The first recommendation proposes the creation of more specific guidelines for patient transfers in order to address the ambiguous accountability that occurs during inter-departmental transfers. The second recommendation suggests a need to incorporate new types of training into hospitals in order to bridge the gap between Information Technology (IT) staff and the clinical users of EHR systems.

7.3.1.1 Policies for Reducing PIPs during Inter-Departmental Transfers

In this study, the hospital’s policies clearly designated the attending physician and registered nurse accountable for the accuracy and completeness of the information in their patients’ records. However, the policies were not clear about which unit was accountable for managing PIPs during inter-departmental patient transfers: the sending department (ED) or the receiving department (in-patient). When the patient-care team members encounter PIPs that are
not fixed prior to patient transfers, it can result in frustration and tension between the team members of the two departments. Therefore, organizations need to create policies that provide specific guidelines for inter-departmental transfers.

Even though patient transfers are a highly researched area (Abraham, 2013; Abraham & Reddy, 2013; Dunn, Gwinnutt, Gray, 2007; Klingner & Moscovice, 2012; Symon, Long, Ellis, 1996), the daily work practices of patient-care team members do not include the successful transfer of accurate and complete patient information during the transfer of a patient. The Joint Commission offers a “National Patient Safety Goal” that directly addresses patient-transfers (The Joint Commission, 2015). Klingner & Moscovice (2012) summarize this goal, which provides guidelines for hospitals to: “implement a standardized approach to hand off communications...including nursing and physician hand offs from the emergency department to inpatient units...[and] a method of communicating up-to-date information regarding the patient’s care, treatment, and services; condition; and any recent or anticipated changes” (p.46). It is recommended that hospital policies provide specific tasks that each department is responsible for performing to ensure the successful transfer of patients. Additionally, Abraham & Reddy (2008) describe how one of four critical processes of patient transfers from the emergency department to the in-patient unit is to ensure the handoff of “accurate and timely patient information.” Dunn et al. (2007) also state that the communication and transfer of accurate information is a necessary part of successful patient transfer between any two units in the hospital to ensure continuity of care. Therefore, based on my findings, I recommend that hospitals create policies that clearly state that the sending department (e.g., ED) is responsible for entering all of the patient data that they collected into the official EHR record before the transfer is complete, and that the receiving department (e.g., in-patient) is responsible for reviewing the patient record for completeness during the transfer. This can provide clear steps to guide the transfer process and also provide a sense of joint ownership for the completeness and accuracy of the patient’s record. However,
studies describe how even when hospitals have patient-transfer protocols, they tend to focus their patient-transfer guidelines on the successful transfer of the patient, but tend to neglect the successful transfer of the information as well (Klingner & Moscovice, 2012; Newgard, McConnell, Hedges, 2006). Therefore, it is also important that hospitals re-enforce these policies by training hospital staff annually and by having organizational leaders continuously verbalize the importance of complying with the policies (Ash & Bates, 2005).

Although these policies can provide formal guidelines for inter-departmental transfers and are important for reinforcing the hospital’s expectations for quality documentation practices, the patient-care team members still may not follow these policies due to their busy and complex work environment. This is where a newly emerging hospital role, called medical scribes, may be able to help with the reduction of PIPs during inter-departmental patient transfers. Due to the rapid implementation of HIT in hospitals, some organizations are creating a new role whose sole purpose is to attend patient meetings with physicians and nurses in order to enter patient information directly into the EHR system while the physician or nurse are interacting with the patient (Gellert, Ramirez, Webster, 2015). Researchers are currently studying the benefits of incorporating medical scribes into busy hospital environments, like emergency rooms (Bastani et al., 2014). Some of these benefits include allowing physicians to see more patients, improving the accuracy of clinical documentation and billing, reducing the time of patient stays, and increasing patient satisfaction (Bastani et al., 2014; Gellert, Ramirez, Webster, 2015; O’Malley, 2011; Scheck, 2009). Therefore, if hospitals identify serious issues with information accuracy and managing PIPs, especially during patient transfers, they could consider incorporating medical scribes into their patient-care teams. These scribes can help identify and manage any PIPs in the patients’ records prior to the transfer of those patients to other departments or facilities, which would avoid the negative cascading effects that occur due to persistent PIPs in patient records,
7.3.1.2 IT and Clinical Training

With the increasing use of HIT in hospitals, it is important that the clinical staff is adequately trained on how to use the HIT systems. Additionally, it is also important that the IT staff in the hospital stay informed on any usability issues that the clinical staff encounters while using the HIT systems. This includes being aware of how HIT systems are helping or hindering the patient-care team’s ability to identify and manage PIPs.

Currently, hospitals are working towards incorporating more staff members with clinical expertise into their IT departments and incorporating more clinical staff into the process of configuring and implementing HIT systems (Weckman & Janzen, 2009). Additionally, the American Medical Informatics Association (AMIA) has also recognized the importance of addressing the gap between clinical staff and IT by offering professional education and certifications for healthcare professionals. As Detmer, Munger, & Lehmann (2010) state: "The need for informatics as an essential component of daily medical care and research cuts across all primary specialties." Therefore, the incorporation of staff with clinical expertise into the IT department can help improve awareness about challenges that the clinical users face when using HIT systems, including how to better support the identification and management of PIPs.

Although there are efforts to provide HIT training to clinical staff and incorporate more clinical expertise into the IT department, the findings from my study highlight that there is still a separation between the clinical teams and the IT staff within the hospital environment. During both my preliminary study and main study, I only observed two IT staff members who entered the clinical environment and both times the IT staff were there to fix a printer that was not working. The IT group also sits in a separate building from the ED and in-patient units. Although this may be due to building space constraints, it creates a physical separation between the clinical users and IT staff, which reduces their communication and interaction with one another in the clinical environment. Additionally, when I was talking to an attending about a confusing alert message
that she received in the system I asked her if she had notified the IT helpdesk about the issue and she responded: “I probably could have, but I just don’t have time for that and wouldn’t even know who to tell.” This appeared to be the common consensus among the patient-care team members that I spoke to. None of the participants I asked knew who to contact to report HIT usability issues.

