Patient-Centered Perspectives of Communication and Handover between the Emergency Department and General Internal Medicine

by

Ilinca Popovici

A thesis submitted in conformity with the requirements for the degree of Master of Health Science in Clinical Engineering
Institute of Biomaterials and Biomedical Engineering
University of Toronto

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Abstract

Effective communication among clinicians is critical for patient safety. This multi-site observational study analyzes inter-clinician communication and interaction with information technology, with a focus on the critical process of patient transfer from the Emergency Department to General Internal Medicine. The study provides insight into clinician workflow, evaluates current hospital communication systems, and identifies key issues affecting communication. It suggests opportunities for improvement:

- extending the role of the electronic patient record,
- rendering it available on a mobile platform,
- developing an improved paging system.

It also identifies design trade-offs to be negotiated:

- synchronous communication vs. reducing interruptions,
- notification of patient status vs. reducing interruptions,
- portability vs. screen size of mobile devices,
- speed vs. quality of handovers,
- information privacy vs. accessibility.
The results inform the potential development of an intervention meeting seven principles: interconnectivity, context awareness, accessibility, redundancy, user customization, security, and intuitive user interfaces.
Acknowledgments

This dissertation would not have been possible without the guidance and help of several great individuals who were dedicated to the success of this study.

I would like to thank:

My supervisor Dr. Joseph Cafazzo, for his constant support, great advice, and confidence in my work;

My committee members: Dr. Diane Doran, Dr. Edward Etchells, Dr. Stephen Lapinsky, Dr. Dante Morra, and Dr. Robert Wu, for taking the time to help me plan and execute this research;

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My Mom and Dad, for their unconditional love and support, every step of the way;

My friends and loved ones, for being such a positive influence in my life.
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<th>Description</th>
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<td>BBM</td>
<td>BlackBerry Messenger</td>
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<tr>
<td>BMS</td>
<td>Bed Management System</td>
</tr>
<tr>
<td>CTAS</td>
<td>Canadian Triage and Acuity Scale</td>
</tr>
<tr>
<td>ED</td>
<td>Emergency Department</td>
</tr>
<tr>
<td>EDIS</td>
<td>Emergency Department Information System</td>
</tr>
<tr>
<td>EHR</td>
<td>Electronic Health Record</td>
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<tr>
<td>GIM</td>
<td>General Internal Medicine</td>
</tr>
<tr>
<td>IM</td>
<td>Internal Medicine</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>MAR</td>
<td>Medication Administration Record</td>
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<tr>
<td>MSH</td>
<td>Mount Sinai Hospital</td>
</tr>
<tr>
<td>REB</td>
<td>Research Ethics Board</td>
</tr>
<tr>
<td>SHSC</td>
<td>Sunnybrook Health Sciences Centre</td>
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<tr>
<td>SMS</td>
<td>Short Message Service</td>
</tr>
<tr>
<td>TGH</td>
<td>Toronto General Hospital</td>
</tr>
<tr>
<td>UHN</td>
<td>University Health Network</td>
</tr>
<tr>
<td>UML</td>
<td>Unified Modeling Language</td>
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<td>WIPS</td>
<td>Web-based Application and Paging System</td>
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Chapter 1
INTRODUCTION

Communication and effective flow of information between clinicians is a very important aspect of healthcare, with evidence indicating that errors in communication lead to substantial increases in clinical mortality and morbidity (Coiera, 2000). Collection, transcription and handovers of information and responsibility across shifts are particularly complex and critical communication activities which, if performed ineffectively, can cause adverse events.

With the current trend of increasing adoption of digital and wireless technology in hospitals, there is opportunity to improve communication and information access. In particular, the increased use of mobile devices provides the unique opportunity of enabling clinicians to access Electronic Health Record (EHR) information anywhere in the hospital. While many groups have developed new technologies designed to address individual aspects of information and communication needs (i.e. narrow focus on the impact of pagers, or smartphones, etc, on nursing or physician communication), the potential impact of these technological solutions as a whole are largely understudied.

A better approach to developing new solutions that address the most critical issues related to communication of clinical information is starting from first principles, by mapping out patterns of communication within the modern hospital as a whole. Such studies that reliably identify key communication issues through ethnographic methods are missing in the literature.

1.1 Background

The Harvard Medical Practice Study reviewed 30,121 medical records from 51 randomly selected acute care hospitals in New York in 1984, revealing that sentinel events occurred in approximately 3.7% of hospitalizations, 27.6% of which were due to negligence (Brennan et al, 2004). Based on a similar protocol, the Canadian adverse events study conducted by Baker et al in 2004 showed that 7.5% of hospitals admissions are associated with adverse events, of which 36.9% are preventable. In addition, there was a trend for adverse events to occur more often in teaching hospitals, rather than community
hospitals. This might be partly due to the complexity of care in teaching hospitals, which increases the risk for adverse events caused by miscommunication and lack of coordination of care. (Baker et al, 2004)

Poor communication among clinicians is ubiquitously considered one of the main root causes of these adverse events. In fact, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) cited communication as the main cause of sentinel events occurring between 1995 and 2006 (JCAHO, 2008). Further illustrating this point, a study by Sutcliffe et al in 1999, which consisted of semi-structured interviews with residents regarding work environments and recent medical mishaps, revealed that communication and patient management were the two most commonly mentioned contributing factors to the reported mishap incidents. Residents participating in the study described their role as closely connected to other medical staff, and communication difficulties within their relationships with other clinicians appeared to be associated with occurrence of medical mishaps. (Sutcliffe et al, 2004)

The strong link between communication and patient safety is not surprising, given that:

> Communication space is apparently the largest part of the health system’s information space [...] and seems to be where most of the information in the clinical workplace is acquired and presented. The biggest information repository in health care lies in the people working in it, and the biggest information system is the web of conversations that link the actions of these individuals. (Coiera, 2000)

Indeed, it has been shown that clinicians spend the majority of their time engaged in communication. In the emergency department, nurses and doctors spend up to 80% of their time communicating, as revealed by an observational study conducted by Coiera et al (Coiera et al, 2002). Similarly, a time-motion study of hospitalist activities showed that physicians spend 69% of their time on indirect patient care, which included review of medical records and test results, documentation (notes, discharge instructions, prescription), communication, and orders (O’Leary et al, 2006). Furthermore, the clinical environment is highly interruptive, with 10-11 interruptions per hour in emergency
departments (Coiera et al, 2002; Chrisholm et al, 2000). While this interruptive approach ensures that patient management issues are dealt with immediately, they also cause inefficiency and stress in the workplace. Frequent interruptions can disrupt items stored in the working memory, generating errors. (Alvarez & Coiera, 2005)

Medical errors can be categorized into two types: active and latent. Active failures refer to unsafe acts committed by clinicians involved in direct patient care, which have a direct and usually short-lived impact. By contrast, latent conditions refer to less apparent weaknesses that reside within the system organization or design, which contribute to the occurrence of errors. (Reason, 2000) From the background presented thus far, it is evident that this complex communication space represents a source of latent error in health care settings. Moreover, the communication that takes place during handovers (i.e. shift changes, patient transfers between care providers) is considered particularly critical for ensuring patient safety. During handover, clinicians exchange information necessary for planning patient care, so incomplete or inaccurate information can have severe negative consequences (Alvarado et al, 2006). In addition, unclear transfer of responsibility to follow up on patient care can lead to inefficiency (e.g. duplicate testing), or worse, inadequate patient care (e.g. missing tests, delayed procedures, medication errors, etc.). In a survey regarding adverse events of residents at two teaching hospitals conducted by Jagsi et al (2005), problems with handoffs were quoted as one of the most common reasons for mistakes (15%), alongside excessive work hours and inadequate supervision. When asked about the factors perceived as contributing to mistakes in patient care, 12.9% of residents felt poor handoffs contributed greatly, and 40.8% felt that they contributed somewhat. (Jagsi et al, 2005) Furthermore, handovers occur very frequently in the hospital setting, due partly to the number of different health professionals involved in the care of a patient. A study conducted in the Auckland City Hospital showed that medicine patients saw an average of 17.8 health professionals (6.0 doctors, 10.7 nurses, 1.0 allied health professionals) and surgery patients saw 26.6 health professionals (10.0 doctors, 15.9 nurses, 0.8 allied health professionals) during an average hospital stay (Whitt et al, 2007). Frequent handovers imply an increased likelihood of incomplete or distorted information being passed on, which can result in medical mishaps. Despite the large and potentially hazardous role played by handovers in
patient care, handover practices are not yet standardized, varying widely across and within hospitals. These practices typically involve a combination of verbal, written, and taped reports, and rarely employ artifacts such as patient health records or test results. (Alvarado et al, 2006; Behara et al, 2005; Sinha et al, 2006)

Furthermore, handovers are understudied, and most handover communication research to date focuses on shift handovers within a specialty. Studies on communication around patient transfers, such as the transfer from the emergency department (ED) to general internal medicine (GIM) are much less prevalent, despite the particularly high risks involved. (Horwitz et al, Jun. 2009) An important patient safety risk regarding the ED to GIM handover relates to the concomitant transfer of departmental responsibility and patient physical location, which may not happen simultaneously. This can cause confusion regarding which team is responsible for the patient during transfer. (Behara et al, 2005) Another factor is that during this transition, results of tests are frequently pending, which creates a risk for missed follow-up (Horwitz et al, Jun. 2009). Transfers to GIM wards in particular, as opposed to transfers to other internal medicine (IM) wards, require a higher number of consults and involve more interaction between various clinicians, thus increasing the risk for miscommunication. Also, the ED to GIM transfer typically takes place in the ED, which is a chaotic environment, filled with interruptions (Coiera et al, 2002; Chrisholm et al, 2000). Additionally, these handovers occur when the patients are least stable and most vulnerable to medical mishaps (Horwitz et al, Jun. 2009), and sometimes when the exact diagnosis of the patient is not yet clear. As examples of potential vulnerabilities of the ED to GIM transfer process, a survey conducted by Horwitz et al revealed several communication issues: inaccurate or incomplete patient information, particularly of vital signs; cultural and professional conflicts; difficulty in accessing key information such as vital signs, pending data, ED notes, ED orders, and identity of responsible physician; and ambiguous responsibility for sign-out or follow-up (Horwitz et al, Jun. 2009). The next section presents a more detailed literature review of ED to GIM transitions of care.
1.2 Literature review of ED-GIM handover

The main focus of the present project is to investigate communication around patient transfer from the ED to GIM. Therefore, a systematic literature search was conducted to determine previous research in this domain, the methods used, and main findings.

The databases searched were Scopus (largest database of peer-reviewed literature) and MEDLINE (11 million citations from health and medical journals).

The keywords used for the search were:

- “emergency department” (or “emergency”, or “ED”) AND
- “internal medicine” (or “inpatient”, or “hospitalist”) AND
- “handover” (or “transfer”, or “transition”, or “handoff”, or “admitting”)

The exclusion criteria were as follows:

- non-English publications
- case studies
- studies on ED boarding, patient throughput, or communication with the patient
- psychiatric hospital studies

The relevant articles were selected through an examination of the titles and abstracts of the search results. Relevant studies cited in these results were also included for review.
Table 1 - Summary of methodology and main findings for studies on patient transfer from the emergency department (ED) to internal medicine (IM) or general internal medicine (GIM)

<table>
<thead>
<tr>
<th>Study</th>
<th>Methods</th>
<th>Participants</th>
<th>Setting</th>
<th>Data analysis</th>
<th>Goals of the study</th>
<th>Main findings</th>
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<tr>
<td>Apker et al, 2007, <em>Communicating in the &quot;Gray Zone&quot;: Perceptions about Emergency Physician - hospitalist Handoffs and Patient Safety</em></td>
<td>Interviews</td>
<td>6 ED physicians, 6 IM physicians</td>
<td>One regional teaching hospital, US</td>
<td>Constant comparative, thematic analysis</td>
<td>Identify perceptions of physicians regarding ED to GIM handoffs.</td>
<td>Physicians perceived ED to GIM handoff communication as a gray zone characterized by ambiguity about patients' conditions and treatment. Poor handoffs, consisting of faulty communication behaviours and conflicting expectations for information, contribute to patient boarding conditions that can pose safety threats.</td>
</tr>
<tr>
<td>Horwitz et al, Jun. 2009, <em>Dropping the baton: A Qualitative Analysis of Failures During the Transition From Emergency Department to Inpatient Care</em></td>
<td>Survey</td>
<td>ED house staff, ED physician assistants, IM house staff, and hospitalists</td>
<td>One urban academic medical center, US</td>
<td>Standard qualitative analysis techniques</td>
<td>Describe adverse events occurring because of inadequate communication between emergency medicine and the admitting physician.</td>
<td>Several vulnerabilities relating to communication failures: inaccurate or incomplete information, particularly of vital signs; cultural and professional conflicts; crowding; high workload; difficulty accessing key information such as vital signs, pending data, ED notes, ED orders, and identity of responsible physician; nonlinear patient flow; &quot;boarding&quot; in the ED; and ambiguous responsibility for sign-out or follow-up.</td>
</tr>
<tr>
<td>Study</td>
<td>Methods</td>
<td>Participants</td>
<td>Setting</td>
<td>Data analysis</td>
<td>Goals of the study</td>
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</tr>
<tr>
<td>Horwitz et al, Sep. 2009, <em>Evaluation of an Asynchronous Physician Voicemail Sign-out for Emergency Department Admissions</em></td>
<td>Surveys before/after intervention; examination of administrative data</td>
<td>ED house staff, ED physician assistants, IM house staff, and hospitalists</td>
<td>One urban academic medical center, US</td>
<td>Standard qualitative analysis techniques, some quantitative measures</td>
<td>Evaluate a voicemail-based, semi-structured, asynchronous physician-physician sign-out compared with the traditional synchronous sign-out.</td>
<td>Voicemail sign-out for the ED-IM patient transfer was easier than oral sign-out without any change in early ICU transfers or perceptions of major adverse events. Interaction among physicians was reduced.</td>
</tr>
<tr>
<td>Matthews et al, 2002, <em>Emergency Physician to Admitting Physician Handovers: An Exploratory Study</em></td>
<td>Direct observation in ED and interviews</td>
<td>ED and IM physicians</td>
<td>Two hospitals: military hospital and large urban teaching hospital, US</td>
<td>Informal qualitative analysis</td>
<td>Document phases and issues found in ED handovers</td>
<td>Phases for ED to IM handovers were similar to those documented for shift changes in other industries (e.g. paper mill, air traffic control). Three vulnerable areas discovered include spoken communication between physicians, selection of diagnostic tests based on the specific admitting physician, and use of surrogates by the admitting physician.</td>
</tr>
<tr>
<td>Ye et al, 2007, <em>Handover in the emergency department: Deficiencies and adverse effects</em></td>
<td>Observations of handover sessions; post-handover surveys of IM doctors; general survey of ED doctors</td>
<td>60 handover sessions for 914 patients; 707 post-handover interviews with IM doctors; 50 ED doctors surveyed</td>
<td>Three large metropolitan ED, Australia</td>
<td>Qualitative and descriptive quantitative analysis</td>
<td>Determine problems resulting from ED handover, deficiencies in current procedures, and whether patient care or ED processes are adversely affected.</td>
<td>Medical information was handed over better than communication and disposition information. Information was perceived as lacking in 15.4% of handovers, in particular details of management, investigations, and disposition. Inadequate handovers led to adverse patient outcomes in 4.7% of cases, including repetition of assessment, delays in disposition and care.</td>
</tr>
</tbody>
</table>
A total of 6 publications were identified for further review, shown in Table 1. The main methods used, as well as the main findings are also listed in Table 1.

From the main findings, it seems that there is agreement among the 6 studies that ED to GIM handover is a critical area characterized by severe communication vulnerabilities.

The small number of studies, as well as some important methodological limitations (e.g. predominance of subjective methods such as surveys and interviews; limited focus on physician to physician communication; limited to one site; etc), suggest that further work in this area is needed. These methodological limitations, and the proposed ways in which the present study will address these, are explored next.

Firstly, only half of the studies identified incorporate some form of direct observation in their methodology. The rest are based solely on interviews or survey responses - methods which are less conclusive, since subjective recollections can be inaccurate or biased. Furthermore, the three that do incorporate direct observation have their own limitations: one study (Apker et al, 2010) looks only at audio recordings of phone handoff conversations, while the other two (Matthews et al, 2002; Ye et al, 2007) focus solely on the handover phases and the spoken handover conversation, or rely more on the post-handover surveys than the direct observation in their data analysis, respectively. The present study is based on extensive direct observation to provide a rich overview of communication around patient transfer from the ED to GIM.

Secondly, only two of the six studies identified are conducted at multiple sites: two US hospitals for Matthews et al (2002) and three Australian hospitals for Ye et al (2007). To address this limitation, the present study was conducted at three institutions which vary in terms of practices and levels of information technology (IT) adoption. This allowed the researcher to identify a larger range of possible communication issues and better inform possible areas of improvement.

Another limitation is that all six studies limit their research scope to the actual handover conversation, rather than looking at all the patient-related communication taking place around the transfer, and during the period immediately following. The present study covers a broader spectrum of communication around the handover process.
An additional key factor is that four of the six studies are limited in scope to the communication between ED and GIM physicians. The other two studies also include ED and IM house staff; however, these studies are survey-based. The present research addresses this limitation by studying the entire communication network that exists for each individual patient, around the time of ED to GIM handover. Importantly, looking at the information exchanged between healthcare professionals involved in the care of a single patient at a time allows the researcher to focus on interactions that have a direct effect on patient care and safety. Also, the broad scope of patient-centered care allows the researcher to study communication and information needs of various health care professionals (physicians, nurses, allied health professionals, etc).

Another important limitation of the six studies is that none are concerned specifically with communication technology, how clinicians interact with formal information sources (e.g. patient health record, lab results, vitals, etc), or how these interactions influence communication. Rather, most studies focus solely on the verbal communication between physicians. One notable exception is the study by Horwitz et al (Sep. 2009), but this study has the very narrow scope of evaluating an asynchronous physician-physician sign-out system compared with the traditional synchronous sign-out. The present study focuses on the interaction with technology in addition to the type of patient information that is communicated, to inform technological interventions that formalize these communications with minimal impact on clinician workflow.

Furthermore, most of the studies identified are based solely on qualitative data analysis. Indeed, only two studies incorporate some basic quantitative measures, and none of the studies informed workflow diagrams or another type of modeling or data visualization mapping. These types of results are more suited to inform a future user-centered design process and the development of IT interventions to mitigate the communication issues identified.

Finally, most of the studies are largely exploratory, not focusing directly on informing technological interventions that address the communication issues identified. The only exception is the study conducted by Horwitz et al (Sep. 2009) which evaluates an asynchronous physician voicemail sign-out system compared to the traditional synchronous sign-out; however, this study relies mainly on subjective survey results. By contrast, the proposed study is specifically aimed at determining the value of existing information technology and the potential impact of
technological interventions on communication improvement. The focus on technology is driven by the documented superior effectiveness of such technological interventions compared to staff training or other educational methods (ISMP, 1999).

To summarize, the present study is a patient-centric, multisite, observational study analyzing communication and clinician interaction with IT during the process of patient transfer from the ED to GIM, which will inform technological interventions, since:

The value of any particular information technology can be determined only with reference to the social context in which it is used and, more precisely, with reference to those who use it. (Coiera, 2000)

The study will directly contribute to future development of interventions that integrate within the workflow without adding complexity or increasing the cognitive effort of clinicians. Making this intervention choice requires detailed knowledge of existing workflow, complexities, issues, risks and opportunities for effective communication.

1.3 Study objectives

The general aim of the study is to describe the communication tools used and communication patterns of clinical information inside a modern hospital, in particular during the process of patient transfer from the ED to the GIM unit. In addition, the study focuses on addressing five questions:

1. What information from electronic health records (EHRs) is needed to facilitate communication between clinicians, particularly during the critical time of handovers? As a corollary, what information is available today that enables communication, and what information is necessary but currently unavailable in EHRs?

2. What subset of information from EHRs would be best provided on a mobile device to enable effective communication?

3. How does ownership to follow through on tasks or patients transition from one clinician to another?
4. What are context features that influence the type of information needed to facilitate communication (e.g., patient characteristics, clinical context)?

5. Does the mode of communication influence the type of information exchanged?

The end goal is to document the workflow, characterize the communication tools, and identify communication issues and their impact on patient safety. This research is meant to set the stage for future development of technological interventions to improve hospital communication in general, and communication during ED-GIM transfer in particular.
Chapter 2
METHODS - STUDY DESIGN

2.1 Cognitive ethnography

The study design is based on the method of cognitive ethnography, as introduced by Ball and Ormerod (2000). Cognitive ethnography is a subset of ‘pure’ or ‘genuine’ ethnography, which can be defined as a process of gaining insights about an activity through the observations of people present within the situation.

Table 2 - Ten Features of 'pure' ethnography (taken from Ball & Ormerod, 2000)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>situatedness</td>
<td>data collected by participant observer located within the context of interest</td>
</tr>
<tr>
<td>richness</td>
<td>observer studies behaviour in all manifestations; data collected from wide range of sources (interviews, team discussions, incidental conversations, documents, non-verbal interactions, etc)</td>
</tr>
<tr>
<td>participant autonomy</td>
<td>participants observed not required to comply in any rigid, pre-determined study arrangements</td>
</tr>
<tr>
<td>openness</td>
<td>observer open to discovery of novel or unexpected issues as the study progresses</td>
</tr>
<tr>
<td>personalization</td>
<td>observer makes note of their own feelings in relation to situations encountered during data collection and analysis</td>
</tr>
<tr>
<td>reflexivity</td>
<td>observer takes a reflective and empathetic stance in striving toward an understanding of the point of view of the participants observed, the observer taking account of, rather than striving to eliminate, their own affects upon the behaviour of the participants observed</td>
</tr>
<tr>
<td>self-reflection</td>
<td>observer must acknowledge that any interpretative act is influenced by the tradition to which they themselves belong</td>
</tr>
<tr>
<td>intensity</td>
<td>observations must be intensive and long-term, such that the observer becomes immersed in the ongoing culture of the environment</td>
</tr>
<tr>
<td>independence</td>
<td>observer must not be constrained by predetermined goal-set, mind-set, or theory</td>
</tr>
<tr>
<td>historicism</td>
<td>observer aims to connect observations to a backdrop of historical and cultural contingencies</td>
</tr>
</tbody>
</table>

A prototypical case of ‘pure’ ethnography is characterized by the 10 features shown in Table 2. (Ball & Ormerod, 2000) ‘Pure’ ethnography, although a powerful technique for obtaining insights on human activities, has significant limitations when used for goal-directed research as it will be in the present study. For example, the intensity feature, implying a resource-intensive, multiple-year project, is simply not practical in the present context. Furthermore, the independence feature is automatically violated when the observer has a goal of developing
technological interventions. Finally, the ‘pure’ ethnography lacks verifiability of data, which is problematic when reliable and generalizable technological solutions are being sought.

Cognitive ethnography, on the other hand, purposively violates the features of intensity and independence, and places an emphasis on verifiability (Ball & Ormerod, 2000). Consequently, the present study can be categorized as a case of cognitive ethnography, as it matches the three key features of observational specificity, purposiveness, and verifiability. The study will have observational specificity, meaning that the observation sessions will be scheduled around ED to GIM patient transfer. Furthermore, the observers, although encouraged to immerse themselves in the environment and describe the context of the observation session to the fullest extent possible, will focus mainly on recording details of communication events and the information being exchanged during these communications. Secondly, the present study is purposive, as it is aimed at informing a suitable technological intervention for improving existing communication practices. Lastly, the study is designed with a focus on verifiability, by incorporating strategies such as multiple observers, multiple observation times, multiple sites, and a variety of methodologies for data collection (informal and semi-structured interviews, and direct observation).

2.2 Scope

The project studies communication, defined as the passing of information from one individual to another across any communication channel, including face-to-face conversation, phone, pager, or by consulting or writing into a formal information source (e.g. EHR, paper chart, etc). The focus is on communication of patient-related information in particular, rather than communication of general medical facts or administrative issues unrelated directly to patient care. Finally, the main focus is on the effectiveness of various tools used in communication, rather than any personal communication issues (e.g. hierarchical power issues, etc).

2.3 Setting

The study was conducted at three large teaching hospitals in Toronto, Ontario: Toronto General Hospital (TGH), Mount Sinai Hospital (MSH), and Sunnybrook Health Sciences Centre (SHSC). More specifically, the study took place within the ED and GIM units of each hospital. Although
the three institutions are all large academic health centers, they have different levels of EHR adoption, and have implemented different communication tools (e.g. smartphones are used by IM physicians at SHSC, a web-based messaging system has replaced paging within the GIM at MSH, and an ED-GIM electronic information transfer tool is now being used at TGH).

2.4 Data collection

The data collection methods were consistent across the three sites, as outlined in this section. Further details regarding number of participants, timing of observations, etc, are provided in subsequent chapters.

2.4.1 EHR training

Whenever possible, the direct observers were self-trained in the use of EHRs and other electronic tools at each site, prior to the work shadowing sessions. For this purpose, the investigator made use of user manuals, and training materials for clinicians found on the hospital website. This training helped the investigator learn the communication tools available at each site, fully understand clinician activities observed during work shadowing, and properly identify communication issues from collected data.

2.4.2 Research Ethics Board approval

Research Ethics Board (REB) approval for the project was obtained from the MSH REB (reference #: 10-0181-E), SHSC REB (reference #: 280-2010), UHN REB (reference #: 10-0563-BE), and the University of Toronto REB (reference #: 25721). Each clinician who agreed to take part in the project (work shadowing or interviews) signed a consent form prior to their participation.

2.4.3 Recruitment

The direct observers introduced the project to site investigators, nurse managers, and chief physicians by e-mail and/or informal meetings. Further recruitment efforts included approaching potential study participants (e.g. physicians and nurses from ED and GIM) by e-mail and through presentations during morning rounds. A poster approved by the REB of each hospital was also circulated in order to increase awareness of the research amongst potential participants.
2.4.4 Pilot

During pilot sessions at each site, observers shadowed either one or two professionals from each of these categories: ED nurses, GIM nurses, ED staff physicians, and GIM admitting physicians. Observers shadowed during patient transfers from ED to GIM for periods of time ranging from 30 minutes to 5 hours. Participants received $10 worth of gift certificate for each hour of shadowing (minimum denomination: $20). Furthermore, pilot activities included brief informal interviews with these clinicians, as well as other staff members who expressed interest in the project (e.g. ED and GIM ward clerks, nursing educators, patient navigators). The observers recorded qualitative observations and comments from the pilot sessions using pen and paper.

The pilot sessions helped the researcher become familiar with the environment, and served to define the project in several important ways. Firstly, they allowed the researcher understand the general steps the ED-GIM patient transfer workflow. Based on this initial understanding, the researcher was then able to identify the critical aspects of ED-GIM patient transfer workflow on which to focus during subsequent work shadowing sessions.

Table 3 – Work shadowing strategy

<table>
<thead>
<tr>
<th>Target Clinician</th>
<th>Activities</th>
<th>Duration</th>
</tr>
</thead>
</table>
| Admitting GIM physician (junior resident or medical school student) | - review information with senior resident  
- decision to admit  
- placing admission order  
- placing order set  
- regular patient care | 2-4 hours |
| ED nurse                               | - arrange transfer  
- regular workflow  
- preparation for transfer  
- handover | 1-3 hours |
| GIM nurse                              | - receive handover  
- organize patient information post-transfer  
- regular workflow | 1-3 hours |

The ED-GIM patient transfer consists of two separate transfers: (1) transfer of responsibility from the ED physician to the admitting GIM physician, and (2) physical transfer of patient between units and handover from ED nurse to GIM nurse. Since the complete transfer can take up to 24 hours, with many periods of waiting which are uneventful from a communication study perspective, the researcher selected a key shadowing period of 4-6 hours per patient handover. This period includes various activities performed by the admitting GIM physician, ED nurse, and GIM nurse, as shown in Table 3.
The work shadowing data collected covers the following:

- Observations of clinicians during regular workflow in order to:
  (1) address the use of communication aids (project goals, question 1),
  (2) examine the access to patient information while in transit (project goals, question 2),
  (3) determine how the mode of communication influences the type of information exchanged (project goals, question 5), and
  (4) evaluate the effectiveness of various communication tools and identify potential issues;

- Observations of GIM team review of the patient case, and of the nursing handover, in order to:
  (1) address the use of communication aids (project goals, question 1),
  (2) determine how context features influence communication (project goals, question 4), and
  (3) evaluate the effectiveness of various communication tools and identify potential issues;

- Observations of GIM physician communication with other clinicians in two distinct situations, regarding:
  (1) patient(s) physically located in the ED (i.e. the transferred patient), and
  (2) patient(s) physically located in the GIM (i.e. previously admitted patients in their care).

Furthermore, pilot sessions helped the researcher gain an initial understanding of the communication tools used by clinicians at each hospital. Finally, the researcher gained insight into the layout and organizational structure, and rotation schedule at each site, which helped with patient recruitment for the work shadowing component of the project.

The scope of the work shadowing plan does not include the ED physician handover to the senior GIM resident, since this is a very brief conversation which is followed by a full patient consultation; during this stage, missing information is not absolutely critical.
2.4.5 Work shadowing

Four to five work shadowing sessions were typically conducted at each site, each session consisting of shadowing clinicians involved in the care of a single ED-GIM transfer patient. At MSH, for each session, the admitting GIM physician was shadowed for 2-4 hours after the patient consultation, the ED nurse was shadowed for 0.5-1.5 hours prior to the nursing handover, the face-to-face nursing handover was observed, and the GIM nurse was shadowed for 1-1.5 hours after the nursing handover.

At SHSC and TGH, the nursing handover is not as clearly defined, since it involves filling out an online form (TGH) and a phone conversation (SHSC), both prior to the physical transfer. Hence, 2 observers were required at SHSC and TGH in order to fully capture the entire processes. At TGH, the first observer shadowed the GIM physician for 2-4 hours starting from the moment when they ended the patient consultation. While the first observer was still shadowing, the second observer shadowed the ED nurse, starting from the moment when the admitting physician entered new orders for the transfer patient, for 1-3 hours, until the nursing handover occurred. Finally, the first observer then shadowed the admitting GIM nurse for 1-3 hours, starting from the moment when a bed became available in the GIM unit, until 30 minutes after the patient was physically transferred to the unit.

At SHSC, the waiting period before an admitted GIM patient was assigned a bed in the GIM unit was much longer, and unpredictable. The work shadowing sessions consisted of five “physician handover” sessions where the GIM physician and the ED nurse were shadowed simultaneously for 1-3 hours, and five “nursing handover” sessions, where the ED nurse and the admitting GIM nurse were shadowed simultaneously for 1-2 hours during the patient transfer.

The observers followed clinicians everywhere, but did not go inside patient rooms. This was to avoid being intrusive, and was also because not all patients agreed to offer consent. Although the focus was on communication regarding the patient being transferred, the observers made note of all activities and communication events involving the clinician shadowed, in order to extract as much information as possible from the shadowing sessions. The observers strove to be as unobtrusive as possible, but at the same time ask questions for clarification in order to fully
understand the activities and communication taking place. This strategy, commonly referred to as contextual inquiry, combines the strengths of interviewing and direct observation.

**Table 4 – Work shadowing categories**

<table>
<thead>
<tr>
<th>Category</th>
<th>Explanation</th>
<th>Example(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start Time</td>
<td>Start time of current activity, recorded using watch, ±2 seconds</td>
<td>16:20:34</td>
</tr>
<tr>
<td>End Time</td>
<td>End time of current activity, recorded using watch, ±2 seconds</td>
<td>16:20:45</td>
</tr>
<tr>
<td>From</td>
<td>Clinician performing an activity or initiating a communication event</td>
<td>ED nurse, Pharmacist, Admitting GIM medical student</td>
</tr>
<tr>
<td>To</td>
<td>Clinician on the receiving end of a communication event</td>
<td>ED nurse, Pharmacist, Admitting GIM medical student</td>
</tr>
<tr>
<td>Activity</td>
<td>Main activity performed by shadowed clinician</td>
<td>Direct care, Reading, Supplies, Communication</td>
</tr>
<tr>
<td>Tool</td>
<td>Main tool (electronic or otherwise) used in communication, reading, or writing event</td>
<td>EHR (e.g. CERNER, OASIS), Face-to-face, GIM nursing station phone</td>
</tr>
<tr>
<td>Content</td>
<td>Details regarding the activity performed or patient information exchanged during a communication event</td>
<td>Clarify order, Vitals, Search person</td>
</tr>
<tr>
<td>Props</td>
<td>Communication aids observed for main activity</td>
<td>With CERNER, With nursing care record, Taking notes</td>
</tr>
<tr>
<td>Patient</td>
<td>The patient involved in the current communication / read / write activity</td>
<td>Target (ED-GIM transfer) patient, Other GIM patient</td>
</tr>
<tr>
<td>Interrupt</td>
<td>Whether or not the activity was interrupted, or the recorded communication event was the source of an interruption</td>
<td>Yes/no, Interruption!</td>
</tr>
<tr>
<td>Location</td>
<td>Current location of the target clinician</td>
<td>In transit, ED nursing station</td>
</tr>
</tbody>
</table>

The data collection tools used during shadowing were a watch and pen & paper. The observer filled in a table such as that shown in Appendix A, which was then later anonymized and transcribed into an Excel spreadsheet. The categories given in Appendix A were established based on pilot shadowing, and are fully described in Table 4.

