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Information Delivery from Healthcare Providers to Patients in Emergency Department:
Opportunities for Patient-Centric Technology Design

THESIS

Submitted in partial satisfaction of the requirements for the degree of

MASTER OF SCIENCE

In Information and Computer Sciences

By

Shriti Raj

Thesis Committee:
Associate Professor Yunan Chen, Chair
Professor Alfred Kobsa
Professor Geoffrey C. Bowker

2015

DEDICATION

To my parents, who have been a source of inspiration and to a special friend, who has
supported me in ways that words cannot describe.

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ABSTRACT OF THE THESIS

Information Delivery from Healthcare Providers to Patients in Emergency Department:

Opportunities for Patient-Centric Technology Design

By

Shriti Raj

Master of Science in Information and Computer Sciences

University of California, Irvine, 2015

Associate Professor Yunan Chen, Chair

I present an observational study conducted to understand the phenomenon of information delivery to patients from healthcare providers in an Emergency Department (ED). My observations reveal different phases of a patient's ED care process, which I term as "milestones". I report the composition of these care milestones in terms of information given to patients and the care team members who deliver information. Analysis of contextualized information delivery events across these milestones revealed three factors affecting information delivery and patients' perception of information delivery. These factors are: temporalities in a patient's care process, invisibility of ED work to patients and a patient's expectation and health literacy. My study shows how these factors affect information availability, and the time and content of information delivered to patients. The findings reflect on when and what information is appropriate to be delivered to patients, and how to design patient-centric technologies for information delivery to be appropriate with regards to the time, content and format of information delivery.

CHAPTER 1 – INTRODUCTION

Informed patient is one of the pillars of patient-centered care and patients are increasingly being seen as informed consumers of medical services. Increased access into health information has shown to improve patient's sense of ownership and control [44]. Research has established that meeting information needs of patients is imperative to increase participation of patients in their care and more research is required to understand patients' perceptions of information delivered to them [45].

Even though the importance of information needs and perceptions of patients have been acknowledged, current technology design of health information systems is often provider-centric with patients as the secondary users having indirect access to information through the healthcare providers. Additionally, research has shown that there is a difference between technological preferences of patients and providers regarding the use of technology in medical settings [3]. Hence, there is a need to reconsider the design of health information systems to include patients' perspectives and patient-centric features to foster their participation in their own care [44].

Research has increasingly acknowledged the importance of designing patient-centric information technology for information delivery to patients to increase their engagement during hospital stay. There is research in the form of randomized control trials of inpatient engagement interventions to assess patient satisfaction. Few studies have designed in-

room patient-centric information delivery platforms to provide information to Emergency Department (ED) patients [30][51]. They found positive impact of providing information on both patients and caregivers in terms of aiding patient's memory, decreasing anxiety by increasing situational awareness, facilitating post visit information review through information archives and sharing data with caregivers.

These studies have reported what types of information should be made available to the patients. However, they are yet to account for complete automation of information delivery that requires considering when should the information be released, simplification of medical information for appropriate information format and exploring patients' information needs. Thus, there is a need to better understand how patient's information needs and their perceptions of information delivered during their hospital stay can inform technology design.

Furthermore, the above-mentioned interventions use inputs from healthcare providers to design technology for patients. These providers have shown concern for automated delivery of few information types such as lab tests and vitals. They specifically wish this information to be delivered after they have communicated with the patient [52]. Such clinical information requires interpretation and patients may not understand it in the absence of clinicians. Hence, the occurrence of patient-provider communication for providing information to patients requires to be considered in the design of patient-facing information delivery platforms.

Information delivery to patients is an important aspect of patient-provider communication. In order to address the previously identified research gaps, there is a need to understand situated information delivery to patients during their hospital stay in relation to the contextual features of hospital work. Additionally, there is also a need to investigate patients' perception of information delivery as to whether it meets their needs and expectations. I believe that designing information technology to provide information to patients requires exploring patients' situated experience of information delivery as much as it requires exploring providers' inputs on what information should be given to patients. Obtaining patients' perspective is justified because patients are the primary information consumers.

To understand information delivery better I conducted an observational study in ED, focusing on how information is delivered to a patient by providers in different roles throughout the patient's ED visit. ED is an ideal setting for research on patient-facing information platforms because it presents a time-critical information rich environment where patients are faced with uncertainty and could have immediate information needs. Additionally, the complexity of ad-hoc collaboration in ED challenges providers' work, which could have implications for the task of information delivery to ED patients. Hence, investigation of events that unfold during a patient's ED visit along with her interaction with the health providers can give insights into the dynamics and perceptions of information delivery to patients, specifically situated in the complex working context of ED. The overarching goal of my study is to address two central questions:

1. What are the factors affecting situated information delivery from providers to patients throughout their ED care and how do they influence patients?
2. How can information technology be designed to fit the context of ED work and better support information delivery to patients?

I investigated *in-situ* information delivery events as they occur in different phases of a patient's ED visit to extract the time, content and the provider giving information. I found the composition of a patient's care process and how information delivery to patients is practiced within the temporal framework of their care process. Through my analysis, I show three key factors that affect information delivery and influence patient's perception of information given to her. I then provide recommendations for designing futuristic patient-centric information displays.

The major contribution of this work lies in the patient-centric approach towards exploring how information delivery affects patients and what can be done at the system design level to help them. While prior studies have mostly relied on surveys and interviews, I observed the ED stay of patients. The contextual factors affecting information delivery in the working environment of ED may not be extracted through interviews or surveys. Observations provide in-depth knowledge of the situated practice of information delivery and the inherent breakdowns that may impact patient's perception of ED care. Additionally, prior studies have focused on information delivery between medical workers, e.g. communication between nurses. However, I studied communication between two marginally distinct sides, patients and providers, which revealed interesting factors related

to the complex nature of ED work and expectations and health literacy of patients. Thus, I

contribute by providing insights into the provider's task of delivering information as well

as patient's experience of receiving information.

CHAPTER 2 – RELATED WORK

2.1 Health Information Technology and Collaboration in Medical Settings

Supporting collaboration amongst providers in medical settings through health information technology (HIT) is an important research concern in the field of medical informatics. Chiasson et al. performed an evaluation of health information systems and have shown that theories related to collaborative work have been increasingly used in health care IT research [9]. Consequently, research has been carried out to investigate the situated use of HIT in medical settings. Karunakaran et al. found the barriers towards the use of Electronic Medical Records (EMR) in collaborative information work of providers and concluded that EMR design does not support collaborative information seeking activities [19].

Studies have also investigated the communication challenges that exist in the complex operational environment of hospitals. Lee et al. conducted an observational study and reported the communication issues faced by patient care teams in ED producing guidelines to design communication technologies to support better team collaboration [23]. Futuristic communication technologies have been deployed to study their effect on provider-provider communication. Favela et al. deployed a context-aware mobile communication system. They identified contextual elements that a context-aware application for delivering information to the providers would use to decide when to deliver incoming messages to providers. These elements are location, delivery time, artifact location and state, and role reliance [14]. Tang et al. deployed a hands-free mobile communication tool to help

minimize spatial movements for communication between providers and received mixed response from them [43].

Many CSCW studies have investigated the role of temporalities in medical settings. Reddy et al. investigated how the temporal organization of work affects collaboration amongst providers by affecting the way providers seek, provide and manage information [33]. Additionally, these temporalities have been regarded as a source of information in collaborative work [32]. Tang et al. investigated information flow during nursing shift hand-offs and reported the intricacies of temporal coordination required for information assembly and disassembly by the nurses [42]. Medical work is split across multiple stakeholders that include the clinical and non-clinical staff and is team-based [29]. Abraham et al. have shown that lack of awareness and coordination amongst these clinical and non-clinical staff can affect patient care [1].

Research has found that spatiality as another feature in medical work restricts awareness and work coordination and consequently, large displays have been designed to support awareness amongst team members. Bardram et al. created AwareMedia, a context-aware large display to afford spatial and temporal awareness of teams in a surgical unit along with shared messaging between providers [4]. Kusunoki et al. conducted design workshops in emergency departments to explore design ideas for creating large displays. They identified features of teamwork such as team member awareness, elapsed time awareness and patient-driven task awareness concluding that these features can be used for designing awareness promoting platforms [22].

Collaboration amongst providers for seeking information and performing care activities is crucial for effective patient care and many studies have reported the effect of collaboration challenges on communication between providers. Nonetheless, there is very little investigation into how do these coordination challenges affect communication between patients and providers.

2.2 Patient-Provider Communication and Information Delivery

2.2.1 Information Giving in Patient-Provider Encounters

Effective patient-provider communication is correlated to better patient health outcomes [37]. Given the importance of providing information to patients, studies have been conducted to extract factors that affect information giving in patient-physician encounters in the outpatient settings. One of these studies found that patient related factors such as patient's expressiveness and question-asking attitude resulted in physicians giving more information to patients [38]. Other studies have found social factors related to doctors and patients such as social background of the doctor, patient's age, gender, diagnosis and prognosis that affect information transmittal to patients. They also found factors related to clinical situation such as number of patients and types of patients during a day affected information giving in medical consultations [49][48]. More investigation is required into the practice of information delivery in a hospital setting to assess how contextual factors related to hospital work can affect the way information is delivered to the patients.

2.2.2 Patient-Provider Communication Tools

Patient-provider communication has been studied extensively in the outpatient settings. Multiple tools have been designed to support information sharing with patients during face-to-face patient-provider consultations. Ni et al. explored the use of a projection based handheld device to facilitate medical information exchange for patients with physical injuries. The tool was used by physical therapists in face-to-face consultations. The study targeted doctors as the primary users with a motive of improving in-situ patient education, and some benefit to the practitioner in terms of better health outcomes. The tool led to higher retention of instructions given to patients with physical injuries [28]. Alsos et al. reported how the form of information device, its user interface and physician's communication strategy affects patient-physician interaction. They reported that different information devices let doctors configure what kind of awareness can be established for the patient. PDA was found to restrict face-to-face communication while paper allowed for gestures and afforded action visibility for patients [2].

Gonzales et al. worked with cancer patients and oncologists to design a patient-centered health communication tool using participatory design approach to bridge the information gap between patients and providers introduced due to communication around complex information. They found that patients preferred large displays whereas oncologists preferred handheld devices. Patients considered preventing information overload by letting the oncologist tailor information on the fly during consultations if the patient is unable to understand. Additionally, they reported that patients wanted the tools for

communication to be separate from other systems in exam room to increase patient engagement [18]. This points to the need to consider both patients and providers for designing information delivery interventions.

The above-mentioned studies have targeted providers as the primary users of communication tools. In a different study, Alsos et al. established the notion of secondary user experience based on findings of a usability evaluation study of mobile devices in hospital settings. The study compiles issues faced by patients as secondary users because of systems designed around providers as primary users and discusses considerations and trade-offs designers should remember. They found conflicting design considerations from providers and patients. One of the notable design guidelines produced by them is to provide system visibility to the secondary users [3]. In a similar direction, Chen et al. explored the dynamics of technology use by providers during consultations in exam rooms and suggested that use of devices such as movable computers facilitate patient's active engagement in the interaction with clinicians [8].