Therefore, in order to reduce this lack of communication and interactions between the IT staff and clinical HIT users, I propose that hospitals include a clinical rounding training program for IT staff. In this study, care coordinators and pharmacists regularly rounded with the clinical team in order provide real-time expertise and support to the clinical team. This interdisciplinary rounding generated a friendly rapport between the different roles and provided an opportunity for them to learn more about the challenges and issues that the clinical team experienced during their daily patient-care activities. Therefore, if IT staff members engaged in this type of rounding as part of their initial training, they could learn about the actual user activities of the patient-care teams firsthand, including how the HIT system helps or hinders their ability to identify and manage PIPs. Additionally, the regular presence of an IT staff member could also help develop an open, friendly rapport between IT staff and clinical users so that feedback on system functionality and real-time support could occur on a continuous basis for the clinical teams.

7.3.2 HIT System Design

The design of EHR systems allows for patient information to be dynamically displayed in a digital format that can be viewed from a variety of distributed locations (e.g., computers, laptops, mobile devices). This differs from paper records that include static information with visual cues indicating who updated the record (e.g., signature, initials, handwriting) and when it was updated (e.g., date, change in ink, new sheet of paper) (Weir et al., 2011). This shift from paper to electronic documentation changes the way that patient-care teams enter, view, and share
information and how they do their work. Therefore, given the serious effects that PIPs can have on patient care, it is important to more closely examine the design of HIT systems and the impact that they can have on the identification and management of PIPs.

Based on the findings of this study, I propose adding the following system features to improve the usability of HIT systems and to better support patient-care teams’ ability to identify and manage PIPs: connecting segregated data and flagging and annotating PIPs.

7.3.2.1 Connecting Segregated Data

The segregated design of HIT systems results in users having to enter and review patient data across many different fields located on many different screens. This results in users losing a cohesive overview of the patients’ records and, at times, the ability to identify emerging problems with the patients (Ash, Berg, Coiera, 2004). This study classified segregated data as a PIP that team members encountered during hospital work. Participants primarily acknowledged segregated data when they needed to know who ordered a medication/test/procedure and why that medication/test/procedure was ordered, which resulted in user frustration and additional work to piece together the segregated data from different areas of the EHR. Therefore, my recommendation is for HIT designers to consider how to make system interfaces more responsive to users’ information needs. This could include linking standardized fields (e.g., medication orders) to free-text fields (e.g., progress notes that state why the medications were ordered) by allowing users to click or hover over fields to see additional information. Miller et al. (2014) have proposed the use of hover boxes in EHRs that allow users to hover over the “first-line information” in order to see additional information that can then be “saved, printed, or copied into the patient record” if relevant. This design recommendation could help decrease the occurrence of the segregated data PIP type and prevent team members from having to delay their patient-care work to piece together the segregated information.
Consider the following scenario based on findings from this study: Before morning rounds, a resident reviews a patient’s record and does not understand why the patient was prescribed Amoxicillin and cannot tell who prescribed the medication. The resident leaves the patient’s screen and navigates to another part of the patient’s record in the EHR to open the 8-page progress note from night-shift. Then resident then reads through the note to understand who prescribed the medication and why it was prescribed. Alternatively, the resident could also leave the patient’s screen and navigate to the pharmacy system to look up the order to find the information. In order to find out who ordered a patient’s medication and why it was ordered, the resident has to leave the current EHR screen and spend additional time searching for the information that she needs within other areas of the system. This task could be simplified for the resident if the EHR system included functionality that would allow her to visually connect this segregated patient information. Figures 7-2 through 7-4 illustrate how these hover boxes could help connect segregated data in HIT systems.
Step 1) The resident right-clicks on the possibly outdated “Amoxicillin” prescription in the patient’s EHR record to find more information about who ordered it and why it was ordered.
Step 2) A drop-down menu appears and the resident selects the “View order details” option.

Figure 7-3: Hover Box – Step 2: User selects “View order details”
Step 3) The system collects the ordering information about the Amoxicillin prescription from other areas of the system (e.g., progress note, pharmacy system), including who ordered the medication and why the medication was ordered. The system displays this information in a hover box. The resident can temporarily view this information, and then she can click the “x” in the upper right corner to close the hover box.

Figure 7-4: Hover Box – Step 3: System displays order details
7.3.2.2 Flagging and Annotating PIPs

When patient-care team members encounter PIPs, they do not always address the PIPs immediately if they are in the middle of another important task. However, this delay in fixing PIPs allowed the problems to persist in the system and potentially affect other team members who rely on the accuracy of that information to do their work. In order to address this issue of persistent PIPs, I would recommend including a flagging mechanism in HIT systems that would allow users to flag and annotate PIPs to alert other members that there is a concern with the accuracy of the data. Flagging information could include making the text a specific color or adding an icon next to the data in question. An annotation function associated to the flag could also allow the users to add a brief, temporary comment to discuss why the highlighted data is considered a PIP or to clarify assumptions about who they think is responsible for fixing the PIP. This flagging mechanism allows team members to visually notify others about PIPs without having to interrupt their own work to immediately fix the PIPs. It also visually alerts the authors of the information that there is something questionable about their original data entry. This flagging and annotating function can also start a dialogue between team members about who is accountable for fixing the PIP.

Additionally, the study described how historical patient records can include PIPs, such as wrong information. However, these historical patient progress notes are “locked down” and only allow users to add notes at the very end of these documents. The flagging and annotating mechanism could allow users to highlight PIPs within the text of the historical document and provide annotations without changing the original text. This would allow all team members to be aware of the PIP at the point that it occurs in the record, instead of waiting to read about it until the end of the record.