In addition, the observer took qualitative notes throughout the shadowing sessions, which included details regarding unsuccessful calls, unsuccessful searches for clinicians, sources and effects of interruptions, and any other data that could help unveil issues with the communication tools and workflow at each hospital.
Furthermore, for each shadowing session, the observer filled in the qualitative observation guide shown in Appendix B. This guide, developed based on pilot shadowing sessions to address the project goals, served as a reminder to record:

- context information such as: the experience of the GIM physician shadowed, the overall health status of the patient, etc (project goals, question 4);
- observations regarding: use of EHR as a communication aid (project goals, question 1), activities of clinicians in transit (project goals, question 2), communication of responsibility to follow-up (project goals, question 3);
- clinician preference regarding EHR access on a mobile device (project goals, question 2) and ideas on how communication can be improved; and
- (optional) answers to some of the semi-structured interview questions (project goals, questions 1-5), only if time allows for such in-depth communication between the observer and the shadowed clinician.

In order to minimize the effect of the observer on the activities observed, all participants were informed that the purpose of the project was not to evaluate clinicians’ performance, but rather to understand the effectiveness of various hospital communication tools.

2.4.6 Semi-structured interviews

Three to five semi-structured interviews were conducted at each site with clinicians involved in the ED-GIM patient transfer (e.g. GIM physicians, GIM and ED nurses, etc). Each interview, conducted off-site, lasted between 30min and 60min, and consisted of 10 large open-ended questions (see Appendix C), as well as follow-up questions based on the responses of the interviewee. The questions were derived from the five objectives of the study, with an emphasis on communication around the ED to GIM patient transfer process. The purpose of the questions was to validate the field observations, and also to clarify those aspects of the workflow and communication preferences that were more difficult to observe. The interviews were recorded and transcribed using professional transcription services. The recordings were destroyed upon transcription. Each participant received a $30 gift certificate as compensation for their time.
2.5 Data analysis

From the data gathered through direct observation and interviews, workflow diagrams were generated using Unified Modeling Language (UML), a useful tool for clarifying work processes and functions. Specifically, the diagrams reflect the flow of patient-related information between clinicians during the patient transfer from the ED to the GIM at each site, including the technology (e.g. phone, pager, EHR access, etc) and the patient information communicated. Vertical columns (swim-lanes) were used to group the tasks performed by each clinician involved in the process. Also, an explicit distinction was made between synchronous (parties communicating in real-time, ex: phone, face-to-face communication) and asynchronous communication (one party sending a message that is subsequently received by the other party, e.g. paging, e-mail). Finally, notes were used to indicate alternate workflows and any additional relevant information that was difficult to represent in diagram form. The granularity of the UML diagrams allows the reader to identify potential areas of communication break-down within the workflow at each site. Furthermore, the main communication tools and communication aids used during the ED-GIM patient transfer process at each site, and their benefits and drawbacks, are described in detail. Finally, the last chapters introduce a comparison between the workflow and tools at the three sites. The five study questions outlined at the start (see section 1.3) are also answered in detail. The final discussion includes a commentary on the main overall issues and target areas of improvement, and introduces several benchmarks for interventions designed to address the main issues uncovered during the study.
Chapter 3
RESULTS - MOUNT SINAI HOSPITAL FINDINGS

3.1 Participants

During the pilot phase at MSH (October – November 2010), the investigator spent a total of 16.5 hours observing physicians and nurses in the ED and GIM units performing regular tasks during work hours. Participants observed during this phase included one GIM nurse, one GIM medical school student, one GIM junior resident, one ED physician, 2 ED nurses, as well as brief informal conversations with GIM and ED ward clerks, the GIM senior resident, the GIM attending physician, and the patient navigator.

During the work shadowing phase at MSH (November – December 2010), the investigator observed nurses and physicians involved in an ED-GIM patient transfer during five separate transfers, for a total of 22.5 hours of observation. Of these 22.5 hours, 10.5 hours were spent observing physician workflow and 12.5 hours were spent observing nursing workflow. The participants involved in this phase of the study included: 2 GIM medical school students, 3 GIM junior residents, 5 ED nurses and 4 GIM nurses. The investigator spent 16 hours observing inside the ED, and 6.5 hours inside GIM units.

In order to ensure that the observations were as unbiased as possible and could be generalized to MSH as a whole, observers shadowed GIM admitting physicians (junior residents or medical school students) from each of the 4 GIM teams and GIM nurses from each of the 3 GIM nursing units. Furthermore, observations were collected at various times of day, ranging from 13:00 to 23:00, during weekdays and week-ends.

During the interview phase at MSH (January 2011), the investigator interviewed 3 clinicians who were regularly involved in the ED-GIM patient transfer process in their work: one GIM junior resident, one GIM nurse, and one ED nurse. These semi-structured interviews each lasted between 30 and 60 minutes.
3.2 MSH environment overview

MSH is a large academic teaching hospital affiliated with the University of Toronto (Toronto, ON, Canada). There are 3 GIM units staffed with nurses and allied health professionals and 4 GIM physician teams, each consisting of 1 attending physician, 1 senior resident, 2-3 junior residents, and 3-4 medical school students. Based on a rotating schedule, one of the 4 GIM teams is “on-call”, admitting patients and caring for GIM patients throughout the night. The ED is staffed with 3-4 physicians working at once, and nurses (typically 2 nurses to 4-5 patients).

The environment is hectic in both the ED and GIM units, particularly during the daytime. Notably, all clinicians engage often in interruptive face-to-face communication. The background noise is very high, especially in the ED, where incoming phone calls are announced using overhead speakers. GIM physicians are very mobile, travelling between the ED and the 3 GIM units, while ED physicians and nurses from both ED and GIM are confined to travelling between the nursing station, supply rooms, and patient rooms within their unit.

The nursing stations in the ED and GIM units are equipped with fixed landline phones and computer terminals with internet and EHR access. Occasionally (in some of the GIM units and areas of the ED) computer terminals can also be found inside patient rooms and medication supply areas. The EHR system (PowerChart®, Cerner Corporation) is used almost exclusively in the GIM, whereas charting in the ED remains mainly paper-based.

3.3 ED-GIM patient transfer workflow

The UML diagram depicting the full process of ED-GIM patient transfer is provided in Appendix D. The first page is an overview of the entire process, while subsequent pages show each step in more detail. Briefly, the transfer begins with the physician handover, meaning a transfer in responsibility between the ED physician and the admitting GIM physician from the “on-call” team. The patient then remains in the ED, where the GIM physician’s orders are filled by the ED nurse and any AH personnel or consulting physicians, as required. When a bed becomes available in one of the GIM units, the patient is physically transferred out of the ED, and the nursing handover takes place. Afterwards, the patient continues to be seen by GIM physicians, and orders are filled by GIM nurses, AH, and consulting physicians, as required.
The process begins with a request from the ED physician to the GIM senior resident on-call to admit the patient to GIM. Following a brief conversation with the ED physician, the GIM senior resident does a quick patient consultation, and then assigns the patient to a junior resident or medical school student (clinical clerk) from the GIM team. The admitting physician does a full patient consultation, writes consultation notes, and then reviews the case with the senior resident. The decision to admit the patient is then made, after which the admitting resident places the admission orders and any testing or medication orders in the EHR. If the admitting physician is a clinical clerk, a cosignature from the GIM senior resident is required for any orders. The patient is then still in the ED, while arrangements are made for a bed in the GIM. Once a bed becomes available, the ED nurse contacts the GIM unit to negotiate a time for transferring the patient. The ED nurse then physically goes with the patient to the GIM unit, where the nursing handover takes place in person.

The diagram depicts the typical workflow for a non-urgent, uncertain admission, and omits deviations in workflow due to urgency and certainty of admission. The diagram focuses in on the various communication tools and aids used in the transfer process, and the type of patient information exchanged, accessed, or recorded at each step.

3.3.1 Communication channels

Based on the UML diagram, the researcher evaluated separately the communication channels available to different pairs of clinicians, and identified the risks and relative potential patient safety consequences of miscommunication in each case. The results are summarized in Table 5.
<table>
<thead>
<tr>
<th>Clinicians involved</th>
<th>Description</th>
<th>Communication issues</th>
<th>Patient safety risk</th>
<th>Observations</th>
</tr>
</thead>
</table>
| **GIM admitting physician & ED nurse** | - communicate admission status, clarification of new orders, updates on patient status, concerns  
- face-to-face communication or numeric paging | - ED nurse is in the ED, the GIM physician is mobile  
- risk of delays with paging  
- lack of salience of new/modified orders in the EHR  
- reliance on GIM physician to alert ED nurse of stat orders | **High**  
- potential delay of urgent nursing care  
- physician potentially unaware of changes in patient status | - the EHR and the paper chart are not trusted, up-to-date, or easy-to-understand  
- reliance on interruptive face-to-face communication (E.g. 28% of the 43 interruptions to the GIM admitting physician during 9.5 hours of observation were in-person, caused by an ED nurse)  
- reliance on nursing handover face-to-face communication to understand medication orders |
| **GIM admitting physician & GIM nurse** | - communicate clarification of new orders, updates on patient status, concerns  
- face-to-face communication or WIPS; additional direct paging for urgent issues  
- physicians at the nursing station sometimes identify nurse carrying smartphone by phoning them | - GIM nurse is in the GIM, the GIM physician is mobile, often in GIM  
- risk of delays associated with WIPS | **High**  
- potential delay of urgent nursing care  
- physician potentially unaware of changes in patient status | - communication channel highly variable based on personal preference  
- difficult to schedule time to review, several attempts  
- in 2 out of 5 cases, review after admission orders in the EHR |
| **ED nurse & GIM nurse** | - short (2-10minute) face-to-face conversation taking place in the GIM nursing station  
- communication aids: EHR on a computer terminal, the ED patient chart and a paper transfer checklist | - risk of forgetting to exchange patient information on the spot | **Medium**  
- potential of GIM nurse remaining unaware of relevant patient information  
- risk mitigated by paper transfer checklist | - communication channel highly variable based on personal preference  
- difficult to schedule time to review, several attempts  
- in 2 out of 5 cases, review after admission orders in the EHR |
| **physicians within GIM team** | - face-to-face review of the case (10-30min)  
- communication aids: EHR, paper chart, paper consultation notes  
- all carry pagers and the senior resident sometimes carries a mobile phone  
- SMS on personal phones often used as well | - scheduling a time to review prior to the patient admission | **Medium**  
- potential of delayed guidance from senior resident regarding the case | - communication channel highly variable based on personal preference  
- difficult to schedule time to review, several attempts  
- in 2 out of 5 cases, review after admission orders in the EHR |
| **ED physician & GIM senior resident** | - short (2 minute) phone conversation  
- communication aid: patient's ED paper chart  
- to initiate contact, the ED physician pages the GIM senior resident | - risk of forgetting to exchange patient information on the spot (particularly for a complex case or incomplete ED paper chart) | **Low**  
- mitigated by the full patient consultation performed by the admitting GIM physician  
- worst case scenario – underestimate case urgency | - significant drop in the patient's RBC count (meaning high urgency case) allegedly omitted during handover, but this was caught during the full patient consultation performed by the admitting GIM physician |
This evaluation reveals that the communication channels between the admitting GIM physician and the ED nurse, as well as the channel between the admitting GIM physician and the GIM nurse, are most susceptible to breakdowns and most critical from a patient safety standpoint. This is because there is no structured communication embedded in the workflow, and the main means of contact (numeric paging, smart paging, using landline phones at nursing stations) are relatively inefficient and prone to delays. The main communication tools involved in the process of ED-GIM patient transfer are further described and evaluated in the next section.

3.3.2 High-risk workflow segment

The highest-risk time period from a patient safety standpoint is when the patient is admitted by the GIM but still physically located in the ED. Firstly, the ED is a very busy unit, more hectic than the GIM units, and thus not suitable for a long stay for very sick patients. Secondly, the shift in responsibility can create confusion regarding the appropriate person to contact with patient care issues.

Furthermore, due to the difference in EHR implementation between the ED and the GIM units at MSH, new orders placed by the GIM physicians can be missed and patient care delayed because nurses have to check the EHR rather than the paper chart, as is the case with the other ED patients. The interview with an ED nurse at MSH confirmed that it is hard for them to remember to check the EHR at times, since they are habituated to a workflow involving orders on paper:

All our notes are paper and when I have admitted patients I forget their MAR [Medication Administration Record] because I don't go online that much - we don't do patient care online so I'm almost never looking at their MAR online, so I will forget and it will be new and I'll think, oh, maybe they have meds and I'll have missed meds by two hours because I just don't look... You're not used to checking it so you just don't check it.

Face-to-face follow-up from the GIM physician to the ED nurses responsible for the transfer patient can mitigate this risk, but it does not occur consistently. This problem was confirmed by the GIM junior resident interviewed, who pointed out that orders can get missed in the confusion during this critical time period:
The patient is officially under team medicine but physically is in the ED and [there is a lot of confusion], some nurses want the orders on paper, some want them in the PowerChart, some want just face-to-face talk and I think that there's no clear cut guideline for this short or long period of time and my orders have been missed in this period of transition.

Adding to the problem, the ED nurses are unaware of the patient’s care plan and goals until the “Consultation Request and Report” paper form is added to the chart, which only happens after the case review between the GIM senior resident and the GIM admitting physician.

A related issue is that when any orders are placed in the EPR by the GIM physicians, the nurses have to keep checking the EPR to find these orders, and sometimes stat orders are delayed when the physicians forget to notify the nurses directly. According to the GIM nurse interviewed, who has 4 years of experience as a registered nurse in the GIM at MSH, stat orders are indeed often delayed because of this issue:

There's other times when they enter in stat orders and we're not notified. It is a requirement for all residents to notify nurses if they put in a stat order, you know, through the telephone or also in person but it doesn't happen, I'd say, 90% of the time. So, a lot of stat orders are delayed by an hour or two.

Paradoxically, the idea of a system that notifies the nurses whenever a new order is entered was not welcome by the GIM nurse interviewed, who pointed out that it would generate too many interruptions, and “be more frustrating”. When designing a technological tool for notifying clinicians of a change in patient status (such as new test results, new vital signs, or modified orders), there is tension between the necessity of receiving this information and the necessity of being able to work without constant interruption.
3.4 Communication tools

The main communication tools and aids used during the process of ED-GIM patient transfer are listed in Table 6, including the type of communication that they support (synchronous, asynchronous, communication aid), type of information exchanged using the tool, and typical users.

Table 6 – List of communication tools used at MSH in ED-GIM patient transfer workflow

<table>
<thead>
<tr>
<th>Tool</th>
<th>Tool type*</th>
<th>Information exchange</th>
<th>Users / Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>face-to-face, verbal communication</td>
<td>S</td>
<td>rich patient information, context</td>
<td>all</td>
</tr>
<tr>
<td>fixed landline phones at nursing station</td>
<td>S</td>
<td>rich patient information, context</td>
<td>all</td>
</tr>
<tr>
<td>VoIP WiFi mobile phone</td>
<td>S</td>
<td>rich patient information, context</td>
<td>ED physician, GIM senior resident</td>
</tr>
<tr>
<td>smartphone (iPhone, Apple Inc.)</td>
<td>S</td>
<td>request for direct care, set-up meeting, quick update</td>
<td>users: GIM nurses; callers: patients (mainly), physicians and AH (from GIM nursing station only)</td>
</tr>
<tr>
<td>web-based application and paging system (WIPS)</td>
<td>A</td>
<td>text pager: announcement of urgent task or # of non-urgent overdue tasks; computer terminal: summarized request / concern / update</td>
<td>users: GIM physicians; senders: GIM nurses</td>
</tr>
<tr>
<td>numeric pager</td>
<td>A</td>
<td>extension where page sender can be reached (i.e. nursing station phone number)</td>
<td>users: physicians, some AH; senders: all</td>
</tr>
<tr>
<td>Short Message Service (SMS) on personal phones</td>
<td>A</td>
<td>set up meeting, prompt to follow-up, co-signature request, etc</td>
<td>within some GIM teams</td>
</tr>
<tr>
<td>EHR system (PowerChart®, Cerner Corporation)</td>
<td>A, C</td>
<td>patient information</td>
<td>all (used partially in the ED and almost exclusively in GIM)</td>
</tr>
<tr>
<td>ED whiteboard system (FirstNet Whiteboard, Cerner Corporation)</td>
<td>A, C</td>
<td>patient information summary (several ED patients)</td>
<td>ED staff, anyone seeing a patient in the ED</td>
</tr>
<tr>
<td>Paper patient chart</td>
<td>A, C</td>
<td>patient information</td>
<td>all (used partially in the GIM and almost exclusively in GIM)</td>
</tr>
<tr>
<td>Paper “patient transfer checklist” form</td>
<td>C</td>
<td>patient information summary</td>
<td>ED-GIM nursing handover tool</td>
</tr>
<tr>
<td>WIPS patient sign-out tool (printed summary)</td>
<td>C</td>
<td>patient information summary (several GIM patients)</td>
<td>GIM medical team communication aid</td>
</tr>
</tbody>
</table>

*Note:  
S = synchronous communication  
A = asynchronous communication  
C = communication aid
### 3.4.1 Summary

**Table 7 – Advantages and disadvantages of communication tools used at MSH in ED-GIM patient transfer**

<table>
<thead>
<tr>
<th>Tool</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Comments</th>
</tr>
</thead>
</table>
| face-to-face, verbal communication | - story, context  
- chance to ask questions  
- immediate feedback  
- helps build trust & teamwork | - interruptive  
- searching for a clinician is time consuming | - preferred means of communication for most clinicians |
| fixed landline phones at nursing station | - story, context  
- chance to ask questions  
- immediate feedback | - very disruptive (GIM units)  
- noise of overhead announcements (ED)  
- delays due to call transfers | - used often for paging and waiting for call-backs |
| VoIP WiFi mobile phone | - user is easily accessible  
- story, context  
- chance to ask questions  
- immediate feedback | - interruptive to user  
- bulky | - VoIP WiFi mobile phone extension is not widely publicized throughout the hospital |
| smartphone (iPhone, Apple Inc.) | - GIM nurse is easily accessible by patients  
- can reduce stationary phone traffic at GIM nursing stations | - inconvenient workflow for physicians to respond to urgent WIPS  
- nurses need to log on to read physician response | - tool deployed within the GIM only  
- numeric paging is still used for urgent tasks |
| web-based application and paging system (WIPS) | - messages sorted by urgency  
- less incoming non-urgent interruptions for physicians | - inconvenient workflow for physicians to respond to urgent WIPS  
- nurses need to log on to read physician response | - tool deployed within the GIM only  
- numeric paging is still used for urgent tasks |
| numeric pager | - direct extension to reach one clinician  
- simple workflow for caller (through locating services) | - delayed, unanswered pages  
- caller needs to wait near a phone for page return  
- page user needs to find a phone to respond  
- unknown urgency or caller  
- interruptive to user | - user feedback is very poor  
- contact information typically found by phoning locating services |
| Short Message Service (SMS) on personal phones | - convenient workflow for users, easy to respond  
- answer to non-urgent messages can be postponed | - privacy concerns  
- lack of story, context | - users are comfortable with this communication system |
| EHR system (PowerChart®, Cerner Corporation) | - centralized, accessible database of patient information  
- no issues with handwriting legibility | - lacks consolidated summaries  
- lacks planned orders, context  
- not kept up-to-date  
- placing orders is unintuitive  
- the MAR is difficult to understand and follow  
- no notification for stat orders | - used partially in the ED and almost exclusively in GIM |
| ED whiteboard system (FirstNet Whiteboard, Cerner Corporation) | - up-to-date  
- quick summary view | - missing details regarding patient information and order status  
- unintuitive symbols | - used often by ED staff |
| Paper patient chart | - centralized database of patient information  
- promotes ad-hoc face-to-face communication | - accessible by only one clinician at one time  
- delays & interruptions associated with searching for it  
- handwriting legibility issues  
- parts can be lost / incomplete | - used partially in GIM and almost exclusively in the ED |
| Paper “patient transfer checklist” form | - portable  
- may reduce risk of omitting relevant patient information | - time-consuming, work duplication  
- not well-integrated in nursing workflow | - often omitted during handover  
- feedback from nurses is positive |
| WIPS patient sign-out tool (printed summary) | - portable  
- quick summary | - risk of losing print-out (breach of patient confidentiality) | - used extensively by all GIM physicians |
The benefits and drawbacks of each of the communication tools and communication aids listed above were summarized in Table 7. Overall, clinicians seem to prefer synchronous communication over asynchronous communication means although paradoxically, these generate interruptions. Numeric pagers stand out as the most inefficient and least preferred communication tool available at MSH. The WIPS system addresses some of the limitations of numeric pagers, but has its own drawbacks. There are several important areas of concern with the EHR system, though it does have important benefits over the traditional paper chart. The paper checklist system implemented to support the ED-GIM nursing handover has its merits, though it is not used as it was intended. Having a quick patient summary for all GIM patients handy (like the print-out from WIPS sign-out) greatly facilitates communication and acts as a “to do” list for GIM physicians. Descriptions of each communication tool or aid, as well as the observed usage and the main benefits and drawbacks of each, are provided in separate subsections below.

3.4.2 Face-to-face

Direct face-to-face communication refers to verbal discussion, in-person, scheduled or unscheduled, with or without communication aids. Based on direct observation and interviews, face-to-face communication is the preferred means of communication in both the ED and GIM units. Indeed, most clinicians will first search for the person with whom they wish to communicate and attempt to engage in face-to-face communication and only when unsuccessful turn to other communication tools that are available to them. This observation is confirmed by our interview with the GIM nurse, who stated:

A lot of us have a tendency to like [the GIM medical team] to be on the floor and then we try to address everything that we need while they’re there.

It was observed that face-to-face communication allows for presenting a story and context, and provides a chance to ask questions for clarification. Another important benefit of the face-to-face method is that feedback is immediate, reducing the need for clinicians to remember many tasks at once. Finally, face-to-face communication can help build trust and working relationships with other clinicians.
An important drawback of face-to-face communication is that it causes interruptions, which have been shown to cause disruption in working memory, generating errors (Alvarez & Coiera, 2005).

**Table 8 – Incoming interruptions recorded during direct observation at MSH**

<table>
<thead>
<tr>
<th>Clinician interrupted</th>
<th># of participants</th>
<th>total observation time</th>
<th>total # of interruptions</th>
<th>average # of interruptions / hour</th>
<th>total # of face-to-face interruptions (% of total)</th>
<th>total # of phone interruptions (% of total)</th>
<th>total # of pager interruptions (% of total)</th>
<th>total # of face-to-face interruptions involving searching for another person (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIM admitting physician</td>
<td>5</td>
<td>9hrs28min</td>
<td>43</td>
<td>4.5</td>
<td>36 (84%)</td>
<td>0 (0%)</td>
<td>7 (16%)</td>
<td>5 (12%)</td>
</tr>
<tr>
<td>ED nurse</td>
<td>5</td>
<td>6hrs3min</td>
<td>18</td>
<td>3.0</td>
<td>15 (83%)</td>
<td>3 (20%)</td>
<td>n/a</td>
<td>2 (11%)</td>
</tr>
<tr>
<td>GIM nurse</td>
<td>4</td>
<td>5hrs12min</td>
<td>18</td>
<td>3.5</td>
<td>15 (83%)</td>
<td>3 (20%)</td>
<td>n/a</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>

**Note:** The values provided above may not be accurate due to the small sample size and short observation sessions (focused on ED-GIM patient transfer activities).

Two of the 4 GIM nurses observed carried smartphones. All 5 GIM admitting physicians carried a numeric pager, and one of the 5 also carried a WIPS pager.

As shown in Table 8, there were 36 (or 84% of the total of 43 interruptions) instances of incoming face-to-face interruptions observed during the work shadowing of five GIM admitting physicians over a total period of 9.5 hours. Of these 36 face-to-face interruptions, 12 (33%) occurred during charting, 11 (31%) during the review of the case with the senior resident, and 10 (28%) while the physician was placing orders in the EHR, all important activities which are critical for maintaining patient safety. Similarly, 15 (or 83% of the total of 18 interruptions) instances of incoming face-to-face interruptions were observed while work shadowing 5 ED nurses for a total period of 6 hours, 14 (93%) of which occurred during charting. Finally, 15 (or 83% of the total of 18 interruptions) instances of incoming face-to-face interruptions were observed while work shadowing 4 GIM nurses for a total period of 5.2 hours. Of these, 5 (33%) occurred while reading the orders from the EHR, 4 (27%) occurred while preparing medication, 3 (20%) occurred during direct patient care, and 3 (20%) occurred while receiving a handover from the ED nurse, which are all important activities from a patient safety standpoint. Furthermore, although it was difficult to assess the urgency of each incoming interruption, another drawback of face-to-face communication is that it can generate interruptions that are less urgent than the current task of the interrupted clinician.
Finally, face-to-face communication often involves searching for other clinicians, which can be time consuming. While nurses can be found relatively easily at the nursing station or around the patient rooms in their ward, physicians are more mobile, and thus more difficult to find. Searching for a person often causes interruptions as well, since third parties are usually asked whether they have seen the clinician required. For instance, of the 43 incoming interruptions to the workflow of the GIM admitting physicians observed, 5 interruptions were due to another clinician (typically an ED nurse) searching for the senior resident on-call or physicians from another GIM team.

3.4.3 Fixed landline phones

Nursing stations in both the ED and GIM units are equipped with fixed landline phones for both outgoing and incoming calls. In the GIM, clinicians take turns answering the phone, and they need to ask colleagues to identify the person for whom the call is for. In the ED there is call display, and overhead paging from the front desk to announce the identity of the callers. These phones are often used for paging and receiving calls.

As with other synchronous means of communication, important benefits of phone communication include that it allows for presenting a story and context, offers a chance to ask questions, and facilitates immediate feedback.

A benefit of having a shared landline, as articulated during the interview with a GIM nurse, is that colleagues can take a message for a nurse that is busy with patient care. However, this situation can create further issues, since messages can become distorted (“broken telephone” game), and the memory load of the person taking the message is needlessly increased.

Main drawbacks of the fixed landline phones are that they cause interruptions and add to the chaotic hospital working environment. For instance, each incoming call in the GIM nursing station prompts clinicians working nearby to ask each other whether someone was expecting a call, causing multiple interruptions. The availability of phone terminals in some GIM nursing stations has also been identified as an issue. In the ED, the constant overhead paging creates a very noisy and distracting working environment. The researcher noted that during 6 hrs of
observation in the ED over 3 separate days, at various times between 3pm and 7pm, there were on average 7.5 overhead pages announcing incoming calls each hour.

Furthermore, it was observed that due to the workflow around the fixed landline phones described above, clinicians often have to wait for over 1 minute to connect with the right person by phone.

3.4.4 Mobile phone (VoIP WiFi)

Some clinicians (i.e. ED physicians and some of the GIM senior residents) carry mobile phones. The extension for their mobile phone is only available within the department of the clinician, rather than hospital-wide.

As with other synchronous means of communication, important benefits of phone communication include that it allows for presenting a story and context, offers a chance to ask questions, and facilitates immediate feedback. Furthermore, the mobile phone minimizes interruptions and distractions for other clinicians located nearby, compared to the landline phones found at nursing stations. Finally, a main benefit is that the user of the mobile phone is easily accessible to teammates or anyone else who knows the extension.

A main drawback for the user of the mobile phone is that incoming calls can cause interruptions, and are not filtered by urgency. Furthermore, the phone is bulky, and likely impractical to carry around at all times. The researcher observed two instances when the mobile phone was left on a desk in the ED charting room, while the user of the phone (GIM senior resident) had to step out for a few minutes.

3.4.5 Smartphone

GIM nurses carry smartphones (iPhone, Apple Inc.), which are used for incoming calls only. The smartphone extensions are posted at the nursing station. The smartphones are also connected to a device in each patient's room, which allows patients to call the nurse directly if they require assistance. There is a call display feature for the patient room, allowing missed calls from patients to be traced back to the caller. However, in the case of a missed call from a clinician calling from the nursing station (where the extensions are posted), the identity of the caller...
remains unknown. Other applications are also available, including best practice guidelines, pharmacy resources, e-mail, and vital signs recording on one GIM unit, but direct observation revealed that these are not used in practice. EHR access will also be made available on the smartphones in the future.

One benefit of the smartphones, as used at MSH, is that the patients can easily reach the GIM nurse. Furthermore, GIM nurses can identify the identity of a missed patient call, and attend to it when less busy. Another benefit is that smartphones could help reduce call traffic at GIM nursing stations if incoming calls are transferred onto the smartphones; however, direct observation revealed that this is not the case.

An important drawback of the smartphone implementation at MSH, and perhaps the reason why the phone is not used for outgoing calls, is that the system requires the user to enter a password before dialing or answering calls. The GIM nurse interviewed confirmed that having to enter the password is very cumbersome, takes time and can cause nurses to miss the call. This illustrates that resolving privacy concerns can paradoxically lead to decreasing the usefulness of the communication device by rendering it inaccessible to the user.

Another drawback of the smartphone is that the identity of the caller is unknown (unless it is a patient call); because of this, the nurse is unable to follow up in the event of a missed call, and may have to stop important activities in order to attend potentially non-urgent calls. Furthermore, smartphone extensions are only available at nursing stations, and direct observation revealed that clinicians prefer to search for the GIM nurse face-to-face, rather than call them on the smartphones. Finally, the iPhones and their protective cases are bulky and cumbersome to carry at all times. Indeed, only 2 out of the 4 GIM nurse observed actually had the smartphone in their possession (although the observations were done during nighttime, and usage may be higher during daytime). Another contributing factor to the limited usage could be that logging into the smartphone system takes up a lot of time.
3.4.6 Web-based application and paging system (WIPS)

WIPS is a web-based application and paging system used by GIM nurses to send GIM physicians urgent messages and non-urgent tasks. Urgent tasks require responses within 10 minutes, and non-urgent tasks require responses within 2 hours and up to 24 hours.

Nurses log on to the computer application to send a new task, and they resend it if they do not receive an answer within a reasonable time period.

Figure 1 – Sample screenshot of patient list and patient’s task list in WIPS – from training manual – patient names are fictional

![Patient's Task List Section]

Figure 2 – Sample screenshot of adding an urgent task in WIPS – from training manual – patient names are fictional
The nurse generates a new urgent or non-urgent task by selecting the patient from a list (see Figure 1), and then typing in their own name and phone extension, as well as details regarding the task itself (see Figure 2).

The GIM physician carrying the alpha-numeric WIPS pager receives a brief message for urgent tasks, and reminders of the number of non-urgent overdue tasks. However, they cannot respond to the task through the alpha-numeric pager. The list of patients shown in Figure 1 can be accessed by the physicians on a computer terminal to view and respond to current tasks.

Figure 3 – Sample screenshot of physician task inbox in WIPS – from training manual – patient names are fictional
Physicians can also view and respond to their active tasks by accessing their task inbox through the computer application (see Figure 3).

Nurses need to log on to check whether the physician responded to a task. Direct observation and informal interviews revealed that unanswered WIPS messages are typically followed up by paging GIM physicians directly (see section 3.4.7).
WIPS also has an electronic agenda of contact information for various clinicians and other hospital personnel (see Figure 4). According to direct observation, this agenda is used often by GIM physicians.

The main advantage of the WIPS system is that it sorts out incoming communication by urgency, so that physicians can postpone answering non-urgent messages until they are less busy. The junior resident interviewed also liked that they could see short messages that are urgent directly on the pager. It was observed that GIM physicians log into the WIPS computer terminal periodically to check for new non-urgent messages, similarly to e-mail. This system can thus help reduce the number of incoming non-urgent interruptions for physicians.

The main issue with the WIPS system is that the GIM physicians cannot respond to an urgent WIPS page directly using the alpha-numeric pager. Instead, they need to find a computer terminal and log in to WIPS in order to view the entire message and respond to it. This is inconvenient, and can lead to delays in addressing urgent WIPS messages. For instance, it was observed that one physician took 7 minutes to log in and respond to an urgent WIPS, although there was a computer terminal nearby. In another instance, a physician took 14 minutes to respond, due to battery issues with the WIPS pager.
Similarly, the nurses cannot read the response of the physician immediately, without logging in to WIPS on one of the nursing station computer terminals. The GIM nurse interviewed confirmed that it is:

> [...] cumbersome to have to go back to check to make sure [the WIPS message] was answered and if not then [they] have to resend it.

These drawbacks are also reflected in the fact that GIM nurses prefer to page the physicians directly rather than sending an urgent WIPS, since they feel that they have a better chance of reaching them in a timely manner via numeric paging, and receive immediate feedback through a phone call back. The junior resident interviewed expressed that the number of urgent WIPS messages received can at times be overwhelming.

### 3.4.7 Numeric pager

Many physicians and other hospital personnel (e.g. radiology, allied health professionals, etc) carry numeric pagers. These devices have an individual extension associated with them. When the extension is called, the pager makes a sound and it displays the phone number of the caller (typically a nursing station fixed landline). Clinicians usually call other clinicians on their numeric pagers through the hospital locating services. Numeric pagers are ubiquitous at MSH. All physicians observed during pilot and work shadowing carried a numeric pager.

The advantage of numeric pagers is that pager users can give out a phone number where they can be reached at all times, other than their own personal phone number. Furthermore, the workflow for calling the pager is very simple and fast, involving only a quick call to locating services.