Communication for continuous care has been studied in the context of patient portals. Sun et al. studied a patient portal for analyzing patient-provider communication threads. All the patient communication happened through the nurse and they found that this mediation introduced inaccuracy. They also reported that sharing extra information with the patients made them challenge providers' suggestions [41]. Winkelman et al. studied the effect of providing EMR access to patients with a chronic illness and report that providing access led to "a sense of illness ownership, of patient-driven communication, of personalized support,

and of mutual trust". Information becomes the driver of communication and patients feel more comfortable communicating when they have equal access to the information that doctors have. They concluded that providing communication tools as a part of information platforms (EMR) is an important consideration for designing ICT tools [54].

2.3 Information Delivery and Patient-Provider Communication in ED

2.3.1 Information Delivery for Patient Satisfaction

Information delivery is important for patient satisfaction in ED and it has shown to be directly correlated with patient's perception of quality of care [27]. Conclusions from numerous studies show that communication and information delivery is one of the most important determinants of patient satisfaction in ED [6][7][39][40]. Most of the patient complaints result out of communication failures and communication training of providers has been identified as a central requirement to improve communication [46].

2.3.2. Nature of Patient-Provider Communication in ED and Challenges

Patient-provider communication in ED comprises of five communication tasks namely establishing rapport, gathering information, giving information, providing comfort and collaborating and is characterized by specific impediments [20]. Apart from the much discussed psychosocial and cultural factors in literature, this study also lists ED environmental characteristics such as time scarcity and interruptions as factors that deter physician-patient communication in ED. Majority of patient-provider interaction in ED is face-to-face, verbal and is executed under time pressure [13]. A major proportion of the

patient-provider interaction in ED is spent in giving and receiving information wherein providers who seek and deliver information to patients dominate the verbal exchange of information [24]. Studies also found that physicians spend more time in information gathering than information giving [34]. Most of these studies have characterized patient-provider interactions through the analysis of audiotaped sessions of patient's in-room conversation with practitioners.

High communication load, interruptions, uncertainty in communication and irrelevant communication can result into potential failures and compromise patient safety in ED [11][55]. ED providers adopt different strategies to ensure effective communication [25]. Complex strategies such as teach back and test of patient's instruction recall capabilities are less frequently used due to time constraints. This may also result into providers being unaware of what patients do not understand.

2.3.3 Patient Perspectives of Information Delivery in ED

Many studies have revealed that patients do not understand information given to them through their ED care and discharge denoting communication failures [12][17]. Specifically, one study investigated patient's perspective on information delivery using patients' self reported information to assess their comprehension of information delivered to them, treating comprehension as a qualitative indicator of communication [12]. Another study investigated patient's understanding of discharge instructions to identify communication efforts in the form of follow up phone calls for better education on discharge instructions [57]. One study reported that patients do not just want their

diagnosis, they wish to know the reasons to understand better [6]. Accordingly, they proposed information delivery guidelines for giving comprehensive information to patients to increase communication adequacy.

A study on patients' perception of team communication in ED found that patients do not perceive enough encouragement to ask questions during the ED care [26]. They have compared communication performance of physicians in ED with studies on inpatient and other clinical settings and found that communication in settings other than ED is better. Nonetheless, there is no account of the operational factors and ED characteristics in relation with communication or the task of information delivery to patients. Moreover, these studies have mainly provided guidelines for improving communication and do not account for guidelines to design information delivery technology.

2.4 Information Delivery Interventions in ED and Inpatient Settings

Given the positive correlation of information delivery and patient satisfaction, studies in the medical research community targeting information delivery interventions have been conducted. Corbett et al. conducted a study wherein patients were shown videotapes describing how ED works during the time spent in waiting area and found out that giving this information resulted in better satisfaction around waiting time and reduced anxiety [10]. Krishel et al. conducted a similar study by dispatching information on how ED works in the form of a brochure and found that it increased overall patient satisfaction [21]. Schiermeyer et al. conducted a study to test patient satisfaction ratings after giving business cards with MD information and found higher patient satisfaction ratings [35].

These studies introduced information delivery interventions at specific points of care such as waiting area, or arrival and do not cover the dynamics of in-situ information delivery throughout a patient's ED journey.

Research studies in HCI and design have pointed to the disparity between the use of patient-centric HIT interventions in outpatient and inpatient settings with outpatient settings witnessing greater attention. Information delivery is the goal of many patient engagement interventions implemented in the inpatient settings specifically under the following genres: general information delivery and patient specific information delivery [31]. Few studies have deployed interventions in the inpatient hospital units and bedside units of ED.

Wilcox et al. have established the importance of written medical information in improving patient comprehension and deployed a paper based prototype in the inpatient unit of an emergency department to provide patients information such as reason for their visit, health profile/allergies, vitals, what's next, what has been completed, medications and care team. The patients showed overall positive response about the information and also requested printed handouts of the information for archiving purposes. The researchers obtained inputs from clinical teams and patient's medical records to come up with different information types. They have focused on the content of information that should be made available and have discussed the challenges towards automation [51]. Nonetheless, they do not account for concerns regarding the temporal availability of information and the downtime before information becomes available and can be given to a patient.

Bickmore et al. deployed an embodied conversational agent in the form of virtual nurses to automate the patient education process at discharge in an inpatient unit. The virtual nurse performed many functions such as give information to patients, test their comprehension, and serve as a medium to transfer patient requests to human providers. The patients showed overall satisfaction with the new process of patient education and preferred virtual nurses to doctors and human nurses since the virtual nurses spent more time with the patients. Patients also reported increased involvement in their care. The design of virtual nurse agent was rooted in the findings from an observational study of patient education through a human nurse [5]. This intervention was successful but it covered information delivery only at a specific point of care when most of the activities related to patient's care process have concluded.

Wiclox et al. conducted another study to obtained cardiac patient's medication information needs by interviewing patients and nurses and produced design insights for improving patient facing view of clinical information. With respect to the different types of information that patients wanted to see, they reported that a view into the changes in medication information gives them a sense of progress of care [50]. In a follow up study, Vawdrey et al. investigated the deployment of a tablet application to provide medication information to cardiology patients. Patients reported in the interviews that they liked the capability of tracking information in their own time and suggested adding communication abilities to the application. The tablet application sourced data from EMR by querying EMR in real time and instantaneously reflecting changes made to the EMR data by the providers.

The study also found that physicians presented concerns about the automated delivery of medical information such as lab tests [47].

Vardoulakis et al. used mobile phones to display information to patient during their stay in Emergency Department. It provided patients with "a dynamic, interactive report on their progress, care plan, and care team throughout their emergency department stay". Through patient interviews regarding the use of mobile phone information delivery system they found that the tool was helpful in improving patient awareness and empowering patients by giving them access to their information [30]. Nevertheless, these studies did not discuss the potential issues might arise when the EMR is not updated by the doctor for a long time and patient does not see any update on his end.

Skeels et al. conducted interviews with patients in the inpatient units to identify design opportunities for inpatient technology to improve overall patient experience. They found that patients desired a better way to communicate their needs to the nurses so that nurse can prioritize their requests. They have additionally pointed out to the lack of patient involvement in the HIT infrastructure and the slow shift towards promotion of patient-centeredness of HIT [36]. They do not point to the situated issues within medical practice that can hinder how information is made available to patients.

Given the role of medical collaboration in ensuring effective patient-care and the importance of patient-provider communication in the ED settings, there has not been enough investigation into how the operational characteristics and the collaboration

challenges within ED affect the way patient-provider communication takes place for information delivery to ED patients. Additionally, patient-provider communication and information delivery tools have been designed using providers' perspectives in both inpatient and outpatient settings. Furthermore, most of these studies rely on interview and survey techniques and investigate one specific point of information delivery such as discharge or waiting room. In this study, I report the findings from an observational study of patients' complete ED journey, specifically focusing on the in-situ patient-provider communication for information delivery to patients at bedside. My study identifies the issues engendered by information delivery to ED patients in the time-critical and information rich environment of ED. The goals of this study are to understand the phenomenon of information delivery to ED patients as it unfolds during their ED visit and provide insights into the design of patient-facing information delivery technologies to support information delivery to patients.

CHAPTER 3 –METHODOLOGY

This study was conducted in the Emergency Department (ED) of a teaching hospital. The goal of the study was to understand the situated nature of information delivery from providers to a patient in relation with the ED care process with an aim to inform the design of patient-centric technologies for effective information delivery to ED patients.

3.1 Research Setting

The ED is divided into the following zones: Waiting Room, Front Desk, Triage A, Triage B, Triage C, ED1, ED2, ED3, Nurse Station, Doctors' Room and Trauma Resuscitation. ED1, ED2 and ED3 are bedside units. A patient is assigned an Emergency Severity Index (ESI) during triage, which determines patient acuity. ESI ranges from 1 to 5 with 1 being the highest acuity and 5 the lowest. For this study, I followed patients with ESI of 3 or below because such patients are kept in one of the EDs and have a longer ED stay that gives more opportunities to capture their comprehensive experience of information delivery while patients with ESI 4 or 5 do not go to any of the ED1, ED2, or ED3 and have a very brief stay.

The care of patients with ESI 3 or below begins in Triage A followed by bedside treatment in one of the EDs depending on patient acuity. ED1 caters to patients with maximum severity and houses an open nurse station in the central part. It has a mix of closed rooms and open beds surrounded with curtains. Patients with life threatening complaints such as cardiac disease, renal failure and senior citizens are assigned a bed here. ED2 is mainly a psychiatric unit with an open nurse station and only closed rooms. It may also be used for

other patients depending on bed unavailability in other units. ED3 has regular rooms and one specific room for ophthalmic consultation. Patients with complaints such as a rash, headache, or eye issues go to ED3. ED3 nurse station is an enclosed room. Except for ED2 rooms, all the beds and rooms are mounted with computer workstations for providers. ED1 and ED2 are connected though the Doctors' Room, which is a working area for physicians and prohibited for patients.

For my study, I shadowed a diverse set of patients through Front Desk, Triage A, Triage B and all of the three ED units. I studied the ED visit of 35 patients in total from which 14 patients were assigned ED1, 10 patients went to ED2, 7 patients went to ED3 and one patient was kept in Triage B due to room unavailability. The remaining three patients did not get past the waiting room stage during my observation session. Since I wanted to understand every patient's care process while ensuring the safety of patients and myself, I interacted with the patient's care team members whenever required.

3.2 Methods and Data Collection

I employed observations and interviews as primary methods of data collection during this study. My observations focused on shadowing patients to understand different components of their care process and information delivery from providers to patients as carried out throughout the care process. A typical observation session started from the Front Desk of ED. I selected patients as study subjects based on a set of criteria. Trauma patients, patients with language barriers, patients coming in with a contagious disease and psychiatric patients were excluded. A total of 113 hours of observations were conducted within a span

of 5 months. The average duration of one observation was about 3.5 to 4 hours. Both morning and evening shifts were covered on weekdays, weekends and official holidays to represent exhaustive work conditions in the ED.

Observations were recorded using time stamped notes to reproduce the sequence of events in a patient's ED visit. Comprehensive notes were taken describing the events, the activities undertaken by providers, use of artifacts, the communication between patients, caregivers and providers and information exchanged. Whenever possible, I recorded data about ED specific processes and protocols. I interviewed health providers when possible during the observations to record and verify my understanding of all the events taking place in a patient's care process. I collected artifacts with permission from relevant stakeholders. These include the patient information sheet for registration and images of artifacts in patient room such as whiteboard.