To illustrate this recommended flagging and annotating function, I will continue with the previous scenario where the resident used a hover box function to find additional information
about an Amoxicillin order: *After reviewing the order details, the resident returns to the patient’s medical record to view the most recent lab results to see if the patient still has a Urinary Tract Infection (UTI). The lab results show no sign of infection, so the resident believes that the patient can be taken off the Amoxicillin. However, the resident first wants to check with the attending before discontinuing the medication to make sure there are no other infectious concerns that would require the patient to continue with the Amoxicillin.* In the current EHR design, the resident would have to leave the Amoxicillin order active while she followed up with the attending. However, the nurse who is responsible for medication administration would still see the Amoxicillin order as active in the system. This could lead to the nurse giving the patient the Amoxicillin even though the resident believes that the patient may not need the medication anymore. The only way for the nurse to know that the patient may not need his Amoxicillin is if the resident calls or pages the nurse this information, if she remembers to do so. In order to improve awareness across the team, the system could include a flagging function that would visually alert anyone looking at patient’s record that the Amoxicillin order was currently being discussed. An annotation function could also allow users to write a short, temporary note that explains the flagged information. Figures 7-5 through 7-8 illustrate how this flagging and annotating function could work.
**Step 1)** The resident right-clicks on the “Amoxicillin” prescription in the patient’s EHR record to flag the information as being possibly outdated.

![Screenshot of EHR record showing the Amoxicillin prescription and its details.](image-url)

**Figure 7-5: Flagging Function – Step 1: User identifies a PIP**
Step 2) The resident selects the “Flag item” option.

Figure 7-6: Flagging Function – Step 2: User selects “Flag item”
Step 3) The Amoxicillin order turns red and displays a red flag icon.

Figure 7-7: Flagging Function – Step 3: System flags PIP
Step 4) The resident clicks on the red flag icon to add a comment to the flagged information, which provides additional details to any other team member who may be using this information in their own patient-care activities.

Figure 7-8: Flagging Function – Step 4: User adds a flag comment
7.4 Chapter Summary

This chapter summarizes how I addressed my study’s original research objectives of developing a better conceptual understanding of PIPs, and providing socio-technical recommendations to help collaborative patient-care teams better identify and manage PIPs. In order to improve the conceptual understanding of PIPs, I presented a PIP taxonomy that classifies, defines, and describes the types of PIPs that occur in hospital work. I also presented a conceptual framework that illustrated how patient-care teams identify and manage PIPs in hospitals, including the factors that can influence how they identify and manage the PIPs. I then provided a more comprehensive discussion about the specific challenges that patient-care teams face when managing PIPs, including cascading effects and ambiguous accountability for managing PIPs. Finally, I concluded by offering socio-technical recommendations for how to improve hospital policy and training, as well as suggestions for HIT design features that can better support the identification and management of PIPs by patient-care teams. The next chapter will revisit the study’s research questions, summarize the study’s contributions, and discuss future directions of this research.
8 Conclusion

Researchers have described the complexity of managing information across highly collaborative, multi-functional hospital teams (Abraham & Reddy, 2008; Bardram & Hansen, 2010; Lee, Tang, Park, Chen, 2012). The distributed, dynamic, and multi-tasking environment of hospitals can make it difficult to ensure the accuracy and completeness of patient information over time. This is why PIPs frequently occur in hospitals. Although researchers have extensively studied the causes of PIPs (Abramson et al., 2012; Ash, Berg, Coiera, 2004; Dillon & Lending, 2010; Embi et al., 2004; Goldberg et al., 2010; Koppel et al., 2005; Park, Lee, & Chen, 2012; Siegler & Adelman, 2009; Turchin, Shubina, & Goldberg, 2011; Zhou et al., 2009) and the impacts of PIPs (Austrian et al., 2011; Harrison, Koppel, Bar-Lev, 2007; Koppel et al., 2005; Sittig & Singh, 2011; Taib et al., 2011; Wright et al., 2007; Wright et al., 2011; Zhang et al., 2004), there is still a limitation in understanding the types of PIPs that occur and how patient-care teams identify and manage the PIPs.

This dissertation study aimed to address this gap in research by examining how patient-care team members identified and managed PIPs during their collaborative work. The research objectives of this study were to provide a conceptual understanding of the ways that patient-care teams identify and manage PIPs and offer socio-technical design recommendations for how to improve the design of hospital policies and HIT systems to better support the identification and management of PIPs. I first conducted a preliminary study in the ED to better understand the collaborative management of information in the hospital environment. This preliminary ED study informed my main in-patient study by focusing my research questions on studying the identification and management of PIPs. I then conducted the main study in the in-patient ward of the same hospital. In the in-patient ward, I shadowed patient-care teams during morning rounds to gather data on how these collaborative teams identified and managed PIPs. The results of these studies make an important contribution to the conceptual and technical understanding of PIP
identification and management. This final chapter describes these contributions and discusses directions for future work on PIPs.

8.1 Study Contributions

I began my main study by identifying two research questions, which were based on limitations in previous research and based on the initial findings in my preliminary study:

**RQ1: How do collaborative patient-care teams identify patient information problems?**
- **RQ1a:** How does the EHR system help or hinder the identification of PIPs?
- **RQ1b:** How do work practices help or hinder the identification of PIPs?

**RQ2: How do collaborative patient-care teams manage patient information problems?**
- **RQ2a:** How does the EHR system help or hinder the management of PIPs?
- **RQ2b:** How do work practices help or hinder the management of PIPs?

These two research questions helped me address the following research objectives of this dissertation study:

(a) Provide a *conceptual understanding* of the ways that patient-care teams identify and manage PIPs, including the development of a PIP taxonomy and conceptual framework.

(b) Develop *socio-technical design recommendations* for how to improve the design of hospital policies and HIT systems, which will better support the identification and management of PIPs by collaborative patient-care teams.

In this section, I provide answers to these research questions by highlighting the major findings and contributions of my study.

8.1.1 Conceptual Understanding of PIPs

A conceptual contribution of this study is a PIP taxonomy that classifies, defines, and describes seven types of PIPs that occur in hospitals (Table 6-1 and Appendix E). Although this is
a preliminary taxonomy that does not include an exhaustive list of all possible types of PIPs, it provides a better conceptual understanding of the different PIPs that patient-care teams encounter in their work. The types of PIPs that occur in hospitals include: wrong, missing, incomplete, questionable accuracy, unclear meaning, outdated, and segregated information. Next, I aimed to better understand how the patient-care team members identified these PIPs.