Based on feedback obtained during pilot and work shadowing sessions, the numeric pagers emerged as the most problematic communication tool that is currently in use at MSH. Firstly, it is sometimes difficult to know whom to contact, and the caller often pages through locating services. This workflow has its drawbacks. For instance, the ED nurse interviewed explained that when they attempt to reach the admitting GIM physician, they often receive a call back from another GIM team member (the person responsible for carrying the pager).
Next, another important disadvantage for the caller is that paging ties them down to one location (near a phone) where they have to wait for a call back. This was one of the main emergent themes regarding clinicians’ frustration with pagers. On occasion, the person has to leave the phone area after sending a page, which results in a missed call. Similarly, the receiver of the page needs to find a phone to call back, which can cause delays. The ED nurse interviewed expressed that there are instances when a call-back is not required, and a short message (e.g. I will be down in 2 hours, or I will call back in 20 minutes) would be a more appropriate response.

Another important issue is that the urgency of the request is not included in this communication. The GIM junior resident interviewed pointed out that they did not appreciate receiving the extension and having to call back, without knowing if it’s a routine issue or if they had to get to the patient’s bedside as soon as possible. Similarly, the ED nurse interviewed expressed dissatisfaction with not being able to indicate the urgency of the page:

*It would be nice for [the physicians] to have an idea of what the priority is because otherwise every page could be, your patient is about to code, can you come down.*

Perhaps not surprisingly, the number of incoming pages can be overwhelming during busy times, and can cause interruptions (some of which may be non-urgent). During a 20 minute review of the ED-GIM patient transfer case between the senior resident and the admitting GIM medical school student, there were 4 interruptions due to numeric pages (which were returned right away). Because of these reasons and also potential issues with battery or reception, it is not surprising that all study participants agreed that instances of unanswered or delayed pages are commonplace. Despite the relatively short observation period, the researcher also observed an instance when a page from the admitting GIM junior resident to radiology had to be repeated, and was finally returned 17 minutes later.

### 3.4.8 Short Message Service (SMS) on personal phones

On occasion, physicians within a GIM team contact each other through Short Message Service (SMS) using their personal mobile phones. The content of the messages typically includes setting up meetings, asking for a co-signature, etc. Private patient information is not exchanged using this communication tool.
The main advantage of this asynchronous communication tool is that the user can read and reply to messages on the spot, without having to find a computer (as is the case with WIPS) or a phone terminal (as is the case with numeric pagers). Furthermore, the urgency of the message can be determined by reading the message, rather than stopping the current activity and having to call back, as is the case with numeric pagers. Finally, since the users are familiar with this type of communication, the adoption of such a system of communication would likely be high.

Although patient-related information is not exchanged in practice with this communication tool, there is a potential security issue with transferring unencrypted sensitive patient information, thus privacy is the main limitation. The privacy issues could be addressed by adopting a secure messaging tool, such as Research in Motion’s BlackBerry Messenger (BBM). Another concern, as pointed out by the GIM junior resident interviewed, is that SMS can sometimes replace synchronous communication, but in an inefficient manner that involves many messages sent back and forth.

3.4.9 EHR system (PowerChart®, Cerner Corporation)

DESCRIPTION

The EHR system implemented at MSH is PowerChart® by Cerner Corporation. The user interface implemented in the ED is FirstNet, which is identical to PowerChart.

<table>
<thead>
<tr>
<th>Patient information</th>
<th>ED</th>
<th>GIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary (for several patients, at a glance)</td>
<td>FirstNet whiteboard</td>
<td>WIPS patient sign-out tool print-out</td>
</tr>
<tr>
<td>Current location</td>
<td>FirstNet</td>
<td>PowerChart</td>
</tr>
<tr>
<td>All Orders (before GIM admission)</td>
<td>Paper chart</td>
<td>n/a</td>
</tr>
<tr>
<td>All Orders (after GIM admission, including admission orders)</td>
<td>FirstNet</td>
<td>PowerChart &amp; transcribed in Kardex (paper)</td>
</tr>
<tr>
<td>Patient care; AH, nursing notes; vitals (before GIM admission)</td>
<td>Paper chart</td>
<td>n/a</td>
</tr>
<tr>
<td>Patient care; AH, nursing notes; vitals (after GIM admission)</td>
<td>FirstNet</td>
<td>PowerChart &amp; transcribed in Kardex (paper)</td>
</tr>
<tr>
<td>Physician’s notes</td>
<td>Paper chart</td>
<td>Paper chart</td>
</tr>
<tr>
<td>Historical data (previous MSH admission)</td>
<td>FirstNet</td>
<td>PowerChart</td>
</tr>
<tr>
<td>Echocardiography results</td>
<td>EchoWeb</td>
<td>EchoWeb</td>
</tr>
<tr>
<td>Results (labs, microbiology, pathology, cytology, radiology, etc)</td>
<td>FirstNet</td>
<td>PowerChart</td>
</tr>
<tr>
<td>Radiology Images</td>
<td>eFilm Fusion</td>
<td>eFilm Fusion</td>
</tr>
</tbody>
</table>
The EHR system is used more extensively in the GIM units than in the ED, as shown in Table 9. Before the patient is officially admitted to GIM, orders and other patient care information (nursing notes, vitals, medications, etc) are recorded on paper. Once the patient is admitted to GIM (even while the patient is physically still in the ED), the orders are placed in PowerChart by the GIM physicians, and patient care information is also recorded in the EHR. This lack of homogeneity of EHR implementation in GIM vs. the ED has created issues for the admitting GIM physicians (who work in both units). It can also carry safety risks for the patients transferred between the two units, especially in the case of delays with new orders (see section 3.4.10 for more details).

The EHR serves as a central repository of patient information, accessible by all clinicians on computer terminals throughout the hospital. Furthermore, it is often used as a communication aid during handover and during review of a case within a medical team. Patient information found in the EHR includes: current location, demographics, allergies, history, orders, medication, results, vitals, and forms.

BENEFITS

The main benefit of the EHR is that it is a centralized database of patient information, accessible by all clinicians throughout the hospital. For example, PowerChart allows clinicians to view all of the patient’s orders and medications in one place, a feature which was appreciated by the MSH nursing and medical staff. If updated regularly by all clinicians involved in the patient’s care, the EHR can serve as a trusted information repository, helping clinicians “stay on the same page”, and reducing the need for time-consuming side conversations. In practice, however, clinicians did not seem to trust that the EHR information was up-to-date and relied heavily on direct communication with other clinicians. Another benefit is that the EHR eliminates issues with handwriting legibility.

DRAWBACKS - MISSING COMPONENTS

A main drawback of the EHR is that it often lacks consolidated summaries, and offers excessive information that can obscure relevant items. As an example, one of the admitting GIM junior residents, despite 7 weeks of experience with the EHR at MSH, could not find a past test for the
patient, and had to re-order it, potentially leading to unnecessary test duplication. The patient had a voluminous EHR record due to previous MSH hospital admissions. Adding a “search” feature in the EHR was suggested by the resident as a potential solution to the issue in this example.

Another missing component of the EHR is planned orders, courses of action, thoughts, and context. This component would help keep every clinician involved in the care of the patient up-to-date with new or planned orders, and avoid conflict between existent orders and new orders suggested after each new consultation. PowerChart does allow users to record “suggest orders”, pending approval from the main physician caring for the patient; however, an interview with a GIM junior resident confirmed that these are not updated reliably.

Furthermore, there is no simple way to see in PowerChart whether a consult was done, except by continuously checking for new “suggest orders”. The GIM junior resident interviewed expressed that a clear summary of consult status (i.e. “done” or “not done”) would be a helpful addition:

*I think it’s just one small option to add to the PowerChart, but it will resolve a lot of confusion.*

Another potentially useful component that is currently missing in PowerChart is a notification system for stat orders, information which is currently only communicated by the physicians to the nurses verbally.

Another component currently not included in PowerChart is the ability to view radiology images, which are currently only accessible on a different system. The GIM junior resident interviewed agreed that this would be a valuable addition which would save clinicians a lot of time.

Finally, the ED nurse interviewed pointed out that a summary of medication administration records (MARs) for several patients would be helpful as a tool during the medication administration workflow:

*It would be really helpful if you said these are my four patients and you were able to see their MAR times together.*
DRAWBACKS – PROBLEMATIC FEATURES

Furthermore, of the existing features of the EHR, one that stands out as problematic, based on direct observation, is the unintuitive user interface for placing orders in PowerChart. Three of the admitting GIM junior residents shadowed, with experience at MSH ranging between 1 week and 7 weeks, all struggled with order entry in PowerChart, and with entering order sets in particular. As a coping mechanism, one of the physicians looked at previous orders for guidance, which suggests the risk of repeating previous mistakes. All three physicians eventually asked colleagues for assistance. One of the physicians shadowed made an error, ordering a blood sample meant to be taken once in the morning as a stat order. The error was caught while discussing the order with the ED nurse, face-to-face. The GIM junior resident explained in the interview that the search feature for placing new orders is unintuitive, and requires the users to adapt to a new language structure:

Let’s say, you want to order a CT scan. So if you put scan, C-T, it can't be read in PowerChart. So, you put [...] C-T and then, let's say you want to order chest CT scan. If you put chest CT scan you can't find anything. You should put CT scan, chest.

Similarly, not all medications can be searched by both the generic and the scientific name, so they can be difficult to find. This is a significant drawback of the current EHR system in place at MSH, since mistakes with order entry can easily translate into inappropriate treatment for the patient.
The second problematic feature of PowerChart is the way in which the MAR is displayed (see Figure 5). The MAR is consulted by the nurse right before medication administration, and it can be very complex, particularly in the case of chronic patients taking many different medications. Feedback from nurses consistently revealed that the MAR layout is difficult to interpret. The ED nurse interviewed pointed out that the “start dose now” default setting for medication entry causes medications to show up in the MAR as starting at different times (e.g. 11:52, 11:57, 11:58, etc), which makes the MAR unclear for the nurses. The nurse also noted during the interview that the font used for the MAR makes it very hard to see which medications have been administered:

*It's easy to see what's due [...] with the bright red boxes, that's helpful, but once the medication has been given it's [...] so small and it's really hard to just get a quick overview.*
Supporting this, direct observation revealed an instance when a GIM nurse did not understand the timing for one of the medications in the MAR, until clarified verbally during the nursing handover by the ED nurse. An issue with this feature of the EHR also implies a high patient safety risk, since it can lead nurses to administer the wrong medication.

Thirdly, the GIM junior resident interviewed explained the usability issue around over-structuring forms in PowerChart:

One of the reasons I prefer EPR to PowerChart, for example, for nursing notes, they should just check some boxes, and there are fifty boxes and it's so confusing - I'm just tracking all the boxes and I come to the end of the page, then I miss the information on the top.

This issue suggests a need for more free-text options and flexibility in the EHR.

Figure 6 - Sample of symbols used within the EHR at MSH

Finally, the EHR system at MSH is not very easy to use overall, due to the obscure symbols used throughout (see Figure 6).
DRAWBACKS - USAGE

Another important drawback of the EHR as an asynchronous communication tool at MSH is that it is not being updated in a timely manner by all clinicians. Despite the short work shadowing sessions, the researcher observed an instance when the EHR was not updated by radiology with an assessment of the image, which meant that the GIM physician was required to page radiology and discuss the image directly over the phone, which took up 20 minutes. Furthermore, a lack of up-to-date record of patient consultations was observed, as clinicians rely on verbal communication regarding which consultations have occurred, and which are still pending. One of the participants suggested that the EHR is “too flexible”, allowing orders to appear as “not completed” for days. In summary, because the EHR takes a long time to update (which busy clinicians do not have) and is missing forcing functions for keeping the records up-to-date, its information is often outdated and not trusted. As a result, if something really needs to be done, clinicians follow up verbally with each other (in person or by phone).

Interestingly, the workflow observed during shadowing did not fully match the training materials created for the EHR. For instance, according to the training materials, the ED physician should place a "consult order" in PowerChart prior to contacting the senior resident; however, in practice the ED physician simply pages the senior resident. Also, the training materials showed that the physicians can adjust the medication dose; however, in practice they assign the pre-programmed doses in PowerChart. This suggests that reliance on the EHR is not as great as anticipated, and that users will adapt how they use the tool in order to simplify their workflow.
3.4.10 **ED whiteboard system (FirstNet Whiteboard, Cerner Corporation)**

**Figure 7** – Sample screenshot of ED whiteboard system at MSH – from training manual – patient names are fictional

<table>
<thead>
<tr>
<th>Patient Name</th>
<th>Admission Status</th>
<th>CTAS Score</th>
<th>Bed</th>
<th>Age</th>
<th>Gender</th>
<th>Length of Stay</th>
<th>Complain</th>
<th>Initials</th>
<th>Clinician</th>
<th>Isolation Needs</th>
<th>Events</th>
<th>Patient Care</th>
<th>Labs</th>
<th>Radiology</th>
<th>Consultations</th>
</tr>
</thead>
<tbody>
<tr>
<td>HERNANDEZ, J</td>
<td>Urgent</td>
<td>4</td>
<td>42</td>
<td>19</td>
<td>Male</td>
<td>6</td>
<td>Abdominal Pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MARTINEZ, L</td>
<td>Emergency</td>
<td>3</td>
<td>43</td>
<td>21</td>
<td>Female</td>
<td>8</td>
<td>Headache</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RODRIGUEZ, M</td>
<td>Urgent</td>
<td>2</td>
<td>45</td>
<td>22</td>
<td>Male</td>
<td>4</td>
<td>Chest Pain</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Cerner interface for the ED provides users with a whiteboard-type view of the current status of all ED patients (see Figure 7). This is displayed on a large screen at the front desk of the ED, and on computer terminals throughout the unit. The patient information provided on this electronic whiteboard is kept relatively up-to-date, and includes admission status, patient information (bed, CTAS acuity score, name, age, gender, length of stay, complaint), initials of clinician assigned to the patient, isolation needs, and various icons symbolizing pending and completed labs, radiology orders, consultations, etc. Work shadowing revealed that ED nurses glance at the ED whiteboard system several times in an hour.

The main benefits of the ED whiteboard system are that it is kept up-to-date (it is directly connected to the EPR) and that it provides a quick summary view. However, the system is missing details regarding patient information and order status. Furthermore, based on a heuristic evaluation conducted by the researcher, as well as feedback from junior residents who rotate between the different sites, the usability of the system is low. One of the main usability issues is that the icons under the “events” and “patient care” columns (see Figure 6 and Figure 7) are very obscure.
3.4.11 Paper patient chart

Despite the implementation of an EHR system the paper patient chart is still used extensively at MSH, in particular in the ED (see section 3.4.2). The paper chart consists of various forms filled in by clinicians by hand, test results, and other items, and can usually be found at the nursing station nearest to the patient’s room.

The main benefit identified for the paper chart as an asynchronous communication tool is that it contains a record of patient information in one place. Another indirect benefit of the paper chart is that it promotes ad-hoc face-to-face communication in proximity to the chart, as clinicians reaching for the same chart discover that they are caregivers for the same patient.

One of the main drawbacks of the paper chart is that it can only be accessed by one clinician at a time. Direct observation revealed that clinicians sometimes spend a long time searching for the chart - it may have been in use by another clinician or simply not returned to the standard nursing station location. Furthermore, interruptive communication typically accompanies the search for the paper chart. Another drawback of the paper chart involves handwriting legibility issues. Shadowing and direct feedback from the participants revealed that on occasion, clinicians cannot read parts of the patient’s chart due to this issue. Finally, in particular in the ED, the patient chart is not bound together. According to feedback from ED nurses, parts of the paper chart often go missing, which can significantly affect patient care.
3.4.12  Paper “patient transfer checklist” form

Figure 8 – “Patient transfer checklist” form used at MSH

![Patient Transfer Checklist form](image)

**Transfer Criteria**

1. **Demographics**
   - ☐ Patient name
   - ☐ Patient age
   - ☐ Patient gender

2. **MRN**
   - ☐ MRN number given
   - ☐ Identification band present on patient wrist/ankle
   - ☐ MRN number on patient identification band identical to MRN number in patient chart (adult patients)
   - ☐ MRN on newborn band identical to mother’s MRN

3. **Admitting Diagnosis**
   - ☐ Admitting diagnosis and pertinent history of present illness given
   - ☐ Past medical history given
   - ☐ Old chart available on transfer ☐ Yes ☐ No ☐ N/A
   - ☐ Patient admitted from ☐ Home ☐ Nursing Home

4. **Allergies** (e.g., type, past reactions, treatment needed during reaction)
   - ☐ Allergies reported
   - ☐ Allergy band present on patient wrist/ankle

5. **Patient Belongings Accompanying Patient on Transfer**
   - ☐ Patient belongings/Clothes bag
   - ☐ Shoes
   - ☐ Glasses/Contact lens
   - ☐ Other (specify)

6. **Code Status**
   - ☐ Living Will? ☐ No ☐ Yes ☐ Full code status
   - ☐ DNR
   - ☐ Other (specify)

7. **Isolation Required**
   - ☐ Airborne
   - ☐ C. difficile precautions
   - ☐ Droplet
   - ☐ Chicken pox/Shingles
   - ☐ Contact
   - ☐ MRSA/VRE precautions
   - ☐ MRSA/VRE swabs completed ☐ Yes ☐ No ☐ N/A

8. **Primary Language**
   - ☐ Primary language reported including sign language
   - ☐ Interpreter required ☐ Yes ☐ No

9. **Monitoring/Level of Observation Required**
   - ☐ Telemetry required ☐ Yes ☐ No
   - ☐ Restraints required ☐ Yes ☐ No
   - ☐ Constant observation required ☐ Yes ☐ No

10. **Vital Signs/Physical Findings on Assessment**
    - ☐ Vital signs/physical findings reported including pain assessment/score.

11. **Intake and Output**
    - ☐ NPO status, IV access, IV infusions type and amount infused, oral intake, urinary output, any and time of last stools or vomiting reported.

12. **Medications Administered/Pending**
    - ☐ Name, dose, route, time last administered, time next due, response to medications reported.

13. **Labs/Diagnoses Completed or Pending**
    - ☐ Abnormal results and/or tests not yet completed, and/or results pending reported.

14. **Treatments or Therapies Completed or Pending**
    - ☐ Wounds/Dressings ☐ Yes ☐ No ☐ N/A
    - ☐ Follow-up appointments ☐ Yes ☐ No ☐ N/A
    - ☐ Parent CPR training ☐ Yes ☐ No ☐ N/A
    - ☐ Direct donors ☐ Yes ☐ No ☐ N/A
    - ☐ Car seat probing ☐ Yes ☐ No ☐ N/A

See reverse for Guidelines for Use →
The "Patient transfer checklist" (see Figure 8) is a paper form filled out by ED nurses before the patient transfer to GIM, and used as a communication aid during handover to the GIM nurse. The headings are: demographics, patient identification number, admitting diagnosis, allergies, patient belongings, code status, isolation needs, primary language, level of observation required, vital signs and physical findings on assessment, oxygen saturation, intake and output, medications administered and pending, labs and diagnostics administered and pending, and treatments or therapies completed or pending.

The main benefits of this communication aid are its portability and the fact that it provides a succinct and structured summary of relevant points to cover during the face-to-face nursing handover conversation, which can reduce the risk of omitting relevant patient information. User feedback from both ED and GIM nurses regarding this communication aid was also very positive. Feedback from the interview with an ED nurse showed that the checklist is great for ensuring that code status and allergies are covered during the handover.

However, direct observation revealed limited use of the “patient transfer checklist” form in practice. Out of the 4 ED-GIM nursing handover observed, in one handover the form was used but not filled out, and in another the form was not used at all.
Furthermore, the guidelines for use shown in Figure 9 were never strictly followed. The main reasons for limited usage of the form as a communication aid during ED-GIM nursing handovers are likely that filling out the form involves extra time on the part of the ED nurses (who are extremely busy) and that the process is not well-integrated into the workflow of the ED nurses. The information from the form can also be found in the EHR and paper chart, so the process of filling it out involves work duplication on the part of the ED nurses. Furthermore, the information on the checklist is time-sensitive, so filling it out ahead of time is not useful since the form will not be accurate by the time the patient is physically transferred to the GIM. ED nurses typically have to fill out the form right before the transfer, and sometimes there is not enough time to do so. On occasion, the form is filled out from memory, while in transit, which may result in inaccurate information. Finally, direct feedback from an interview with an ED nurse revealed that the topics on the checklist are organized differently than the orders in PowerChart, so going through it can be cumbersome.
3.4.13  WIPS patient sign-out tool (printed summary)

The WIPS software includes an online patient sign-out tool, which contains a brief summary of the diagnosis and care plan of all admitted GIM patients, updated once daily by the GIM physicians. GIM physicians (in particular junior and senior residents and clinical clerks) carry print-outs of the summaries for the patients in their care. They use these often as a “to do” list and as a communication aid during handover or review within the GIM medical team. The online WIPS patient sign-out tool is also read by GIM nurses, according to the GIM nurse interviewed.

The main advantage of the WIPS patient sign-out tool is that, when printed, it provides access to summarized medical information to the GIM medical staff while they are in transit. The main disadvantage of using the print-out is the risk of breach of patient confidentiality if the paper is lost.

3.5  General communication issues

In addition to the issues related to individual communication tools used at MSH, two main general issues also affected the process of ED-GIM patient transfer. Firstly, work shadowing revealed that physicians typically carry multiple devices (e.g. numeric pager, WIPS pager, hospital-provided mobile phone, personal phone, etc), and also check e-mail and updates in the EHR. The task of keeping track of all of these devices can be overwhelming and make prioritizing and answering medical requests difficult. The use of multiple communication systems at once can cause workflow inefficiency and delays in patient care, which can jeopardize patient safety, in particular with transfer patients who require coordination amongst many physicians. Furthermore, the admitting GIM physicians rotate between different hospitals with different policies and IT systems, making it difficult for them to adapt to varied communication systems. Finally, direct observation also revealed that accessing patient data from other hospitals is very difficult, in particular because other hospitals have different EHR systems in place. This all suggests that making communication tools minimal in number, intuitive to learn, homogenous throughout the hospital, and compatible between hospitals would be ideal requirements for an effective hospital communication system.
Finally, finding contact information for a particular clinician has proven difficult as well. For instance, in several instances the ED nurse was unaware of which GIM medical team was currently on-call (due to a rotation schedule between the 4 different GIM medical teams). Also, the physicians were occasionally struggling to find the proper contact information for AH or other departments (radiology, labs, etc); they were forced to either call “locating” services or search the address book incorporated in the WIPS system. It was often unclear which contact numbers were functional during off-hours. All of this suggests that the hospital might benefit from a role-based communication system that takes into account procedures that vary according to the time of day, provided that the system is simple, homogenous, and implemented throughout the hospital.
Chapter 4
RESULTS - SUNNYBROOK HEALTH SCIENCES CENTRE
FINDINGS

4.1 Participants

During the pilot phase at SHSC (January & February 2011), the investigator spent a total of 15 hours observing physicians and nurses in the ED and GIM units performing regular tasks during work hours. Participants observed during this phase included one GIM nurse, one GIM medical school student, one GIM junior resident, one GIM senior resident, and one ED nurse, as well as brief informal conversations with GIM and ED ward clerks, GIM nurse managers, and staff training hospital personnel in the use of the EHR and other software tools.

During the work shadowing phase at SHSC (March – April 2011), two investigators observed nurses and physicians involved in an ED-GIM patient transfer during five physician handover sessions (including patient admission to GIM and order entry) and five nursing handover sessions (including the nursing report and physical patient transfer), for a total of 10 patients and 28 hours of observation. Of these 28 hours, 9 hours were spent observing GIM physicians, 9.5 hours observing ED nurses involved in regular patient care and order entry during GIM admission, 5 hours observing ED nurses involved in nursing handover to GIM, and 4.5 hours observing GIM nurses receiving a patient from the ED. The participants involved in this phase of the study included: 1 GIM fellow resident, 1 GIM senior resident, 2 GIM junior residents, 1 GIM clinical clerk, 10 ED nurses, and 5 GIM nurses. The investigators spent 22 hours observing inside the ED, and 6 hours inside GIM units.

In order to ensure that the observations were as unbiased as possible, and could be generalized to SHSC as a whole, observers shadowed GIM admitting physicians (junior residents or medical school students) from various GIM teams and GIM nurses from various GIM nursing units. Furthermore, observations were collected during daytime, evenings, and week-ends.

During the interview phase at SHSC (May 2011), the investigator interviewed 3 clinicians who were regularly involved in the ED-GIM patient transfer process in their work: one GIM junior
resident, one GIM nurse, and one ED nurse. These semi-structured interviews each lasted between 30 and 60 minutes.

4.2 SHSC environment overview

SHSC is a large academic teaching hospital affiliated with the University of Toronto (Toronto, ON, Canada). There are 4 GIM wards staffed with nurses and allied health (B4, C4, D4, and D2), and 6 GIM physician teams (blue, yellow, orange, green, red, and silver), each team generally consisting of 1 attending physician, 1 senior resident, a few junior residents, and several medical school students. Based on a rotating schedule, one of the 6 GIM teams is “on-call”, admitting patients during evenings and week-ends. During regular work hours (Monday to Friday, 9-5), two staff internists (one attending physician, and one fellow, senior, or junior resident) are physically located in the ED and are responsible for all admissions from ED to GIM. Post-admission, the staff internist hands over the patient to a physician belonging to one of the 6 GIM physician teams. The ED is staffed with physicians and nurses, and has 4 zones: blue and green (for regular patients), purple (for minor injuries), and orange (transit zone for patients waiting for a hospital bed).

The environment is hectic in both the ED and GIM units, particularly during daytime. Notably, all clinicians engage often in interruptive face-to-face communication. The background noise is usually very high. Except for the daytime GIM staff internists, GIM physicians are very mobile, travelling between the ED and the various GIM units, while ED physicians and nurses from both ED and GIM are confined to travelling between the nursing station, supply rooms, and patient rooms within their unit.

The nursing stations in the ED and GIM units are equipped with phones and computer terminals with internet and EHR access. Occasionally (in some of the GIM units and areas of the ED) computer terminals can also be found inside patient rooms and inside medication supply areas. The EHR system (Oacis, v.7.1, TELUS) is used homogeneously throughout the hospital, in combination with paper charting.
4.3 ED-GIM patient transfer workflow

The UML diagram depicting the full process of ED-GIM patient transfer is provided in Appendix E. The first page is an overview of the entire process, while subsequent pages show each step in more detail. Briefly, the transfer begins with the physician handover, meaning a transfer in responsibility between the ED physician and the admitting GIM physician from the “on-call” team during off-hours, or the ED physician and the staff GIM internist during regular hours. The patient then remains in the ED, where the GIM physician’s orders are filled by the ED nurse and any AH personnel or consulting physicians as required. When a bed becomes available in one of the GIM units, the patient is physically transferred out of the ED, and the nursing handover takes place. Afterwards, the patient continues to be seen by GIM physicians, and orders are filled by GIM nurses, AH, and consulting physicians as required.

The process begins with a request from the ED physician to the GIM senior resident on-call or staff internist to admit the patient to GIM. Following a brief conversation with the ED physician, the GIM senior resident does a quick patient consultation, and then assigns the patient to a junior resident or medical school student (clinical clerk) from the GIM team. The admitting physician does a full patient consultation, writes consultation notes, and then reviews the case with his or her superior. The decision to admit the patient is then made, after which the admitting resident places the paper admission orders and any paper testing or medication orders in the order box. Radiology orders are requested directly by the physician in the EHR, while all other orders are written on paper and transcribed into the EHR by the nursing staff. If the admitting physician is a clinical clerk, a cosignature from the GIM senior resident is required for any orders. The patient remains at this time in the ED while arrangements are made for a bed in the GIM. Once a bed becomes available, the ED nurse contacts the GIM unit by phone to provide a verbal handover. The GIM nurse takes notes using a paper “Transfer of accountability” form (see section 4.4.13). The patient is then transported to the GIM unit by a porter, where the GIM nurse continues to provide care.

The diagram depicts the typical workflow for a non-urgent, uncertain admission, and omits deviations in workflow due to urgency and certainty of admission. The diagram focuses in on the
various communication tools and aids used in the transfer process, and the type of patient information exchanged, accessed, or recorded at each step.

4.3.1 Communication channels

Based on the UML diagram, the researcher evaluated separately the communication channels available to different pairs of clinicians, and identified the risks and relative patient safety consequences of miscommunication in each case. The results are summarized in Table 10.
<table>
<thead>
<tr>
<th>Clinicians involved</th>
<th>Description</th>
<th>Communication issues</th>
<th>Patient safety risk</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GIM admitting physician &amp; ED nurse</strong></td>
<td>- communicate admission status, clarification of new orders, updates on patient status, concerns - face-to-face communication near paper chart or numeric paging</td>
<td>- ED nurse is in the ED, the GIM physician is mobile - risk of delays with paging - low salience of modified paper orders - reliance on GIM physician to alert ED nurse of stat orders</td>
<td><strong>High</strong> - potential delay of urgent nursing care - physician potentially unaware of changes in patient status</td>
<td>- the EHR and the paper chart are not trusted, up-to-date, or easy-to-understand - heavy reliance on paper charting and face-to-face communication - issues with understanding and consolidating paper orders - smart paging was often attempted and then replaced by paging through call locating (faster) - paging through call locating sometimes resulted in having the wrong resident call back</td>
</tr>
<tr>
<td><strong>GIM admitting physician &amp; GIM nurse</strong></td>
<td>- communicate clarification of new orders, updates on patient status, concerns - face-to-face communication or numeric paging</td>
<td>- GIM nurse is in the GIM, the GIM physician is mobile, often in GIM - risk of delays associated with paging</td>
<td><strong>High</strong> - potential delay of urgent nursing care - physician potentially unaware of changes in patient status</td>
<td></td>
</tr>
<tr>
<td><strong>ED nurse &amp; GIM nurse</strong></td>
<td>- short (2-10 minute) phone conversation - communication aids for ED nurse: patient chart and/or EHR and EDIS - GIM nurse takes notes on a transfer checklist paper form</td>
<td>- risk of forgetting to exchange patient information - paper form used on one side only can constrict the communication - main caregiver sometimes unreachable by phone, another nurse gives/receives report in their place</td>
<td><strong>Medium</strong> - potential of GIM nurse remaining unaware of relevant patient information - EHR and paper chart act as safety net, but not always complete or clear</td>
<td>- nurses share administrative and patient care tasks for multiple patients - tension regarding content of handover, stemming from different expectations on ED and GIM side</td>
</tr>
<tr>
<td><strong>Physicians within GIM team</strong></td>
<td>- face-to-face review of the case (10-30 min) - communication aids: EHR, paper chart, paper consultation notes - all carry pagers, senior resident sometimes carries smart phone - SMS on personal phones often used as well</td>
<td>- scheduling a time to review prior to the patient admission</td>
<td><strong>Medium</strong> - potential of delayed guidance from senior resident regarding the case</td>
<td>- no major frustrations voiced by the participants regarding communication within the GIM medical team - daytime handovers involve an additional handover within the GIM teams</td>
</tr>
<tr>
<td><strong>ED physician &amp; GIM senior resident</strong></td>
<td>- short (2 minute) conversation in-person or over the phone - communication aid: patient’s ED paper chart - to initiate contact, the ED physician pages the GIM senior resident or searches for them in the ED</td>
<td>- risk of forgetting to exchange patient information on the spot (particularly for a complex case or incomplete ED paper chart)</td>
<td><strong>Low</strong> - mitigated by the full patient consultation performed by the admitting GIM physician - worst case scenario underestimate case urgency</td>
<td>No observed issues</td>
</tr>
</tbody>
</table>
This evaluation reveals that, as with MSH, the communication channels between the admitting GIM physician and the ED nurse, as well as the channel between the admitting GIM physician and the GIM nurse, are most susceptible to breakdowns and most critical from a patient safety standpoint. Like MSH, there is no structured communication embedded in the workflow, and the main means of contact (numeric paging, smart paging, landline phones at the nursing station) are relatively inefficient and prone to delays. Another problematic communication channel is that between the ED and GIM nurses, since the phone transfer introduces difficulties with reaching the responsible nurse, and the communication is constrained by a checklist which is followed by only one of the two parties. The main communication tools involved in the process of ED-GIM patient transfer are further described and evaluated in the next section.

4.3.2 High-risk workflow segment

For similar reasons to MSH, the highest-risk time from a patient safety standpoint is when the patient is admitted by the GIM but still physically located in the ED (see section 3.3.2). Based on direct observation, this critical period also seems to be longer on average at SHSC compared to MSH, mainly due to lower GIM bed availability. Delays in GIM patient admission workflow may also be due to the multiple systems used for processing the admission (i.e. Oacis, EDIS, BMS, eSignOut), as each additional step introduces a waiting period.

Furthermore, physicians at SHSC write orders on paper, which are then transcribed by the nurses into the EHR. Clarifications with the paper orders are often needed by the ED nurses, and can be difficult to obtain from the GIM physicians, who are typically only in the ED to perform patient consultations. Also, if other medical specialists consult the transfer patients and have suggested orders during this time, the ED nurses must again reach the GIM physician and obtain a verbal approval or signature. Unlike MSH, at SHSC there are no software tools (i.e. the EHR) available to facilitate this process.