I conducted semi-structured interviews with patients that I shadowed and a few providers. All the interviews were recorded and transcribed for data analysis. Patient interviews were aimed at obtaining a narrative of their experience through different phases of the ED visit including the waiting room, triage, bedside and discharge. This supplemented observations and provided insights that observations cannot offer such as how patients perceive their ED visit. The interview comprised of structured questions in the beginning to find out the reason of patient's ED visit, the caregiver who accompanied the patient, the total time spent in ED and basic demographic information. I then asked the following open-ended questions to patients:

- Their experience of different phases of the ED visit in relation to care activities performed, communication with the providers, information shared by the providers and patient's comprehension of it.

- The questions they asked or wanted to ask.

- The amount of wait time between phases of communication with providers and patient's activities during wait time.

- Their expectation from ED care.

- Their opinions on use of technology.

- Challenges faced by them and their feedback for improvement or changes.

15 formal interviews were conducted with the patients and their caregivers. I interviewed only the subjects that had already been shadowed for this study to relate the situated findings from observations to the actual perceptions that patients hold. 7 interviews were conducted with only patients and 2 interviews took place with both the patient and the caregiver. In cases where patient could not interview because of severe health condition or a language barrier, I interviewed the caregiver who accompanied the patient during the ED visit. This was not an issue since the caregivers accompanied their patients throughout the ED visit and were aware of all that happened. There were 6 such cases. The interviews were conducted within seven days of observations to ensure that participants can recall the details of ED visit.

Towards the completion of patient interviews, 6 clinicians were interviewed including one senior attending physician, 3 residents and 2 nurses. Provider interviews were targeted

towards obtaining an understanding into how providers practice information delivery in ED. I asked them the following questions:

- Types of information they provide to patient

- The points in the care process when they go to deliver information to patients

- The challenges they face while communicating with patients

- The questions patients ask and providers' perception of patients' comprehension of information given to them.

3.3 Data Analysis

The events of patient-provider interaction formed the units of data analysis. I first extracted sequential snippets of patient-provider interaction for individual patients from the field notes and then analyzed these examples in two phases. In phase one, data was analyzed with an overarching focus on building a formalized template of the care process of a patient as consisting of standard phases characterized by well-defined care activities and information delivery events. These events were analyzed for breakdowns in care process and information delivery. They were broken down into the following codes: the sender of information, the recipient, the content of information, the source of information and the phase of patient-provider interaction. This resulted into the formulation of a general ED care process, the distribution of information delivery events and major types of information delivered to patients.

In the second phase I analyzed information delivery events in relation to the sequence of events occurring immediately before and after information delivery to contextualize these

events in a bigger working context of ED. I extracted the underlying factors that affect

patient-provider interaction and information delivery events. These factors were analyzed

in a bottom-up manner and iteratively grouped and regrouped under broader contextual

themes. A comprehensive analysis was performed over entire observation data to validate

the recurrence of these themes until no new theme or factor was discovered and all the

factors were meaningfully grouped within already discovered themes.

CHAPTER 4 – FINDINGS

In this section, I present the results of my analysis of the practice of information delivery from providers to patients in the bedside unit of ED. I first provide an overview of the information delivery phenomenon as it occurs throughout a patient's care process. I then describe the issues of information delivery including the challenges of information delivery media and patient's perceptions of information delivery in ED. Lastly, I present the results of my analysis describing the factors that affect information delivery and introduce potential breakdowns.

4.1 Information Delivery and Patient's Care Process

Information delivery to ED patients is situated in the temporal framework of a patient's care process, which consists of distinct phases that I call *milestones*. Across these milestones, the patient interacts with multiple providers who execute care activities and deliver information to the patient. Hence, in this section, I first provide a scenario describing a patient's experience of a complete ED visit. I then articulate a patient's care process in terms of the milestones and the care team and describe the *in-situ* nature of information delivery events in the care process.

The following scenario depicts the chronological events that unfold in front of a patient starting from ED arrival till the point of final care decision.

Kate arrives at ED with her caregiver John and registers with the receptionist at front desk. A nurse sitting next to the receptionist quickly assesses Kate to obtain chief complaints and reason for ED visit. She records these details in the Electronic Medical Record (EMR). Shortly after this a nurse calls Kate into triage A. Kate undergoes another assessment and basic lab tests. She comes out of triage and waits for a bed in the waiting room. After a while of waiting a bed opens up and an escort guides Kate and John to the designated room in ED3.

A different nurse receives Kate at bedside in the patient room. The nurse opens the EMR on the mounted computer and performs a clinical assessment while simultaneously updating the information in EMR. She asks Kate questions on her symptoms, medical history and lifestyle such as marital status and drug abuse. Before leaving she updates Kate that the doctors will visit soon and gives her a gown to change into. Five minutes later, an officer comes to take Kate's signature on insurance forms and leaves. Fifteen minutes later a junior clinician visits Kate in her room to perform a comprehensive clinical assessment. Kate informs the clinician of her abdominal pain and answers clinician's questions. John fills in details that she may have left out. Before leaving, the clinician briefly discusses the potential care plan to give pain medicine and get an X-Ray.

Half an hour after the clinician leaves, a technician comes into the room and takes Kate to the X-Ray room, gives instructions while performing X-Ray and brings her back to the ED3 bed. After a few minutes, Kate presses the call button. The nurse comes to her room and Kate requests pain medicine. The nurse informs Kate that there is no order yet. John wants to leave for lunch and asks nurse when would the clinician come. Not getting a definite answer he

leaves for lunch. About 20 minutes later, the nurse visits Kate again to execute orders for pain medicine and a set of lab tests. She informs Kate that the pain medicine will make her drowsy. John comes back after an hour and waits with Kate in her room.

After two hours of waiting, another senior clinician visits Kate and asks a few confirmatory questions on her symptoms. After ten minutes, the junior clinician comes back and updates Kate on the X-Ray results, orders for intravenous fluids (IV) and medication and the need for more investigation. Shortly after, the nurse comes to execute more orders for IV and medicines and elaborates on the purpose of medicines. An hour later when the senior clinician becomes available, she comes to check Kate's status and updates her that a gastrointestinal (GI) specialist will come to see her soon. About half an hour later the specialist comes to perform another assessment and informs Kate of a possible endoscopy. About forty minutes later, the senior clinician comes to inform Kate that she will be admitted. Kate waits to be transferred to a specialized inpatient unit of the hospital, not knowing where she would be taken and when.

The above scenario shows that a patient goes through multiple phases of patient-provider interaction during the ED stay and each round of interaction involves information delivery from the providers to patient side. Providers visit patients based on their availability to dispatch information. Patients do not know how long will they need to wait and they may need information before provider becomes available or information itself becomes available. Even though information is given to them, it may not be sufficient as per their needs. Additionally, patients may not be equipped to understand the content of information

given to them. Use of terms such as "GI" and "endoscopy" may or may not be appropriate for patient's understanding. Closer investigation of when and how information is delivered and who delivers it is needed to understand intricacies of situated information delivery. I now describe a patient's care team and milestones in the care process using the above scenario. This is followed by a description information delivery events, most of which happen during the milestones with some information being delivered at patient requests between these milestones. My descriptions focus heavily on the events occurring after patient's bedside arrival and touch briefly upon events before that.

4.1.1 Patient's Care Team and Care Milestones

It is evident in the above scenario that Kate goes through different phases in the care process such as clinical assessment, execution of X-Ray, administration of medicine and updates on results from the clinicians. These phases are marked by patient-provider communication and care activities performed by different providers. I call these phases as milestones because they are major points in a patient's care process where information delivery and care activities happen and each successive milestone marks progress of the care process. Figure 1 describes the temporal organization of a patient's care process starting from patient's arrival in ED until the point of care decision as experienced by the patient. It highlights the milestones and the provider that patient interacts with at each milestone. Based on the above scenario, I now provide a categorization of these milestones and describe the care team members the patient meets at these milestones.
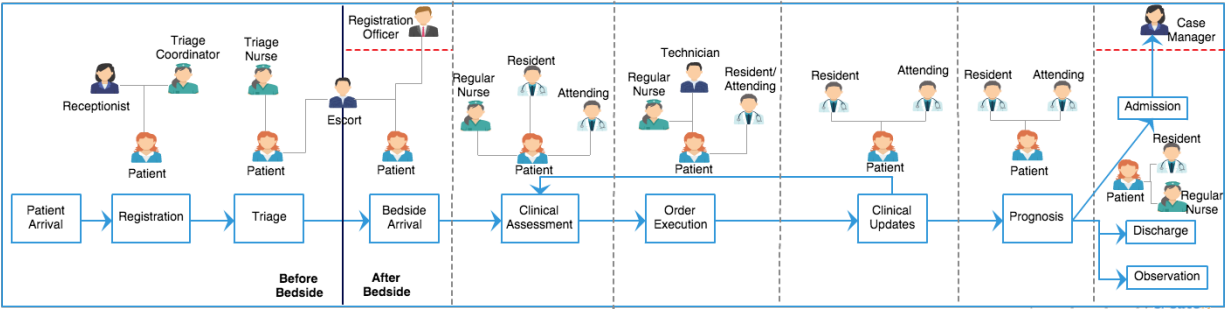
Figure 1: Overview of a patient's care process

Each blue box depicts a milestone in the care process. The human figures show providers in various roles and their interaction with the patient

Before moving to the bedside unit of ED, Kate undergoes *Registration* at the front desk where she meets the Receptionist and the Triage Coordinator (TC). This is followed by *Triage* where the Triage Nurse (TN) assessed her for acuity. Upon *Bedside Arrival*, Kate undergoes a series of *Clinical Assessment*. The Regular Nurse (RN) first assesses Kate followed by a junior clinician, who is the Resident (R). The resident performs a more detailed assessment than RN. Later in the care process, the senior clinician, who is the Attending (A), and the Specialist (S) re-assess the patient. Hence, as shown in Figure 1 these assessments happen in loops with the aim to obtain information from patient and frame a care plan.

Next, Kate undergoes an X-Ray when the Technician (Tech) takes her to the X-Ray room. This is followed by lab tests and administration of pain medicine by the regular nurse. This marks the *Order Execution* phase. Orders are executed as and when clinicians decide the steps for a patient's care. The resident then comes to update Kate about the X-Ray results and the changes in the care plan to inform that more investigation is needed to diagnose

her. This is the *Clinical Updates* phase where information on care progress is given to patients. For Kate, Clinical Updates is followed by another round of Order Execution and Clinical Assessment. Final ED milestone is reached when the attending comes to update Kate about the hospital admission. This is *Prognosis* where the patients and providers agree on a definite care plan and a decision to either admit, discharge or observe the patient.

Additionally, during the observation I noticed few auxiliary members of the care team who either do not directly contact the patient or have a very brief interaction with the patient for reasons such as substitution of a care team member, ED bed assignment, consent form signatures, insurance data and patient admission at the end of ED care process. These are the Float Nurse (FN), the Charge Nurse (CN), and the Case Manager (CM). The Registration Officer (RO) is also an auxiliary care team member because he interacts very briefly with the patient for getting signatures on forms as shown in the scenario above.

4.1.2 Information Delivery Events in ED

In this section, I describe major information delivery events in a patient's care process after bedside arrival. My description of information delivery events is contextualized in relation to the scenario presented above. Most of these events comprise of information delivery at the milestones described above and additional information delivery in response to patient's requests between these milestones.