**RQ1: How do collaborative patient-care teams identify patient information problems?**

There are four activities that team members perform when they identify PIPs. These four PIP identification activities include: *not finding needed information, encountering conflicting information, making sense of information*, and generalizing unreliable sources of information (Table 7-1 and Appendix F). It is also important to consider the socio-technical nature of hospitals to understand how the EHR system and the work practices of team members help or hinder the ability to identify PIPs.

The EHR is the primary information management tool used by patient-care teams. This system is dynamically updated throughout the day to create a shared awareness across the patient-care team and, therefore, it is the primary place where team members identify PIPs. The EHR system can both help and hinder the team member’s ability to identify PIPs. EHRs can help identify PIPs because team members compare all other information (e.g., paper-based notes, verbal conversations) to the EHR to determine if there is a PIP. If patient information is not found, not complete, or not correct in the EHR system, then the team identifies that as a PIP. Although the EHR plays a large role in PIP identification, the design of the system can also cause issues with identifying PIPs as well. One issue is that EHRs do not include a mechanism that alerts other team members if there is a potential PIP in the system. This can result in a PIP persisting in the EHR and lead to other team members not realizing that there is a PIP.
Additionally, the work practices of team members can also help and hinder the ability to identify PIPs. These work practices are the day-to-day patient-care activities performed by team members, including any organizational policies or social norms that can influence the team members’ behaviors during their work. The collaborative nature of patient-care teams can help to identify PIPs. This includes physician teams discussing patient information with other members of the team (e.g., consulting physicians, nurses, care coordinators, pharmacists) during rounds. This frequent, in-person communication across the patient-care team leads to team members helping each other identify conflicting information or make sense of any patient information that does not look right. There are times when rounding teams do not always include other members of the overall team in their rounding activities. This can occur when the rounding teams have a large number of patients in their care causing them to rush from room to room, or when they discuss patients in areas that exclude other members of the team (e.g., resident workrooms, areas not close to the patient rooms). These work practices that limit communication to only the rounding physicians does not allow other team members to contribute to the discussions about patients, which could hinder the ability to identify PIPs.

**RQ2: How do collaborative patient-care teams manage patient information problems?**

The five ways that patient-care teams manage PIPs include: *finding more information about the PIP, fixing the PIP themselves, finding someone to fix the PIP, ignoring the PIP, and working around the PIP* (Table 7-1 and Appendix F). Additionally, both the design of the EHR system and the work practices of team members can help or hinder the ability to manage PIPs.

Hospital work is highly mobile (Bardram & Bossen, 2003). Physicians must travel between multiple hospital floors and units during their rounding activities. Therefore, the digital nature of the EHR system, which can be accessed from any computer, laptop, or mobile device, helps team members quickly manage PIPs from anywhere in the hospital. These quick resolutions
of PIPs in the EHR system reduce any negative cascading effects on other team members who rely on the accuracy and completeness of the patients’ records in the EHR. However, EHRs can also hinder the management of PIPs in hospitals. Although EHRs provide a significant amount of patient information, the current system design does not always display who entered the patient data and, in some cases, why they entered the data (e.g., why a test was ordered, why a medication was prescribed). One of the primary ways that patient-care team members manage PIPs is by first finding more information from others about the PIP before they can fix it. Not being able to readily view who entered information associated with a PIP in the EHR hinders the ability to manage that PIP. Additionally, certain roles in the hospital cannot change PIPs that they identify in the system because their role does not authorize them to do so. This can include nurses who cannot change patient medication orders and care coordinators who cannot change a physician’s discharge notes. These users could also benefit from being able to quickly see who is responsible for entering the patient information associated with the PIPs that they identify. EHR systems include audit trail mechanisms that track every user action in the system (van der Linden et al., 2009), but this information is not visible to the users who are trying to determine who entered certain information into the patient record. Therefore, this is a limitation in the EHR system that can hinder a patient-care teams’ ability to manage PIPs.

Additionally, the work practices of team members can also help and hinder the ability to manage PIPs. Team members who are located in the same unit (i.e., intra-departmental) typically perform work practices that increase communication with each other in order to discuss and manage PIPs together. This includes frequently using communication devices, like phones and pagers, to contact each other if they need to manage a PIP. However, sometimes the work practices of team members from different departments or facilities (i.e., inter-departmental) hinder the ability to manage PIPs. This can be due to hospitals having vague policies that do not clearly describe who is accountable for managing PIPs during inter-departmental transfers. When
this ambiguous accountability occurs between units or facilities, it can result in frustration and tension between the members of the different units or facilities. Furthermore, two ways that team members can manage PIPs are to ignore the PIP or workaround the PIP. When team members chose not to fix the PIP, this behavior can result in negative cascading effects on other members of the team who rely on the accuracy and completeness of that information to do their work.

8.1.2 Socio-Technical Design Recommendations

The second contribution of this study is socio-technical design recommendations for hospital policies, training, and HIT design. Based on the findings associated with my research questions, I proposed recommendations to create inter-departmental policies about PIP management, develop IT and clinical training initiatives, and include HIT design features that better support the identification and management of PIPs.

Inter-Departmental Policies for PIP Management: One work practice that can impact PIP identification and management is the transfer of incomplete or inaccurate information during patient transfers between units or facilities. During these transfers, there can be an ambiguous understanding about who was responsible for fixing PIPs that are transferred with the patients. This ambiguous accountability causes frustration and tension between units and facilities. Therefore, I recommend that organizations create clear policies about the transfer of accurate and complete information during these patient transfers. This includes managing any PIPs during the transfer. However, although these policies help provide guidelines and set expectations for quality documentation practices, hospital staff still may not follow these policies due to their busy and complex work environment. That is why I also recommend that hospitals who have a serious problem with PIPs during patient transfers consider including medical scribes as part of their patient-care teams. This newly emerging role can help with ensuring the accuracy and completeness of patient records prior to the patient transfer.
**IT and Clinical Training:** Due to the increasing use of HIT in hospitals, it is important that the clinical staff is adequately trained on how to use the HIT systems. It is also important that the hospital's IT staff members are aware of any HIT usability issues that could negatively impact the identification and management of PIPs. Therefore, I recommend that hospitals continue their efforts in incorporating more clinical staff into IT departments and into the HIT configuration and implementation processes within hospitals (Detmer, Munger, & Lehmann, 2010; Weckman & Janzen, 2009). Additionally, I also propose that hospitals include a clinical-rounding training program for IT staff. This will allow IT staff members to observe how clinical users utilize the HIT systems during their patient-care activities. This can include seeing how the HIT system helps or hinders their ability to identify and manage PIPs. Additionally, the regular presence of an IT staff member could also help develop a friendly rapport between IT staff and clinical users so that there is an opportunity for honest feedback on HIT usability issues.