Finally, as is also the case at MSH, the ED nurses are unaware of the patient’s care plan and goals until the “consultation request and report” paper form is added to the chart, which only happens after the case review between the GIM senior resident and the GIM admitting physician.
4.4 Communication tools

Table 11 – List of communication tools used at SHSC in ED-GIM patient transfer workflow

<table>
<thead>
<tr>
<th>Tool</th>
<th>Tool type*</th>
<th>Information exchange</th>
<th>Users / Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>face-to-face, verbal communication</td>
<td>S</td>
<td>rich patient information, context</td>
<td>all</td>
</tr>
<tr>
<td>fixed landline phones at nursing station</td>
<td>S</td>
<td>rich patient information, context</td>
<td>all</td>
</tr>
<tr>
<td>smartphone (BlackBerry, Research In Motion)</td>
<td>S, A</td>
<td>calling, BBM, looking up web references</td>
<td>GIM senior resident.</td>
</tr>
<tr>
<td>numeric paging</td>
<td>A</td>
<td>extension where page sender can be reached (i.e. nursing station phone number)</td>
<td>some physicians and allied health personnel.</td>
</tr>
<tr>
<td>smart paging (alpha-numeric)</td>
<td>A</td>
<td>extension where page sender can be reached, or text message sent from computer terminal</td>
<td>most physicians, allied health personnel, pharmacy, and nursing team leaders.</td>
</tr>
<tr>
<td>SMS on personal phones</td>
<td>A</td>
<td>set up meeting, prompt to follow-up, co-signature request, etc</td>
<td>within some GIM teams</td>
</tr>
<tr>
<td>EHR system (Oacis, TELUS)</td>
<td>A, C</td>
<td>patient information</td>
<td>all (both GIM and ED)</td>
</tr>
<tr>
<td>Paper patient chart</td>
<td>A, C</td>
<td>patient information</td>
<td>all (both GIM and ED)</td>
</tr>
<tr>
<td>EDIS</td>
<td>A</td>
<td>demographics, current location, admission status</td>
<td>clinicians physically located in the ED; to find current ED bed location when the ED patient is moved.</td>
</tr>
<tr>
<td>BMS</td>
<td>A</td>
<td>beds, cleaning status</td>
<td>clinicians throughout the hospital; to find current floor plan of beds in the entire hospital.</td>
</tr>
<tr>
<td>GIM whiteboard</td>
<td>A, C</td>
<td>patient information summary (several GIM patients), consults</td>
<td>GIM staff, clinicians seeing patients in the GIM</td>
</tr>
<tr>
<td>“Transfer of Accountability” form</td>
<td>C</td>
<td>patient information summary (checklist)</td>
<td>ED-GIM nursing handover tool</td>
</tr>
<tr>
<td>eSignOut</td>
<td>C</td>
<td>patient information summary (several GIM patients)</td>
<td>GIM medical team communication aid; occasionally consulted by nurses and allied health personnel.</td>
</tr>
</tbody>
</table>

*Note:  
S = synchronous communication  
A = asynchronous communication  
C = communication aid

The main communication tools and aids used during the process of ED-GIM patient transfer are listed in Table 11, including the type of communication that they support (synchronous, asynchronous, communication aid), type of information exchanged using the tool, and typical users.
### 4.4.1 Summary

<table>
<thead>
<tr>
<th>Tool</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>face-to-face, verbal communication</td>
<td>- story, context</td>
<td>- interruptive (GIM units)</td>
<td>- preferred means of communication for most clinicians</td>
</tr>
<tr>
<td></td>
<td>- chance to ask questions</td>
<td>- noise of overhead announcements (ED)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- immediate feedback</td>
<td>- delays due to call transfers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>fixed landline phones at nursing station</td>
<td>- story, context</td>
<td>- delayed, unanswered pages</td>
<td>- used often for paging and waiting for call-backs</td>
</tr>
<tr>
<td></td>
<td>- chance to ask questions</td>
<td>- caller needs to wait near a phone for page return</td>
<td>- used for ED-GIM nursing transfer</td>
</tr>
<tr>
<td></td>
<td>- immediate feedback</td>
<td>- pager user needs to find a phone to respond</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- unknown urgency or caller</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- interruptive to user</td>
<td></td>
</tr>
<tr>
<td>smartphone (BlackBerry, Research In Motion)</td>
<td>- story, context</td>
<td>- very interruptive to user</td>
<td>- phone number not widely publicized throughout the hospital</td>
</tr>
<tr>
<td></td>
<td>- chance to ask questions</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- immediate feedback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- portable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>numeric paging</td>
<td>- direct extension to reach one clinician</td>
<td>- user feedback is very poor</td>
<td>- user feedback is very poor</td>
</tr>
<tr>
<td></td>
<td>- simple workflow for caller (through locating services)</td>
<td>- contact information holds for more than 2 people</td>
<td>- contact information is another phone number where user can call another person to communicate with</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- typically found by phoning locating services</td>
<td></td>
</tr>
<tr>
<td>smart paging (alpha-numeric)</td>
<td>- can indicate caller and urgency in a short message</td>
<td>- interruptive to user</td>
<td>- depending on usage, it has also acts as numeric paging (see above)</td>
</tr>
<tr>
<td></td>
<td>- connected to up-to-date database of clinicians’ schedule</td>
<td>- no validation of message receipt</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- difficult workflow to send a message</td>
<td></td>
</tr>
<tr>
<td>SMS on personal phones</td>
<td>- convenient workflow for users, easy to respond</td>
<td>- privacy concerns</td>
<td>- users are comfortable with this communication system</td>
</tr>
<tr>
<td></td>
<td>- answer to non-urgent messages can be postponed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EHR system (Oacis, TELUS)</td>
<td>- centralized, accessible database of patient information</td>
<td>- SHSC implementation lacks MAR</td>
<td>- physicians write paper orders, which are then transcribed by the nurses into the EHR (except radiology orders – entered by physicians directly and medication orders – faxed to pharmacy)</td>
</tr>
<tr>
<td></td>
<td>- less issues with handwriting legibility</td>
<td>- SHSC implementation lacks vital signs record</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- suggested dosages upon order entry</td>
<td>- no notification for new results</td>
<td>- advantages and drawbacks for paper ordering included under “paper patient chart”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- lacks planned orders, context</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- lacks documentation of consultation status</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- poor platform for viewing radiology results</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- placing orders is unintuitive</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- workflow for viewing test results is cumbersome</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- not kept up-to-date</td>
<td></td>
</tr>
<tr>
<td>Tool</td>
<td>Advantages</td>
<td>Disadvantages</td>
<td>Comments</td>
</tr>
<tr>
<td>--------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Paper patient chart</td>
<td>- centralized database of patient information</td>
<td>- accessible by only one clinician at one time</td>
<td>- used extensively in both the ED and GIM units</td>
</tr>
<tr>
<td></td>
<td>- promotes ad-hoc face-to-face communication</td>
<td>- delays &amp; interruptions associated with searching for it</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- new paper orders in special bin are visible to nurses</td>
<td>- handwriting legibility issues</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- parts can be lost / incomplete</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- writing paper orders is slower for some physicians</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- transcription of paper orders is cumbersome for nurses</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- paper orders can be incomplete</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- consolidating paper orders is difficult</td>
<td></td>
</tr>
<tr>
<td>EDIS</td>
<td>- kept relatively up-to-date</td>
<td>- unintuitive user interface and layout</td>
<td>- used often by ED nurses</td>
</tr>
<tr>
<td></td>
<td>- quick summary view</td>
<td>- poorly used for documenting consultation status</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- communicates current patient location</td>
<td>- only accessible from the ED</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- communicates hospital bed availability for transfer patients</td>
<td>- requires manual updating (not linked up to EHR or other tool)</td>
<td></td>
</tr>
<tr>
<td>BMS</td>
<td>- centralized database of patient information</td>
<td>- low rate of usage</td>
<td>- hospital-wide platform, high potential for expanding its usage applications</td>
</tr>
<tr>
<td></td>
<td>- kept relatively up-to-date</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- quick summary view</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- hospital-wide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GIM whiteboard</td>
<td>- kept relatively up-to-date</td>
<td>- requires manual updating</td>
<td>- various physical whiteboards implemented in each GIM unit</td>
</tr>
<tr>
<td></td>
<td>- quick summary view</td>
<td>- non-universal coding scheme, can be difficult to decipher</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- flexible coding scheme, can adapt to user needs</td>
<td>- only accessible within the unit</td>
<td></td>
</tr>
<tr>
<td>“Transfer of accountability” paper form</td>
<td>- may reduce risk of omitting relevant patient information</td>
<td>- risk of over-structuring handover communication</td>
<td>- high adoption rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- not well-integrated in nursing workflow – only used on one side during the handover communication</td>
<td>- feedback from nurses is generally negative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- clustered layout</td>
<td></td>
</tr>
<tr>
<td>eSignOut</td>
<td>- portable in print-out form</td>
<td>- risk of losing print-out (breach of patient confidentiality)</td>
<td>- used extensively by all GIM physicians</td>
</tr>
<tr>
<td></td>
<td>- quick summary</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The benefits and drawbacks of each of the communication tools and communication aids described above were summarized in Table 12. Overall, clinicians seem to prefer synchronous communication over asynchronous communication means, although paradoxically, these generate interruptions. Numeric pagers stand out as the most inefficient and least preferred communication tool available at SHSC. The smart paging system addresses some of the
limitations of numeric pagers, but sending a message is more difficult and takes a longer time. There are several important areas of concern with the EHR system, though it does have important benefits over the traditional paper chart. EDIS and BMS have some important advantages as communication aids over physical whiteboards, though they also require manual updating and contain user interfaces that are not considered intuitive. The paper checklist system implemented to support the ED-GIM nursing handover has its merits, though it fails to properly support the phone handover conversation. Having a quick patient summary for all GIM patients, such as a print-out from eSignOut, greatly facilitates communication and acts as a “to do” list for GIM physicians. Descriptions of each communication tool or aid, as well as the observed usage and the main benefits and drawbacks of each, are provided in separate subsections below.

4.4.2 Face-to-face

Prevalence, advantages, and disadvantages of face-to-face communication at SHSC are very similar to those at MSH. Please refer to section 3.4.2 for a complete discussion.

Table 13 – Incoming interruptions recorded during direct observation at SHSC

<table>
<thead>
<tr>
<th>Clinician interrupted</th>
<th># of participants</th>
<th>total observation time</th>
<th>total # of interruptions</th>
<th>average # of interruptions / hour</th>
<th>total # of face-to-face interruptions (% of total)</th>
<th>total # of phone interruptions (% of total)</th>
<th>total # of pager interruptions (% of total)</th>
<th>total # of face-to-face interruptions involving searching for another person (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIM admitting physician</td>
<td>5</td>
<td>6hrs51min</td>
<td>21</td>
<td>3.1</td>
<td>12(57%)</td>
<td>6(29%)</td>
<td>3(14%)</td>
<td>1 (5%)</td>
</tr>
<tr>
<td>ED nurse</td>
<td>10</td>
<td>13hrs9min</td>
<td>44</td>
<td>3.3</td>
<td>40(91%)</td>
<td>4(9%)</td>
<td>n/a</td>
<td>2 (5%)</td>
</tr>
<tr>
<td>GIM nurse</td>
<td>5</td>
<td>4hrs25min</td>
<td>16</td>
<td>3.6</td>
<td>15(94%)</td>
<td>1(6%)</td>
<td>n/a</td>
<td>1 (6%)</td>
</tr>
</tbody>
</table>

Note: The values provided above may not be accurate due to the small sample size and short observation sessions (focused on ED-GIM patient transfer activities).

Three of the 5 GIM admitting physicians carried an alpha-numeric (smart) pager and a personal phone, one of the 5 carried a personal smartphone which was set to receive smart pages, and one of the 5 carried a numeric pager and a personal phone.

The level of interruptions observed is also similar (see Table 13). There are some fewer overall interruptions for the GIM admitting physicians at SHSC than at MSH (3.1/hour vs. 4.5/hour), and significantly fewer face-to-face interruptions, which might be because the charting area for physicians in the ED is more secluded and spacious at SHSC compared to MSH. Also, the
proportion of phone interruptions is higher at SHSC compared to MSH (29% vs. 0%), likely because GIM physicians at SHSC make more use of their personal phones in addition to the fixed landline phones found at the nursing stations.

4.4.3 Fixed landline phones

The description, usage, advantages, and disadvantages of fixed landline phones at SHSC are very similar to those at MSH. One key disadvantage, as underlined by the GIM resident interviewed, is that the nursing station phones introduce delays:

*Trying to reach someone through the hospital phone system is very frustrating because not everyone picks up. When you have someone’s cell phone the process is much better.*

The average number of overhead announcements in the ED (most of which announce incoming calls) is 16/hour, as sampled for one hour periods over five separate days. See section 3.4.3 for a complete discussion.

4.4.4 Smartphone

The GIM senior residents typically carry a secure, hospital-provided smartphone (BlackBerry, Research In Motion), which they use for calls, exchanging messages through BBM, and web resources. No information is actively pushed on the device. In the past, clinicians used to receive critical lab values directly on their smartphones or pagers, but this practice was stopped because it generated constant interruptions. This situation illustrates the paradoxical need of physicians to be informed in a timely manner of critical results, and yet not be interrupted.

The main benefit of having these devices, as with other synchronous communication means, is that it allows for presenting a story and context, offers a chance to ask questions, and provides immediate feedback. Furthermore, using the smartphones for calls minimizes interruptions and distractions for clinicians located nearby, compared to landline nursing station phones. Finally, the smartphones are portable, which allows the mobile physicians to easily stay in touch with others from anywhere in the hospital.

However, a related downside is that incoming calls can cause interruptions and are not filtered by urgency. This is why most clinicians using mobile phones choose to not make their phone
numbers public. Thus, paradoxically, physicians prefer synchronous communication, but choose to avoid it in some scenarios due to the interruptions that it generates.

BBM has the benefit of allowing users to postpone the reply until they are free, and also reply on the spot from anywhere in the hospital. When messages are exchanged using hospital-provided handheld devices, the information is encrypted, so there is no security issue (as is the case with personal mobile phones).

4.4.5 Numeric paging

The description, usage, advantages, and disadvantages of numeric pagers at SHSC are very similar to those at MSH. See section 3.4.7 for a complete discussion.

Most pages sent out and received by clinicians during the shadowing sessions were actually returned very promptly. Six out of 7 pages sent out by the shadowed physicians and nursing staff were returned within 5 minutes, and one non-urgent smart page was returned after 13 minutes. Similarly, out of a total of 9 pages (both numeric and smart pages) received by the physicians shadowed, 8 were returned within 5 minutes, and 1 was returned after 10 minutes. Although the pages were generally returned very quickly, in one instance the connection failed (no answer), and in another instance the physician had to wait on the phone for 2 minutes and 40 seconds before finally connecting with the sender of the page. Oftentimes, the person answering the phone when a page was returned was not the sender of the page. Although the issue of delayed or unanswered pages was not observed during the shadowing sessions at SHSC, direct feedback from clinicians suggested that these problems do exist. One of the GIM junior residents shadowed said that pagers cause delays and complained of too many pages regarding minor issues. The GIM physician interviewed explained:

If you're calling the ward, typically, different wards have different lengths of time they take to pick up on the phone based upon who works there but it can be anywhere between 10-15 seconds at best to minutes. I've had times where I've been paged to the ward and I've called back and I've waited minutes for something to pick up.

Furthermore, the need to wait near a phone for a call-back emerged as an issue from the shadowing sessions as well. One of the physicians shadowed actually gave out a personal phone
number when paging others, rather than a nursing station phone number, since there was no time to wait near a phone.

4.4.6 Smart paging

Most physicians, allied health personnel, pharmacy staff, and nursing team leaders at SHSC carry alpha-numeric pagers that are linked up to a “smart paging” system. This system allows other clinicians to log in through the intranet hospital website on any computer terminal and contact the pager carriers in one of two ways: (1) by sending an text message (if a response is not required), and/or (2) by sending the extension where they can be reached and waiting for a call back (if a response is required). The text message and/or the extension typed at the computer terminal are then immediately displayed on the alpha-numeric pager. The database of clinicians used by the smart paging system is updated manually, and represents the current on-call schedule for SHSC. Role-based messaging (e.g. sending a message to the nephrologist on call on Thursday evening) is supported by this system. Smart paging can also be done by dialing the pager extension from any phone and then entering the call-back phone extension. Smart paging a text message, however, needs to be done from a computer terminal.

Smart paging has the same drawbacks of traditional numeric paging when used to send an extension rather than a message: the caller must wait at one location for the call back; if forced to leave, he or she then misses the call. An excerpt from the interview conducted with an ED nurse perfectly illustrates this situation:

"Often I will page a resident. I have the intention of waiting for them to call back and then be called into a room and I can’t really tell the patient or whoever is calling me into the room that I have to stay at the desk and wait for a phone call. That just doesn’t fly. […] So often I'll page someone, miss their page, page them back, miss their page and then they get quite angry, which I understand but at the same time […] the nature of our work is not that we can sit at the computer and wait for a call back."

Similarly, the receiver of the page is forced to find a phone to call back, which can cause delays. Issues with unanswered pages were reported by the clinicians shadowed, and on occasion pages
needed to be sent repeatedly. Finally, when used as a numeric pager, the urgency of the page is unknown to the receiver (refer to section 4.4.5 for further details).

However, the ability to send text messages through this system is an important advantage over traditional numeric paging: smart paging allows users to specify the urgency within the message and provide a description of the issue in the form of a short text. Direct feedback from some of the GIM physicians shadowed confirmed that it was preferable to receive a page with text about the urgency involved and the identity of the sender. Smart paging is also more efficient than traditional paging for one-way communication, since the receiver is not automatically required to call back. However, even with one-way communication, clinicians often include a call-back request as validation that their message was received. The GIM physician interviewed expressed dissatisfaction with the fact that they cannot respond with a text page:

*In general I dislike the fact that I cannot respond to a message on this. So, when the nurse sends me something I can't say, acknowledge, you know, I'm aware of this, I'm not going to call you back because it takes too long but I know about it.*

An important disadvantage of numeric paging and smart paging is that the number of incoming pages can be overwhelming during busy times, causing interruptions.

Another disadvantage is that the workflow for sending a message through smart paging is much more complex than numeric paging through the hospital locating services. Some of the SHSC nursing staff expressed that they preferred to page through locating since it was easier and faster for them. This was supported by direct observation, with three separate instances when clinicians (one GIM physician, one ED nurse, and one GIM nurse) attempted to use smart paging but stopped when it proved to be too difficult and time consuming, resorting to a page through call locating services instead. However, the ED nurse interviewed pointed out that, although the workflow is easy, calling through locating services is inefficient since:

* [...] there’s so many teams and it seems that it varies by the hour who’s doing consults in emerg and who is doing the day consults and now who is doing the night consults [and we] get the wrong resident almost consistently.*
By contrast, an important advantage of the smart paging system is that the role-based search makes it easier (at least in theory) to contact the right person at the right time. Direct observation revealed that clinicians use smart paging often as a reference tool for finding out the identity of the right person to call, particularly during off-hours.

In summary, smart paging emerges as valuable in its versatility, but limited by ease-of-use issues and by many of the disadvantages of traditional numeric paging.

4.4.7 SMS on personal phones

The description, usage, advantages, and disadvantages of SMS on personal phones at SHSC are very similar to those at MSH. See section 3.4.8 for a complete discussion.

Most of the GIM physicians shadowed expressed that they prefer to get in touch with other clinicians on their team via SMS, and that this is usually done on personal phones, since there is an insufficient number of hospital-provided phones. These physicians believe this means of communication to be faster than paging. As the GIM physician interviewed pointed out:

*Getting a text on the cell phone is almost always faster than trying to page someone and because you can reply it's a lot faster than calling back and waiting for them to come on the phone. So, for almost all situations it's preferable to get a text on your cell phone rather than get a page. Except for in the middle of the night. The pagers are much louder and can wake you.*

However, since SMS on personal phones is not yet standardized, doing so is not always possible. Regarding the risk of transferring sensitive patient information unencrypted via SMS, the GIM physician commented:

*Text messaging has everything that an alphanumeric pager has plus the ability to respond which is the next level... It's unfortunate that it's not a secure means of communication and we shouldn't be using it for patient information but I think you'll find anonymously everyone does.*

It should be noted that the privacy issues could be addressed by adopting a secure messaging tool, such as Research in Motion’s BBM.
4.4.8 EHR system (Oacis, TELUS)

The EHR system implemented at SHSC is Oacis, version 7.1, by TELUS. The EHR system is implemented homogeneously throughout the hospital, with no difference in coverage between the ED and GIM units.

Table 14 – EHR coverage at SHSC

<table>
<thead>
<tr>
<th>Patient information</th>
<th>Record Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary (for several patients, at a glance)</td>
<td>Oacis eSignOut tool print-out</td>
</tr>
<tr>
<td>Current location</td>
<td>Oacis EDIS (ED only)</td>
</tr>
<tr>
<td></td>
<td>BMS</td>
</tr>
<tr>
<td>Admission orders</td>
<td>paper</td>
</tr>
<tr>
<td></td>
<td>EDIS (ED only, transcribed by nurses)</td>
</tr>
<tr>
<td>Non-medication orders (except radiology)</td>
<td>paper</td>
</tr>
<tr>
<td></td>
<td>Oacis (transcribed by nurses)</td>
</tr>
<tr>
<td></td>
<td>Kardex (paper, transcribed by nurses)</td>
</tr>
<tr>
<td>Radiology orders</td>
<td>Oacis (entered by physicians)</td>
</tr>
<tr>
<td></td>
<td>Kardex (paper, transcribed by nurses)</td>
</tr>
<tr>
<td>Medication orders</td>
<td>paper</td>
</tr>
<tr>
<td></td>
<td>Kardex (paper, transcribed by nurses)</td>
</tr>
<tr>
<td>Patient care, ambulatory, AH, consult, nursing notes, vitals</td>
<td>paper</td>
</tr>
<tr>
<td>Physician’s notes</td>
<td>paper</td>
</tr>
<tr>
<td>Historical data (previous admissions, encounters)</td>
<td>Oacis</td>
</tr>
<tr>
<td>Results (labs, microbiology, pathology, cytology)</td>
<td>Oacis</td>
</tr>
<tr>
<td>Results (radiology)</td>
<td>Oacis Medical Imaging Web 1000 Impax</td>
</tr>
</tbody>
</table>

Table 14 summarizes the EHR coverage at SHSC, as well as the other sources of patient-related information. As opposed to MSH and TGH, new orders (except medication orders and imaging tests) are written on paper by physicians and then transcribed into Oacis by nurses. Imaging tests are entered directly into Oacis by the physicians. Finally, medication ordering and the MAR remain paper-based. A copy of any new medication orders is faxed to the pharmacy, and a list of current medications is generated every 24 hours by the pharmacy (using the pharmacy medication software) and stored in Oacis.
The EHR serves as a central repository of patient information, accessible by all clinicians on computer terminals throughout the hospital. Furthermore, it is often used as a communication aid during handover and during review of a case within a medical team. The software is typically used in the roster view (see Figure 10). The patient information found in the EHR includes: current location, demographics, encounters (contacts with the hospital and/or clinics), lab results (with graphs), microbiology results, radiology results, transcribed reports (e.g. historical reports, discharge summaries), and orders (excluding medication orders).

**BENEFITS**

The main benefit of the EHR is that it is a centralized database of patient information, accessible by all clinicians throughout the hospital. However, unlike the MSH and TGH EHRs, Oacis does not include a MAR, which is seen as a disadvantage by some of the clinicians shadowed. If updated regularly by all clinicians involved in the patient’s care, the EHR can serve as a trusted information repository, helping clinicians “stay on the same page”, and reducing the need for time-consuming side conversations. In practice, however, clinicians do not seem to trust that the
EHR information is up-to-date, relying heavily on direct communication with other clinicians instead.

Another benefit is that the EHR usually eliminates issues with handwriting legibility. Also, based on direct feedback, the feature of suggesting appropriate dosages for orders is well-liked by physicians. However, these two benefits disappear due to the workflow at Sunnybrook, where nurses are the ones entering most of the orders into the system.

DRAWBACKS – MISSING COMPONENTS

Firstly, the MAR would be a useful addition to Oacis. The lack of a consolidated record of all medications for a patient came up as an issue several times during the shadowing sessions at SHSC.

Another missing component of the version of Oacis implemented at SHSC, as confirmed through feedback from some of the GIM physicians that participated in the study, is vital signs. These are now done on paper, which does not allow the user to view trends over time.

Oacis is also missing the patient diagnosis, which can be found in the paper chart.

Another useful addition to Oacis would be a feature providing notifications or alerts for new results. Although in theory these new results are indicated in bold font (see Figure 10), the system is not actually aware of the current user, rendering this feature useless.

An important missing component of the EHR is planned orders, courses of action, thoughts, and context. This component would help keep every clinician involved in a patient's care up-to-date with new or planned orders, and avoid conflict between existent orders and new orders suggested after each consultation. Currently at SHSC, physician’s orders, including suggested orders from other consulting physicians, are written on paper and then consolidated primarily by nurses. The risk of missed or repeated orders is high with the current system.

Furthermore, there is no simple way to see in Oacis whether a consult was done. Currently, this is documented in part using a specialized ED software program called Emergency Department Information System (EDIS) (see section 4.4.10 for further details). However, integration of this
feature into the EHR may simplify the workflow and improve the rate of documentation of consult statuses.

Similarly, the completion status of tests is not communicated in Oacis or elsewhere, which introduces difficulties with patient care planning. One of the GIM physicians confirmed this during the semi-structured interview:

*One of the downsides to [Oacis] is that it's actually very difficult to tell if a test has been received by the lab, is in progress in the lab, has never been drawn but ordered. It's very difficult to find out what the status is of the test you've ordered.*

Oacis is also lacking a system for identifying which orders have been completed and which are pending. Although this has not been observed, direct feedback suggested that it causes orders to sometimes be missed when patients are transferred. As the GIM physician interviewed explains:

*When we order a lot of things on the admission some of it gets done by the emerg nurses, not all of it, [...] and we're always concerned that when they move up to the floor we always feel like part of what we ordered gets lost. It just never gets done. The problem is because of [Oacis] we can't really check to see what has and hasn't been done easily, so no one really knows.*

Finally, another limitation of the version of Oacis used at SHSC is that, although it includes radiology images, these do not load very well, thus alternate systems are typically used to view radiology results (i.e. Impax or Medical Imaging Web 1000).
DRAWBACKS – PROBLEMATIC FEATURES

Figure 11 – Sample screenshot EHR system at SHSC (order entry view) – from training manual – patient names are fictional

Of the existing features, one that stands out as problematic, based on direct observation, is the unintuitive user interface for placing orders in Oacis (see Figure 11). Finding the appropriate order or lab test is difficult because the search feature is based on a “yellow pages” type of set-up, where only a limited combination of words can generate useful search results. The GIM junior resident interviewed also elaborated on some of the most important order entry issues that physicians encounter at SHSC:

"It's pretty tricky to find the tests you want if they're a little bit esoteric and certain tests are duplicated in multiple sections, so you're not sure which one you should be using. The most confusing ones are usually the imaging ones because they have a lot of them for emerg, not for emerg and then a lot of the notations are radiology notations. So, they would have, CT head 1P, 2P, 3P and I'm just like, I want a CT head I don't know what these 1P, 2P, 3P are...which ones should I order?"
Furthermore, two of the GIM residents shadowed explained that viewing test results in Oacis, in particular viewing trends, requires too many steps. As one GIM physician explained during the semi-structured interview:

*Sunnybrook’s system [...] takes more time getting used to. Especially, it's not as intuitive for things like trending or trying to organize the data in a certain way. I know at UHN it's easier to get the trends for a lab value over time to see what the pattern has been and you can graph it. Here you can do it, but it's an older system with Boolean commands.*

DRAWBACKS – USAGE

A drawback of the EHR as an asynchronous communication tool at MSH is that it is not being updated by all clinicians. Most of the charting, including nursing notes, vitals, consultation notes, is currently done on paper.

A very interesting pattern of EHR usage at SHSC is that physicians write orders on paper, which are then transcribed by the nurses. The implications of this workflow are explored below.

BENEFITS and DRAWBACKS of PAPER ORDERS ENTERED by NURSES

One benefit of having paper doctor’s orders is that new orders (placed in special bins near the patient chart) are highly visible to the nurses (compared to electronic records, where the viewer must log on to a computer terminal to check for new orders). Work shadowing revealed that the admission orders were entered within less than 3 minutes in all four GIM patient admissions observed. However, it seems that any ED nurse who first notices new orders in the box enters them into the EHR system, regardless of whether they are actually responsible for that patient or not. Indeed, in 3 out of 4 cases, an ED nurse different than the main caregiver ED nurse actually entered the orders. This carries patient safety risks, as nurses who are unfamiliar with the patient become involved in their care, while nurses who are familiar with the patient remain unaware of the new orders.

All of the nurses shadowed, when asked, agreed that they would prefer the physicians to enter the orders into the EHR system directly. Interestingly, most of the GIM physicians shadowed expressed that they would prefer to enter orders in the EHR, rather than the current paper
ordering system. Only one of the physicians shadowed expressed a preference for ordering on paper, citing its greater speed. However, this physician also spoke of missing the EHR feature of suggesting a dosage. Feedback from the same doctor revealed that sometimes physicians ordering medication on paper purposefully omit including the dosage, and rely on the nurse to fill this in with the suggested dose when entering it into the EHR. Although the extent of this practice cannot be confirmed by the present study, it poses a high patient safety risk. One instance was observed where a paper order did not specify the dose or frequency for a drug, in which case the GIM nurse responsible paged the physician to clarify the order. As confirmed by the GIM nurse interviewed, paper ordering often involves incomplete orders:

Sometimes they don't write the time especially when there's a change of the drug or a dose or the route [...] and the paper is loose because the ring is broken from the paper and you don't know which one goes first and they’re both written on the same day and then you have to call the doctor to clarify their order. Very often it's the drug clarification. Like, there's no frequency, there's no dose or there's no route.

Another danger of paper ordering, as pointed out by one of the ED nurses shadowed, is that if the physicians change an order, the previous orders are typically still in the chart; this can lead to errors with a high impact on patient safety. For example, since there is no time stamp with paper ordering, one of the GIM nurses shadowed had a difficulty determining which orders belonged to the ED physician, and which to the GIM physician, and hence which ones were more recent. Paper ordering leads to many such situations, in which clinicians are forced to guess the intentions of those who wrote the orders – a clear source of danger to patients.

4.4.9 Paper patient chart

Prevalence, advantages, and disadvantages of the paper chart at SHSC are very similar to those at MSH. Please refer to section 3.4.11 for a complete discussion. One important difference is that at SHSC medication orders are also stored in the paper chart, rather than using an electronic MAR. Furthermore, a lot of documentation (nursing notes, vitals, etc) is done on paper at SHSC, which increases the clinicians’ reliance on the paper chart. Some of the implications of this are explored during the discussion of benefits and drawbacks of the EHR in section 4.4.8.
During an example of the disadvantages of the paper chart described in section 3.4.11, an ED nurse was observed having to clarify a paper order with the GIM physician because the writing was illegible.

Direct observation also revealed that most GIM physicians use the paper chart as a reference while writing up consultation notes or admission orders, rendering it unavailable to the nurse for extended periods of time (up to 1 hour in some cases). This causes delays, and other clinicians were observed spending a considerable amount of time searching for the chart. Also, two separate instances were observed where the ED nurse had to interrupt the GIM physician writing out consultation notes in order to ask for the nursing notes. Notably, there was one instance when the nursing notes travelled back and forth between the physician and the nurse several times within half an hour, since both clinicians needed them at the same time. Feedback obtained during the interview with a GIM junior resident from SHSC confirmed these observations:

*Trying to find the paper chart takes up a substantial portion of the day. Charts are supposed to be in the chart racks but almost always they could be located with someone or in another room or in the med room or in the patient room or off the ward or... It's very difficult to find the actual chart.*

In the ED, the patient chart is unbound, which introduces the additional risk of having parts of the chart get lost. This was confirmed during the interview with an ED nurse, who stated:

*I think there definitely are issues with our paper charts because things often get missed just because they even been put [...] in a spot that's not obvious or even in the wrong patient's [...] slot.*

It is also apparent that finding relevant information within a paper chart is difficult. The GIM physician interviewed explains:

*The organization of the chart sometimes is dubious. You don't find things where they expect to be. It’s very difficult to read the majority of doctors' handwritings. Some people don't date their notes. Some people don't time their notes. You're not sure which page came before what page.*
Finally, during an example of the main benefit of the paper chart described in section 3.4.11, it was consistently observed that the paper chart acts as a focal point of direct interaction between clinicians. Confirming this observation, the GIM junior resident stated:

*Any time I see someone looking at a chart of one of my patients and if I don’t recognize them or if I do recognize them, I usually go and talk to them to get an update.*

### 4.4.10 Emergency Department Information System (EDIS)

The Emergency Department Information System (EDIS) is accessible only in the ED. EDIS is used to keep track of the location of the ED patients, and includes information such as patient demographics, arrival time, room # (illustrated on the ED floor plan), admission status (consult requested / responded / done, patient admitted, bed requested / available), etc. The bed location and admission status are mostly updated in EDIS by the ED staff. While there are no large computer screens or whiteboards in the ED, EDIS is accessible on all computer terminals at the ED nursing stations.