4.1.2.1 Information Delivery at Major Milestones

The clinical assessment milestone is characterized by delivery of information of the preliminary plan of care and the immediate next steps. In the above scenario when Kate arrives at bedside, during the first clinical assessment by the regular nurse, she answers various questions asked by the nurse. At the end of the assessment, the nurse informs her of the next step to see the doctor. The resident then comes to perform the clinical assessment and asks more questions to figure out Kate's symptoms and diagnosis. At the end he discusses the care plan briefly and informs Kate that she would be given pain medicine and taken for X-Ray.

During the order execution milestone, providers executing the orders may deliver information on the procedures and medicines. This information includes instructions on the procedure, the side effects of medicine or procedure, and the recovery time. In the above scenario Kate undergoes order execution of X-Ray, pain medicine and lab tests. The technician who performed the X-Ray delivered instructional information. This mainly includes instructions on body positions to get correct images. Additionally, the nurse while executing medication order informs her of the side effects of pain medicine. The next time she gives medicines to Kate she informs her of the purpose of medicines.

The clinical updates milestone is where providers share information about the results, the diagnosis, changes of care plan to include new orders and the treatment plan. In the above scenario, the resident comes to provide clinical updates on Kate's care progress. He informs her of the results and the requirement for more investigation. He also informs her of new

orders for IV and medication. Later the attending comes to inform Kate that a specialist would come to see her. Additionally, clinical information needs to be delivered by clinicians such as resident, attending or specialist. Nurses cannot provide clinical information even if they are aware of it because of ED protocols associated with the practice of medicine.

During the prognosis milestone, the clinicians inform the patient about the long-term care plan and their care decision. The decision involves discharge, admission or overnight ED observation. In the above scenario, at the end when the clinicians decided on a prognosis, the attending came to inform Kate that she would be admitted and the specialist informs her of endoscopy. This is the point of care decision where Kate's ED care ends and she would be transferred to inpatient unit.

4.1.2.2 Information Delivery at Patient Requests Between Milestones

Every patient room has a call button which when pressed, lights up a bulb above the door of the patient room (Figure 2). Patients can use it to get provider's attention and request for food and medicine. Additionally, they also use this call button to request for general status information such as wait time to see the clinician, wait time for results and general ED information such as location of restroom and exit to the waiting room. These requests mostly happen between successive milestones. For e.g. in the above scenario, after clinical assessment and before order execution for pain medicine, Kate makes a request for pain medicine using the call button. The regular nurse visits her room to provide her information on the status of pain medication order.

Figure 2: Call light above exam room door

Situated information delivery at different milestones is important for patients as it provides them with the progress of their care process and a way to understand the care situation. As described above, information delivery happens at all these milestones and additionally in response to patient's requests for information. Even though information is given to patients I found that patients do not consider it satisfactory. Additionally, the task of information delivery is challenging for the providers because of its verbal nature and the unsuitability of the information delivery medium in ED. In the next section, I present these information delivery issues.

4.2 Information Delivery Issues

In this section, I describe the existing information delivery media and elaborate on their challenges in facilitating information delivery to ED patients. I then describe how patients perceive the way information is given to them pointing towards the need to further investigate these issues in the context of the operational challenges inherent in ED.

4.2.1 Information Delivery Media and Challenges

The primary mode of information delivery is face-to-face interaction between patients and providers. This is reliant on availability of specific providers who bear the responsibility of delivering a specific information type. Additionally, by protocol, nurses cannot deliver clinical information to patients unless directed by physicians.

When physicians are unavailable, a patient may have to wait for long hours before any clinical updates are delivered. Due to physician's unavailability patients request information from the nurse. This challenges information delivery because a nurse does not bear the responsibility of providing clinical information to patients. When requested to do so, she may not be able to satisfy patient's request. The following case highlights this issue:

P34, a 68 years old male patient, came to ED at 1:45pm with his caregiver (CG) for high potassium level in blood. He was taken to ED1 bed at 2:20pm and the resident and attending assessed him very soon. The clinicians wanted to obtain the lab tests, check potassium level, and administer medicines. Around 4:00pm Regular Nurse (RN) got a call from the lab about the test results, which still indicated high potassium. RN paged the attending about the results but held an update from P34 and CG. At 4:30pm CG came to the nurse station and asked RN about the labs complaining of the long wait time. RN called the attending to collect information she could share with P34 and CG. Immediately after the call she updated them about the result and care plan. CG then brought up follow up questions, which the nurse was unable to answer.

In the above case, the nurse could not initially update the patient or his caregiver about the lab results because of the protocols of information delivery in accordance with the practice of medicine. However, at caregiver's request she tried to mediate patient-attending communication. Even though the mediation resulted into delivery of some information, it did not solve the follow-up information requests.

In addition to verbal updates, another information delivery medium is a whiteboard installed in most of the patient rooms (Figure 3). Nurses are responsible for updating it but I consistently observed that it remained a non-functional artifact. A few times it contained old information of a different patient. Patients confirmed this finding during the interviews.

Nurses are not optimistic about the whiteboard as an information delivery medium for patients in ED because it needs manual update that can be challenging given the busy nature of nursing work. An opinion from one of the nurses highlights this sentiment:

"ED whiteboard is not very realistic. I am here since 3 pm (it is 7:30pm now) and I have already seen 8 patients. Doctors keep changing. The status changes so fast that it is hard to manage updating the whiteboard. It works in inpatient unit because the patient is there for more than 12 hours or so."

This comment highlights that large patient throughput in ED and frequent updates in a patient's short-lived care process challenge the use of whiteboard as a communication medium for information delivery to ED patients because of the manual effort involved.

Figure 3: Patient room whiteboard

Table 1 summarizes my analysis of information delivery to ED patients. It lists information delivered to patients, the milestone at which it is delivered, the provider who delivers it and the medium of delivery. While most of the information is delivered at specific milestones, some information such as general status information, insurance and admission related information do not have specific milestones or media for delivery. A value NA denotes such information in the milestone and the medium field of the table.

Milestone (When)	Relevant Information (What)		Role (Who)	Medium (How)
Clinical Assessment	Next steps, initial orders		Regular Nurse	Verbal, Whiteboard
	Preliminary care plan, orders, next step		Resident	Verbal, Whiteboard
	New care plan, care goal		Resident, Attending	Verbal, Whiteboard
Order Execution	Purpose of procedure/medicine Side effects of procedure/medicine	CT Scan, X-Ray, Ultrasound, MRI, EKG	Technician	Verbal
	Procedure instructions Procedure/medicine alternatives	Medication order, Lab test, Catheterization, Vision test	Regular Nurse	Verbal
	Medicine dosage Procedure turnaround time	Lumbar puncture, Suppository, Bladder irrigation, Physical exam	Resident, Attending	Verbal, Whiteboard
Clinical	Diagnosis, care plan		Resident,	Verbal, Whiteboard

Updates			Attending	
Prognosis	Care goal		Resident, Attending	Verbal, Whiteboard
NA	General status information: order status, clinician's availability, waiting time, contextual information about ED		Regular Nurse	NA/Verbal
NA	Insurance related information		Registration Officer	NA
NA	Patient transfer and admission		Case Manager	NA

Table 1: Summary of information delivery

The table shows milestone when information is delivered, content of information, role of provider giving information and medium of information delivery. "NA" denotes absence of a specific milestone or medium.

4.2.2 Patient's Perception of Information Delivery

I analyzed specific instances of information delivery and patient's opinions reported during interviews to assess its impact on patients. I found few common perceptions of patients about information delivery and the providers giving information. Firstly, patients feel that providers do not answer their questions in a way that helps. One of the patients reported this opinion during the interviews:

"When I asked the question to a doctor or technician down there, I never got a straight answer. I got, "Well, let me go ask" and then they never came back with an answer."

This makes patients feel neglected and affects their perception of the providers who interact with them. The perceived lack of attention leads them to assumptions such as providers do not understand their acuity.

Secondly, patients feel that the providers do not have enough time for them. Following interview excerpt from P21 highlights this issue:

"I felt like they were in a rush. Even the nurse that I had, she wasn't entirely in the room when I wanted to ask her something. They would go in there to pick supplies out of that one room that I was in and people were just going back and forth."

Such a perception restricts patients from asking providers for information as they feel they may interrupt them. Additionally, patients feel that the providers spend little time during the phases of interaction such as clinical assessment or clinical updates. Following is an excerpt from an interview with P33's caregiver:

"There are all these questions running through you and they just come in and walk out real fast. So it is just tough. They tell you what their plan is and then they ask you what are your concerns and then you already forgot what your concerns are because they tell you new stuff that you are worried about."

This reflects the confusion that interaction with providers, specifically for clinical information, can engender for patients and caregivers and consequently, they forget their actual concerns and questions. This further restricts providers' awareness of patients' concerns and what information is appropriate to be delivered to them.

Thirdly, there are also cases when untimely delivery of information may compromise a patient's care. P19 reported the following in his interview:

"*At the end, more or less they didn't want to give me any pain medicine because I had my car there. They wanted me to find a ride home before they gave me pain medicine but I decided not to take the medicine and wait there because I felt they weren't doing anything for me*".

Because the patient got to know of the requirement to find a ride almost towards the end of the ED visit, he could not arrange for a pick up and decided to leave ED without medication.

These issues in the form of challenges of information delivery and patients' perceptions show that even though information is given to patients, it may not be satisfactory for them. It may have been given later than when it is of most utility for patients, or the content of information may be over-complex for patients to consume. Given the situated characteristics of information delivery as practiced in ED and the issues described above, an important questions arises; What affects information delivery and causes the unsatisfactory perceptions amongst patients? Is it the lack of information or is it the factors inherent in ED operations that induce such perceptions reducing the value of information delivery for patients? I answer these questions in the next section where I describe the factors that affect information delivery and how patients perceive the way information delivery happens.

4.3 Factors Affecting Information Delivery and Patient's Perceptions in ED

Inline with the operational challenges etched in ED work, my analysis shows contextual features within the framework of a patient's care process that bear implications for information delivery to ED patients, introducing potential breakdowns and reducing the appropriateness of information delivery. These three features are temporalities at work in a patient's care process, the invisibility of ED work to patients and a patient's expectation and health literacy. I now describe how they impact information delivery in ED and patient's perceptions.

4.3.1 Temporalities at Work

The care process of a patient is organized around different temporalities because there are multiple milestones in the care process that require sequential execution. The activities performed at any milestone are temporally dependent on the tasks performed at the previous milestone. Specifically, the clinical updates milestone depends on order execution. Clinical updates can only be given to patients after successfully going through the preceding milestones since information becomes available only after execution of care activities. Additionally, different members of the patient's care team execute the tasks associated with these milestones. These providers work in various temporal contexts by virtue of being in charge for other patients. This challenges efficient coordination of tasks across milestones of a patient's care process. The following case highlights a temporal issue during the execution of interdependent tasks in a patient's care process:

P13, a 55 years old male patient, came to ED at 1:50pm with the complaint of inflamed pancreas. He was transferred to ED1 bedside at 3:35pm. The resident and attending assessed P13 at 4:00pm and updated the care plan to give some medicines, obtain a CT scan, ultrasound and admit him. P13 was urgently required to provide a urine sample before the regular nurse (RN) could give him medicines. At 4:40pm RN handed over a urine sample bottle to the patient's caregiver. Meanwhile, a radiologist came with a portable X-Ray machine at 4:45pm to perform a bedside X-Ray on P13 and peeped through the curtains to see the patient. Seeing him interrupting P13, RN shouted from another side of ED1: "No! We need the urine first. Everything holds on that!" The radiologist waited for a few minutes and left at 5:00pm. The attending came at 5:10pm to P13's bedside and found out from RN that the X-Ray was not performed yet. He decided to send P13 for CT Scan.