**HIT Design Features:** In this study, I also recommend the inclusion of two HIT design features that can better support patient-care teams in identifying and managing PIPs. As mentioned, current HIT systems do not always display who entered patient data and why they entered the data (e.g., why a test was ordered, why a medication was prescribed). HIT systems include audit trails that can provide information about user activities, and the justifications for why users perform certain actions can typically be found in other areas of the system (e.g., pharmacy system, progress notes). However, current HIT systems do not provide this information to users in a cohesive view within the system. Since the lack of knowing who was associated with a PIP in the system hindered the team’s ability to manage PIPs, I suggest adding a mechanism that connects this segregated data and displays it in a temporary hover-box (Miller et al., 2014). Additionally, another issue highlighted in this study is that HIT systems do not include a mechanism that allows one team member to alert another team member within the system if there is a potential PIP that could impact the other team member. This can result in a PIP persisting in
the system and lead to other team members not realizing that there is a PIP. Therefore, I propose
the inclusion of a flagging and annotating function. This function would allow users to select data
and flag it, which would turn the font red and add a flag icon. The flag icon would then allow the
user to enter a comment annotation to the flagged item to provide information about the PIP to
other team members. This function can visually alert anyone looking at the patient’s record that
there may be an issue with the flagged patient data.

8.1.3 Contributions to Academic Communities

This research contributes to three academic communities: Medical Informatics (MI),
Human-Computer Interaction (HCI), and Computer-Supported Cooperative Work (CSCW). This
section describes the specific contributions to each of these communities.

8.1.3.1 Contributions to MI and HCI

MI and HCI researchers have studied the causes of PIPs, including how user error and the
design of HIT systems can lead to PIPs (Ash, Berg, Coiera, 2004; Embi et al., 2004; Koppel et
al., 2005; Sittig & Singh, 2011). This research provides important insight into how to prevent or
lessen the negative impact of these PIPs on the patient-care workflow. More specifically, MI and
HCI researchers describe how PIPs are being caused in HIT systems due to the automatic
selection of default dosing, inflexible ordering formats that led to wrong orders, separation of
system functionality that resulted in double dosing or incompatible orders, and the automatic
truncation of data fields resulting in lost patient data (Abramson et al., 2012; Koppel, 2005; Sittig
& Singh, 2011). MI and HCI researchers also discuss how the rigid, standardized nature of HIT
systems does not allow for the entry of rich, descriptive data, which can result in PIPs (Ash, Berg,
Coiera, 2004; Dillion & Lending, 2010; Zhou et al., 2009). Furthermore, MI and HCI describe
how users themselves can also cause PIPs. The most common cause of user-generated PIPs is due
to users copying and pasting text in order to save time during patient documentation, which
results in outdated or incorrect information in the patient record (Ash, Berg, Coiera, 2004; Embi et al., 2004; Sieglar & Adelman, 2009).

Therefore, the causes of PIPs are widely studied in MI due to concerns that patient medical errors are being caused by these HIT-related PIPs (Sittig & Singh, 2011). Additionally, since HCI aims to improve usability of system design, this community also studies how to improve HIT design to better facilitate information management in hospital work. However, these research communities have not yet explored how the collaborative nature of hospital work impacts the patient-care teams’ ability to identify and manage these PIPs that are being caused in HIT systems. This includes how to build HIT systems that consider the challenges of managing PIPs within a collaborative team. Therefore, my research can extend MI and HCI research to include a conceptual framework for how PIPs are identified and managed, including the socio-technical factors that can influence PIP identification and management. Additionally, although MI and HCI frequently describe PIPs in their research, there is not yet a taxonomy that classifies and defines these PIPs. My research can also contribute to MI and HCI by providing a preliminary PIP taxonomy, which can be used as a foundation to better understand the types of PIPs that occur in hospitals.

8.1.3.2 Contributions to CSCW

CSCW researchers have focused on describing how the collaborative nature of hospital work impacts the communication, workflow, and information management activities of patient-care teams (Abraham & Reddy, 2008; Paul & Reddy, 2010). This research includes how the mobile aspect of hospital work impacts collaboration (Bardram & Bossen, 2005; Bossen, 2002; Moran et al., 2007) and how the temporal rhythms of the hospital can determine the best time to coordinate work or share information (Reddy & Dourish, 2002; Reddy, Dourish, Pratt, 2002; Tang & Carpendale, 2007). Additionally, CSCW researchers also extensively study how
collaboration affects information-seeking activities including ensuring all patient-care team members are able to meet their information needs in order to make decisions about patient care and coordinate clinical activities with other team members (Poltrock et al., 2003; Reddy & Jansen, 2008; Reddy & Spence, 2008).

This existing CSCW research considers the collaborative challenges that can impact the coordination and completion of patient-care tasks, including collaborative information seeking activities. However, there is a lack of CSCW studies that aim to understand how these collaborative challenges also impact the identification and management of the problems that occur with patient information. Therefore, my PIP framework can extend CSCW’s conceptual understanding of how team’s collaboratively seek and manage patient information to include how they also collaboratively identify and manage PIPs that arise with the patient information.