*Figure 12 – Sample screenshot of EDIS (bed map view)*
EDIS is typically used in the bed map view (see Figure 12), but sometimes also in the patient list view (see Figure 13) for more detailed patient information.

One advantage of EDIS is that it allows clinicians who are coming to see a patient in the ED to locate the patient without having to interrupt other clinicians at the ED nursing station. This is particularly helpful for the GIM physician who admitted a patient in the ED, since the patient may be moved (to the orange zone, or GIM unit, or for testing) without the physician being aware. However, in practice, physicians often fail to understand the patient location from EDIS since they find the layout confusing, and they usually resort to asking the ED nurse directly. For instance, during one shadowing session, an ED patient left for a CT scan, and the attending physician did not know this until asking the ED nurse responsible for the patient.

A positive feature of EDIS is that the border colour change within the bed map view. This signifies the bed availability status for transfer patients (see Figure 12), imparting this information quickly to the ED nurses. In all five nursing transfer instances, the blue border indicating GIM bed availability was noticed by the ED nurses within 10 minutes.
EDIS is also intended for documentation of consultations; however, shadowing revealed that the information available in EDIS regarding consultation status is not reliable, and that a majority of physicians (GIM and other medical specialties) never use EDIS for this purpose. Although in theory all physicians should update EDIS at three time points: (1) when the GIM physician is paged for a new consult, (2) when the physician responds, and (3) when the consultation is started, in practice this is done late, or not at all. Consultations are either signed off in EDIS by the ED nurse (if they happen to be available and aware of the consult), typically with a large delay, or remain undocumented. The paper chart remains a more reliable source of information regarding the stage of the patient consultation. One of the reasons for poor documentation of consults in EDIS is that the steps are cumbersome and unintuitive; they include having to drag a patient’s name onto the bottom left-hand corner of the bed map view (see Figure 12). Another likely reason is that the workflow involves an additional software tool (i.e. EDIS). Inclusion of consult documentation in the EHR, which is routinely accessed by all clinicians, may mitigate this issue.

One of the main drawbacks of the EDIS software, and a likely source of its limited use, is that its user interface is not considered intuitive: some ED nurses and most of the GIM physicians interviewed agreed that EDIS is difficult to navigate. For example, the star symbol (“****”) under the alert column in the patient list view (see Figure 13) was not understood by any ED staff, although it is likely an important piece of information – it communicates that the patient has multiple allergies.

Finally, an important limitation of EDIS is that it can only be accessible from the ED. Also, it requires manual updating, as it is not linked up to the EHR or any other patient information software tool.

4.4.11 Bed Management System (BMS)

The Bed Management System (BMS) is another software tool used to keep track of the occupancy and status of beds throughout the hospital. The nurses enter all relevant patient information in BMS, including visits, admission status, etc. BMS is accessible at any computer terminal inside SHSC.
BMS could act as a communication tool during nursing transfer between the ED and GIM, since
the ED nurse can enter patient information (e.g. isolation requirements, telemetry, code status,
IV, medications, labs, etc) in BMS. However, in practice, this is time-consuming and usually left
incomplete, particularly since the ED nursing perception is that not all of the GIM nurses
actually look at BMS. Direct observation and feedback from GIM nurses confirmed that the GIM
nurses do not regularly check BMS for patient-related information (they typically rely on
information obtained during the phone handover, from the patient’s paper chart, and from Oacis).
Although not used as such, BMS has potential to be used as an electronic transfer note. One of
the ED nurses shadowed expressed that they would like to use BMS for the transfer, instead of
the phone transfer system in place at the moment.

Important advantages of BMS are its hospital-wide accessibility and the fact that the information
that it provides is usually kept up-to-date and trusted by the clinicians. One of the SHSC GIM
nurses confirmed during the semi-structured interview that she appreciated the transparency that
a hospital-wide system such as BMS brought to the journey of patients through the system:

*It's clearly indicated in [BMS] why we're waiting for this bed to be available or because
they're waiting for this patient to be discharged and actually indicates what time and the
date they're being discharged and [when the beds are] dirty, clean and available. So, a
lot of more clarity and a lot more transparency and also helps track where the patient is
because there's the transport option and you can see the status.*

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4.4.12 GIM whiteboard

Figure 14 – Sample GIM whiteboard at SHSC

Each GIM unit at SHSC is equipped with a physical whiteboard listing the current patients, the nurses responsible, consults, discharge date, follow-up status, etc (see Figure 14). This information is manually updated often by the nurse manager, and other GIM staff. The GIM whiteboard is used as a communication aid and updated during bullet rounds (daily meetings between nursing, medicine, and allied health). Colour coding is often used with the whiteboard.
The main benefit of the GIM whiteboard is that it allows nurses, allied health personnel, and physicians to obtain a quick summary view for all of the patients currently present in the GIM. Another advantage is that the type of physical whiteboard used at SHSC allows clinicians the flexibility to use customized symbols and organize the information in a way that makes sense for them.

One important drawback of the GIM whiteboard system in place at SHSC is that it is not linked up to any EHR system, meaning that changes to the patient information are not captured instantly, instead requiring manual updating. The main risk associated with a manual system such as this is that the information presented may not be accurate or up-to-date. For example, an issue with manual updating was uncovered during a shadowing session in one of the GIM units, during which there were two whiteboards, each one indicating a different GIM nurse responsible for admitting the patient from the ED. The GIM nurse shadowed was expecting to receive a patient, although another GIM nurse had actually been assigned the patient half an hour before.

Furthermore, the symbols used by the GIM nursing staff on the whiteboard are typically difficult to interpret for other clinicians who are less accustomed to it, such as physicians and allied health personnel.
4.4.13  “Transfer of accountability” form

Figure 15 – “Transfer of accountability” form used at SHSC

Transfer of Accountability

This template is based on best practices to standardize communication between health care providers to ensure that accurate and relevant information is discussed at the time of transfer. This form has been developed to support unit to unit transfers. The content may be adapted for specific patient populations, shift to shift and other handovers.

Guidelines:
1. Items relevant to the patient’s care/condition should be reviewed by the health care providers involved in the transfer of accountability.
2. To ensure critical information is shared it is recommended that all BOLDED ITEMS are included and be read back.
3. This document is to guide the verbal handover and not to duplicate or replace documentation in the patient care record.

SITUATION:
Patients Name: ____________________________ Language: □ English □ Other ____________________________
Reason for Transfer: ____________________________ Family Contact # on chart: □ YES □ NO
HFN/Armband Checked: ____________________________ Is a family member or substitute present for transfer?
□ YES □ NO
Valuables to safekeeping: □ YES □ NO Is a family member or substitute aware of transfer?
□ YES □ NO If no, who will notify them? ____________________________

BACKGROUND

Diagnosis: _______________________________________
Additional Pertinent Medical History: _______________________________________
Allergies: _______________________________________
Code Status: ____________________________

ASSESSMENT: (at time of transfer)

Vital Signs: BP _____ HR _____ RR _____ SaO₂ _____ O₂ Delivery _____ Temp _____
Neurological/Cognitive/Behavioral Status: Observer required:

Pain Assessment: ____________________________ Skin & Wound Assessment:
Mobility/Risk for falls/Aids: ____________________________ Nutritional Requirements:
Labs/Diagnostics: ____________________________ Meds/IV’s administered /on hold:
IP&C screening completed: □ YES □ NO Isolation Requirements: ____________________________
Significant status changes: ____________________________

RECOMMENDATIONS

Interventions initiated and monitoring required: ____________________________
Labs/Diagnostics pending: ____________________________
Medications pending: ____________________________
Patient/Family concerns requiring follow-up: ____________________________
Any other issues/concerns or risks you anticipate for this patient? ____________________________


PR 14120 (2010/02/26) NOT A CHART COPY
The “Transfer of accountability” form (see Figure 15) is a paper form filled out by the GIM nurse during the handover phone conversation with the ED nurse when a patient is transferred from the ED to GIM. The main headings include: demographics, patient identification number, reason for transfer, diagnosis, medical history, allergies, code status, assessment (vital signs, pain score, labs, etc), isolation and other special requirements, interventions initiated and monitoring required, labs/diagnostics pending, medications pending, and patient or family concerns that require follow-up.

Adoption of the form during ED-GIM nursing handover was observed to be high, as it was used in all nursing transfers observed. However, feedback was predominantly poor.

The main drawback of the form is related to the workflow around it - the GIM nurse fills it out during the phone transfer conversation with the ED nurse, who does not have a copy of the form. This creates a mismatch in expectations regarding the information communicated during the phone transfer: while the GIM nurse wants to address the points in the checklist in order, the ED nurse communicates the information that they consider most relevant. Feedback from ED nurse interviewed, referring to the handover to GIM nurses, confirms this:

*Sometimes I think they get fixed, like for example, they want to know the MRSA, VRE, isolation swabs. That will be sometimes their first question. Not necessarily what we think is the most important information.*

The anecdotal and contextual information regarding the patient that the ED nurses often provide during the phone transfer is thus not recorded on the form, and is often ignored by the GIM nurse whose goal is to fill out the checklist. Recording all of the information provided by the ED nurse requires the GIM nurses to partly ignore the form, and write free text notes on a scrap piece of paper. This practice was observed in two out of four cases. Frustration with this transfer of accountability system was evident during the shadowing sessions and from direct feedback from both GIM and ED nurses.

Furthermore, feedback from the GIM nurses shadowed indicates that the layout of the form is too chaotic, and certain categories should have been allocated more blank space. The opinion of the GIM nurse interviewed also echoes this feedback:
The form I find, personally, is very clustered. So, even though I know what's on the page, no matter how many times I've used it, I still can't find where I need to write things. [There are a lot of categories that do not] always apply to every individual you don’t need [them]. So, it’s a nice form to have to help guide you to give report but I don't know if it's necessary for the person receiving to use the form because we usually have our own piece of paper and our own assignment paper that we can write on.

The main benefits of this communication aid are the fact that it provides a succinct and structured summary of relevant points to cover during the phone nursing handover conversation, which can reduce the risk of omitting relevant patient information.

4.4.14 eSignOut

Once daily, GIM physicians at SHSC fill in up-to-date patient information (name, patient identification number, responsible physician / contact list, code status, main diagnosis, past medical history, allergies, additional precautions, and history of present illness) for the patients in their care, using the eSignOut software tool. The GIM physicians (in particular junior and senior residents and clinical clerks) carry print-outs of the information in eSignOut for the patients in their care. They use them often as a “to do” list and as a communication aid, during handover or review within the GIM medical team. The information filled in by the physicians in eSignOut is also occasionally read by the GIM nurses. Interestingly, eSignOut also includes one section to be filled out by nurses, and one for allied health personnel, however, these two sections are almost always left blank.

The main advantage of eSignOut is that, when printed, it provides GIM physicians with access to summarized medical information while in transit. There was general consensus amongst the GIM physicians shadowed that the eSignOut information was very useful, particularly while they were on-call and covering patients that they were not very familiar with. Referring to eSignOut, the GIM physician pointed out during the interview that:

*It's pretty much indispensible. It's how we keep track of which patients are on our team. We edit it every day for things that need to be done and things that we're following on a continuing basis and it's pretty much what we hold in our pockets on call every night so*
that when we get paged in the middle of the night we can take a quick refresher about each of the patients and what their past medical histories are.

Also, it seems that clinicians currently believe that it is easier and faster to update the information on paper rather than typing it. Throughout the day, the GIM physicians take notes on the paper print-out, which they then update in the software only once daily. During the interview, the GIM physician expressed his feelings on the matter:

*It's a lot easier to write on paper than to be typing, even my iPhone... trying to add notes. You can circle things. You can cross things out... It's much, much faster and it's a lot more fluid.*

The main disadvantage of using the print-out form is the risk of breach of patient confidentiality if the paper is lost. Indeed, as confirmed during the interview with the GIM junior resident from SHSC:

*We've all heard of horror stories about people who've lost it in the cafeteria and then patient information [...] is disclosed to the public. Despite the fact that it's supposed to be discarded and never taken out of the hospital I'm pretty sure it's very often taken out of the hospital and then when you get home you have the conundrum of how to dispose of it properly.*

### 4.5 General communication issues

In addition to the issues related to individual communication tools at SHSC, three main general issues also affected the process of ED-GIM patient transfer. The first two issues are common between SHSC and MSH: (1) a high number of specialized tools, and (2) difficulty for clinicians in determining the schedule and contact information of other hospital workers (see section 3.5). The third issue identified at SHSC is related to inefficiencies due to work duplication.

Firstly, as with MSH, physicians carry multiple devices (e.g. numeric pager, alphanumeric pager, hospital-provided smartphone, personal phone, etc). In some cases, the GIM physicians had the smart paging system connected to their own smartphone, which was unanimously viewed as convenient as opposed to carrying both a phone and a pager. Similarly, ED nurses must interact
with multiple systems: BMS, EDIS, and Oacis, and the admitting GIM nurses must gather patient information from multiple sources: phone transfer, the paper chart, Oacis, eSignOut, and BMS. Often clinicians simply lack the time to interact with all of these systems, and important information can thus be missed in the process. As an example, the GIM physician interviewed pointed out that:

*There is always a lag period between when transcriptions are actually done and when it shows up on EPR, which could be a problem. Same thing with discharge summaries because sometimes we have to look through the discharge system separately to look for something that was recently done that hasn't shown up on EPR yet.*

The use of multiple communication systems can cause workflow inefficiency and delays in patient care, which in turn impact patient safety.

Secondly, contact information for hospital clinicians, particularly during off-hours, is not readily available. Although this information is available through the smart paging system, it remains inaccessible to most clinicians due to the fact that the interface for the smart paging system is unintuitive. GIM physicians were seen looking up contact information of other GIM physicians through eSignOut, yet this system is not hospital-wide. The lack of access to up-to-date contact information is exemplified by an instance observed during shadowing within a GIM unit, when a fax sent by the GIM nurse to request telemetry did not go through. It was only after calling the unit that the nurse learned that the fax number had changed. All of this indicates a need for a role-based system of contacting other clinicians and services such as smart paging, but faster and easier to use than the current smart paging system.

Finally, feedback obtained during work shadowing revealed a common frustration for many SHSC clinicians: work duplication. For example, the ED nurses have to enter the type of service, code status, and type of bed in BMS prior to patient transfer, although all of this information, except for code status, can already be found in EDIS. Similarly, physicians have to re-write similar patient summaries in the paper chart, in eSignOut, and upon patient discharge, in another software tool called eDischarge. This suggests that any new interventions should not involve extra work on the part of the users, but rather utilize the information already available in novel ways in order to simplify clinicians’ workflow.
Chapter 5
RESULTS - TORONTO GENERAL HOSPITAL FINDINGS

Due to the large scope and narrow timelines of the project, an external human factors analyst (Ashleigh Shier, Human Factors Intern, Centre for Global eHealth Innovation) was employed to lead the project at the TGH site. Consistency of data collection methods and analytical approach across sites was ensured through intensive training, and direct involvement of the lead researcher as a second observer and secondary interviewer at TGH. The study report summarizing TGH findings follows the template used for MSH and SHSC, and is provided in its entirety in Appendix F.
Chapter 6
RESULTS - COMPARATIVE ANALYSIS

6.1 Comparison of ED-GIM patient transfer workflow

Figure 16 – General workflow for ED-GIM patient transfer (UML diagram)
All hospitals investigated have a similar general workflow when a patient is transferred from the ED to GIM (see Figure 16). The workflow for the GIM physicians is dependent on the certainty and urgency of the admission. The nursing handover takes place later in the process when the patient is physically transferred to the GIM unit. Note that the process shown in Figure 16 includes only the communication directly related to the ED-GIM patient transfer. The regular clinician workflow also includes morning or noon rounds (GIM senior, junior residents and clinical clerks), review within the GIM medical team with the attending physician, and morning bullet rounds (GIM physicians, nurses, allied health personnel).

The most critical workflow segment of the ED-GIM transfer at all institutions occurs when the patient is under the care of the GIM team, but physically located in the ED, as the lines of communication between various clinicians are least optimal during this period.
<table>
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<tr>
<th>Table 15 – ED-GIM patient transfer workflow differences between MSH, SHSC, and TGH</th>
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<tr>
<td><strong>MSH</strong></td>
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<tr>
<td><strong>overall nursing handover</strong></td>
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<tr>
<td><strong>overall physician handover</strong></td>
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<tr>
<td><strong>new orders</strong></td>
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<tr>
<td><strong>consultations</strong></td>
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<td><strong>regular nursing care</strong></td>
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Although the process is basically identical at the three sites, each hospital uses different tools and a slightly different approach to ensure appropriate communication and flow of patient information throughout the handover. The main differences between the workflow at MSH (see Appendix D), SHSC (see Appendix E), and TGH (see Appendix F) are summarized in Table 15.

The nursing handover approach is different at each site, with a face-to-face report at MSH, a phone report at SHSC and a written report at TGH. While the face-to-face report at MSH is time-consuming for the ED nurses who travel with the patient to the GIM, it also involves the most thorough information exchange. The face-to-face communication allows for clarification, immediate feedback, and the ability to scan through the EHR and paper chart together. By contrast, the handover approach at TGH is fastest, but lacks this rich synchronous communication. These two opposing handover strategies suggest a trade-off between speed and quality of the handover. The phone report approach used at SHSC involves partial compromises on both speed and quality. The phone handover is slower than the TGH written report, and faster than the face-to-face handover strategy used at MSH. It also allows for more in-depth, interactive communication relative to the TGH written report, but no opportunity to build trust and teamwork, or scan through patient data together, as with face-to-face handovers.

The physician handover approach is similar among the three sites, except for the double handover necessary during regular hours at SHSC. New orders and suggested orders from other consultations are placed in the EHR at MSH and TGH, and on paper at SHSC, where the nursing staff is more involved in the process. Finally, one or two nurses are individually responsible for the patient at all three sites, except that more tasks are shared among the nursing staff at SHSC. Differences in tools used during the ED-GIM transfer process at each site are explained in the next section.

6.2 Comparison of communication tools

Although the three teaching hospitals included in the present study utilize varied communication tools, the intended functionality of these tools is similar across the sites. The main communication tools involved in the ED-GIM patient transfer can be grouped into the following four categories: (1) EHR, (2) electronic ED whiteboard system, (3) alternatives to numeric
paging, and (4) nursing handover checklist. A discussion regarding the implementations of each of these tools across the three sites is presented in the subsections below.

6.2.1 Electronic Health Record

As mentioned in previous chapters, the EHR systems are different across the three sites: PowerChart at MSH (see section 3.4.9), Oacis at SHSC (see section 4.4.8), and EPR at TGH (see Appendix F). The main differences in usage and usability among these three EHR systems are explored in this section.

Both PowerChart and EPR include almost all patient information (historical data, test results, nursing notes, orders, and the MAR), except physician’s notes. Furthermore, PowerChart is also used for charting vitals, which is a useful feature as it allows clinicians to easily observe trends. However, charting remains mainly paper-based for ED patients at MSH and TGH, except for historical data and test results which are always found in the EHR. This introduces the risk of nursing staff not noticing orders placed in the EHR right away, since they are accustomed to paper orders. At TGH, the ED whiteboard mitigates this risk, as nurses often check for a simple symbol that indicates that new orders have been placed. By contrast, the EHR system at SHSC is used consistently in the GIM and ED, but only includes historical data, test results, and some orders (radiology orders entered by the physicians, and non-medication orders transcribed by the nurses).

The user interfaces of the three EHR systems were compared based on feedback from clinicians, and direct observation of their interactions with the systems. All three systems have order entry based on index searching which is not intuitive; however, of the three, order entry seemed most problematic at MSH and least problematic at TGH. The EHR system used at MSH also has an unintuitive MAR layout and uses obscure symbols (see section 3.4.9). The main complaints regarding the EHR system used at SHSC concern the overall layout and the many steps required for viewing results. The EHR system used at TGH has a good overall layout and nursing inbox feature, although viewing results was also unintuitive, with too many options and steps.

Overall, all physicians interviewed during the study (who had rotations at MSH, SHSC, and UHN) prefer EPR over the other two EHR systems, since it is “more user-friendly in general”.

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Direct observation supports this feedback, since physicians and nurses seemed to interact with EPR more easily than with PowerChart or Oacis.

Although limited, this data suggests that EPR is the most desirable system of the three, particularly if implemented consistently throughout the hospital.

### 6.2.2 Electronic ED whiteboard system

An ED whiteboard system is useful in the ED-GIM patient transfer, as it communicates relevant patient information (e.g. location, pending tests and consultations, etc) to the ED nurses and GIM physicians. The ED at each of the three hospitals under study uses a different type of electronic whiteboard system. SHSC uses EDIS (see section 4.4.10), which is a separate system accessible only within the ED. By contrast, the systems used at the other two hospitals – ED whiteboard at TGH (see Appendix F) and FirstNet whiteboard at MSH (see section 3.4.10) are both connected to the respective EHR used at each site.

Information is entered only manually into EDIS, and both manually and automatically updated from the EHRs in the TGH and MSH whiteboards. While the electronic ED whiteboard systems used at MSH and TGH are up-to-date and trusted by clinicians, the information in the SHSC system is often stale or incomplete. This contrast clearly highlights the importance of having the whiteboard system connected to a centralized source of patient information, such as the EHR. In addition, the TGH whiteboard has a link to EHR patient information; it shows test results and historical documents. Clinicians preferred to access this information through the whiteboard rather than using the EHR directly, which again stresses the importance of interconnectedness.

The content of the whiteboard systems is similar across sites, and direct observation revealed that the key basic categories include: patient demographics, location, status of test/consults, and names of most responsible nurse and physician. An important difference among the systems is that the TGH and MSH whiteboards have a place for comments, which was a feature used often by clinicians to communicate immediate, relevant information (e.g. “patient transfer scheduled for 4pm, GIM room 401”), while EDIS lacks this feature.
Next, a very important quality of any ED whiteboard system that determines the extent of its adoption is ease of use. The system in use at MSH fares low on usability, mainly due to the obscure symbols used to communicate information (see section 3.4.10).

Similarly, EDIS exhibits many severe usability issues (obscure symbols, unintuitive commands, poor layout), some of which are explored in section 4.4.10. By contrast, the TGH electronic ED whiteboard system has a simple layout and intuitive symbols (e.g. pill icon communicates pending medication orders in the EHR).

In conclusion, the ED whiteboard system in use at TGH is the most up-to-date, easy to use, and well-liked out of the three different systems. It should be noted, however, that the main users of the whiteboard (in this case, ED nursing staff), often tend to generate a colour coding system that is difficult to interpret by outside staff, such as GIM physicians.

6.2.3 Alternatives to numeric paging

At all three sites, physicians can be contacted through traditional numeric paging (see section 3.4.7). This is often the preferred option due to the simplicity of the workflow involved in placing a numeric page through call locating services. However, since numeric paging has many disadvantages, each of the three sites has developed an alternative to numeric paging. Interestingly, each hospital uses a different strategy to solve the numeric paging issue: the WIPS system at MSH (see section 3.4.6), smart paging at SHSC (see section 4.4.6), and the smart web paging system at TGH (see Appendix F). A comparison between these different approaches, and lessons learned, are explored in the remainder of this section.

Firstly, all three systems give users the option to send a text page to the physician. This offers a key advantage over traditional numeric paging, since the receiver of the page can quickly infer the identity of the caller and the urgency of the issue. However, the main drawback of all three systems is that the receiver of the page cannot easily respond to the message, and often a call-back is required. The call-back workflow requires the sender of the page to wait near the nursing station phones, or, as is often the case, leave to tend to other patient care matters resulting in delays and a missed call. WIPS does offer users at MSH the option of logging into a computer terminal to respond by text instead of a call-back; however, this workflow is cumbersome for
physicians who are mobile throughout the hospital. TGH shows the highest potential for improvement, in that its smart phone-equipped physicians could easily send a text back, if this were supported by the system.

Secondly, the workflow for sending a page needs to be very simple; otherwise users will prefer the traditional method of numeric paging through call locating. As an example, the interface for the smart paging system in place at SHSC is difficult to interact with, which deterred a majority of the observed clinicians from using the system. The user interfaces for the systems in place at MSH and TGH are not overly complex, but this may only be due to the fact that the back-end is simpler, as the scope of the systems at MSH and TGH is GIM-only rather than hospital-wide.

Thirdly, the system at TGH is set up in such a way that only one person (the senior resident) receives all of the incoming pages, and is then responsible for distributing them to the rest of the team. This workflow can introduce delays and miscommunication, and should be avoided. An important benefit of the MSH and SHSC systems is that it allows users to contact the target clinician directly.

Finally, it is interesting to note how users assign unintended meanings and usage patterns to new technology. For instance, both at TGH and MSH, smart paging was adopted mainly for less urgent matters, and traditional numeric paging was still used for urgent or escalating issues.

In conclusion, an ideal paging system should be hospital-wide, have a simple user interface, send its messages to mobile devices, include the option of responding with a text message, and provide the sender a confirmation that their message was received in case a response is not required.

6.2.4 Nursing handover checklist

While all three hospitals under study employ a type of checklist meant to formalize the information transfer during the ED-GIM nursing handover, the approach is different at each site. At MSH, the checklist is filled out by the ED nurse and used as a communication aid during the face-to-face nursing report; at SHSC, the checklist is filled out by the GIM nurse while receiving information from the ED nurse over the phone; and at TGH, the checklist is filled out online by the ED nurse and then printed and read by the GIM nurse.
The content of the checklists at the three sites is similar, though not identical (see Appendices E, I, and J). In all cases, some of the required categories are items readily available in the EHR, so work duplication is involved on the part of the nurse filling out the checklist. This is one of the reasons why the checklist at MSH was used as a communication aid but not always filled out. This suggests that adoption of a system that automatically populates the transfer checklist with relevant patient information available in the EHR might be desirable.

In terms of the layout of the three checklists, the most criticized was that of the SHSC checklist, which was seen by the GIM nurses as chaotic and lacking sufficient space for the inclusion of certain information. At TGH, the format of its online checklist was generally described as positive.

At SHSC, despite the poor workflow involved in the phone information transfer between nurses (ED and GIM nurses have differing procedural expectations, see section 4.4.13) user adoption of the checklist is high. Since SHSC is the only hospital where the ED nurse is not writing the checklist, this may suggest that the ideal scenario should involve both the ED and GIM nurses using the checklist as a communication aid during the handover, but only the GIM nurse assuming the responsibility for filling it in.
6.2.5 Summary

<table>
<thead>
<tr>
<th>Tools Used in ED-GIM Patient Transfer at Each Institution</th>
<th>MSH</th>
<th>SHSC</th>
<th>TGH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electronic health record (EHR)</strong></td>
<td>PowerChart</td>
<td>Oacis</td>
<td>EPR</td>
</tr>
<tr>
<td>- Most advanced stage of transition from paper to electronic charting</td>
<td>- Least advanced stage of transition from paper to electronic charting</td>
<td>- Most intuitive user interface</td>
<td></td>
</tr>
<tr>
<td><strong>Electronic ED whiteboard system</strong></td>
<td>FirstNet whiteboard</td>
<td>EDIS</td>
<td>ED whiteboard</td>
</tr>
<tr>
<td>- Connected to the EHR</td>
<td>- Not connected to the EHR</td>
<td>- Connected to the EHR</td>
<td>- Most intuitive user interface</td>
</tr>
<tr>
<td>- Unintuitive user interface</td>
<td>- Unintuitive user interface</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Alternatives to numeric paging</strong></td>
<td>WIPS</td>
<td>Smart paging</td>
<td>Smart web paging</td>
</tr>
<tr>
<td>- Login at a computer terminal needed to view page and respond</td>
<td>- Hospital-wide</td>
<td>- One person receives all pages</td>
<td>- Sender of the page cannot receive text as a response (call-back only)</td>
</tr>
<tr>
<td>- Login at computer terminal needed to send page and check for reply</td>
<td>- Complex user interface</td>
<td>- Cannot respond to page by text (call-back only)</td>
<td></td>
</tr>
<tr>
<td><strong>Nursing handover checklist</strong></td>
<td>Paper checklist filled out by ED nurse</td>
<td>Paper checklist filled out by GIM nurse</td>
<td>Online checklist filled out by ED nurse</td>
</tr>
<tr>
<td>- not always filled out</td>
<td>- poor layout</td>
<td>- positive user feedback</td>
<td></td>
</tr>
</tbody>
</table>

The summarized advantages and disadvantages of the primary tools used during ED-GIM handover at each site are shown in Table 16. The EHR is used most extensively at MSH, while charting remains mostly paper-based at SHSC. Of the three different EHR systems, EPR used at TGH stands out as the most intuitive and easy-to-use. The TGH whiteboard system used in the ED is also the most up-to-date and easy-to-use of the three systems. Each hospital has implemented a different alternative to numeric paging, none of which is ideal. Based on an evaluation of positive and negative features of each, the ideal system should be hospital-wide, simple to use, connected to mobile devices, give users the option of responding with a text message, and provide the senders confirmation that their messages were received in cases where a response is not required. Finally, the checklist used to support the ED-GIM nursing handover should be partly populated with patient information from the EHR to avoid work duplication, then filled out by the GIM nurse and used as a reference by both parties during synchronous communication.
Chapter 7
SYNTHESIS, DISCUSSION, AND RECOMMENDATIONS

The research questions outlined in section 1.3 are explicitly addressed below based on the data collected from all sites. In particular, questions 1 and 2 are addressed in detail, as they most directly define the current role of the EHR in communication during ED-GIM patient transfer and identify the solution that should be developed to enhance this role.

7.1 EHR as a communication aid

What information from electronic health records (EHRs) is needed to facilitate communication between clinicians, particularly during the critical time of handovers? As a corollary, what information is available today that enables communication, and what information is necessary but currently unavailable in EHRs?

Communication events

As shown in detail in the UML workflow diagrams (Appendices D, E, and F), the main events during patient transfers from the ED to the GIM are the following:

- ED physician handover to GIM senior resident;
- Admitting GIM physician completion of the consultation report;
- Admitting GIM physician review with GIM senior resident; and
- ED nurse handover to GIM nurse.

ED physician handover to GIM senior resident

The ED physician handover to the GIM senior resident is a brief (2 minute) conversation typically occurring in person or over the phone. When in person, no communication aids are used; when on the phone, the ED physician sometimes uses the patient’s paper chart and the EHR as a reference.
The ED physician communicates the items shown in Table 17, focusing on the rationale for requesting GIM admission. As shown in Table 17, only a subset of this information is included in the EHR; the rest is found in the paper chart – e.g. paper ED physician’s notes, the paper ED nursing notes.

Admitting GIM physician completion of the consultation report

Before and after performing a full patient consultation, the admitting GIM physician forms an understanding of the patient’s story by accessing the information listed in Table 18.

Table 18 – Items accessed by admitting GIM physician

<table>
<thead>
<tr>
<th>Patient information</th>
<th>PowerChart</th>
<th>Oacis</th>
<th>EPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Current location</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Test orders</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Medication orders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allergies</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Vital signs</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Test Results</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>ECG results</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiology images</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Reports from previous admissions</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Presenting illness (i.e. why they are in the ED)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Physician’s web resources</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Only a subset of this information is accessible in the EHR, the majority being paper-based. Other sources accessed by the admitting physician during this phase include specialized imaging software for viewing radiology results, as well as physician’s web resources (e.g. Up-To-Date Inc.) to facilitate decision-making.

The physician summarizes the information on a paper “consultation report” form, which is handwritten, and typically involves several pages of free text (the length depending on the complexity of the case). The admitting physician keeps the form in their possession until after the case
review with the senior resident, when he or she adds the form to the patient’s paper chart. Feedback from the ED nurses suggests that this form contains information that would help them provide the best care for their patients; these nurses complain that they cannot access it as soon as it is completed by the admitting physician. This issue could be addressed by converting the “consultation report” form from paper to an electronic format.

**Admitting GIM physician review with GIM senior resident**

The case review with the GIM senior resident is performed face-to-face, by following the “consultation report” form described above. Occasionally the physicians access some of the patient data listed in Table 18 above if more information is required than what was summarized by the admitting GIM physician on the paper form. If the GIM physicians decide to admit the patient, the admission orders as well as any new orders for medication and tests are entered in the EHR (TGH and MSH) or written on paper (SHSC).

**ED nurse handover to GIM nurse**

The ED-GIM nursing handover typically includes a patient summary, course of action, and indication of which orders have been completed in the ED and which ones remain to be done in the GIM. See Table 19 for a comprehensive list of relevant items.

**Table 19 – Items communicated during ED-GIM nursing handover**

<table>
<thead>
<tr>
<th>Patient information</th>
<th>PowerChart</th>
<th>Oacis</th>
<th>EPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Admitting diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allergies</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Code status</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Isolation requirements</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Monitoring level required</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Vital signs and nursing physical assessment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen delivery</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake and output (IV, urinary, etc)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medications administered and pending</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tests (labs/diagnostics) completed and pending</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Treatments and therapies completed and pending</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

The extent to which the EHR is used as a communication aid varies among the three institutions.
The nursing handover at MSH occurs face-to-face, and the EHR is used as a communication aid throughout in conjunction with the paper chart (see Figure 17). The nurses have expressed that they appreciate that orders are accessible in one place inside the EHR; however, the handover conversation is key for clarifying these orders since the layout (in particular the layout of the MAR) seems unintuitive.