Attending: "I need the X-Ray. I saw there were a lot of CTs ordered before this so I ordered X-Ray because I needed to look at some images quickly. Please send him for CT now."

The above case has two manifestations of temporal issues. Firstly, the radiologist is unable to perform an X-Ray because of a conflict with the nurse's requirement to prioritize urine sample collection. There is a conflict between two order executions for the same patient. Secondly, this conflict affects attending's work of analyzing X-Ray images and updating the patient. When the attending hoped he would get X-Ray images, he did not have any information and he was unable to provide clinical updates to patient. Thus, delay in order execution milestone affected subsequent clinical updates to patient. This causes extra wait for the patient before clinicians can provide information. Waiting between milestones can induce frustration. The following interview comment from a patient provides more insight:

"When the doctor took that long I actually thought she just forgot about me because it took quite like 3 hours. Like I was waiting there I got kind of frustrated."

The above comment highlights the negative feelings that generate as a result of unexplained waiting. Patients may feel that doctors have forgotten about them and perceive it as lack of care.

The above vignette represents a case of a conflict within ED and shows how delayed information delivery after long wait times affects patient's perception. These conflicts also arise due to events external to ED. The following case outlines this issue:

P19, a 44 years old male patient, came to ED at 3:10pm following the referral of his neurologist for high BP and a headache. At 4:15pm he got a bed in ED2. The resident assessed him at 4:38pm. He informed P19 that he would refer to the neurologist's EMR notes and then give him food and pain medicines. Not having found any note from P19's doctor, the resident goes back to P19 at 5:05pm to confirm the name of the neurologist. As soon as he left, P19 pressed the call button and requested for pain medicine. RN informed him that there is no order yet. At 5:19pm the resident comes to inform P19 that he could not speak with the right person and he would wait for the neurology team to call him before making further decisions. At 6:15pm, the resident came to P19 with details from the neurologist and the care plan. Soon RN came to ascertain if P19 had somebody to drive him home since pain medicine can induce drowsiness. P19 realized his friend could only pick him up at 1:00am. He decided to leave ED without pain medicine and food.

The above case outlines a complex interplay of information availability time, information delivery time and time when information is most useful for patient. Resident's reliance on the neurology unit delayed clinical updates. Additionally, this delay reduced the utility of information for patient. Had the patient known the requirement associated with pain medicine sooner, he could have made alternate arrangements for a pick up. Furthermore, this affected patient's decision to relinquish ED care. The patient explained this during the interview: *"I was really frustrated at that point, I said, "OK, I'm just going to leave. Don't give me anything, I'm leaving."*

The above cases highlight that the temporal dependence of milestones and different temporal work structures of providers affect task execution, which delays information availability and providers' ability to deliver information to patients in response to clinical updates and patient requests. Consequently, patients may feel increased frustration due to long unexplained wait time and a perception of lack of care, which might affect their decision to receive care.

4.3.2 Invisibility of ED Work to Patients

Another factor affecting patient's perception of information delivery is a patient's incomplete knowledge of the care process and the care team members in ED. I found two types of invisible features that influence information delivery to patients. One feature corresponds to the occurrence of clinical tasks such as generation of orders and interpretation of results performed by clinical team members. The other feature corresponds to information associated with administrative tasks performed by non-clinical

team members such as the case manager and registration officer. I describe these features one by one.

4.3.2.1 Invisible Milestones

In addition to the milestones described in the previous section, the overall care process consists of provider-specific milestones related to clinical activities of generating the orders, receiving results and interpreting information to make clinical decisions. These milestones do not require patient's involvement and hence, they do not occur in the active context of a patient. There is no patient-provider interaction for information delivery at these milestones. I term these as *invisible milestones* because patients are unaware of their occurrence.

I call the other set of milestones described in the previous section as *visible milestones* because they occur in the active context of a patient. As described above, there are also milestones, specifically associated with clinical tasks, which are not visible to patients. A patient's care process thus, becomes a combination of visible and invisible milestones. Figure 4 highlights the unified care process after incorporating invisible milestones that consist of *Order Generation*, *Order Completion* and *Result Assessment*. Order Generation is the phase where clinicians create orders in the EMR such as pain medicine and X-Ray. Order Completion is the point when result information becomes available from these orders. Result Assessment is the phase when resident and attending interpret the results and figure out treatment and prognosis. *Care Plan Revision* is yet another milestone that may or may not be visible to the patients depending on clinicians' preferences of

dispatching information. It is the phase when clinicians decide to perform another set of orders to get more information.
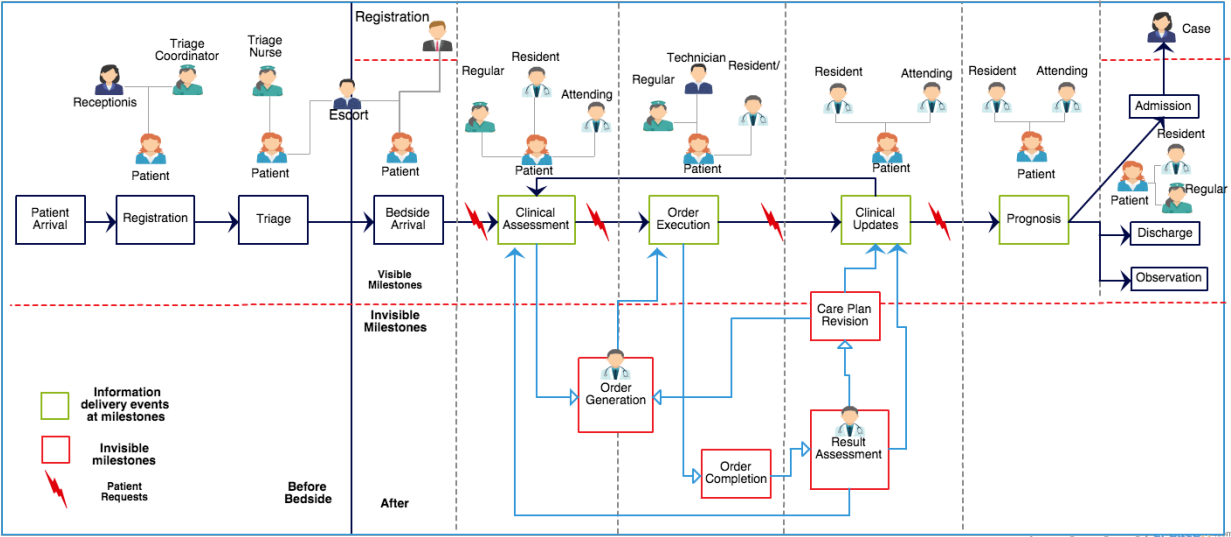
Figure 4: Patient's care process consisting of visible and invisible milestones.

As a result of this invisibility, patients experience their care process in fragments. This creates a contextual gap between the patients and providers, as providers possess a holistic awareness of the care process. This becomes a source of potential issues for information delivery to patients because what may be extremely obvious to the provider is unnoticeable for the patient. Even though providers are aware of this contextual gap, the issues rooted in this invisibility remain unaccounted and manifest in subtleties that are beyond providers' and patients' understanding. The following case describes one such issue:

P12, a 44 years old female patient, came to ED at 1:45pm with a complaint for shortness of breath and chest pain. RN executed the order for labs upon P12's bedside arrival at 2:00pm. The resident performed the first assessment on P12 at 2:15pm. At about 3:00pm RN realized that there was still no care plan update for P12 and asked the resident to update P12 about it. The resident was working on figuring out P12's case and asked RN to hold back partial updates from P12 until the entire plan is figured out. Around 3:10pm, the attending came to perform another clinical assessment and updated P12 of the potential care plan of overnight ED stay. At this time, results from blood test are back but P12 is not aware. Around 4:45pm, RN updates the EMR with P12's vitals and informs her that the clinicians will be waiting to see another set of blood tests. P12 gets confused as to which blood test was RN talking about.

In the above case, even though the providers were moving to the next set of blood tests, the patient was still waiting on the results of first blood test and in the lack of an update held by the resident she understood that the first blood test results are unavailable at the time when nurse updates her. The order completion and result assessment milestones are not apparent to the patient. This results into a loss of information for the patient as information generated during invisible milestones does not reach her and gets abstracted in the form of a high-level care plan. This abstraction restricts patient's rationality to understand provider decisions and care plan. Additionally, the interpretation of information from all these milestones is packed into one information delivery session. This results into an information overload for the patient challenging her rationality yet again.

Few patients attempt to uncover invisible milestones by generating request for information between successive visible milestones. The time during which invisible milestones are executed becomes a period of inactivity for patients. This makes them impatient and they continuously try to obtain a provider's attention. The following case highlights this typical consequence of invisible milestones:

P9 came with the complaint of headache, nausea and weakness. After resident assessed P9, she mentioned that he would be given some pain medicine. At 5:06pm, P9 presses the call button to ask for pain medicine and the regular nurse informs him there is no order from the resident. At 5:20p, regular nurse went to check P9's vitals and he asked if the resident had put the orders and received a negative reply. At 5:40pm P9 presses the call button again but there was no order yet. The regular nurse then decided to look for resident in person to ask about the order status.

In the above case, as a result of not knowing about the order generation milestone the patient kept requesting for pain medicine. Once patient knew that it is related to order generation he kept checking with the nurse if the resident had generated orders yet. During interview with the patient, he made the following remark:

"I continued to ask for it (pain medicine). I don't know whose fault that is, doctor or nurse."

Patient viewed this as a fault of one of the providers. He was not sure if the nurse didn't convey his request or if the delay happened because of the resident. Thus, not knowing about these invisible milestones can make patients restless. They perceive this as lack of

care and indulge in fault finding. Consequently, they attempt to remind the providers again and again.

4.3.2.2 Invisible Team Members

Another point of invisibility in the care process corresponds to the work of non-clinical staff. Team members such as the registration officer and case manager do not interact with the patients during the care process. They manage their work associated with a patient without coming in patient's active context. Hence, I call them *invisible team members.* However, patients may have questions that deal with information such as insurance, demographics or admission process, which are handled by the non-clinical staff. Since these team members are not actively present to take such requests, patients misdirect questions to other providers and may end up not receiving information.

As an example, I present the scenario of a case manager's role. Case managers handle the admission process of a patient from ED to another unit of the hospital. They become involved once clinicians make a decision to admit the patient. However, they do not appear in the active context of a patient at any milestone in the care process. Their function is close to inexistent for the patient. The following vignette highlights a related issue:

P23, a 34-year-old female patient, was brought to ED for stabilizing the side effects of chemotherapy. Her case was straightforward and ED clinicians decided to admit her. P23's husband (CG) was communicating with the clinicians on her behalf because of her severe condition. He had multiple questions on P23's admission. He wanted to know if P23 would be

kept in ED or another unit, the exact building and the amount of time she would be under

admission. CG posed these questions to the attending. However, the attending was not aware

of this information and informed CG that such information is beyond her knowledge.

In the above case, the caregiver misdirects questions on admission process to the attending but she is not responsible for this information and fails to provide it. The admission process is initiated and managed by the case managers, who do not interact with the patient or the caregiver at any of the milestones. This restricts patient's access to information that could be provided by the case managers since the patient is not aware of her existence and tries to seek information from more accessible members of the care team. Additionally, patients may need information such as insurance and consent forms. The officials in charge of this information such as the registration officers are not accessible to them and neither are patients aware of their role.