### 8.2 Study Limitations

In order to be transparent about the methods and transferability of this dissertation’s findings, I will describe three limitations of my studies. These limitations commonly occur in ethnographic studies (Creswell, 2007) and do not diminish the contributions of this dissertation. Instead, they highlight opportunities for future research that can help to further refine and strengthen the PIP taxonomy and conceptual framework.

(a) **Single observer:** One limitation of this study is that it was conducted by a single observer.

One researcher in a large hospital setting is not able to observe all instances of PIPs that occur. Being a single observer required me to make choices about who to observe and where to focus my attention when many different activities were occurring simultaneously. However, the goal of this study was not to present an exhaustive list of PIPs, but rather to identify common PIPs that occur in hospitals and describe how they are typically identified and managed by the patient-care team members. I believe that I was able to collect the
appropriate types of data and the appropriate amount of data to create a preliminary taxonomy and conceptual framework of PIPs in hospitals. The next section on Future Work will discuss the importance of conducting additional studies to further refine and strengthen the taxonomy and conceptual framework presented in this dissertation.

(b) **Observable nature of PIPs:** Another limitation of this study is that I, as the researcher, am not medically-trained and not a part of the clinical patient-care team. When collecting data on the PIPs that occurred in my studies, I could not observe and identify the PIPs myself since I was not a hospital staff member responsible for reviewing the patient data. Instead, I relied on my participants to verbalize the PIPs that they were identifying and managing. At the beginning of the studies, I notified my participants of my study’s purpose, which resulted in my participants frequently pointing out PIPs to me during the observations, shadowing, and interviews. I also learned to listen for certain key words or phrases during observations and shadowing (e.g., “this doesn’t look right,” “I can’t find it,” “the progress note is different than the chart”), which helped me know when the team may have encountered a PIP. I would then follow-up with additional questions to verify the content of the PIP conversations to ensure that I correctly understood the PIP. Relying on my participants to verbalize or discuss the PIPs can result in missing certain occurrences or types of PIPs. However, as previously mentioned, the taxonomy and conceptual framework in this study are not meant to be exhaustive and should be further explored in future research. Additionally, I also found it very difficult to watch participants navigate the EHR during rounds due to the narrow and busy nature of hospital hallways and the inability to position myself behind participants (e.g., most participants leaned up against walls to be out of main hallway flow). Although I still spoke with participants about their use of the system and watched them navigate the EHR in the resident workroom, I was not able to watch their EHR use as much as I wanted during rounds. Addressing this issue in future work is further discussed in the next section.
(c) Sources of PIP identification: Due to the scope of my IRB, I only included patient-care team members as my participants. I did not include patients or visitors (e.g., family members, caregivers) as participants since this requires additional written consent from each of the patients and visitors, which would have caused a disruption to the flow of the morning rounds. Additionally, the scope of this study was only focused on understanding the patient-care team members’ role in the identification and management of PIPs. However, it should be noted that patients and visitors can also play a role in identifying and managing PIPs. In Table 6-2: Identification of PIPs by Role, I highlighted this by including both “patient” and “patient’s family” as sources of PIP identification. These roles are included based on statements that my participants made about how their patient or patient’s family member played a role in identifying the PIP. For example, in a data excerpt from Section 6.1.1 Wrong Information, an attending told her team about how she asked a patient about her mastectomy and the patient told her that she never had breast cancer or a mastectomy. This was a story told by the attending who recounted what the patient said to her. In the next section, I suggest that researchers further explore the role that patients and their family can play in the identification and management of PIPs.

As mentioned, these limitations are common issues faced by ethnographic researchers and they do not diminish the contributions of this dissertation. Instead, they highlight opportunities for future research, which are described in the next section.

8.3 Future Work

Given the rapid growth of HIT in hospitals, it is important to continue investigating how PIPs are caused, identified, and managed by collaborative patient-care teams. Although this study provides a preliminary foundation for defining and conceptualizing the identification and management of PIPs, there is still much more research needed to fully understand PIPs within the
context of collaborative hospital work. In this section, I provide three areas of future work: (a) refining the PIP taxonomy and framework, (b) further assessing the role of HIT design in PIP identification and management, and (c) engaging patients and family members in the identification and management of PIPs.

(a) **Refining the PIP taxonomy and conceptual framework:** This study provided preliminary insights into how to classify types of PIPs and how to conceptualize the process of identifying and managing PIPs in hospitals. However, one limitation of my study is that it was conducted by one researcher at one field site. In order to accurately conceptualize PIPs in a way that can be more transferable to other hospitals, additional research studies must be conducted to gather more data on PIPs in order to refine and strengthen the taxonomy and conceptual framework. Since some researchers may not be medically trained or know when a PIP occurs, future research studies can also include making the participants more aware of these PIP types prior to the study by discussing the PIP taxonomy and framework with them. This increased awareness about PIPs can lead to the participants discussing their own experiences with PIPs and describing how they identify and manage PIPs. Additionally, as discussed in Section 7.1, the framework can also be expanded to include other socio-technical factors that are internal or external to the hospital. Future research could also shift the analytical perspective of the PIP framework by analyzing PIP management for different types of information, roles, units, departments, facilities, countries, and so on.

(b) **Further assessing the role of HIT design in PIP identification and management:** During my field studies, I had a difficult time assessing the use of the EHR during patient-care activities. I did have opportunities to watch the residents do some patient documentation in the workroom, but during rounds only one member of the team had a laptop and I was not always able to position myself to see the EHR screen. I would have liked to see more of the human-computer interaction with the EHR in order to better assess how it helped or hindered
the team members’ abilities to identify and manage PIPs. Therefore, this is an area of future research that is important to further explore, especially given the impact that HIT design can have on the creation of PIPs. With that being said, there is currently an access barrier that many HIT researchers are facing related to observing HIT systems. During my field study, I learned that many EHR vendors have very strict non-disclosure agreements (NDAs) as a part of their vendor agreements with the hospitals. These NDAs restrict the hospital staff from taking screenshots of the system and discussing system usability issues with anyone outside the hospital organization. Koppel & Kreda (2010) summarize this issue with EHR vendor NDAs: “Users can inform vendors and colleagues within the same organization but remain at legal peril for talking beyond their organization or for sending images of application screens to other practitioners…this is a huge barrier to the exchange of information that clinicians are supposed to rely upon to make learned decisions” (p.13). Although the vendors state that the NDAs are to protect the intellectual property of their system design, many physicians and HIT researchers are frustrated about their inability to share knowledge about system-related errors and usability concerns. Dean Sittig, a HIT researcher at University of Texas Health Science Center in Houston, said he tried to get permission from an EHR vendor to allow his masters student to use screenshots of an EHR in his HCI-related thesis: “I have personally asked [Epic’s CEO] for permission to publish screenshots in a student’s master’s thesis and have been told no” (Tahir, 2015). The design of HIT is a critical part to ensuring patient safety, so vendors, hospitals, and academic researchers must determine a way to allow for more in-depth analysis of the EHR design and its usability issues, especially related to the identification and management of PIPs.