The nursing handover at SHSC occurs over the phone, using the communication aids summarized in Figure 18. The paper orders are typically not well-consolidated, and difficult to
communicate. After the transfer is complete, the GIM nurse consults the paper chart and EHR to learn more about the patient.

**Figure 19 – TGH handover: communication aids**

![Diagram showing ED nurse filling in transfer note and GIM nurse reading it with paper chart and EHR reference]

The nursing handover at TGH occurs through a transfer note in the EHR. The ED nurse fills in the transfer note with summarized patient information using the paper chart and EHR as a reference (see Figure 19 for details). The GIM nurse prints out and reads the transfer note, and also looks at the patient’s paper chart and the EHR for orders, for the MAR, and for any abnormal results.

**Use of EHR in ad-hoc communication**

During phone communication with other clinicians (i.e. allied health, imaging, pharmacy, other medical specialists, etc), physicians often access patient information from the paper chart or the EHR, typically using these tools to learn:

- test results; and
- current orders.

It follows that when paged physicians usually return the calls in close proximity to the paper chart and a computer terminal with EHR access. Having this type of patient information accessible on a mobile device might be beneficial to support phone communication during transit between units.
Other communication aids

Other sources of information that enable communication, but which are unavailable in the EHRs, include:

- a sign-out summary print-out of key patient information, which is used to support communication among GIM physicians (see sections 3.4.13 and 4.4.14, and Appendix F);
- the ED whiteboard system, which includes information about the responsible clinician, consultation status, pending tests, and GIM bed availability (see sections 3.4.10 and 4.4.10, and Appendix F); and
- checklists, which are used to support the ED-GIM nursing handover (see sections 3.4.12 and 4.4.13, and Appendix F).

Conclusion

The patient information needed to facilitate communication between clinicians during ED-GIM patient transfers was presented in this section. Some of this information is already available in the EHR, while other items are only available on paper or within other specialized software (e.g. patient sign-out tool, electronic whiteboard). Patient information that is presented within the EHR rather than on paper better supports communication since it is easily accessible by multiple clinicians at once, and simplifies the task of compiling and visualizing data (e.g. medication administration schedule, trends for lab results). There is an opportunity to improve the role of the EHR in supporting communication between clinicians by expanding its scope to include patient information that is currently only available on paper.

7.2 EHR on a mobile device

What subset of information from EHRs would be best provided on a mobile device to enable effective communication?

The need for EHR access while in transit was assessed through direct observation and clinician feedback (sought directly during shadowing and in the semi-structured interviews).
Medication administration record and vital signs capture

Medication administration and vital signs capture are two high-risk areas within the nursing workflow. EHR access on a mobile device could provide a powerful support to these activities.

ED and GIM nurses are very mobile within their wards, but usually travel only very short distances (less than 30 seconds), between the nursing station, patient rooms, and supply rooms. Direct observation revealed that a typical workflow for ED and GIM nurses at MSH involves looking up the orders or medications in the EHR at the nursing station computer terminals, picking up needed medications and/or supplies from another room, entering the patient’s room for direct care or medication administration, and then returning to the nursing station for charting.

The researcher identified two key areas, common to all three hospitals, where the nursing workflow may lead to negative patient safety consequences:

- Nurses have to memorize the types and dosages of medication needed for each patient between the time they look at this information on the EHR or paper MAR and deliver the medication to the patients in their rooms. Each nurse typically is responsible for several patients, many of whom are prescribed several medications at once. Hence the memory load on nurses is high, which can lead to mistakes in the medication administered.
- After taking the vital signs inside a given patient’s room, nurses typically write this information down on a glove or a scrap piece of paper and then transcribe it into the EHR or paper chart at the nursing station. This process of recording vital signs away from the point of care using manual transcription can lead to mistakes or delays.

Some of the study’s user feedback supports the notion that medication administration and vital signs capture could be improved through mobile access to patients’ records. The ED nurse interviewed at MSH would have preferred to record the medications administered while administering them inside patients’ rooms. The current workflow of medication administration and documentation holds a high patient safety risk, as explained by the ED nurse:
The most unsafe way, which a lot of people do, is they go through the meds, they pour them all into a cup, [...] and they probably threw out [the packaging], so then they’re trying to remember which ones they gave and which ones the patient refused.

The ED nurse also found it helpful to have a mobile device with EHR access so that, in cases where patients asked questions, nurses could capture vital signs or check orders while at the bedside.

However, not all feedback about the idea of introducing new mobile devices was positive. In fact, most responses indicated that ED and GIM nurses at SHSC are satisfied with the current situation and do not wish to access the MAR or perform vital signs capture on a mobile device. A GIM nurse from MSH stated in the interview that access to the MAR on the computer terminals at the nursing station, at the medication room, and inside patients’ room is sufficient, adding:

If I try to walk and check the information at the same time I think I’ll probably just walk into somebody.

Stat orders

Stat orders are written down as regular orders (on paper and/or in the EHR) and communicated to the nurse verbally by the physician. Although no problem incidents were observed, this workflow can lead to delays, as physicians may not find the nurse responsible and either be forced to relay the message through someone else or simply forget to notify the nurse. Direct feedback confirmed that occasionally nurses are not notified of stat orders. A mobile device could be used to alert nurses of stat orders, although the benefits of this would have to be weighed against the disadvantage of introducing new interruptions.

Pending patient arrival

GIM nurses at TGH typically check for the presence of the transfer note in the EHR as an indication of a pending patient transfer from the ED; the note is then printed and read by the nurses. Since GIM nurses are very mobile within the ward, the arrival of the patient from the ED was often observed to catch them unprepared, as they did not have time to check whether the
transfer note was completed in EPR. A mobile device could be used to alert the GIM nurse of pending patient arrival.

**Recent test results and order entry**

GIM physicians are often in transit between the ED and various GIM units. When required to see a patient, they usually travel immediately to the unit where the patient is located. They then either visit the patient first and access the EHR at a nursing station computer terminal afterwards, or vice-versa. At SHSC, since more of the charting is paper-based, physicians have been seen to carry with them parts of the paper chart, including their own consultation notes, for up to an hour and use it as a communication aid while answering or making calls to request tests, consultations, etc.

When physicians carrying a mobile phone receive a call while in transit, they often rely on memory to communicate patient information. Access to this information on a mobile device may be helpful to decrease their memory load.

While some of the GIM physicians expressed that they would prefer to access the EHR on a mobile device rather than a computer terminal, others declared that they had no need for EHR access while in transit. Those supportive of EHR access on a mobile device stated that they would like to perform all typical activities on the device (e.g. accessing patient information, including lab work, vital signs; placing orders, etc). Positive feedback from the GIM junior resident interviewed at TGH included:

_EPR on my BlackBerry? That would be great!_

The ED nurse from MSH stated during the interview that mobile access to the EHR might help physicians enter orders on the fly, which could speed up the ordering process.

EHR access on a mobile device may benefit the GIM physician workflow though the extent of this benefit is as of yet unclear. The information best provided on a mobile device would likely be recent test results and orders. Order entry functionality would likely be beneficial as well.
Short summary of current diagnosis and course of action

Direct observation revealed that most GIM physicians print out a summary of diagnosis and course of action for several patients in their care, using an electronic sign-out tool (see sections 3.4.13 and 4.4.14, and Appendix F). They then use the print-out as a reference and “to do” list for the duration of the shift, referring to it during shift handovers, bullet rounds, and impromptu communication with other physicians or nurses. The main concern regarding this workflow involves the risk of losing the paper, which could lead to a breach of patient confidentiality. The use of a secure mobile device for this purpose would mitigate this risk.

Feedback from the GIM physicians supports the notion that the sign-out summary would be useful on a mobile device. The GIM junior resident interviewed at TGH mentioned that the sign-out tool should be updated more frequently; a mobile platform could facilitate this. However, the feedback also suggests that the paper print-out would still be preferred for quick note-taking, even if the information were available on a mobile device:

*Functionality-wise I think even if it was available on my iPhone I would take a paper copy with me. Nothing beats the ability to write things down.*

In conclusion, a mobile sign-out summary view that was both succinct and easy to update, and included diagnosis and course of action for several patients, would likely be useful to GIM physicians on a mobile platform.

User-customizable alert system for critical test results

Direct observation revealed that physicians typically are informed of critical patient test results by attending nurses or by repeatedly checking for results in the EHR. For the exchanges between physician and nurse, the lines of communications are not ideal, relying on antiquated methods such as paging. This workflow may introduce delays, which is particularly problematic since patients often have time-sensitive care needs. At the time of the present study, none of the hospitals had automatic alert systems in place for announcing critical results to the GIM physicians.
Paradoxically, introducing an alert system for critical results may become more detrimental than beneficial to patient safety because of the associated increase in interruptions. This design tension can be mitigated by ensuring that the system can be customized by the user to minimize unwanted interruptions. Feedback provided by a GIM physician during the interview supports this notion:

*It would be nice if you could set alerts so blood work results actually come to your phone if you wanted to. So, when you turn on EPR you could set an alert and say, send it to my BlackBerry as soon as the result is back. That would be cool.*

In conclusion, a user-customizable alert system for critical results could be useful to GIM physicians on a mobile platform.

**Conclusion**

Although feedback is mixed regarding the notion of EHR access on a mobile device, clinicians tend to agree on the most useful subset of information that it could include. This is shown in Table 20.

**Table 20 – Items that might be useful on a mobile platform**

<table>
<thead>
<tr>
<th>Patient information</th>
<th>ED nurse</th>
<th>GIM nurse</th>
<th>GIM physician</th>
<th>Confidence level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medication Administration Record</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>medium</td>
</tr>
<tr>
<td>Vital signs capture</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>high</td>
</tr>
<tr>
<td>Stat orders</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>high</td>
</tr>
<tr>
<td>Pending patient arrival</td>
<td></td>
<td>✓</td>
<td></td>
<td>low</td>
</tr>
<tr>
<td>Recent test results</td>
<td></td>
<td></td>
<td>✓</td>
<td>high</td>
</tr>
<tr>
<td>Order entry</td>
<td></td>
<td></td>
<td>✓</td>
<td>high</td>
</tr>
<tr>
<td>Short summary of current diagnosis and course of action</td>
<td></td>
<td></td>
<td>✓</td>
<td>high</td>
</tr>
<tr>
<td>User-customizable alert system for critical test results</td>
<td></td>
<td></td>
<td>✓</td>
<td>medium</td>
</tr>
</tbody>
</table>
7.3 Communicating ownership to follow through

*How does ownership to follow through on tasks or patients transition from one clinician to another?*

**Synchronous communication**

Ownership to follow through on tasks or situations is typically communicated implicitly, during synchronous direct communication (face-to-face, phone). Occasionally, it is stated explicitly during these conversations, in particular within a team working together closely (e.g. within the GIM team, the senior resident was observed to give the junior residents or medical students explicit directions to follow up). Communication of responsibility to follow through on some tasks (e.g. “follow up on the CT scan that I just requested”) could potentially be standardized into an explicit task list that could be shared or transferred between clinicians.

**Asynchronous communication**

Ownership to follow through on tasks is also communicated to physicians through paging, and to nurses through orders. Since at SHSC paper orders are usually charted by the nurse who notices them first, rather than the main nurse caring for the patient, the ownership to follow through is not well-communicated.

**The EHR**

Transition of ownership to follow through on tasks or situations is not well-communicated through the EHR. At MSH, the EHR includes a feature for marking orders as “pending review” from nursing, pharmacy, etc, but these are not forcing functions and are often overlooked in practice. Furthermore, PowerChart is also lacking a feature for automatic follow-up (e.g. for stat orders), so following-up becomes a judgment call on the part of the clinician.

Direct observation and informal interviews revealed that the greatest risk of improper transition of ownership to follow through on tasks or situations occurs with parties that lack a strong line of communication and rely almost exclusively on the EHR for communication. An informal interview with a patient navigator at MSH revealed that instances occur when it is unclear who is responsible to follow up. For example, one GIM patient had a radiology test booked in
PowerChart. The patient navigator followed up with radiology 2 days later, only to find that radiology was waiting for a call from the physician to confirm the test, a situation of which the physician was unaware. This anecdote reinforces the fact that the EHR is not helpful for communicating ownership to follow through on tasks or situations. Items can “fall through the cracks”, with a highly negative impact for patient safety.

Multiple medical consultations

The most problematic area regarding transition of responsibility to follow up on tasks at TGH is related to communication and coordination between multiple consulting medical specialists (e.g. GIM, cardiology, urology, etc). At TGH, consultations pending and consultations completed are indicated in the ED electronic whiteboard. However, a GIM physician and ED nurse indicated that recording that a given consultation has been completed in the whiteboard is not ingrained in clinician workflow and is often forgotten. This leads to confusion as to whether a consultation is still pending or not. Direct feedback from ED nurses showed that there are situations in which one patient has multiple orders from different consults and the ED nurse is unsure of which to follow.

Another critical area, as identified during interviews with a GIM junior resident and a GIM nurse from MSH, revolves around follow-up after consultations with other medical specialties. Although there is an option in PowerChart for the consulting clinician to suggest an order (pending approval by the GIM physician), some physicians are not used to this workflow, and update the order in the patient’s paper chart only. Also, there is no reliable system in place at MSH to notify the GIM medical team when a consult is done, so the GIM physician has to keep checking in PowerChart for suggested orders or rely on the nurse for verbal notification. The junior resident interviewed described a common scenario, where the resident kept looking for the suggested orders in the EHR (and assuming that the lack of orders meant that the consult had not yet happened), only to learn the next day that the consult had been done hours before and the suggested order had not been entered in PowerChart. This caused a 24-hour delay in placing an order for that patient, a significant loss of time.
The patient navigator

At MSH, a key player in ensuring that ownership to follow through is well-communicated is the patient navigator. Patient navigators at MSH act as the link between physicians, nurses, AH, external clinicians, and the patient, and also follow-up with tests and bookings. They are permanent workers, who act as “institutional memory”, meaning that they understand the technology, support the local policies and practices, and mitigate problems related to resident rotation which takes place every couple of months. In addition, patient navigators have a sense of everyone's schedule and can physically locate clinicians with ease. In their work, they use the following tools: binder with personal notes, WIPS sign-out page, pager, mobile phone, and PowerChart. The main benefits of the presence of patient navigators are that they act as a safety-net for potential communication issues, facilitate communication between clinicians, take on a patient-centric perspective, and act as a link between stationary nurses and mobile clinicians. The main risks associated with too much reliance on patient navigators are that their limited clinical expertise can create issues when relaying clinical information and that relaying messages carries the normal “broken telephone” game danger of miscommunication.

Bullet rounds

Another key time for ensuring that items will not “fall through the cracks” is the daily review between the GIM team, GIM nursing, and allied health personnel, called “bullet rounds”.

Patient handovers

Ownership to follow through on patients is transferred between clinicians at set points within the ED-GIM patient transfer workflow, as indicated in the UML workflow diagrams shown in Appendices D, E, and F. For instance, at MSH the GIM physician becomes responsible for the patient once the decision to admit is documented in the EHR, and the GIM nurse becomes responsible for the patient once the patient is physically brought to the GIM unit by the ED nurse (and the nursing handover has taken place). Responsibility for the patient is also transferred at shift changes through scheduled face-to-face handovers. This explicit process ensures that clinicians are constantly aware of the patients that they have in their care.
However, external parties (e.g. allied health, consulting physicians, etc) may not be aware that this shift of responsibility has occurred. For instance, direct observation revealed several instances of clinicians, unsure of the transfer status, calling to find out the current location of a patient.

Another common problem with patient transfers is that clinicians often have difficulty knowing whom to contact (see a description of this issue at MSH in section 3.5). A centralized, up-to-date repository of contact and scheduling information for all caregivers in the hospital is lacking, which makes coordination of care difficult. The ED nurse interviewed at MSH described an example that perfectly exemplifies this issue:

*We took a patient upstairs and they were a GI patient, and they went to a GIM floor so the GIM nurse called and said, I don’t recognize the admitting doctor’s name, so I don’t know whom to contact for care on this patient.*

Transition of ownership between the ED and GIM nurses is more problematic at TGH compared to MSH and SHSC, since there is a lack of direct synchronous communication. Having the nursing report delivered asynchronously through a note in the EHR is seen by the ED nurses as a less reliable form of transition of ownership:

*The whole verbal or face-to-face communication comes more into play because I know your face now, I’m giving you the report, it's all on you now and you can't come back at me saying, well, you didn’t tell me this. (TGH ED nurse).*

The follow-through on giving a patient medications was particularly problematic, as the GIM nurse sometimes expected the patient many hours prior to arrival, and on finally arriving the patient was long past due to receive medications.

**Conclusion**

Ownership to follow through on tasks or situations is typically communicated implicitly during synchronous communication, either in person or over the phone, which carries the risk of failure to follow through. Occasionally, ownership is stated explicitly (e.g. “please follow up on the CT
scan that I just requested”), and there is potential for standardization into an explicit task list to be shared or transferred among clinicians.

The ownership to follow through is typically not communicated through the EHR, whiteboards, or other such IT tools. Ownership to follow through on tasks is also communicated to physicians through paging and to nurses through paper or electronic orders.

Coordination of tasks among multiple caregivers (e.g. GIM physician, consulting physician from another medical specialty, radiologist, etc) is particularly difficult, and ownership to follow through is not always well-communicated. Nurses are often the main links in this scenario, although MSH also employs “patient navigators” who act as connections between various clinicians involved in a patient’s care and who also follow up with tests and bookings.

Daily meetings between physicians, nurses, and allied health personnel, called “bullet rounds”, play an important role in ensuring that items do not “fall through the cracks”.

The ownership to follow through on patients is transferred explicitly between clinicians, at set points within the ED-GIM patient transfer workflow. However, external parties (e.g. allied health personnel, pharmacy, radiology) may not be aware that this shift of responsibility has occurred.

7.4 Influence of context features on ideal communication aids

What are context features that influence the type of information needed to facilitate communication (e.g., patient characteristics, clinical context)?

Some context features that were hypothesized to influence the information exchange (particularly, the type of information needed to facilitate communication) were explored during direct observation, and include:

- time of day (workload of the unit), and
- patient acuity and special needs.
While these factors did not have an observable impact on the type of information needed to facilitate communication, other factors did, such as:

- number of previous hospitalizations,
- complexity of the care plan, and
- the type of clinicians involved.

**Workload of ED and GIM units**

Direct observation sessions were conducted at various times of the week and day in order to cover both very busy and less busy times. At MSH, out of 5 sessions, the level of activity in the ED was considered average for 3, less than average for 1, and greater than average for 1. During one session in particular, the GIM team was extremely busy (understaffed with 10+ admissions). Direct observation revealed that information exchange occurred in a similar manner during all of these scenarios, although it was somewhat rushed when the clinicians were very busy, causing communication aides such as the EHR to be used less often. This trend was also observed at SHSC and TGH, where the information needed to facilitate communication did not seem to depend on how busy the ED and GIM units were.

**Patient acuity and special needs**

The level of patient acuity and any special needs were noted for each ED-GIM patient transfer observed. At MSH, the Canadian Triage and Acuity Scale (CTAS) is used as an index of patient acuity, ranging from 1 to 5 (1=immediate life threat, 2=need immediate treatment, 3=distress, 4=minor injuries, 5=not acute). The scores for each of the 5 MSH transfer patients observed were: TBD, 2, 3, 3, and 3. In addition, 2 of the 5 patients were in need of isolation. Neither the slight differences in CTAS scores, nor the special needs seemed to influence the type of information needed to facilitate communication between clinicians. This could be due, however, to the very small variations in CTAS score between the patients. As with MSH, the CTAS scores of patients at SHSC and TGH varied between 2 and 3 and did not seem to influence the type of communication aides used by clinicians. However, at all the sites special patients needs such as isolation or telemetry monitoring did influence the type of GIM room required by the patient and represented an important piece of information to be communicated during the nursing transfer.
At TGH during pilot shadowing, a patient being transferred to the GIM from the ED needed to first travel to Princess Margaret Hospital for a consultation before arriving in the GIM. This extenuating circumstance not only made the Transfer Note from the ED nurse ‘stale’, but also meant that on arrival in the GIM the patient was already several hours late for receiving medications. This kind of situation requires the ED nurse to call the GIM nurse directly, rather than relying on information communicated asynchronously through a transfer note.

**Previous hospitalizations**

It was observed at all three sites that doctors had difficulties accessing some of the information for patients that had many caretakers and had been in and out of hospital for a long time; accessing data from other hospitals was particularly challenging. These scenarios meant more time was invested in communication and increased the chances of gaps in a patient’s story, which represent a patient safety risk.

**Complexity of care plan**

One of the 5 transfer patients at MSH had a particularly complex care plan, including many different medications. For this patient, it was observed that the ED and GIM nurses had to use (to a greater extent than usual) the orders and MAR in PowerChart as a communication aid during the nursing handover. Furthermore, patients with a complex care plan at TGH would require the ED-GIM nursing transfer to take place synchronously (most likely, through a phone call), rather than be based solely on information communicated asynchronously through a transfer note.

**Clinician type**

Various types of clinicians are interested in different aspects of patient care, so they need different types of information to facilitate communication within their group. For instance, nurses are more interested in orders, in particular ones that they have to carry out; doctors are more interested in discussing results; and AH or other consults are more preoccupied with particular aspects of the patient condition or patient care that involves them. This tendency applies to all three hospitals under study.
Conclusion

The main factors that influenced the type of information needed to facilitate communication are:

- previous hospitalizations,
- complexity of care plan, and
- the type of clinician involved in the communication.

Specifically, previous hospitalizations require more communication, and access to data from other institutions is typically very challenging. Similarly, if the patient has special needs (e.g. telemetry, isolation, etc) or a complex care plan, this information needs to be communicated directly, and any communication aids (e.g. the MAR) must be used to a greater extent.

Finally, various clinicians are interested in slightly different aspects of patient care, which translates into a difference in requirements regarding information needed to facilitate communication. For example, nurses use orders and the medication administration schedule more extensively, while physicians are more interested in the patient’s past history and test results.

7.5 Influence of mode of communication on information exchange

*Does the mode of communication influence the type of information exchanged?*

**Synchronous vs. asynchronous communication**

Synchronous communication (i.e. over the phone or face-to-face) allows for a rich exchange of patient information and offers both parties a chance to ask questions, while asynchronous communication (i.e. alphanumeric paging, SMS) is more factual and brief.
As illustrated in Figure 20, synchronous communication is best suited for communicating complex issues, since it facilitates communicating context and ensuring that the message is understood. On the other hand, for non-urgent, simple requests, asynchronous communication is sufficient.

Both scenarios arise frequently in practice, so having a set line of communication regardless of the type of request (e.g. paging followed by phone conversation only), although the norm today, is clearly inefficient and can lead to delays and miscommunication.

**Charting**

The EHR is a special case of asynchronous communication, which, if implemented fully and updated in a timely manner, would allow clinicians to share a large amount of patient information. However, since clinicians cannot trust that the EHR information is up-to-date and complete, they usually supplement EHR use with direct communication, which typically occurs face-to-face. Although seemingly redundant, communicating through both the EHR and directly (e.g. face-to-face, by phone, etc) may help improve patient safety by providing an additional chance to catch any issues.

Physical proximity to the patient’s paper chart and computer terminals with EHR access often dictates the extent to which these tools are used to facilitate communication.
Conclusion

Clinicians are currently provided with set means of communication (e.g. nurses page physicians) which dictate the type of information that can be exchanged. However, the reverse should ideally be true: the communication means available to clinicians in any particular situation should be dependent on the type of information exchange required.
8.1 Conclusions

Based on the rich data collected through direct observation and interviews at MSH, SHSC and TGH, Chapters 3, 4 and 5 set the stage for an in-depth analysis of communication during the ED-GIM patient transfer, by describing the workflow and communication tools used during the process. Next, Chapter 6 compared the workflow at each site and the primary communication tools used, highlighting the main differences and emerging themes. Finally, Chapter 7 addressed the research questions, exploring ideas such as EHR use as a communication aid on mobile devices, transfer of responsibility among clinicians, and influence of context features and mode of communication on the information exchanged. Based on the work presented in previous chapters, this section introduces the most critical communication issues, some design guidelines for technological interventions that would address these issues (design trade-offs and broad principles), as well as design guidelines for a specific project involving a “smart” paging system.

8.1.1 Communication issues

As outlined in previous chapters, direct observation at the three sites revealed many usability and workflow issues around the ED-GIM patient transfer process and communication tools used during this process. Out of these, the eight communication issues listed in Table 21 were the most prevalent. The red symbol (★) signifies that these communication issues are considered critical, meaning that they could endanger patient safety and/or very negatively impact users’ tasks and their experience, which in turn affects patient safety.
### Table 21 – Communication issues and related patient safety risk

<table>
<thead>
<tr>
<th>Communication issue</th>
<th>Main patient safety risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. There is a high reliance on interruptive communication. All clinicians engage in interruptive communication, particularly face-to-face. In addition, hospital tools such as pagers, common phone lines, and overhead paging also contribute to a chaotic, distracting work environment. Interruptions have been shown to cause disruption in working memory, generating errors.</td>
<td>Errors in providing patient care, consequences vary depending on interrupted activity</td>
</tr>
<tr>
<td>2. Numeric pagers involve severe workflow inefficiencies and cause delays. Although an antiquated means of communication, numeric pagers are often used at all three hospitals, particularly as a means for nurses to get in touch with physicians regarding patient status updates or patient care concerns. The workflow involves the caller having to wait for a call-back near the nursing station phones, and the receiver of the page to immediately search for a phone, without being made aware of the urgency of the issue. Delayed or unanswered pages are the norm, and user feedback regarding numeric paging is unanimously very poor.</td>
<td>Delays in patient care</td>
</tr>
<tr>
<td>3. Clinicians are required to use a multitude of unconnected specialized tools, which introduces workflow inefficiencies and delays. Physicians often carry multiple devices (multiple pagers, hospital-provided smartphone, personal phone, etc), which can make prioritizing and answering medical requests difficult. All clinicians have to interact with multiple patient information systems. For instance, an ED nurse at SHSC needs to interact with EDIS, BMS, the EHR, and the smart web paging interface, at a minimum. Work duplication is often an issue, as clinicians are required to chart similar patient-related information in up to four different systems. Accessing this multitude of information sources is also difficult and time-consuming.</td>
<td>Delays in patient care Inaccessible patient information</td>
</tr>
<tr>
<td>4. There is a lack of awareness among clinicians regarding completion status of patient tests and consultations. Clinicians, particularly mobile physicians, are often unaware of the completion status of other consultations. Since orders suggested by other consulting physicians require consent from the most responsible physician (i.e. the GIM resident after patient admission to GIM), this workflow is often associated with delays. Nurses must typically follow up with the GIM physician directly, and in cases where there is an electronic ordering system, the GIM physician checks the EHR repeatedly for orders suggested by the consulting physician. There is often a lack of communication regarding the patient’s schedule or current location, as several instances were observed where the patient had left for a CT scan procedure, but the physicians as well as the nurses responsible were unaware. This information is sometimes communicated using the electronic whiteboards, though this system is not ideal because it requires manual updating, and the display layout is unintuitive.</td>
<td>Delays in patient care</td>
</tr>
<tr>
<td>Communication issue</td>
<td>Main patient safety risks</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>5. The paper chart is an inefficient means of storing and accessing patient information. Paper charting is used extensively at the three sites. The main associated issues include hand writing legibility, delays and interruptions associated with its use by multiple clinicians concomitantly, inability to search through the information, and the risk of ignoring or losing parts of it if unbound. Paper orders are particularly dangerous, as they are difficult to compile and changes to orders can easily remain unnoticed.</td>
<td>Missing, duplicated, wrong or incomplete orders Delays in patient care</td>
</tr>
<tr>
<td>6. Many of the hospital software tools, particularly EHRs, have unintuitive user interfaces. Each of the three EHR systems analyzed in this study has severe usability issues, particularly surrounding order entry and results viewing. Finding a new order usually involves interacting with an index search based system, and viewing results involves too many steps. Furthermore, other software programs that clinicians interact with on a regular basis, such as electronic whiteboard systems, and SHSC tools such as EDIS and the smart web paging interface have cluttered interfaces that are difficult to use. Consequently, clinicians have been observed to struggle repeatedly when interacting with these systems.</td>
<td>Mistakes in entering clinical information (including orders) Delays in retrieving clinical information (e.g. test results, MAR)</td>
</tr>
<tr>
<td>7. The mixed use of EHR and paper ordering causes confusion and delays. At MSH, ED nurses receive electronic orders from GIM physicians, while orders from ED physicians are written on paper. This often causes delays, as nurses are not in the habit of checking the EHR for orders during their regular practice. Nurses at TGH receive orders both on paper and electronically, which causes redundancy and confusion. Also, electronic orders are sometimes duplicated on paper, and it is unclear which set of orders should be followed.</td>
<td>Duplicated or incomplete orders Delays in patient care</td>
</tr>
<tr>
<td>8. Finding the contact information for the right clinician at the right time is difficult. It is very difficult for clinicians to find out the identity and contact information of other clinicians, particularly during off-hours. All of the hospitals lacked an accessible and comprehensive hospital-wide contact information list or on-call schedule. The smart web paging system implemented at SHSC is closest to filling in this role; however, it falls short due to its user interface which is not easy to use. Clinicians often learn the identity of others involved in their patient’s care and exchange contact information directly with them when both parties attempt to use the patient’s paper chart at the same time.</td>
<td>Delays in patient care</td>
</tr>
</tbody>
</table>
As confirmed by interviews with GIM physicians, although patient safety incidents related to ED-GIM handovers were not directly investigated in the present study, they represent a common-place occurrence:

*It's very often on a clinical basis that we notice, like, almost every patient there's something missing that we thought was done but it's not done and you wait days and days and days, and sometimes patients stay in hospital days and days and days, waiting to have something done that was supposed to have been done in emerge or on the floor or just...or it gets done twice.*

Individual recommendations to address the issues listed in Table 21 are not provided, due to the complexity of the communication web and interrelated nature of these issues. Instead, design trade-offs and several general design principles for a system-wide solution are provided in the following sections.

### 8.1.2 Design trade-offs

Any developer planning to address the shortcomings of current hospital communication tools should be aware of the fact that there is no “right answer”. The ideal technological intervention will depend on specific use case scenarios, and at times on factors that are difficult to measure, such as hospital culture and personal preferences.

Emerging themes from the present ethnographic study revealed several conflicting user needs. Awareness of these “paradoxes”, or “trade-offs”, represents a first step towards developing communication tools that better meet the needs of clinicians and improve patient safety.

**Synchronous communication vs. reducing interruptions**

Most clinicians prefer synchronous communication, since it allows for the provision of story and context and for immediate clarification. However, synchronous communication is extremely interruptive, and interruptions have been shown to contribute to errors and negatively affect patient safety.
To help resolve the paradoxical task of providing clinicians with means for synchronous communication while reducing interruptions, context-aware smartphones that become “silent” when the user is engaged in safety-critical tasks could be considered. Based on lessons learned from deployment of a suite of context-aware technologies which included a mobile phone application displaying current location of clinicians on surgical wards, Bardram et al (2006) concluded that context-aware applications are useful for clinicians.

Notification of change of patient status vs. reducing interruptions

Direct observation and feedback from clinicians revealed an important and recurring patient safety risk related to delays in communicating orders and test results to the clinicians concerned.

**Figure 21 – Common changes of patient status**

![Figure 21](image)

Figure 21 provides an overview of the type of patient status changes communicated amongst clinicians. Orders include nutrition, tests, and medication. Test results include radiology, microbiology, hematology, biochemistry, and vital signs. Orders and test results can usually be found in the EHR.

Although stat orders and abnormal results are classified as urgent (see Figure 21), nurses currently rely on physicians to remember to notify them verbally of any stat orders, and physicians rely on nurses to page them once they notice an abnormal test result.

The challenge is creating a system that automatically notifies clinicians of these changes of status without adding unnecessary interruptions. Clinicians currently use their discretion to only interrupt others with urgent or important items. An automated system that alerts clinicians of all changes in patient status would generate an intolerably high number of interruptions which would negatively affect patient safety.
This tension could be resolved by allowing users to customize the level of alerts received on their mobile device for each patient in their care, and, using context-awareness technology, to program for interruption only if the urgency of the alert is higher than the urgency of their current task.

**Portability of mobile device vs. screen size**

When presenting clinical information on a mobile device, the choice of device is an important factor dictating the level of user adoption.

**Figure 22 – Trade-off between portability and screen size of mobile device**

As shown in Figure 22, the choice between the two main categories of mobile devices (tablets and smartphones) involves a trade-off between portability and screen size. The ideal device will depend on the application and user preference.

The type of applications created for the mobile device should take into account the screen size and limit user interaction to simple tasks (e.g. there is no need for the device to support the entry of extensive free text, as this can be performed at computer terminals).

**Speed vs. quality of ED-GIM nursing handover**

Direct observation revealed a trade-off between speed and quality of the nursing handovers for patients admitted from the ED to the GIM.
As shown in Figure 23 and detailed in section 6.1, the most thorough handovers involve face-to-face communication between the ED and the GIM nurse, as both examine the patient chart together; however, these require the ED nurse to travel with the patient to the GIM unit, which can be very time consuming. The fastest approach involves handover through a form (paper or electronic) filled out by the ED nurse; however, this approach lacks synchronous communication, which is important for conveying the patient’s story, and providing immediate clarifications. A compromise between these two approaches involves a phone handover, which is of middling speed by comparison and allows for a moderate level of synchronous communication.