The above cases illustrate how invisibility into few milestones challenges patient's rationality to comprehend the care process in a contextualized manner and leads to impatience and negative perception of the providers. The exclusion of non-clinical care team members from a patient's active context affects information delivery by abstracting information source, which could have been made available if the patients could access those team members or were at the least aware of their existence in the ED.

4.3.3 Patient's Expectation and Health Literacy

Patients coming to ED have varying levels of expectations of ED care by virtue of having different treatment needs based on their knowledge about their health. Additionally, they have different levels of health literacy. These factors play an important role in patient-provider interaction by affecting how patients seek and perceive information that is delivered to them. I first describe two cases of patient expectation arising out of a priori knowledge of their health condition. This is followed by two cases of how a patient's health literacy affects their interaction with providers.

4.3.3.1 Patient's Expectation

Many patients come to ED with a predefined knowledge about their health, which guides their expectation to receive specific treatment. The first variable governing patient's knowledge is a referral from their specialists or primary care physicians. Referred patients mostly possess some knowledge based on information received from external providers and expect to receive ED care accordingly. The following case highlights a referred patient's experience:

P19 came to ED with a high blood pressure (BP) and a severe headache upon a referral from his neurologist. He was suffering from hydrocephalus, a medical condition associated with the brain. When resident assessed him, he did not find P19's BP to be alarmingly high. The resident held back ordering pain medication for P19 because he wanted a confirmation from his neurologist. However, P19 came form the neurology unit with the knowledge that his BP was high, which was causing a severe headache and he expected to receive medication to

treat his pain and BP. P19 received this negatively because he felt that the resident did not

believe his complaints.

Following interview excerpt highlight's P19's perception of his interaction with the
resident:

"It was really frustrating, because the doctors, they are like, "Well, your pressure's not that

bad. Why did your doctor send you here?" I was expecting for them to at least try and figure

out why I had high blood pressure, instead of just saying, "It's not that bad"."

In the above case, patient's expectation conflicted with resident's understanding of the

patient's case. Because of patient's complex condition, the resident wanted complete

information before making decisions. This did not translate well for the patient who

expected appropriate treatment and perceived that the resident did not believe him. It only

added to patient's frustration.

The second variable governing patient's knowledge that guides their expectation is an

associated medical history. Patients develop knowledge by experience and their

expectation of care is framed by this knowledge. They want to receive more information

than what they already know about their condition. The following case highlights this:

P20, an 83 years old male, came to ED with his wife (CG) for a complaint of urine retention. He

recently had a prostate surgery and his catheter was removed few days ago. Based on the

issues faced earlier he knew that he would require catheterization again. The resident

followed the usual care process of clinical assessment to decide the care plan and informed

that he would be speaking with P20's oncology team before making any decision. P20 and CG

could foresee that catheterization would happen and asked several questions about the

procedure, type of catheter used and the process of bladder irrigation. The resident was still

figuring out P20's case according to the steps followed in ED and he could not immediately

inform the patient about these details.

In the above case, P20 came to ED knowing that he needed ED providers to perform the

catheterization procedure because he had recently undergone catheterization to solve

similar issues. The patient and caregiver did not associate enough utility with the clinical

assessment and expected to know more than what they already knew. Since ED resident

was not at par with the information possessed by the patient and caregiver, he could not

immediately inform them of the procedural details of catheterization.

The above cases highlight how patient's knowledge leads to expectations around ED care,

in turn affecting the type of care they require and the information they want to know

during their ED visit. If they do not receive information appropriately to satisfy their

expectation, they frame negative perception of ED care.

4.3.3.2 Patient's Health Literacy

Patients and their caregivers coming to ED have varying levels of health literacy. This

affects the way they seek and receive information from providers and their understanding

of the information given to them. The following case reflects how patients or their

caregivers influence information delivery by virtue of their health literacy:

P34's caregiver (CG) was a medical safety officer and possessed exceptionally higher health literacy than the usual ED patients. During the first clinical assessment with the resident, he discussed the details of the care plan, requirement for hospital admission and alternative to an admission. Later, CG asked more detailed questions on the names of each and every medicine that the resident was going to order.

The above case shows that the caregiver is comfortable understanding clinician's plan for the patient and can bring up concerns ahead of time such as the question around hospital admission. Additionally, because of higher health literacy, he is able to ask detail-oriented questions about complex information on medication, as he is familiar with the technical terms. On the other hand, patient's incomplete of knowledge of the technical terms that providers may use during communication can induce fear and anxiousness amongst them. The following is a contrasting case where the patient had limited understanding of terms used by providers:

P11 came to ED with an eye infection. The ophthalmologist performed a detailed assessment of P11's eyes. While trying to diagnose the issue, the ophthalmologist shared some potential prognosis with P11. Since P11 was not familiar with the terms, she felt scared.

She confirmed her fear during the interview:

"I didn't understand everything they said coz I guess they were talking about actual codes. I didn't know the vocabulary. But when they made guesses at what I could have and I kind of knew what it was that scared me... I really didn't quite understand everything they talked about."

In the above case, the patient did not have enough understanding of the technical terms used by the ophthalmologist. But when she even had a little knowledge of what she was told, she felt afraid about suffering from some serious condition. However, she hardly asked follow up questions to confirm what those terms mean. The ophthalmologist remained unaware of patient's state of fear.

The above cases highlight how patient's health literacy affects the way they seek and perceive information given by providers. Patients having more health literacy are comfortable with a technical format of information delivery but the same does not apply for patients with little health literacy. Additionally, use of technical terms with the latter type of patients may increase their anxiety and presumed disease burden.

CHAPTER 5 – DISCUSSION

In my findings I have shown how whiteboard as a medium does not support information delivery to patients because of the manual effort involved. I have also described the factors that affect patient's perception of information delivery and the consequent breakdowns such as delayed information delivery and patient's lack of contextual awareness of the care process. As a result of patient's unawareness about what affects information delivery, a patient may frame negative perception of the information she received and the providers who interact with her. Hence, there is a critical need to facilitate patient awareness with regards to information delivery events in the context of ED work. I now discuss insights into making information delivery effective based on the factors identified in the findings.

5.1 Awareness of Temporalities

I have shown that lack of temporal coordination for execution of care activities at various milestones compromises timely information delivery to patients. My findings are supported by prior studies that have shown how different temporal work structures among team members (i.e. physicians, nurses, pharmacists) can create problems in coordinating care-related activities [33][32], since knowledge of temporal work patterns is needed to aid awareness in social collaboration [16]. In ED, coordination of order execution, order completion, result assessment and clinical updates are necessary for timely information delivery. This coordination requires a-priori knowledge of temporalities in a patient's care process. However, the ad-hoc nature of ED work restricts

pre-defined coordination of these temporally aligned tasks, and requires ad-hoc coordination situated in the care process.

Many studies have investigated temporalities in relation with information work of providers and the coordination challenges that these temporalities engender [42][32]. Nevertheless, these studies focus on the temporal issues related with providers without taking into account how patients receive the impact of these coordination challenges. Patients, though unaware of these coordination challenges, receive the actual impact in the form of long wait time and delayed delivery of information as shown previously. Waiting to receive information makes them impatient, increases their frustration and may also affect their decision-making. The coordination challenges are not easily addressable due to ad-hoc ED work and will remain an inevitable part of operational characteristics of ED, compromising timeliness of information delivery to patients.

Additionally, apart from these coordination issues, information delivery time also depends on whether information to be given is general status information or clinical information because dispatch of clinical updates may depend on physician's availability. Information on general status does not require physician's intervention and can be delivered to patients in real time. The whiteboard contains information on the standard turnaround time for few tests such as blood tests, urine tests, X-Ray, Ultrasound and CT-Scan however; these components of the whiteboard are not actively used and the standard times may not hold because of uncertainty of task execution.

Thus, the real problem is patient's unawareness of the temporal structure of the milestones and the effect of inherent uncertainties of task execution on when information delivery can happen. When we speak of information delivery issues between providers, by virtue of being professionals in the same domain they have similar awareness about the general care process and the operational challenges that exist. They may adopt practices to overcome these issues [23]. However, information delivery between patients and providers is characterized by a difference in a-priori awareness of the milestones and challenges between the two sides. Not knowing the care process in advance and the delay induced by the uncertainties associated with the execution of these milestones causes anxiety and frustration amongst patients. This awareness gap is a barrier for changing perceptions of delayed information delivery. Thus, patients need to be given a better knowledge of these coordination challenges and the consequent effect on their care process. They need to be made aware that information delivery depends on the occurrence of few milestones that have to be successfully completed. This can induce a sense of temporal awareness that will avoid the frustration that indefinite wait time can cause.

Additionally, they should be made aware that clinical information requires interpretation and hence it is more appropriate to be delivered by physicians so that their follow up questions can be answered. This would justify patient's wait for physicians. They should be given explicit information about physician's unavailability to make waiting appropriate and reduce the anxiousness associated with not knowing what is going on.

Hence, the knowledge of uncertainties in the temporal layout of milestones in a patient's care process can afford temporal appropriateness of information delivery as to when can patient expect to receive information. It may positively influence patients' perception of wait time around information delivery events by exposing them to the uncertainty of ED work.

5.2 Operational Transparency

Medical teamwork consists of multiple roles including clinicians such as doctors, nurses, and specialists, to non-clinical members, e.g. technicians, secretaries and social workers [23][29]. I found similar distribution of clinical and non-clinical roles in a patient's ED care team. While these studies have explored the nature of these roles with regards to provider specific tasks, I have highlighted the relevance of these roles with respect to patient-provider communication for information delivery to patients.

I have shown that a patient's lack of knowledge about the invisible milestones of the care process related to clinical tasks affects information delivery. In the absence of transparency into clinical work, patients generate more information requests such as "what's happening" and "what's going on". Providers as professionals possess the knowledge of usual clinical tasks and their status through platforms such as the EMR but patients as consumers receive information at the end when all the clinical tasks have completed. In my findings, I described this as a contextual gap that exists between patient and clinicians by virtue of patients' invisibility into clinician-specific milestones, clinicians' knowledge of these tasks and lack of information delivery at these milestones. Patient's invisibility and the

consequent contextual gap results into unaccounted confusion for patients, information overload, unexplained wait time between milestones and multiple patient requests for information.

I have also shown that the existence of non-clinical staff, e.g. registration officers and case managers, is not apparent for patients and caregivers during the care process. Additionally, the patient room whiteboard has placeholders for the names of limited care team members such as the nurse and physician. Patient's unawareness of non-clinical team members leads to misdirected questions about obtaining few types of information, which would not have been the case if patients were aware of these team members and could in some way access them. The issues engendered by invisibility of clinical milestones and administrative care team members are suggestive of providing patients a greater transparency into the operational dynamics of their care process and the organization of complete care team including the informational roles of clinical as well as non-clinical staff.

Providing patients information transparency into how ED works has shown to improve patient satisfaction [21]. However, just explaining basic ED workflow is not enough for patients to understand their ED care because every patient's care process is different. There are many nuances in the care process that cannot be explained by general ED information. It is also an established concern that giving extra information to patients may result into more questions for providers and an increased information burden for patients [47]. On this account, an important question to answer is that what extent of operational transparency should be given to patients? Deciding the appropriate level of transparency

as to how general or how specific information should be given requires consideration of the above-mentioned issues.