(c) Engaging patients and family members in PIP identification and management: The Medical Informatics community has identified patient engagement as a critical area for improving patient safety and patient care in our current healthcare system. The use of
technology, including HIT and informatics software, provides the tools to “transform patient-provider relationships and overall healthcare delivery” [Brennan et al., 2014]. This shift towards looking at how patients can help improve the accuracy of their own information is important to consider when studying PIPs. The findings of this dissertation identified patients and patient family members as two roles who helped to identify PIPs (Table 6-2). Although the scope of this study did not include observations and interviews with patients or their family members, the participants still mentioned them in their discussions with one another. This highlights an opportunity for future research that includes a focus on the role that patients and their family members play in PIP identification and management.

8.4 Closing Remarks

Patient-care teams frequently encounter patient information problems during their daily work. However, if these PIPs are not identified and properly managed, they can result in delayed work, persistent errors that affect other members of the patient-care team, or even medical errors that negatively impact the patient. This dissertation described a qualitative study that aimed to better understand PIPs in hospitals. Through a field study in the emergency department and in-patient ward of a hospital, I developed a PIP taxonomy and framework that provides a better conceptual understanding of the identification and management of PIPs, as well as socio-technical factors that can influence how patient-care teams identify and manage PIPs. This study contributes, not only a better conceptual understanding of PIPs, but also specific socio-technical design recommendations for how to improve hospital policies, training, and HIT design to better support the collaborative identification and management of PIPs. The insights gained from this study provide a foundation for future research on PIPs in hospitals.
References


Appendix A: Verbal Consent Form

SUMMARY EXPLANATION OF RESEARCH
Penn State College of Medicine
The Milton S. Hershey Medical Center

Title of Project: Exploring Information Accuracy in Healthcare Communication
Principal Investigator(s): Alison R. Murphy, Madhu C. Reddy PhD

You are being invited to volunteer to take part in a research study. Research studies include only people who voluntarily choose to take part. This summary explains information about this research. You are urged to ask questions about anything that is unclear to you.

Research Purpose: The purpose of this research is to learn about how healthcare teams identify and manage information issues during their daily work and to understand how the technologies you use may help or hinder the ability to manage different types of information issues. These information issues may include missing, outdated, incomplete, wrong, or conflicting information that you rely on to do your work.

Research Procedures:
During shadowing observations, the following procedures will occur:

- The researcher will follow you during your daily activities. You may ask the researcher for privacy at any time, especially during certain private activities, such as confidential conversations.
- The researcher will take field notes on the types of communication and documentation activities that are performed during your daily work and any information issues that you may encounter.
- Anonymized health information about patients will be collected to provide context for your communication and documentation activities. However, no protected health information will be collected about the patients.
- If the participant shows the researcher an electronic medical record, paper record, or other confidential artifact as part of the observation, the researcher may review the records to better understand the situation. However, no protected health information will be collected from the record.
- The researcher will transcribe any field notes into an electronic format.
- The electronic field notes will be stored on a password-controlled desktop computer at The Pennsylvania State University. Any paper copies of the data will be stored in a locked desk within an access-controlled laboratory at The Pennsylvania State University.

Duration: The researcher will be in the hospital for approximately 4-months.
**Risks:** There are no risks in participating in this research beyond those experienced in everyday life. The only risk is a possible loss of confidentiality if your information or your identity is obtained by someone other than the investigators, but precautions will be taken to prevent this from happening.

**Benefits:** You will not benefit from taking part in this research study. However, the results of this research can lead to improving the design of healthcare technology systems and work processes that better support the communication and documentation of accurate healthcare information.

**Costs:** There are no costs for participating in this research study and you will not receive any payment or compensation for being in this research study.

**Funding:** The institution and investigators are not receiving any funds to support this research study.

**Confidentiality:** Your participation in this research is confidential. The only personally identifiable information that could be collected about you is your name so that we will know who has given verbal consent to take part in this research study. A list that matches your name with a code number will be kept separate on the password-controlled desktop computer of the Principle Investigator (Alison Murphy) located at The Pennsylvania State University. Any electronic data resulting from your part in the observations and interviews of the healthcare participants will be anonymized and kept on password-controlled desktop computers at The Pennsylvania State University. Any physical copies of the data will be kept in locked filing cabinets within controlled access rooms at The Pennsylvania State University. Only those people listed as members of the research team will have access to the data. All data will be destroyed 3 years after the close of the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

**Participant Rights:** You have the right to ask any questions you may have about this research. If you have questions, complaints or concerns or believe you may have been harmed from participating in this research, you should contact Alison Murphy at 814-880-4439. If you have questions regarding your rights as a research participant or concerns regarding your privacy, you may contact the research protection advocate in the HMC Human Subjects Protection Office at 717-531-5687. You may call this number to discuss any problems, concerns or questions, get information, or offer input.

You do not have to participate in this research. Taking part in the research study is voluntary. Your decision to participate or to decline the research will not result in any penalty or loss of benefits to which you are entitled. Your decision to allow or not to allow the shadowing of your daily activities to be observed and recorded will have no effect on your employment.