A potential novel way to resolve the tension between speed and quality of handover is to enhance phone communication by introducing video calling and a shared desktop solution, which would allow nurses to consult the patient EHR simultaneously while pointing out the items of interest.

**Information privacy vs. accessibility**

Direct observation revealed a trade-off between information privacy or the security of communication tools and their accessibility, as shown in Figure 24.

**Figure 24 – Trade-off between security and accessibility**
Tools such as the EHR and hospital-provided smartphones are password-protected. While this helps address information privacy issues, it also introduces an additional step which makes the tool less accessible to users. This trade-off is evident in the example of smartphones used by GIM nurses at MSH: the requirement that nurses enter a password before answering a call leads to missed calls. On the other hand, printed patient information and unencrypted SMS on personal phones involve a risk of breach of patient confidentiality, but high accessibility and user convenience.

The tension between information privacy and accessibility could be resolved by ensuring that data is only stored and exchanged on encrypted, password-protected devices, while minimizing the number of different passwords required and ensuring that password entry does not impede time-sensitive tasks such as answering a call.

8.1.3 Broad design principles for technological interventions

This section provides general guidance for the design of an intervention that could improve the overall communication and information access workflow during ED-GIM patient transfer. The main emphasis is on connectedness, as it is important to correct the problems stemming from the current multitude of isolated, specialized hospital IT tools. Furthermore, the solution is not department-specific: in order to minimize interdepartmental communication breakdowns (such as those that occur during ED-GIM patient transfers), it needs to be implemented consistently throughout any given hospital.
In order to cover all facets of communication and information access, the suggested solution maps itself onto three closely interconnected subsystems: an EHR system, an electronic whiteboard system, and a mobile communication system (see Figure 25). Several broad principles for each subsystem were derived based on ethnography findings.
The EHR system should have a flexible format, include summaries, be comprehensive, allow easy updates, be read without difficulty, and mitigate interruptions (see Table 22).

Table 22 – EHR system

<table>
<thead>
<tr>
<th>Finding</th>
<th>Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>A main complaint of electronic clinical documentation has been that clinical data becomes overly structured into forms and checkboxes, and meaning is lost in the process. Since clinicians communicate through narratives, the EHR should support this process.</td>
<td>Flexible format – The solution should not lead to over-structuring data, and allow users the ability to record and access free text.</td>
</tr>
<tr>
<td>A summary view has been identified as key information missing from the current EHR systems. Summaries, such as those created within the GIM sign-out tools, and nursing transfer checklists, are used extensively to support communication and handovers between clinicians (see sections 7.1 and 7.2).</td>
<td>Includes summaries – The solution should include a summary of the patient’s diagnosis, treatment, and any other patient-specific important items. This is would also support handovers.</td>
</tr>
<tr>
<td>Paper charts are used extensively at the three sites, although they are an inefficient means of storing and accessing patient information, and can cause confusion (see issue #5, Table 21). The mixed use of EHR and paper ordering causes confusion and delays (see issue #7, Table 21).</td>
<td>Comprehensive – The solution should include all aspects of patient care (e.g. vitals, radiology images) and interface with existing systems to eliminate the need for paper records.</td>
</tr>
<tr>
<td>The EHR user interfaces are unintuitive, which results in EHR records not being updated consistently (see issue #6, Table 21). The EHR systems are not used at the point-of-care, and not automatically updated (e.g. vital signs are never imported directly).</td>
<td>Easy to update - Automated as often as possible. Intuitive user interface for data entry (e.g. order entry).</td>
</tr>
<tr>
<td>The EHR user interfaces are unintuitive, which results in user frustration and inefficient data access (see issue #6, Table 21). Viewing test results and the medication administration record are two key problem areas (see section 6.2.1).</td>
<td>Easy to read – Intuitive user interface for accessing data (e.g. viewing and graphing results, critical values, orders, medications).</td>
</tr>
<tr>
<td>Clinicians rely on interruptive communication (see issue #1, Table 21) and are often interrupted while interacting with EHR systems.</td>
<td>Mitigates interruptions – The solution should facilitate resuming interrupted tasks.</td>
</tr>
</tbody>
</table>

The EHR system should connect to the EHR and other hospital equipment, be comprehensive, and feature a layout that is easy to read (see Table 23).
Table 24 – Mobile communication system

<table>
<thead>
<tr>
<th>Finding</th>
<th>Principle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinicians rely on interruptive communication, and they are aware of the status of other clinicians (i.e. Are they currently busy and should not be interrupted? Is the consultation done? Are they on the floor?). See related issues #1 and #4, Table 21, for further details.</td>
<td><strong>Context awareness</strong> – The mobile communication system should be context-aware (e.g. current location, busy status, priority of the call, etc) to minimize interruptions and optimize workflow.</td>
</tr>
<tr>
<td>Asynchronous communication is factual and brief, and well suited to some clinical situations (see section 7.5). Messages are useful if they convey the urgency and the identity of the caller, and clinicians can respond easily and know if their message was read (see section 6.2.3). Numeric pagers fail to properly support asynchronous communication (see issue #2, Table 21).</td>
<td><strong>Support two-way asynchronous communication</strong> – The solution should communicate the urgency, the identity of the caller, means to respond by message, and confirmation that the message was read.</td>
</tr>
<tr>
<td>Clinicians prefer synchronous communication in most instances (despite it being interruptive), as it allows for a rich exchange of context, story, and a chance to ask questions (see section 7.5).</td>
<td><strong>Support synchronous communication</strong> – Synchronous communication should be supported; interruptions can be mitigated through context awareness.</td>
</tr>
<tr>
<td>Finding the contact information for the right clinician at the right time is difficult, particularly during off-hours. All hospitals lack a comprehensive role-based, hospital-wide contact information system (see issue #8, Table 21).</td>
<td><strong>Support role-based calling</strong> – The solution should support hospital-wide role-based communication, connected to the current clinician schedule.</td>
</tr>
<tr>
<td>Transfer of responsibility among clinicians leaves room for items to “fall through the cracks”. There is potential for generating a task list to be shared or transferred between clinicians (see section 7.3).</td>
<td><strong>Include shared “to do” lists</strong> – The solution should include a “to do” list with items that can be shared or transferred between clinicians.</td>
</tr>
<tr>
<td>Many clinicians would access the EHR on a mobile device, if they had the option. This would improve their workflow and provide access to patient information when needed the most (e.g. at the bedside, as a communication aid during an impromptu conversation), and also speed up physician order entry. An alert system for critical results would facilitate physician workflow, as long as it is user-customizable to reduce interruptions. The ideal device should have adequate network coverage and a quick login procedure. See section 7.2 for further details.</td>
<td><strong>Support data access</strong> – The solution should provide users EHR access and customizable alerts. The device should have adequate network coverage and a quick login procedure. The user interface for data entry and display should be suited to mobile device navigation requirements (e.g. minimize typing).</td>
</tr>
<tr>
<td>Currently, many clinicians opt against using sophisticated web paging systems, and revert to contacting others through locating services, because of the much simpler workflow involved. Many of the hospital tools currently in use have unintuitive user interfaces (see issue #6, Table 21).</td>
<td><strong>Intuitive user interface</strong> – The user interface for the solution should be simple and require few steps to perform an action.</td>
</tr>
</tbody>
</table>

The mobile communication system should support both two-way asynchronous communication, and synchronous communication. It should feature context awareness and an intuitive user interface, and it should support role-based calling, shared “to do” lists, and data access (see Table 24).
Clinicians are required to use a multitude of unconnected specialized tools. This introduces workflow inefficiencies, difficulties accessing data, and work duplication (see issue #3, Table 21).

There is a lack of awareness among clinicians regarding completion status of patient tests and consultations, and current patient location (see issue #4, Table 21). There is a high reliance on interruptive communication. Incoming communication is not filtered based on the urgency of the call or current activity of the interrupted clinicians (see issue #1, Table 21).

Some clinicians prefer to enter and access patient data on a mobile device, while others prefer computer terminals. Short login time is also an important consideration (see section 7.2).

Users rely on both synchronous communication and written (electronic or paper) records of patient information. The mode of communication influences the type of information exchanged (see section 7.5).

The type of clinician involved in the communication was identified as one of the main factors influencing the type of information needed to facilitate communication (see section 7.4). Components of the solution, such as level of alerts for critical results, are most useful if user-customizable (see section 7.2).

Although not addressed explicitly in the study, handing patient information involves important security concerns. Some of the current unsafe practices involve unencrypted SMS and carrying printed summaries of patient information which can be misplaced or lost.

Many of the current hospital software tools have unintuitive user interfaces, which can lead to mistakes and delays in entering or accessing patient information (see issue #6, Table 21).

Finally, it is recommended that the solution satisfy seven broad principles, which were derived from the ethnography findings and are consistent with the existing literature: interconnectivity, context awareness, accessibility, redundancy, user customization, security, and intuitive user interfaces (see Table 25).

### 8.1.4 Design principles for an ideal paging system

#### A. Background

The communication channel between nurses and physicians was identified as problematic at all institutions. Generally, nurses send physicians either a numeric or a text page, and physicians respond by calling the fixed landline phones at the nursing stations; the entire process typically takes up a large amount of time and can cause delays in patient care. Addressing the problems
with this process is especially important, as the page-call back system is the primary means of communication between the physician and nurse responsible for GIM admitted patients during the high-risk period when the patients remain in the ED, waiting for the next available GIM bed.

As explained in section 6.2.3, the smart paging solutions currently implemented at the three sites have important advantages over traditional numeric paging, but retain important drawbacks. A similar type of technology – SMS on personal mobile phones – although unregulated and hence unsecure, is also a common means of avoiding some of the pitfalls of traditional paging. The current section maps these five technologies based on scope and function, and introduces several evidence-based design guidelines for an ideal paging system.

B. Users

Table 26 – Typical users of hospital paging systems

<table>
<thead>
<tr>
<th>USER</th>
<th>Nature of work</th>
<th>Phone access</th>
</tr>
</thead>
<tbody>
<tr>
<td>CALLERS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nurse</td>
<td>Constantly moving between nursing station and patients’ rooms</td>
<td>Fixed landline phones at nursing station (only)</td>
</tr>
<tr>
<td>Physicians</td>
<td>Mobile (between departments)</td>
<td>Fixed landline phones at nursing station Mobile device (many but not all)</td>
</tr>
<tr>
<td>Allied Health</td>
<td>Mobile (between departments)</td>
<td>Fixed landline phones at nursing station Mobile device (many but not all)</td>
</tr>
<tr>
<td>RECEIVERS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physicians</td>
<td>Mobile (between departments)</td>
<td>Fixed landline phones at nursing station Mobile device (many but not all)</td>
</tr>
</tbody>
</table>

Typical users of the paging system outlined in this section are described in Table 26. The main issue with the current “smart paging” systems at the three institutions under study is that the sender of the page is typically required to wait for a call-back near the nursing station phones, which does not fit clinicians’ workflow (i.e. the nurses are constantly busy with direct patient care, and other clinicians are moving throughout the hospital).

C. Usage patterns

The message communicated through paging can be both urgent (e.g. the patient is deteriorating) or non-urgent (e.g. meeting has been scheduled with the patient’s family for the next day). Most issues are patient-specific and involve only one patient. Depending on the issue, the ideal response may take the form of a call-back, an in-person patient consultation, a brief message, or no response (note that in this case, a confirmation that the page was received would be desirable).
D. Mapping of paging and messaging technologies currently in use

Figure 26 – Mapping of paging and messaging technologies currently in use

**SCOPE**

<table>
<thead>
<tr>
<th>GIM physicians only</th>
<th>GIM units only</th>
<th>Hospital - wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text messaging (SMS)</td>
<td>MSH - WIPS</td>
<td>Numeric Paging</td>
</tr>
<tr>
<td></td>
<td>TGH - smart paging</td>
<td>SSSC - smart paging</td>
</tr>
</tbody>
</table>

**CONNECT TO...**

HUB (team pager carrier) → INDIVIDUAL (each clinician)

- MSH - WIPS
- SSSC - smart paging
- TGH - smart paging

Note: In practice, this tool frequently leads to connecting to the wrong individual (when calling through hospital locating service).

**INTERRUPTION MANAGEMENT**

No discrimination by urgency → Accounts for massage urgency

- Numeric Paging
- SSSC - smart paging
- TGH - smart paging
- Text messaging (SMS)

Note: Sometimes urgency is implied through tool use (e.g., at TGH - smart paging for non-urgent issues and numeric pager for urgent issues).

**KEY FEATURES**

<table>
<thead>
<tr>
<th></th>
<th>Numeric paging</th>
<th>MSH - WIPS</th>
<th>SSSC - smart paging</th>
<th>TGH - smart paging</th>
<th>Text message (SMS)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TYPICAL CONTENT</strong></td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>phone extension</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>short text</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td><strong>EFFORT TO SEND MESSAGE</strong></td>
<td>yes</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>dial a phone number</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>find a computer terminal</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>navigate portal</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>search for contact information</td>
<td>no</td>
<td>no</td>
<td>yes</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>type text on mobile phone</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>yes</td>
</tr>
<tr>
<td><strong>REPLY OPTIONS</strong></td>
<td>yes</td>
<td>no</td>
<td>yes</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>call-back only</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>text</td>
<td>n/a</td>
<td>yes</td>
<td>n/a</td>
<td>n/a</td>
<td>yes</td>
</tr>
<tr>
<td>user can acknowledge “message read”</td>
<td>n/a</td>
<td>yes</td>
<td>n/a</td>
<td>n/a</td>
<td>no</td>
</tr>
<tr>
<td>automatic confirmation “message read”</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>
Five different technologies (numeric paging, the smart paging systems in place at each of the three institutions, and SMS on personal phones) were grouped based on several key attributes (see Figure 26). This comparison helped inform design principles for an ideal smart paging solution, presented in the following subsection.

**E. Design principles for ideal smart paging solution**

Several principles for an ideal smart paging solution were derived directly from ethnography findings and are provided in Table 27. An associated confidence rating (high, medium, or low) was calculated for each, based on the amount of supporting evidence and the negative impact on patient safety or clinician’s workflow potentially caused by violating the principle.
<table>
<thead>
<tr>
<th>Finding</th>
<th>Principle</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinicians prefer using one tool to get in touch with others, rather than having to learn how to use multiple department-specific tools. In this respect, the SHSC smart paging system was superior to those implemented at MSH and TGH.</td>
<td>The system should be implemented hospital-wide, rather than limited to a single department.</td>
<td>High</td>
</tr>
<tr>
<td>Sharing one team pager within each GIM medical unit was common at three sites, and it involved relying on memory to pass on messages to colleagues. This practice of introducing a middleman in the communication is not only inefficient and time-consuming, but also poses a high risk for miscommunication.</td>
<td>The solution should ensure that each user on the receiving end of the communication (“receiver”) is equipped with an appropriate mobile device for receiving individual pages, rather than sharing one device among several people (e.g. team pagers).</td>
<td>High</td>
</tr>
<tr>
<td>The role-based search for clinicians (updated based on the current call schedule) included in the SHSC smart paging tool was well-appreciated by clinicians. Using numeric paging to reach clinicians through locating services often results in connecting with the wrong clinician.</td>
<td>The paging system should access an up-to-date database of current schedule and patient assignment information for clinicians, and allow role-based messaging (e.g. most responsible physician, on-call radiologist, etc).</td>
<td>High</td>
</tr>
<tr>
<td>Communicating a short text is strongly preferred by clinicians over traditional numeric paging, since it conveys the identity of the caller, and the topic and urgency of the issue.</td>
<td>The system must support and encourage the user on the calling end of the communication (“caller”) to send a short text rather than just their phone extension.</td>
<td>High</td>
</tr>
<tr>
<td>One main drawback of the smart paging systems implemented at SHSC and TGH was that the clinicians only had the option to respond by phone, although a short message was deemed as a preferred mode of response in many cases. The WIPS system implemented at MSH allowed text responses, but only after logging into a computer terminal, which was considered time-consuming and inconvenient by many clinicians.</td>
<td>The system should support the “receiver” to respond via a short text, which can be sent from both the mobile device and any computer terminal. Similarly, the “caller” should be able to send the message and read the reply from both a mobile device (if they have one) and a computer terminal.</td>
<td>High</td>
</tr>
<tr>
<td>There are many instances when messages are sent for informational purposes only, and do not necessitate a reply. Regardless, it was observed at SHSC and TGH that even in these cases the caller still expects a call-back as confirmation that the message was received.</td>
<td>The system should automatically inform the “caller” when the “receiver” has read their message. This confirmation should be accessible to the “caller” on both a mobile device (if they have one) and a computer terminal.</td>
<td>High</td>
</tr>
<tr>
<td>Finding</td>
<td>Principle</td>
<td>Confidence</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Many instances have been observed at the three institutions when</td>
<td>The system should provide the “receiver” the option to reply with a preset message if a call or</td>
<td>High</td>
</tr>
<tr>
<td>unanswered pages are sent a second or third time, although the receiver</td>
<td>an in-person visit to the unit will follow.</td>
<td></td>
</tr>
<tr>
<td>of the page is planning to call back or drop by for a patient consultation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>when they finish with their current higher-priority task. This lack of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>clarity is time-consuming for the clinicians and leads to more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>interruptions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinicians appreciated the stratification by message urgency provided</td>
<td>The mobile device should only produce a noise for urgent incoming messages. Non-urgent messages</td>
<td>Medium</td>
</tr>
<tr>
<td>by the WIPS smart paging system used at MSH, where the only pieces of</td>
<td>should be retrievable on both the mobile device and a computer terminal. Any replies to urgent</td>
<td></td>
</tr>
<tr>
<td>information pushed on the pager are the urgent messages and the number</td>
<td>messages received on a mobile device should also alert the mobile device user.</td>
<td></td>
</tr>
<tr>
<td>of overdue non-urgent messages. However, the workflow of logging into</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a computer terminal in order to access non-urgent messages was</td>
<td></td>
<td></td>
</tr>
<tr>
<td>inconvenient.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinicians often receive a page while in transit, and then require a</td>
<td>The mobile device should include access to patient information, such as the EHR.</td>
<td>Medium</td>
</tr>
<tr>
<td>computer to look up patient-related information before responding.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to patient information (e.g. the EHR) while in transit could be</td>
<td></td>
<td></td>
</tr>
<tr>
<td>beneficial in these instances.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinicians often communicate responsibility to follow-up implicitly,</td>
<td>Upon receiving a message, the agreed-on follow-up strategy (e.g. call or patient consultation)</td>
<td>Low</td>
</tr>
<tr>
<td>without any standardized tools such as “to do” lists to guide them.</td>
<td>should be automatically added to a “to do” list, to help guide clinicians in their work.</td>
<td></td>
</tr>
<tr>
<td>Invariably, tasks are forgotten and multiple follow-ups become a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>necessity.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prior to a direct patient consultation, many clinicians spend minutes</td>
<td>The message should include the current patient location (unit, floor, and room number), updated</td>
<td>Low</td>
</tr>
<tr>
<td>interacting with various software systems, whiteboards, or asking</td>
<td>automatically from a reliable source (e.g. a patient tracking device) in case an in-person</td>
<td></td>
</tr>
<tr>
<td>other clinicians about the current location of the patient that they</td>
<td>consultation is needed.</td>
<td></td>
</tr>
<tr>
<td>are about to see, since patients are moved often and the up-to-date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>location is typically not easily accessible.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
These principles should serve as guidelines for identifying the function and design aspects of the system during future phases of the current project. Although these principles reflect current user needs and should therefore be adhered to as closely as possible, in reality design and engineering compromises will likely become necessary due to budget constraints, regulatory issues, and technical challenges. Some of the key potential challenges are explored in the next section.

F. Potential challenges

The main challenge to implementing a seamless smart paging system that improves the workflow of all clinicians is the fact that nurses, who represent a majority of the callers, are typically not equipped with mobile phones. This implies that the nurses will have to rely on logging into computer terminals to send messages and continuously check for replies, which is relatively inconvenient compared to receiving a notification on a mobile device. In addition, due to the lack of mobile devices, the nurses will likely continue to receive call-backs at the nursing station fixed landline phones, which is problematic since they are often moving away from the nursing station to provide care to their assigned patients.

In addition, as a minimum requirement for the ideal smart paging system, all clinicians on the receiving end of the paging system need to be equipped with a personal mobile device, and this may be problematic due to budget constraints.

Furthermore, there will likely be additional technological challenges around developing and interfacing with a hospital-wide, up-to-date contact information system; a system for keeping track of the most responsible clinician for each patient; a system for tracking current patient location; and a system of mobile EHR access – all of which have been identified as important requirements to support an ideal smart paging solution.

An additional technological challenge will also stem from ensuring appropriate network coverage for throughout the hospital buildings.
G. Impact

A smart paging solution developed based on refinement of the design principles outlined in this section would help address many of the critical communication issues identified in the study (see section 8.1.1), and in particular the following three:

1. There is a high reliance on interruptive communication;
2. Numeric pagers involve severe workflow inefficiencies and cause delays;
3. Finding the contact information for the right clinician at the right time is difficult.

8.2 Study Limitations

The main limitation of the study is that it did not evaluate the long-term impact on patient safety of the observed communication issues. This was omitted due to the impracticality of orchestrating and carrying out such a complex evaluation. Furthermore, because of the complexity of the ED-GIM patient transfer workflow and interrelated nature of the communication issues observed, such an evaluation would likely remain very subjective and difficult to interpret.

Due to time constraints only five patient transfers were observed at each site. Also, in order to minimize the intrusiveness of the shadowing sessions and the effect of the observer on the clinicians shadowed, no secondary observers were employed. This has impacted the ability of the researcher to draw strong conclusions based on the data collected.

8.3 Future work

The report outlines several key areas of hospital communications improvement, emphasizing the link between various communication issues prevalent at three institutions. Future work will involve selecting a smaller area for further investigation, as well as conducting a user-centered design process to generate concrete requirements for an intervention that mitigates current issues, following the general guidance provided in sections 8.1.2 and 8.1.3. One potential area for further investigation is the development of an improved paging solution, which is explored in section 8.1.4. The design process will involve reference to human factors engineering
principles, such as the Hierarchy of Effectiveness (ISMP, 1999) and Usability Heuristics (Zhang et al, 2003).

8.4 Significance of the study

The study provides deep insight into the workflow of clinicians involved in ED-GIM patient transfer, as well as hospital communication systems as a whole. The study is unique due to its reliable data collection strategy based on extensive patient-centric field observations at three institutions. The report provides rich descriptions of communication tools and patterns, and of ED-GIM handover workflow, as well as an insightful analysis of communication issues and improvement opportunities. The design trade-offs described in section 8.1.2 and design principles provided in sections 8.1.3 and 8.1.4 can serve as guidelines for solutions that address hospital communication issues in a more comprehensive and effective way than what has been attempted to-date.
Chapter 9
SUMMARY CONCLUSIONS

Inadequate means of communication between clinicians, particularly during handover, are a significant root cause of hospital adverse events. While many groups have developed new technologies to address individual aspects of information access and communication needs, the impact of these technological solutions on the clinical communication patterns of the larger hospital environment are understudied.

The present patient-centric, multi-site, observational study evaluated the workflow, tools and communication patterns inside the modern hospital, particularly during the critical phase of patient transfer from the emergency department to general internal medicine.

Main findings:

- Clinicians are forced to interact with a high number of specialized communication tools and software programs. This sometimes introduces a steep learning curve, and work duplication.
- There is a general lack of awareness of patient status (i.e. location, pending tests and consults, etc). Systems designed to mitigate this issue, such as electronic whiteboards, have limited success, due to their reliance on manual updates and unintuitive user interfaces.
- The lines of communication between clinicians are often poor, particularly between mobile, transient physicians and stationary nurses. Finding the contact information for the right clinicians at the right time is difficult.
- Despite their many documented drawbacks and inefficiencies, numeric pagers continue to be widely used at all three sites. Additional messaging systems have been introduced, but they usually fail to properly take into account user needs, as both sending a message and replying to it involve a complex workflow.
- The paper chart is an inefficient means of storing and accessing patient information.
- The mixed use of EHR and paper causes confusion with ordering new tests and medications.
Many of the software tools currently in use have unintuitive user interfaces.

Interruptions and distractions are frequent, as clinicians prefer face-to-face communication to other available options.

Potential consequences of these issues are workflow disruptions, delays in patient care, and inadequate access to time-sensitive patient information, all of which can negatively impact patient safety.

The analysis included detailed workflow diagrams for the ED-GIM patient transfer process at each site, highlighting the exact patient information exchange and communication tools used at each step. The diagrams helped identify the main workflow inefficiencies (e.g. the workflow for sending and receiving a numeric page is cumbersome and involves many steps), the critical segments (i.e. period when the patient is under the care of the GIM team, but physically located in the ED), and evaluate the lines of communication between various clinicians who collaborate to provide care to an ED-GIM transfer patient. The workflow is very similar across the three institutions, suggesting that there is potential for developing technological solutions that could be adopted at multiple sites.

By contrast, the information access and communication tools implemented at each site varied widely, despite serving the same main functions. The report provides an in-depth analysis and comparison of the advantages and disadvantages of the various communication tools used in the transfer process at the three institutions: EHRs, paper charts, whiteboards, various paging systems, phones, and paper forms.

In addition, the research questions around EHR use and context factors that influence communication patterns were explored in-depth, in order to help identify the current role of the EHR in communication, and help evaluate the need for a potential communication aid that would enhance this role. The data suggest that there is an opportunity to extend the role of EHR in supporting communication, enhance communication through mobile EHR access, and develop innovative tools to support the transfer of responsibility for follow-up on tasks, situations, and patients.
In order to guide the development of future interventions that address hospital communication issues, the report also identifies several key design trade-offs to be negotiated:

- synchronous communication vs. reducing interruptions,
- notification of patient status vs. reducing interruptions,
- portability vs. screen size of mobile devices,
- speed vs. quality of handovers,
- information privacy vs. accessibility.

Finally, guidelines for an ideal paging system, derived from observation of current paging systems in-use at the three sites are also provided, as an example of how the knowledge obtained through the present in-depth ethnographic study can be translated into design principles.

The study results will inform a user-centered design process, and the development of an intervention that should meet seven basic principles: interconnectivity, context awareness, accessibility, redundancy, user customization, security, and intuitive user interfaces.
References


Appendix A

Work shadowing notes template

<table>
<thead>
<tr>
<th>Start Time</th>
<th>End Time</th>
<th>From</th>
<th>TO</th>
<th>Activity</th>
<th>TOOL</th>
<th>content</th>
<th>props</th>
<th>patient</th>
<th>interrupt</th>
<th>location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</table>
Appendix B

Work shadowing qualitative observation guide

CONTEXT INFO
→ Busy unit?__________________________
→ Resident: # of weeks on service: ______

→ CTAS score _______________________
→ Patient has special needs? __________
→ Patient is stable? __________________

→ Other _____________________________

TO OBSERVE (qualitative observations)
→ How long does the clinician consult the EHR when they use it as a communication aid?

_____________________________________________________________

_____________________________________________________________

→ Clinician activity while in transit? (relaxing, to do list, ad-hoc communication, etc)

_____________________________________________________________

_____________________________________________________________

→ How is the responsibility to follow-up being passed on?

_____________________________________________________________

_____________________________________________________________

→ COMMUNICATION ISSUES (e.g. trouble finding or reaching someone, messages through 3rd parties, sources/effects of interruptions, etc)

_____________________________________________________________

_____________________________________________________________
TO ASK:
→ While in transit, ask clinician if they might wish to access part of the EHR on a mobile device. Or access something else (e.g. clinician location, schedule, vitals, etc)

→ After a communication event, ask what could have made the interaction easier.

BRIEF INTERVIEW QUESTIONS:
→ How could the EHR be improved (to help communication and coordinating care)? Is there anything that they wish was in there but is currently missing? What do they do instead to obtain that information?

→ What is the biggest communication issue that they encounter in their work? Describe an example… Patient safety consequences?...

→ Ask for an example of an instance where some information was not transferred, though it should have been, causing an issue or potential issue.

→ Best/worst communication tool?
Appendix C

Semi-structured interview guide

1. Could you briefly describe your position here? (Note that parts of your response that could identify you will be removed)

2. Can you briefly describe the overall communication workflow of patient information during ED- GIM transfer?

3. Tell me about your experience communicating with a physician/ resident/ nurse/ allied health professional during and after the ED-GIM patient transfer. What means of communication do you typically use? What would your preferred means of communication be? Does this depend on how busy the unit is, or the patient’s acuity? What are the critical pieces of information that need to be communicated for an effective patient transfer? How readily available is this information?

4. Do you use any special tools to support these communications? What are some of the benefits and drawbacks of these tools? (Follow-up with questions regarding each communication tool / aid identified for each hospital)

5. Would access to some of the patient information currently available in the EHR be useful during the handover communications described in question #2? Which information, and when exactly would you access it?

6. Is there anything not available in the EHR that you wish was there? What exactly and when would you access it? What do you do instead to obtain that information?

7. What subset of information from EHRs do you feel would be best provided on a mobile device to enable effective communication? When would you access this information?

8. Can you describe some instances when communication regarding a patient with a physician/ resident/ nurse/ allied health professional failed to clearly identify the person responsible to follow through regarding the patient (leading to things “falling through the cracks”)? Was there an instance where some information was not transferred though it should have been, causing an issue or potential issue?

9. Can you briefly describe some instances of break-down in communication (e.g. missing information, delays, etc) during or after the process of ED-GIM patient transfer that you have experienced or learned about recently?

10. Can you briefly describe an instance of communication with a physician/ resident/ nurse/ allied health professional when you felt that you gave/ received an excellent report regarding a patient? (Focusing on the ED-GIM transfer and/or subsequent consult requests...) What characterized this as an excellent report?

Is there anything else that you wish to add?...
Appendix D

MSH workflow diagrams

ED-GIM patient transfer – FULL PROCESS VIEW
(workflow for ED-GIM patient transfer at Mount Sinai Hospital, page 1 of 7)

ED – GIM patient transfer

- Physician handover

- Regular patient care (transfer patient in ED)
  - GIM bed available?
    - NO
    - YES
      - Nursing handover

- Regular patient care (transfer patient in GIM)
  - Patient re-transferred or discharged?
    - NO
    - YES

NOTE

Activity or data flow:

Synchronous communication:

Asynchronous communication:
Physician handover – part 2
(workflow for ED-GIM patient transfer at Mount Sinai Hospital, page 3 of 7)

<table>
<thead>
<tr>
<th>ED physician</th>
<th>GIM senior resident*</th>
<th>GIM medical student*</th>
<th>GIM junior resident*</th>
<th>Other consulting physician(s)</th>
<th>ED nurse*</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

**ALTERNATE WORKFLOW**
(1) If GIM physicians are using personal phones to communicate with each other, the workflow changes to:
- GIM junior resident or GIM medical student sends a text message to GIM senior resident on personal phone to request consultation.

(2) If the GIM senior resident is not carrying a cordless phone, the workflow changes to:
- GIM junior resident sends a page to GIM senior resident.
- GIM junior resident waits for response to the page or phone call.
- GIM senior resident calls extension from nearby phone.
- Cordless phone consumption to request consultation.

* Alternate, face-to-face rounds have been observed as well.

**Face-to-face Patient is admitted**

**Direct patient consultation**

**PowerChart**
Write admission set (order)

**PowerChart**
Write admission set (order)

**WPS**
Why Add patient to the system?

**Other consults pending?**

**Direct patient consultation**

**PowerChart**
Why? Suggested orders

**PowerChart**
Consult done?

**New / modified orders after consult?**

**New / modified orders after consult?**

**Face-to-face**
* Cranky orders

**Face-to-face**
* Cranky orders

---
* main caretakers for the patient in this workflow segment

---

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Appendix E

SHSC workflow diagrams

ED-GIM patient transfer – FULL PROCESS VIEW
(workflow for ED-GIM patient transfer at Sunnybrook Health Sciences Centre, page 1 of 8)

ED – GIM patient transfer

Time of day?

Physician handover (daytime)

Physician handover (evenings & week-ends)

Regular patient care (transfer patient in ED)

GIM bed available?

NO

YES

Nursing handover

Regular patient care (transfer patient in GIM)

Patient re-transferred or discharged?

NO

YES

NOTE:
The patient is sometimes moved to an intermediary zone (Orange zone) before being moved to the GIM. In this case, there is an additional handover between ED nurses. This is omitted here for simplicity.

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Appendix F

Toronto General Hospital Findings

Report prepared
By Ashleigh Shier

Research completed as part of the Patient-Centered Perspectives of Communication and Handover between ED-GIM thesis for the degree of Master of Health Science in Clinical Engineering
Institute of Biomaterials and Biomedical Engineering
University of Toronto

Ashleigh Shier acted as the primary investigator at TGH with Ilinca Popovici acting as an additional observer

2011

NB: This report will refer to sections from the main thesis paper (e.g. refer to section #.#.#).
F.1 Participants

During the pilot phase at TGH (February-March 2011), the investigator spent a total of 14 hours observing physicians and nurses in the ED and GIM units performing regular tasks during work hours. Participants observed during this phase included two GIM nurses, one GIM junior resident, one GIM senior resident, two ED nurses, as well as brief informal conversations with GIM and ED ward clerks, GIM fellows, and GIM nurse managers.