Additionally, as shown in my findings, most of the patient requests for information are aimed at uncovering the opaque components of their care process. From a provider-friendly perspective, giving increased transparency into hidden milestones could reduce the number of patient requests for information, hence reducing the time providers spend in mediating between the visible and invisible contexts of a patient's care process.

5.3 Patient-Centric Information Delivery

Prior studies have reported patient related factors affecting information giving in patient-physician encounter. These include patient's expressiveness, question-asking attitude and social background [38][48][49]. My findings contribute to this knowledge by showing the influence of patient's expectation and health literacy on patient-provider communication within ED.

I have shown that different types of patients expect different information based on the treatment needs associated with their knowledge of their own health. Their expectations may conflict with the way ED providers approach their care. Hence, even though they want a specific treatment or information, they may not receive it immediately because of reasons such as complexity of a patient's medical case and provider's lack of extra information that patients possess. Consequently, patients may get frustrated because they feel that providers are not able to understand their expectations or they do not trust them.

Additionally, they may associate less value to the stepwise care process followed in ED to first assess patients, gather information and then make clinical decisions. This makes patient expectation an important determinant of the type of information that is appropriate for a given patient. Information given to patients should account for what they already know and what they additionally need to know to satisfy their expectation of ED care.

Health literacy is another determinant in deciding the content and format of information appropriate for a patient. I have shown that patients with higher health literacy are likely to be more comfortable asking and receiving formal and technical information about their care. While patients with little health literacy may become anxious when introduce to complex medical terminology. Prior research has shown the effect of patient's health literacy on patient-provider communication, reporting that patients with poor health literacy have communication issues and there is a need to come up with optimal communication strategies to solicit information from patients [53]. My findings on patient's health literacy contribute in the context of patient-provider communication for information delivery to patients as opposed to providers' information seeking from patients.

Following the influence of patients on information delivery, the challenging aspect about patient-provider communication is the variance in patient and provider backgrounds. Patients come with varied educational and social backgrounds having different expectations as consumers of medical services whereas providers undergo a standard training to work in medical institutions. Thus, the gap between professionals and consumers arises to be a barrier towards understanding what consumer wants and

consumer's comprehension of information. Information given through standard information delivery strategies may not satisfy every patient. The effectiveness of information delivery thus, depends on addressing this barrier.

A study reported that providing patients transparency into their personal health related information helps them better understand the bigger picture of their health [44]. Following the variations in patient backgrounds and expectations, patient-centric information delivery is required to cater to varying informational needs of patients. Whiteboards in the patient rooms cannot be used to accomplish this because of their generic design and their static nature. In order to provide patient-centric information, providers will need to play an important role in judging patient's expectation and the level of health literacy to decide the information that is appropriate for a patient. Accordingly, they would have to tailor the content, amount and formal language of information to fit the informational requirements of different patients.

CHAPTER 6 – DESIGN IMPLICATIONS

I have shown the contextualized nature of information delivery characterized by distinct

milestones and the factors that affect appropriate information delivery. I have discussed

that the challenge lies in communication between medical professionals and patients as

consumers of information, who have contextual gaps and considerable knowledge barriers.

Additionally, the inappropriateness of in-room whiteboards points to the need of better

media to support information delivery to patients. Involving patients as consumers in the

technology ecosystem of hospitals is gaining importance and patient-centric information

delivery tools have been deployed in conjunction with existing HIT such as the EMR for

improving inpatient experience [31]. These studies, however, are framed around design

insights from providers and lack patient's perspective. Based on my insights into how

information delivery varies in different situations of a patient's care process, I propose that

the design of such tools should support the notion of context appropriateness. Such

technologies should facilitate the delivery of appropriate information at the most

opportune moment and in the right format. I present three design guidelines for designing

patient-facing information delivery platforms linked to EMRs with the aim of improving

patient experience.

6.1 Context Appropriate Information Delivery

Prior interventions on inpatient information display in ED source information from EMRs

and deliver information in real time in accordance with the EMR updates [51][30]. While

EMR is a useful information source, these studies are yet to achieve complete automation

that would need investigation of temporal issues that I discussed and their implications for an information delivery system. Furthermore, their design lacks the interplay of information delivery and face-to-face patient-provider communication. I have discussed how one type of information comprising of content requiring clinical judgment is more appropriate to be given by a clinician and another type of information related to general status has no constraints on its delivery. Studies have also found providers' dislike of making the former type of information directly available to patients at the time when they become available [30]. Hence, information delivery to patients need not coincide with the moment information becomes available.

Considering the above-mentioned insights, a patient-facing information delivery platform should be designed to recognize the context in which information is to be given to patients and display information relevant to a patient's situation. Prior studies have used the notion of context-awareness to aid collaboration amongst providers through large displays that are aware of providers' presence and adapt to publish useful information for the provider in the vicinity of the display [15]. I propose the use of such context-aware in-room digital displays linked to EMRs to display context-appropriate information to patients. This context would mainly be the status of a patient's care process sourced from the EMR in terms of the orders that exist in the system and the presence of providers in patient room. While the order status can be easily sourced from EMR, detecting provider presence in the patient room would be a challenging feature of the information delivery platform in terms of implementation. It can be achieved via facial recognition built into the system or by

having a location tracking system for providers. However, it may pose issues related to accuracy of recognition.

I have shown two types of updates that patients need, general status and clinical updates. Specifically, the information for general status updates can be provided in terms of status of different orders sourced from EMR. The EMR contains status information such as if there is an order in the system, if the order is pending or complete and if the clinician has annotated the results of the order. This status information can be directly fed to the display as auto generated message templates since the order can only be in few predefined states such as pending or complete, which can be displayed when order information changes in the EMR. This will provide patients visibility into the provider related tasks, which I described as invisible milestones.

Delivery of clinical updates can be timed with the presence of clinician in the patient room after the EMR reflects order status as complete. Facial recognition or location can be used to detect the presence of a clinician in the patient room. For e.g. the system when detects completion of an order in the EMR and the presence of clinician in the patient room, it can display lab tests sourced from EMR to aid patient-provider communication.

6.2 Supporting Operational Transparency

I have shown that invisibility into the operation of a few milestones and few care team members affects how patients receive information. In the absence of transparency patients generate information requests and it is confusing for them to perceive the actual status of

care. Additionally, I discussed considering the extent of transparency patients should be given into medical operations considering issues such as increased information burden.

In the context of invisible milestones associated with clinical tasks, automated delivery of order status from the EMR can provide an objective visibility of clinical tasks. However, making patients aware of the actual situation and information such as the reason of delay would require creation of custom messages based on a patient's situation and delivery of these messages to the in-room display. While the delivery mechanism would source information from the message creation platform, there are two challenging aspects of customized message creation. Firstly, a platform for creating these messages is needed. EMR in its current state does not have a provision for customized information creation except for the doctors' notes, which may not be suitable for display. Secondly, if there was such a platform the communication responsibility may come down to the nurses who are in charge of handling patient requests. It can be argued that this would require their time but I have shown that nurses already spend time mediating between the visible and invisible contexts of a patient's care process to satisfy patient requests for status information. Typing a message into an electronic platform will help inform patients in advance without physically moving between patient room and workstations, thus reducing the burden.

Changing the EMR to include a message creation section would require a systemic change that could have an organizational impact. Hence, I suggest the use of an adjunct web-based messaging platform linked to the in-room information displays. For e.g. the messaging platform could have room numbers as recipients. A message for a room would feed to the

information display of that room when published by the nurse. Additionally, standard

message templates could be created over time that would only require the nurse to select

the template and publish it to the information display. One of the ED interventions

achieved this through the involvement of study administrators who conducted the study on

testing a handheld mobile information display for ED patients [30]. The study

administrators manually pushed information to patients based on their knowledge of

events. In reality, this would require replacing these administrators with the patient care

team members.

With regards to patient's unawareness of non-clinical staff, the information display could

show a listing of non-clinical roles with their work responsibilities. Providing this

information during the start of patient's care process is important as patients may need

information to plan ahead for admission or insurance related tasks. Prototypes deployed by

prior research already provide information about the clinical care team members [51].

6.3 Patient-Based Content Customization

I have shown that patient expectation and health literacy are important determinants that

influence the quality of patient-provider communication and patient's perception of

received information. Additionally, I have discussed the role of providers in gauging these

factors related to the patient to make a judgment about what information is appropriate for

which patient.

The patient related factors affecting information delivery present a need to incorporate tools for formal assessment of patient's expectation of care and health literacy in the design of information delivery platforms for patients. For e.g. patients could be given a questionnaire for assessment of their expectation and health literacy at the start of their care. Clinicians can then use the results of this assessment to decide what information would satisfy patient's expectation and in what format, technical or simplified, should this information be given to them. Accordingly, clinicians can tailor their face-to-face communication strategy based on this information.

CHAPTER 7 – CONCLUSION

In this study, I investigated the phenomenon of *in-situ* information delivery within the temporal framework of a patient's care process in ED. My observations reveal different phases of a patient's care process, which I have termed as milestones. These milestones are composed in terms of care activities and patient's interaction with providers in different roles who deliver various types of information to patients such as care plan, information on procedure and medication, clinical updates, and prognosis. I report the issues of information delivery including the challenges that providers face with regards to information delivery media in ED and patient's perceptions of the way information delivery happens. My analysis of information delivery events in the context of the operational characteristics of ED reveals three factors that affect information delivery to patients and their perceptions of information delivery: temporalities at work, invisibility of ED work to patients, and patient's expectation and health literacy. I further discuss how does information delivery affect patients and how it can be made more appropriate. Based on my findings, I provide three guidelines for designing patient-centric information delivery platforms: context appropriate information delivery, supporting operational transparency, and patient-based content customization. The guidelines account for the context of information delivery and point to a few challenges in designing for the patient given the provider-centric nature of the EMR.

This study reveals two major insights. Firstly, it points to issues beyond the unsuitability of media within the ED setting. These issues are related to patient's perceptions arising out of

the perceived quality of information delivery from providers. Secondly, it brings forth the awareness, knowledge and background gaps between patients as consumers of medical services and providers as professionals. The gaps between these two distinct sides restrict effective information delivery and indicate opportunities to include patients in the design of HIT.

Studies in the airline transportation research have analyzed the operational uncertainties in airline schedules [56]. My study provides insights into the interplay of collaboration challenges of medical work with patient-provider interaction and the consequent uncertainty of patient care and information delivery. This knowledge can contribute to an understanding of patient-provider communication beyond ED in the conventional inpatient medical settings that have been rich sites for exploring collaboration. Such insights are difficult to obtain using surveys and interviews as research methods. The ethnographic approach to explore patient's experience is one of the unique contributions of this study. More ethnographic investigation is required to further understand the impact of care team collaboration on patient-provider communication. Additionally, communication between the patient and the care team as a whole should be investigated to capture another aspect of patient-provider communication in hospital settings.