**Verbal Consent:** Please tell the researcher your decision regarding whether or not you wish to participate in this research.
Appendix B: Semi-Structured Interview Protocol

Interview Guide:
Exploring Information Accuracy in Healthcare Communication

Interviewer: ___________________________ Participant ID: ___________________________

Date & Time of Interview: ___________________________

Participant Background
1. Can you tell me about your role and your primary responsibilities?
2. How long have you been in this position?

Individual Communication and Documentation
3. How do you typically document information during your daily tasks?
4. What types of tools or technology do you use to document information?
   [Prompt with examples if needed: paper forms, notebooks, white boards, computers, tablets, etc.]
5. What do you like about these tools or technologies?
6. What are the challenges you face when using these tools or technologies?
7. How would you improve the current tools or technologies to better meet your communication needs?

Communication with Others
8. What other roles do you typically communicate with during your daily tasks?
9. How do you provide information to these other roles?
10. How do you obtain information you need from these other roles?
11. What are the challenges you face with providing or obtaining information from others?

Identifying and Managing Information Problems
12. Have you ever had concerns about the completeness of information?
   a) If yes, how did you realize that the information was incomplete?
   b) How did you handle the incomplete information issue?
13. Have you ever had concerns about the accuracy of information?
   a) If yes, how did you realize that the information was inaccurate?
   b) How did you handle the issue with information accuracy?
14. Have you ever encountered information discrepancies during your daily tasks?
   a) If yes, how did you realize that there was a discrepancy in the information?
   b) How did you resolve the information discrepancy issue?
15. Do you have any other concerns or issues with the information you provide or obtain during your daily tasks?

Thank you for your time and participation in this study.
Appendix C: Map of Emergency Department Observations

*Blue areas indicate the location of general observations and red lines indicate controlled-access doors*
Appendix D: Map of In-Patient Shadowing Observations

Blue areas indicate the location of shadowing observations and red lines indicate controlled-access doors.

This is a layout of the 6th floor in the in-patient ward, which is where the resident workrooms and attending offices were located. The 6th floor also included the MIMCU and MICU units, where I conducted a majority of my shadowing. Other floors had a similar configuration.
## Appendix E: PIP Taxonomy

<table>
<thead>
<tr>
<th>PIP Type</th>
<th>Definition</th>
<th>Example from Hospital Field Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrong</td>
<td>Information is not accurate.</td>
<td><em>When the physician team exits the patient’s room, the rounding pharmacist tells the team that the patient is on the medication “Penicillamine” and asks if this is correct, or if it is supposed to be the very similar sounding medication “Penicillin V” instead. After reviewing the medication list and patient history, the team realizes that the wrong medication was carried over in the system from the ED admission. The patient was supposed to be on Penicillin V.</em></td>
</tr>
<tr>
<td>Missing</td>
<td>Information is expected to be there, but all of the information is not there.</td>
<td><em>The attending physician points out that there are no assessment notes in the system from Cardiology even though they said that they saw the patient last night and would provide notes afterwards.</em></td>
</tr>
<tr>
<td>Incomplete</td>
<td>Information is expected to be there but only part of the information is provided, which can result in participants believing they have all of the information when they do not.</td>
<td><em>The resident says that the Urology assessment notes in the system mention that they &quot;placed the stent&quot; but not that they also &quot;removed gritty stones,&quot; which they had told the resident they did while discussing the patient over the phone. The attending mentioned that the removal of gritty stones is good to know about and it should have been included in their notes.</em></td>
</tr>
<tr>
<td>Questionable Accuracy</td>
<td>There is uncertainty about the correctness of the information and there is no way to verify if the original information is correct or not.</td>
<td><em>The physician team visits 3 patients in the ICU and they all have lower than expected blood sugar levels. The attending says, “this patient seems low, the other guy seems low, they all seem lower than they should be. I’m seeing a trend, maybe something is up?” They look for the nurse and ask her to do the blood sugar tests again.</em></td>
</tr>
<tr>
<td>Unclear Meaning</td>
<td>There is uncertainty about the meaning of the information.</td>
<td><em>The physician team is reviewing surgery notes and the attending says, “There’s a recommendation for ‘CLD’? What does ‘CLD’ mean?” The two medical residents do not know. One resident looks it up on her iPhone and after a few minutes says, “Oh I think it means ‘clear liquid diet.’ I’ve never seen that used as an acronym before.” The others agree and discuss how they are confused about why surgery still wants the patient on a clear liquid diet. The attending says, “I don’t see why she still needs to be on a ‘CLD’ as they call it, if that’s what ‘CLD’ actually means. We should follow-up with them to figure out what’s going on.”</em></td>
</tr>
<tr>
<td>Outdated</td>
<td>Information that frequently changes is no longer accurate and has not been updated.</td>
<td><em>During morning rounds, a resident says that the system is showing older inputs and outputs for a patient from 5pm yesterday and they need to talk to the nurse to provide more recent numbers before they decide on next steps.</em></td>
</tr>
<tr>
<td>Segregated</td>
<td>Multiple pieces of related information are stored in different locations and are not easily viewed together.</td>
<td><em>A resident explains that the night shift’s notes don’t specify which anti-coagulant the patient was given. The attending tells the resident to look it up in the pharmacy system. The resident says &quot;yes, but it's such a pain, why can't they just write it in the notes.&quot;</em></td>
</tr>
</tbody>
</table>

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Appendix F: Framework of PIP Identification and Management in Hospitals

**Causes of PIPs**
- User error
- HIT system design

**PIP Identification**
Activities being performed when PIPs are identified:
- Not finding needed information
- Encountering conflicting information
- Making sense of information
- Generalizing unreliable sources of information

**PIP Management**
Activities performed in response to PIPs:
- Find more information about the PIP
- Fix the PIP themselves
- Find someone to fix the PIP
- Ignore the PIP
- Work around the PIP

**INTERNAL FACTORS**: Socio-technical factors that can influence the cause, identification, and management of PIPs

**Social Factors**
- Work practices
- Hospital policies
- Collaborative work

**Technical Factors**
- HIT systems

**EXTERNAL FACTORS**: Factors external to the hospital that can influence PIPs (e.g., government regulations, external facilities)
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