REFERENCES

1. Abraham, J. and Reddy, M.C. Moving patients around: a field study of coordination between clinical and non-clinical staff in hospitals. *Proceedings of the 2008 ACM conference on Computer supported cooperative work*, ACM (2008), 225–228.
2. Alsos, O.A., Das, A., and Svanæs, D. Mobile health IT: The effect of user interface and form factor on doctor–patient communication. *International Journal of Medical Informatics 81*, 1 (2012), 12–28.
3. Alsos, O.A. and Svan\a es, D. Designing for the secondary user experience. In *Human-Computer Interaction–INTERACT 2011*. Springer, 2011, 84–91.
4. Bardram, J.E., Hansen, T.R., and Soegaard, M. AwareMedia: a shared interactive display supporting social, temporal, and spatial awareness in surgery. *Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work*, ACM (2006), 109–118.
5. Bickmore, T.W., Pfeifer, L.M., and Jack, B.W. Taking the time to care: empowering low health literacy hospital patients with virtual nurse agents. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM (2009), 1265–1274.
6. Boudreaux, E.D. and O'Hea, E.L. Patient satisfaction in the Emergency Department: a review of the literature and implications for practice. *The Journal of Emergency Medicine 26*, 1 (2004), 13–26.
7. Bursh, B., Beezy, J., and Shaw, R. Emergency Department Satidfaction: What Matters Most? *Annals of Emergency Medicine 22*, (1993), 586–591.
8. Chen, Y., Ngo, V., Harrison, S., and Duong, V. Unpacking exam-room computing: negotiating computer-use in patient-physician interactions. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM (2011), 3343–3352.
9. Chiasson, M., Reddy, M., Kaplan, B., and Davidson, E. Expanding multi-disciplinary approaches to healthcare information technologies: What does information systems offer medical informatics? *International Journal of Medical Informatics 76*, (2007), S89–S97.
10. Corbett, S.W., White, P.D., and Wittlake, W.A. Benefits of An Informational Videotape. *The American Journal of Emergency Medicine 18*, (2000), 67–71.
11. Eisenberg, E.M., Murphy, A.G., Sutcliffe, K., et al. Communication in Emergency Medicine: Implications for Patient Safety1 This study was funded by a generous grant from the National Patient Safety Foundation. *Communication Monographs 72*, 4 (2005), 390–413.
12. Engel, K.G., Heisler, M., Smith, D.M., Robinson, C.H., Forman, J.H., and Ubel, P.A. Patient Comprehension of Emergency Department Care and Instructions: Are Patients Aware of When They Do Not Understand? *Annals of Emergency Medicine 53*, 4 (2009), 454–461.e15.
13. Fairbanks, R.J., Bisantz, A.M., and Sunm, M. Emergency Department Communication Links and Patterns. *Annals of Emergency Medicine 50*, 4 (2007), 396–406.
14. Favela, J., Martinez-Garcia, A.I., and others. Context-aware mobile communication in hospitals. *Computer 36*, 9 (2003), 38–46.

15. Favela, J., Rodriguez, M., Preciado, A., and Gonzalez, V.M. Integrating Context-Aware Public Displays Into a Mobile Hospital Information System. *IEEE Transactions on Information Technology in Biomedicine 8*, 3 (2004), 279–286.

16. Fisher, D. and Dourish, P. Social and temporal structures in everyday collaboration. *Proceedings of the SIGCHI conference on Human factors in computing systems*, ACM (2004), 551–558.

17. Frank, C., Asp, M., and Dahlberg, K. Patient participation in emergency care – A phenomenographic study based on patients' lived experience. *International Emergency Nursing 17*, 1 (2009), 15–22.

18. Gonzales, M.J. and Riek, L.D. Co-designing patient-centered health communication tools for cancer care. *Proceedings of the 7th International Conference on Pervasive Computing Technologies for Healthcare*, ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering) (2013), 208–215.

19. Karunakaran, A., Hee-Nam, Y., and Reddy, M. Investigating barriers to electronic medical record use during collaborative information seeking activities. *Proceedings of the 2nd ACM SIGHIT International Health Informatics Symposium*, ACM (2012), 743–748.

20. Knopp, R., Rosenzweig, S., Bernstein, E., and Totten, V. Physician-Patient Communication in the Emergency Department, Part 1. *Academic Emergency Medicine 3*, 11 (1996), 1065–1076.

21. Krishel, S. and Baraff, L.J. Effect of emergency department information on patient satisfaction. *Annals of Emergency Medicine 22*, 3 (1993), 568–572.

22. Kusunoki, D., Sarcevic, A., Zhang, Z., and Yala, M. Sketching Awareness: A Participatory Study to Elicit Designs for Supporting Ad Hoc Emergency Medical Teamwork. *Computer Supported Cooperative Work (CSCW) 24*, 1 (2015), 1–38.

23. Lee, S., Tang, C., Park, S.Y., and Chen, Y. Loosely formed patient care teams: communication challenges and technology design. *Proceedings of the ACM 2012 conference on Computer Supported Cooperative Work*, ACM (2012), 867–876.

24. McCarthy, D.M., Buckley, B.A., Engel, K.G., Forth, V.E., Adams, J.G., and Cameron, K.A. Understanding Patient-Provider Conversations: What Are We Talking About? *Academic Emergency Medicine 20*, 5 (2013), 441–448.

25. McCarthy, D.M., Cameron, K.A., Courtney, D.M., and Vozenilek, J.A. Self-Reported Use of Communication Techniques in the Emergency Department. *The Journal of Emergency Medicine 43*, 5 (2012), e355–e361.

26. McCarthy, D.M., Ellison, E.P., Venkatesh, A.K., et al. Emergency Department Team Communication with the Patient: The Patient's Perspective. *The Journal of Emergency Medicine 45*, 2 (2013), 262–270.

27. Muntlin, A., Gunningberg, L., and Carlsson, M. Patients' perceptions of quality of care at an emergency department and identification of areas for quality improvement. *Journal of Clinical Nursing 15*, 8 (2006), 1045–1056.

28. Ni, T., Karlson, A.K., and Wigdor, D. AnatOnMe: facilitating doctor-patient communication using a projection-based handheld device. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM (2011), 3333–3342.

29. Park, S.Y., Lee, S.Y., and Chen, Y. The effects of EMR deployment on doctors' work practices: A qualitative study in the emergency department of a teaching hospital. *International Journal of Medical Informatics 81*, 3 (2012), 204–217.

30. Pfeifer Vardoulakis, L., Karlson, A., Morris, D., Smith, G., Gatewood, J., and Tan, D. Using mobile phones to present medical information to hospital patients. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM (2012), 1411–1420.
31. Prey, J.E., Woollen, J., Wilcox, L., et al. Patient engagement in the inpatient setting: a systematic review. *Journal of the American Medical Informatics Association 21*, 4 (2014), 742–750.
32. Reddy, M. and Dourish, P. A finger on the pulse: temporal rhythms and information seeking in medical work. *Proceedings of the 2002 ACM conference on Computer supported cooperative work*, ACM (2002), 344–353.
33. Reddy, M.C., Dourish, P., and Pratt, W. Temporality in medical work: Time also matters. *Computer Supported Cooperative Work (CSCW) 15*, 1 (2006), 29–53.
34. Rhodes, K.V., Vieth, T., He, T., et al. Resuscitating the physician-patient relationship: emergency department communication in an academic medical center. *Annals of emergency medicine 44*, 3 (2004), 262–267.
35. Schiermeyer, R.P., Tayal, V., and Butzin, C.A. Physician business cards enhance patient satisfaction. *The American journal of emergency medicine 12*, 1 (1994), 125–126.
36. Skeels, M. and Tan, D.S. Identifying opportunities for inpatient-centric technology. *Proceedings of the 1st ACM International Health Informatics Symposium*, ACM (2010), 580–589.
37. Stewart, M.A. Effective physician-patient communication and health outcomes: a review. *CMAJ: Canadian Medical Association Journal 152*, 9 (1995), 1423.
38. Street Jr, R.L. INFORMATION-GIVING IN MEDICAL CONSULTATIONS: THE INFLUENCE OF PATIENTS' COMMUNICATIVE STYLES AND PERSONAL CHARACTERISTICS. *Soc. Sic. Med. 32*, (1991), 541–548.
39. Sun, B.C., Adams, J., Orav, E.J., Rucker, D.W., Brennan, T.A., and Burstin, H.R. Determinants of patient satisfaction and willingness to return with emergency care. *Annals of emergency medicine 35*, 5 (2000), 426–434.
40. Sun, B.C., Adams, J.G., and Burstin, H.R. Validating a model of patient satisfaction with emergency care. *Annals of Emergency Medicine 38*, 5 (2001), 527–532.
41. Sun, S., Zhou, X., Denny, J.C., Rosenbloom, T.S., and Xu, H. Messaging to your doctors: understanding patient-provider communications via a portal system. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM (2013), 1739–1748.
42. Tang, C. and Carpendale, S. An observational study on information flow during nurses' shift change. *Proceedings of the SIGCHI conference on Human factors in computing systems*, ACM (2007), 219–228.
43. Tang, C. and Carpendale, S. A mobile voice communication system in medical setting: love it or hate it? *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM (2009), 2041–2050.
44. Tang, P.C. and Lansky, D. The missing link: bridging the patient–provider health information gap. *Health Affairs 24*, 5 (2005), 1290–1295.
45. Tang, P.C. and Newcomb, C. Informing patients A guide for providing patient health information. *Journal of the American Medical Informatics Association 5*, 6 (1998), 563–570.
46. Taylor, D., Wolfe, R., and Cameron, P. Complaints from emergency department patients largely result from treatment and communication problems. *1*, (2002), 43–49.

47. Vawdrey, D.K., Wilcox, L.G., Collins, S.A., et al. A tablet computer application for patients to participate in their hospital care. *AMIA Annual Symposium Proceedings*, American Medical Informatics Association (2011), 1428.

48. Waitzkin, H. Doctor-patient communication: clinical implications of social scientific research. *Jama 252*, 17 (1984), 2441–2446.

49. Waitzkin, H. Information Giving in Medical Care. *Journal of Health and Social Behavior 26*, 2 (1985), 81.

50. Wilcox, L., Feiner, S., Liu, A., Restaino, S., Collins, S., and Vawdrey, D. Designing inpatient technology to meet the medication information needs of cardiology patients. *Proceedings of the 2nd ACM SIGHIT International Health Informatics Symposium*, ACM (2012), 831–836.

51. Wilcox, L., Morris, D., Tan, D., and Gatewood, J. Designing patient-centric information displays for hospitals. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM (2010), 2123–2132.

52. Wilcox, L.G., Gatewood, J., Morris, D., Tan, D.S., Feiner, S., and Horvitz, E. Physician Attitudes about patient-facing information displays at an urban emergency department. *AMIA Annual Symposium Proceedings*, American Medical Informatics Association (2010), 887.

53. Williams, M.V., Davis, T., Parker, R.M., and Weiss, B.D. The role of health literacy in patient-physician communication. *Fam Med 34*, 5 (2002), 383–9.

54. Winkelman, W.J. Patient-Perceived Usefulness of Online Electronic Medical Records: Employing Grounded Theory in the Development of Information and Communication Technologies for Use by Patients Living with Chronic Illness. *Journal of the American Medical Informatics Association 12*, 3 (2005), 306–314.

55. Woloshynowych, M., Davis, R., Brown, R., and Vincent, C. Communication Patterns in a UK Emergency Department. *Annals of Emergency Medicine 50*, 4 (2007), 407–413.

56. Wu, C.-L. THE INFLUENCE OF OPERATIONAL UNCERTAINTIES ON AIRLINE SCHEDULE PLANNING AND PUNCTUALITY CONTROL ISSUES. (2003).

57. Zavala, S. and Shaffer, C. Do Patients Understand Discharge Instructions? *Journal of Emergency Nursing 37*, 2 (2011), 138–140.