During the work shadowing phase at TGH (March 2011), the investigators observed nurses and physicians involved in an ED-GIM patient transfer during five separate transfers, for a total of 26.2 hours of observation. Of these 26.2 hours, 12.8 hours were spent observing physician workflow, and 13.4 hours were spent observing nursing workflow. The participants involved in this phase of the study included: 2 GIM medical school students, 2 GIM junior residents, 1 GIM fellow, 5 ED nurses and 4 GIM nurses. The investigators spent 21.2 hours observing inside the ED, and 5 hours inside GIM units.

In order to ensure that the observations are as unbiased as possible, and can be generalized to TGH as a whole, the GIM admitting physicians shadowed (fellow, junior residents and medical school students) came from both the regular admitting Team 9 and the on-call staff, and the GIM nurses shadowed came from both of the GIM ward floors. Furthermore, observations were collected at various times of day, ranging from 11:00 AM to 1:00 AM, during weekdays and weekends.

During the interview phase at TGH (April 2011), the investigator interviewed 3 clinicians who are regularly involved in the ED-GIM patient transfer process in their work: one GIM junior resident, one GIM nurse, and one ED nurse. These semi-structured interviews each lasted between 30 and 60 minutes.
F.2 TGH environment overview

TGH is a large academic teaching hospital affiliated with the University of Toronto (Toronto, ON, Canada). There are 2 GIM wards staffed with nurses and allied health, and 5 GIM physician teams (Team 5, 6, 7, 8, and 9). One of the GIM physician teams, Team 9, is responsible for all admissions from the ED to the GIM during regular work hours (Monday to Friday, 9 - 5). The other 4 teams rotate being on call, caring for GIM patients and admitting patients on nights and weekends. Each of these four teams consisted of 1 attending physician, 1 senior resident, 2-3 junior residents, and 3-4 medical school students. Team 9 however consisted of 3 fellows, 1 junior resident, and 1 medical student during February, and consisted of only fellows during March. It should be noted that Team 9 avoided admitting unstable patients, as they preferred to not handover these kinds of patients to on call staff. The ED is staffed with 3-4 physicians working at once, and nurses (1 nurse to 2 to 4 patients).

TGH’s environment was otherwise similar to the environment observed at MSH (Refer to section 3.2 for further details).

F.3 ED-GIM patient transfer workflow

Refer to section 6.1 for the general workflow of ED-GIM patient transfer (applicable to all hospitals).

TGH’s patient transfer workflow differs from the MSH and SHSC workflows primarily during the nursing handover. Unlike at MSH and SHSC, there is no synchronous communication to complete a handover checklist. The ED nurse arranges for a porter to transfer the patient, and completes the electronic ED Nursing Transfer Note in EPR for the GIM nurse to read when the patient arrives. Further differences can be seen in the UML diagrams; however, the other dissimilarities are more related to communication tools used as opposed to actual process differences.

Refer to Appendix 1 for the TGH ED-GIM patient transfer workflow (UML diagram).
F.3.1 Communication channels

Based on the UML diagram, the researcher evaluated separately the communication channels available to different pairs of clinicians, and identified the risks and relative potential patient safety consequences of miscommunication in each case. The results are summarized in Table 1. This evaluation reveals that the communication channels between the admitting GIM physician and the ED nurse are most susceptible to breakdowns and most critical from a patient safety standpoint. This is attributed to the fact that there is no structured communication embedded in the workflow, and the main means of contact are relatively inefficient and prone to delays. It should be noted that the channel between the ED nurse and the GIM nurse is a close second for being most susceptible to patient safety risks. The main communication tools involved in the process of ED-GIM patient transfer are further described and evaluated in the next section.
<table>
<thead>
<tr>
<th>Clinicians involved</th>
<th>Description</th>
<th>Communication issues</th>
<th>Patient safety risk</th>
<th>Observations</th>
</tr>
</thead>
</table>
| GIM admitting physician & ED nurse | - communicate admission status, clarification of new orders, updates on patient status, concerns  
- face-to-face communication or page on smart phone through call locating  
- GIM physician communicates information to ED nurse via patient’s EPR | - ED nurse is in the ED, the GIM physician is mobile  
- risk of delays with paging  
- lack of salience of new/modified orders  
- some orders are on paper, some in EPR  
- nurse unsure which to check  
- reliance on GIM physician to alert ED nurse of stat orders | High  
- potential delay of urgent nursing care  
- physician potentially unaware of changes in patient status | - EPR missing information on whether consultations are done, medications are given  
- many face-to-face interactions inquiring about the actual state of pending orders |
| ED nurse & GIM nurse | - handover by ED nurse completing Transfer Note in EPR  
- GIM nurse prints and reads transfer note  
- occasionally ED nurse will phone GIM to announce transfer  
- no face-to-face interaction | - risk for GIM nurse to not be aware of pending transfer, and delay reviewing Transfer Note  
- risk for Transfer Note to become stale if patient transfer is delayed  
- need for a reliable system to communicate when patient is actually arriving to GIM  
- need to only complete transfer note just before patient is moved from the ED | High  
- potential of GIM nurse remaining unaware of relevant patient information, affecting their care  
- potential of GIM nurse not knowing when the patient will arrive, affecting how quickly they will be attended to once in the GIM | - see commentary above  
- a GIM nurse estimated that it was necessary to call down to the ED after reading the Transfer Note for clarification 20% of the time  
- an ED nurse estimated that she received a call from the GIM nurse post-transfer 1 to 2 times a week |
| GIM admitting physician & GIM nurse | - communicate clarification of new orders, updates on patient status, concerns  
- face-to-face communication or web paging; additional direct paging through call locating for urgent issues or calling Team BlackBerry number | - GIM nurse is in the GIM, the GIM physician is mobile, often in GIM  
- risk of delays associated with web paging when GIM nurse tries to reach GIM physician | High  
- potential delay of urgent nursing care  
- physician potentially unaware of changes in patient status | - during several shadowing sessions, the GIM nurse web paged or called the GIM physician about patient orders either not being ordered properly, or not ordered at all  
- these issues were rarely solved in a timely manner and resulted in delay of medication delivery |
| physicians within GIM team | - face-to-face review of the case (10-30min)  
- communication aids: EHR, paper chart, paper consultation notes  
- senior resident carries Team BlackBerry, junior residents carry Junior BlackBerry, and medical students carry pagers  
- SMS on personal phones often used as well | - scheduling a time to review prior to the patient admission | - difficult to schedule time to review, several attempts  
- in 2 out of the 4 cases, the review took place after the admission orders were placed in EPR  
- in 1 case waiting for the review to enter orders resulted in delay of medication delivery |
|---------------------------|----------------------------------------------------------|-------------------------------------------------|----------------------------------------------------------------------------------|
| ED physician & GIM senior resident | - short (2 minute) phone conversation  
- communication aid: patient’s ED paper chart  
- to initiate contact, the ED physician calls the Team BlackBerry; if the call is not answered, the ED physician will page the Team BlackBerry | - risk of ED physician not reaching the GIM physician in a timely manner  
- risk of forgetting to exchange patient information on the spot (particularly for a complex case or incomplete ED paper chart) | - during pilot shadowing, the GIM physician missed the call from the ED physician because he couldn’t enter the BlackBerry password correctly; 35 minutes later the GIM Team BlackBerry was paged by the ED and the GIM physician phoned back  
- potential for delays in assessing patient admission due to communication tool issues |
|                           | - Medium  
- potential of delayed guidance from senior regarding the case | - Low  
- mitigated by the full patient consultation performed by the admitting GIM physician  
- worst case scenario – underestimate case urgency | - medium potential of delayed guidance from senior regarding the case  
- difficulty to schedule time to review, several attempts  
- in 2 out of the 4 cases, the review took place after the admission orders were placed in EPR  
- in 1 case waiting for the review to enter orders resulted in delay of medication delivery |
F.3.2 High-risk workflow segment

Similar to MSH, the highest-risk time from a patient safety standpoint is when the patient is admitted by the GIM but still physically located in the ED. Firstly, the ED is a very busy unit, more hectic than the GIM units, and thus unsuited for a long stay for very sick patients. Secondly, the shift in responsibility can create confusion regarding the appropriate person to contact with patient care issues.

At TGH, the interaction between the main caregivers during this period, the ED nurse and the GIM physician, is very disjointed and delayed. As the GIM physician is extremely mobile, they are often providing patient care from outside the ED and without the necessary context. For example, when shadowing an ED nurse, the GIM physician placed blood work orders in EPR which the nurse only viewed after she had pushed the patient’s medications. In this situation, the blood work results would be highly affected by the medications and not reliable. As the GIM physician providing the patient care is not in the ED, he was unaware of the patient context resulting in an inappropriate order to be made.

It should also be noted that unlike at MSH, the ED nurse to GIM nurse communication channel is the second most susceptible to breakdowns. This translates into the ED nurse to GIM nurse handover being the workflow segment with second highest risk. This is primarily due to the lack of accurate communication on the arrival time of the patient to the GIM, and the asynchronous mode of communication between the nurses on the patient’s condition.

F.4 Communication tools

The main communication tools and aids used during the process of ED-GIM patient transfer are listed in Table 2, including the type of communication that they support (synchronous, asynchronous, communication aid), type of information exchanged using the tool, and typical users.
Table 2 – List of communication tools used at TGH in ED-GIM patient transfer workflow

<table>
<thead>
<tr>
<th>Tool</th>
<th>Tool type*</th>
<th>Information exchange</th>
<th>Users / Scope</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, verbal communication</td>
<td>S</td>
<td>rich patient information, context</td>
<td>all</td>
</tr>
<tr>
<td>Stationary phone (common lines at nursing stations)</td>
<td>S</td>
<td>rich patient information, context</td>
<td>all</td>
</tr>
<tr>
<td>Team BlackBerry</td>
<td>S, A</td>
<td>urgent phone calls, text pager, non-urgent concerns or overdue tasks</td>
<td>users: GIM physician callers/senders: GIM nurses, ED nurses, ED physicians and AH ED nurses can’t phone the Team BlackBerry</td>
</tr>
<tr>
<td>IP tool (smart web paging system)</td>
<td>A</td>
<td>non-urgent messages</td>
<td>senders: ED nurses, GIM nurses receivers: GIM physicians</td>
</tr>
<tr>
<td>Numeric pager</td>
<td>A</td>
<td>extension where page sender can be reached (i.e. nursing station phone number)</td>
<td>users: physicians, GIM nurses, some AH (pharmacy) callers: all</td>
</tr>
<tr>
<td>SMS on personal phones</td>
<td>A</td>
<td>set up meeting, prompt to follow-up, co-signature request, etc.</td>
<td>within some GIM teams</td>
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<tr>
<td>EPR</td>
<td>A, C</td>
<td>patient information</td>
<td>all (both GIM and ED)</td>
</tr>
<tr>
<td>Nursing Transfer Note (in EPR)</td>
<td>C</td>
<td>patient information summary</td>
<td>ED-GIM nursing handover tool</td>
</tr>
<tr>
<td>ED whiteboard system</td>
<td>A, C</td>
<td>patient information summary (several ED patients), consults</td>
<td>ED staff, anyone seeing a patient in the ED</td>
</tr>
<tr>
<td>GIM whiteboard system</td>
<td>A, C</td>
<td>patient information summary (several GIM patients), consults</td>
<td>GIM staff, anyone seeing a patient in the GIM</td>
</tr>
<tr>
<td>Paper patient chart</td>
<td>A, C</td>
<td>patient information</td>
<td>all (both GIM and ED)</td>
</tr>
<tr>
<td>Sign-out tool (printed summary)</td>
<td>C</td>
<td>patient information summary (several GIM patients)</td>
<td>GIM medical team communication aid</td>
</tr>
</tbody>
</table>

*Note:  S = synchronous communication  
A = asynchronous communication  
C = communication aid

F.4.1  Face-to-face

The GIM nurse and ED nurse interviewed at TGH identified “real time face-to-face” as their preferred means of communication. However, face-to-face communication causes interruptions, which have been shown to cause disruption in working memory, generating errors (Alvarez & Coiera, 2005). As shown in Table 3, there were 28 (or 62% of the total of 45 interruptions) instances of incoming face-to-face interruptions observed during work shadowing 5 GIM admitting physicians over a total period of 10.5 hours. Of these 28 face-to-face interruptions, 25 (86%) occurred while writing the consult notes or patient charting, and 2 (7%) while the physician was placing orders in EPR, which are both activities critical for maintaining patient safety. Similarly, 21 (or 81% of the total of 26 interruptions) instances of incoming face-to-face
interruptions were observed while work shadowing 5 ED nurses for a total period of 8.5 hours, 18 (86%) of which occurred during charting, 6 instances specifically while writing the nursing Transfer Note in EPR. Finally, 14 (or 74% of the total of 19 interruptions) instances of incoming face-to-face interruptions were observed while work shadowing 4 GIM nurses for a total period of 4.9 hours. Of these, 12 (86%) occurred during charting, and the other two instances being during writing a web page and direct patient care. Furthermore, although it was difficult to assess the urgency of each incoming interruption, another drawback of face-to-face communication is that it can generate interruptions that are less urgent than the current task of the interrupted clinician.

Table 3 – Incoming interruptions recorded during direct observation at TGH

<table>
<thead>
<tr>
<th>Clinician interrupted</th>
<th># of participants</th>
<th>total observation time</th>
<th>total # of interruptions</th>
<th>average # of interruptions / hour</th>
<th>total # of face-to-face interruptions / total interruptions</th>
<th>total # of phone interruptions / total interruptions</th>
<th>total # of pager interruptions / total interruptions</th>
<th>total # of face-to-face interruptions involving searching for another person / total interruptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIM admitting physician</td>
<td>5</td>
<td>12hrs50min</td>
<td>45</td>
<td>3.5</td>
<td>28 (62%)</td>
<td>6 (13%)</td>
<td>9 (20%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>ED nurse</td>
<td>5</td>
<td>8hrs31min</td>
<td>26</td>
<td>3.1</td>
<td>21 (81%)</td>
<td>5 (19%)</td>
<td>n/a</td>
<td>4 (15%)</td>
</tr>
<tr>
<td>GIM nurse</td>
<td>4</td>
<td>4hrs53min</td>
<td>19</td>
<td>3.9</td>
<td>14 (74%)</td>
<td>5 (26%)</td>
<td>n/a</td>
<td>2 (10%)</td>
</tr>
</tbody>
</table>

Note: The values provided above may not be accurate due to the small sample size and short observation sessions (focused on ED-GIM patient transfer activities).
3 of the GIM admitting physicians carried a BlackBerry: two carried Junior Blackberries, one carried the Team BlackBerry. The 2 other GIM admitting physicians carried only numeric pagers.

Refer to section 3.4.2 for a more detailed description of face-to-face interaction and its advantages and disadvantages.
F.4.2 Nursing station phone

The drawbacks of nursing station phones are strongly connected to the issues with paging. Nurses page the physicians with the nursing station phone extension, which the physicians must then call back. However, often by the time the physician returns the page, the nurse has moved away from the nursing station to provide direct patient care. As the ED nurse interviewed confirmed, they will not sit at the phone and wait for the call to be returned:

*I’ll just put the page in and then continue on my business...if I can’t get to [the phone] then I’ll just page again.*

This stage disrupts other nurses’ workflow – they answer the phone at the desk, and then must search for the nurse who paged the physician. In addition, the GIM junior resident interviewed stated that physicians don’t wait long on hold before hanging up, as the nurse can always page again. This becomes a long cycle, with the nursing station phone disrupting others and not connecting clinicians with each other efficiently.

Refer to section 3.4.3 for further details on nursing station phones.

F.4.3 Team BlackBerry

DESCRIPTION

The GIM physician teams each have one Team BlackBerry shared amongst its members (or two, in the case of Team 9). The GIM physicians use the BlackBerry to answer incoming phone calls, receive and respond to emails, and receive messages from the web paging system (to be further explained in F.4.4). The Blackberries also receive critical results from EPR, such as positive culture results and severe lab abnormalities (e.g. low potassium). The Team BlackBerry users for Team 9 change on a daily basis, but on other teams the Team BlackBerry is always with the senior resident. In addition, junior residents carry Junior Blackberries (Junior A, B and C). However, the Junior Blackberries do not receive the web pages and emails that are sent to the Team BlackBerry. The holder of the Team BlackBerry receives information and pages for all patients, and must forward this information on to the junior responsible.
BENEFITS

The main advantage of the Team BlackBerry is that it becomes the primary point of contact for a GIM team, and allows for various types of incoming communication (phone, email, page). The GIM team is contacted via the Team BlackBerry by ED physicians, ED nurses, GIM nurses, bed flow and various members of Allied Health. The other benefits of the BlackBerry in relation to the web paging system will be further discussed in the next section.

DRAWBACKS - USAGE

A disadvantage of the Team BlackBerry system is that one or two people have to be responsible for all incoming communication from other medical staff. As a result, the user is responsible for transferring information to the appropriate physician on the team. During a shadowing session of a junior resident, the resident received a web page on the Team BlackBerry related to a patient in the GIM while he was in the ED. He forwarded this message to another resident’s personal mobile who was responsible for the GIM in-patient at that time. An hour later the nurse called the Team BlackBerry, as no one had responded to her originally non-urgent message, which was now a pressing issue. This example demonstrates that adding another link in a communication transfer chain can lead to information not reaching the intended person and delaying patient care.

In addition, the GIM junior resident interviewed explained that seniors will often complete patient specific tasks requested in a page instead of forwarding the page to the junior responsible. This is less than ideal as the senior resident may not have as detailed an understanding of the patient as the assigned junior, and may have many other responsibilities and tasks to complete. Several physicians shadowed confirmed that one team member receiving all information led to various communication breakdowns.

Another disadvantage to the Team BlackBerry system is that the holder of the BlackBerry is frequently changed. This can make it difficult to contact the intended person. During a shadowing session, a junior wanted to contact the senior for the day shift, but when he called the Team BlackBerry it was still in the possession of the senior resident from the night shift. In addition, a medical student shadowed mentioned that he once texted the Team BlackBerry to inform his senior about a patient, but the BlackBerry user had changed.
It was also observed during shadowing that calls to the Team BlackBerry were missed due to the physician not entering the password quickly enough or incorrectly. In this situation, the GIM junior resident missed the phone call from the ED physician and decided to wait till they called back, which was sometime later.

**DRAWBACKS – MISSING COMPONENTS**

Another drawback of this system is that nurses can send text web pages to the GIM physician, but the physician cannot respond in the same way. The physician can either use the information provided in the text without responding, or call the nurse. As a result, the Team BlackBerry is used as a pager, when it in fact has much more functionality. The GIM junior resident interviewed identified this as the largest frustration he had with communication at TGH and that “the Blackberries are great...we’re not really using them up to their potential”. He explained that with the way the current system is used, it doesn’t make a difference whether he is sent a web page or a numeric page, because he has to return the call regardless. The preferred system would allow the physician to respond using text.

Nurses confirmed that they contact physicians for the most part about order clarifications, which then need to be signed off by the physician again. For legal documentation purposes, an order change or clarification for standard orders can be confirmed by the physician including their name in a text. This could easily resolve order clarifications faster than the current system.

While it is a positive that the Blackberries receive some results, GIM physicians want more results to be sent to the BlackBerry as notifications. The GIM junior resident interviewed indicated that it would be ideal to select which results he was interested in, and have them sent to his phone once they appear in EPR.
F.4.4 IP tool: Smart web paging system

DESCRIPTION

The Inter-professional communication tool is a web-based application and paging system used by the GIM and ED nurses to send GIM physicians mainly non-urgent messages. In most emergency situations, this does not replace paging the physicians by call locating. Nurses access the web paging system from the UHN corporate intranet site, which opens an online form to fill in. The nurse selects which Team BlackBerry to contact, their name and contact information, response type (Information Only/No response necessary, Email response requested, Call back requested), the patient’s name, and a free text box for the message (see Figure 1). There is also the option to indicate that this is the second time the nurse has attempted to notify the physician. The web page is then sent to the Team BlackBerry indicated in the form. It should be noted that this web paging form will be decommissioned as of June 2011, but was in use during the entire shadowing period.

**Figure 1 - GIM Web Paging Browser**
BENEFITS

The main advantage of the smart web paging system is that it allows for a non-urgent form of communication, so that physicians can postpone answering the web page messages until they are less busy. As a result, the physicians may conclude that if they are sent a numeric page, it is more urgent. The ED nurse shadowed said that she greatly preferred the system to traditional paging for this reason, as she felt she was ‘harassing’ them less. This system has the potential to reduce the number of incoming non-urgent interruptions for physicians.

The main difference between the smart web paging system used at TGH and WIPS at MSH is that the physicians are equipped with Team Blackberries that greatly facilitate them in responding to the messages (e.g. the physician can call the nurse). At MSH, if GIM physicians are expected to respond, they must find a computer and log into WIPS, a much more disruptive and involving task. In general, it seems that a smart web paging system linked to a BlackBerry is superior to being linked to a pager, which cannot be used to communicate a response. However, the BlackBerry isn’t necessarily being used to its full potential for responding to the messages, as discussed in the previous section.

The feedback on this system was positive from ED nurses, GIM nurses, and physicians.

DRAWBACKS

One drawback an ED nurse mentioned is that depending on the physician, a non-urgent message might have a delayed response time. Nurses preferred to web page the physicians, but if in an emergency both ED and GIM nurses would call locate the physician using a nursing station phone. In addition, ED nurses are not in the habit of web paging physicians from other departments and primarily call locate the GIM physician.

A disadvantage to the system is that it isn’t as reliable as traditional paging. During one shadowing session, the Team 6 BlackBerry web paging was not working, and nurses were told to call the Team BlackBerry phone instead. This would cause the BlackBerry to be more disruptive than a pager, as they are now receiving phone calls instead of pages, which they cannot choose to respond to later.
The system still has some of the same drawbacks associated with regular paging. The GIM nurse interviewed stated that the “issue of them not getting back to us” is still present and the nurses still have to page the physicians repeatedly.

F.4.5 Numeric pager

Many physicians and other hospital personnel (e.g. radiology, allied health professionals, etc.) carry numeric pagers. These devices have an individual extension associated with them. When the extension is called, the pager makes a sound and it displays the phone number of the caller (typically a nursing station common phone line). Physicians are mainly paged on their Team or Junior Blackberries at TGH, regardless of whether it is a numeric page or a web page. However, numeric pagers are the primary contact device used for the medical students. The emergency department physician and nurses may page the GIM physician on their numeric pager if they cannot get a hold of the Team BlackBerry. Infrequency of use greatly reduced the problems associated with the usual disadvantages of pagers (not knowing the urgency of the page, having to wait by or find a phone to return the call, difficulty in knowing who to contact, etc.).

Refer to section 3.4.7 for further details on the advantages and disadvantages of pagers.

F.4.6 SMS on personal phones

On occasion, physicians within a GIM team contact each other through SMS using their personal mobile phones. However, physicians were more likely to send an SMS via the hospital Blackberries than their personal phones at TGH. The content of the messages typically includes setting up meetings, asking for a co-signature, etc. Private patient information is not exchanged using this communication tool. The response to using SMS for communicating was very positive. During shadowing at TGH, it was observed that if the senior was not nearby, medical students and juniors always contacted the senior for patient review via SMS. One of the ED nurses shadowed mentioned she would prefer to communicate with the GIM physicians by SMS, instead of paging.

Refer to section 3.4.8 for further details on the advantages and disadvantages of SMS on personal phones.
F.4.7 EPR system

DESCRIPTION

The electronic patient record used at TGH is called EPR, and it has the same user interface in the GIM and the ED. The GIM and ED have equal access to EPR and related systems, but it is generally used less in the ED for charting (See Table 4). Before the patient is officially admitted to the GIM, orders and other patient care information (nursing notes, vitals, medications, etc.) are recorded on paper. Once the patient is admitted to the GIM (even while the patient is physically still in the ED), the majority of orders are made in EPR. Patient care information such as vitals and nursing notes continue to be recorded on paper.

Table 4 – EPR coverage in ED and the GIM units at TGH

<table>
<thead>
<tr>
<th>Patient information</th>
<th>ED</th>
<th>GIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary (for several patients, at a glance)</td>
<td>ED Whiteboard (linked to EPR)</td>
<td>Sign-out Tool</td>
</tr>
<tr>
<td>Current location</td>
<td>ED Whiteboard (linked to EPR)</td>
<td>GIM Whiteboard (linked to EPR)</td>
</tr>
<tr>
<td>Orders (before GIM admission)</td>
<td>Paper chart/Physician’s Order Sheet</td>
<td>n/a</td>
</tr>
<tr>
<td>Orders (after GIM admission)</td>
<td>EPR &amp; Physician’s Order Sheet</td>
<td>EPR &amp; transcribed in Kardex (paper)</td>
</tr>
<tr>
<td>Patient care; AH, nursing notes; vitals (before GIM admission)</td>
<td>Paper chart</td>
<td>n/a</td>
</tr>
<tr>
<td>Patient care; AH, nursing notes; vitals (after GIM admission)</td>
<td>Paper chart</td>
<td>Paper chart &amp; transcribed in Kardex (paper)</td>
</tr>
<tr>
<td>Physician's notes</td>
<td>Paper chart</td>
<td>Paper chart</td>
</tr>
<tr>
<td>Historical data (previous admission)</td>
<td>EPR</td>
<td>EPR</td>
</tr>
<tr>
<td>Results (labs, microbiology, pathology, cytology, radiology, etc)</td>
<td>EPR</td>
<td>EPR</td>
</tr>
<tr>
<td>Radiology Images</td>
<td>eFilm Fusion &amp; EPR</td>
<td>eFilm Fusion &amp; EPR</td>
</tr>
</tbody>
</table>

EPR serves as a central repository of patient information, accessible by all clinicians on computer terminals throughout the hospital. EPR is also linked to other communication tools, such as the electronic SIMS whiteboards in the ED and the GIM. It is used as a communication aid during the nursing handover, and often used during the review of a case within a medical team. The two main views within EPR at TGH are the Patient Desktop (see Figure 2) and the Chart Review for a patient (see Figure 3). Patient information found in EPR includes: current
location, demographics, allergies, history, orders, medication, results, and forms. The information bar at the top of the patient’s EPR summarizes location, cautions, attending physician and demographics.

Figure 2 - EPR Patient Desktop – from training manual – patient names are fictional
Figure 3 - EPR Chart Review – from training manual – patient names are fictional

BENEFITS

Overall, feedback was positive for the EPR system. The GIM physician interviewed commented that “most people like [EPR] the best” in comparison to other Toronto hospital systems, and several clinicians confirmed this during shadowing.

The main benefit of EPR, similar to the EHR system at MSH, is that it is a centralized database of patient information, accessible by all clinicians throughout the hospital. If updated regularly by all clinicians involved in the patient’s care, EPR can serve as a trusted information repository. Another benefit of all EHR’s, EPR eliminates issues with handwriting legibility, which most nurses mentioned as a particular issue with paper charts and paper orders. It was observed more than once during shadowing that a nurse or ward clerk would have to ask a physician to clarify their handwriting in a chart or in the GIM Admission Order.

Unlike at MSH, clinicians are able to view radiology results directly from a patient chart in EPR. This appeared to be very convenient for physicians when they needed to quickly scan through a
patient’s chart after receiving a request for patient admission. However, physicians still prefer to view the radiology images in Fusion eFilm if possible, as the quality of the images is better and contrast can be adjusted.

Another benefit of the EPR system is the Nursing Inbox feature, which will display new lab tests, stat orders, blood work, blood to be drawn, medications, IV fluids, and results for nurse users. The GIM nurse interviewed stated that nurses check the nursing inbox every time they log in to make sure they’re not missing any orders. However, clinicians still expressed the need for better notification of new orders and critical results as they cannot check the inbox as often as necessary.

GIM admitting physicians shadowed also commented that they liked the desktop layout of EPR, for both the Patient Desktop and the Chart Review.

Order entry is also well designed for formulary orders, and there are order set options that make it easier for physicians to select standard order groups.

DRAWBACKS - MISSING COMPONENTS

EPR currently lacks an effective notification system for stat orders and critical results. Both physicians and nurses commented that there was not enough notification given if orders were placed, and if there were critical results in lab work. An ED nurse mentioned that there was not enough notification if a physician had placed an order overnight, or if stat orders were placed. Another nurse commented that the Nursing Inbox would be more useful if attention was drawn to it immediately in the event of stat orders or critical events, such as the inbox opening immediately. Similarly, a GIM physician explained that in EPR there was no easy way to view all of a patient’s results on one screen, and that this often led to missing critical results if the incorrect view was chosen. To counteract this issue, it would be easier if users were notified of critical results as opposed to having to search for them. A mobile device connected to EPR that provides notifications could also be a solution to this.

Another disadvantage to EPR is that it does not record patient vitals, unlike the EHR at MSH. Many clinicians identified patient vitals as a critical piece of information necessary for handover and patient care, and at TGH it is only accessible from the patient chart. Charting vitals
electronically also allows clinicians to observe trends, which provides more context of patient status.

DRAWBACKS – PROBLEMATIC FEATURES

Viewing a patient’s lab results in EPR was observed to be overly complicated. There are too many options for how to view different results, causing the system to be unnecessarily convoluted. A GIM senior resident shadowed was observed to be very frustrated when attempting to view a patient’s results, and moved in and out of several views. The GIM junior resident interviewed also commented that sometimes he can’t find specific tests. There are multiple options and steps in the process of viewing lab results (see Figure 4). Once lab results have been selected in Chart Review, the user must choose from the lab result options (hematology, biochemistry, etc.). The result option chosen is then sorted ‘By Area’ and ‘By Procedure’, and a selection must be made again. This finally leads the user to a listing of results by date. This is the first time in the results viewing process that there is any indication of critical results. The date with critical results can then be selected, and displayed in various views (ranges, trends, etc.).
Figure 4 - EPR Results Viewing Process – from training manual – patient names are fictional
The user must make three different selections before they are made aware of the patient’s critical lab results, and this is only for the specific lab result option selected at the beginning of the process. If the wrong selections are made, critical lab results can be missed.

Closely related to this issue, clinicians shadowed also disliked having to view results separately as opposed to a summary view of all results. This could be easily simplified. For example, Cerner allows clinicians to view all of the patient’s orders and medications in one place, a feature which was appreciated by the MSH nursing and medical staff.

Clinicians also commented that order entry for non-formulary orders was difficult. The order search is based on index searching, such that the specific term used to label the test in EPR must be used as the search term or it will not be found. Canceling a drug order in EPR was also described as confusing.

F.4.8 Nursing Transfer Note (in EPR)

DESCRIPTION

During nursing handover, the ED nurse completes the ED Nursing Transfer Note in EPR for the GIM nurse to review before or after the patient arrives. The Transfer Note will be filled throughout the time the patient is physically in the ED but admitted to the GIM. The GIM nurse will read and print the Transfer Note, usually once it appears completed in EPR. This is a significantly different handover procedure than at both MSH and SHSC (face-to-face discussion and phone discussion respectively).

The Nursing Transfer Note includes fields for information such as admitting diagnosis, code status, age, whether an interpreter is needed, isolation requirements, MRSA, telemetry needs, recent vitals, mental state, safety, fall risk, blood pressure, blood glucose, pain in ER, airway management, oxygen therapy, etc. This information is mostly answered with a yes or no, or a numeric rating. There is also an Essential Information text field for the ED nurse to include any other information freely. This is typically information such as new orders, in the event that they have just been placed while the patient is being transferred, or patient history.
BENEFITS

Overall, ED and GIM nurses responded positively to the Transfer Note. A GIM nurse shadowed described the Note as a very detailed mental picture of the patient’s condition and needs, and that the sections were not missing any necessary information. Another GIM nurse mentioned that the free text box feature was particularly important for understanding the full context for more complex patients. The GIM nurse interviewed stated it was better than the previous system of phone handover but that there was still “inconsistency in communication”.

DRAWBACKS – MISSING COMPONENTS

Several ED nurses commented that the note doesn’t necessarily provide the GIM nurse with the full context of a patient. A synchronous conversation where the GIM nurse can ask questions and the ED nurse can give anecdotal information is better suited for transfer in the case of complex patients.

In addition, several ED nurses commented that the Transfer Note should have a patient history section, instead of using the free text area for this information.

DRAWBACKS - USAGE

A major drawback of the Transfer Note as a means of communication between the ED and GIM nurses is that the two nursing groups have a very different understanding of the Note’s usage. The GIM nurses interpret a filled Transfer Note in EPR as a signal that the patient will be arriving in the GIM shortly, and print it out soon after seeing it in EPR. It was not observed that the GIM nurse would check for updates to the Note. The ED nurses shadowed and interviewed however explained that they would begin filling out the Transfer Note once the patient was admitted to the GIM. The GIM nurse interviewed confirmed that “sometimes we’ll see it’s not done yet, and it’s up”. The ED nurses often described filling in the Transfer Note as a continuous process throughout the time the patient was in the ED. However, when an ED charge nurse was interviewed she clarified that the proper protocol was for the Transfer Note to be completed within half an hour of the patient transfer, but that nurses had a tendency to partially fill in information prior to this. This seems to be a deviance in protocol that has the potential to affect patient care. As the GIM nurses cannot rely on the ED to call with information about the patient
transfer, they rely on the Transfer Note as an equivalent of this communication. This not only results in the GIM nurse not knowing when the patient will arrive, but also potentially not being aware of the patient’s most recent status and needs upon patient arrival.

The expected protocol is for the ED nurse to complete the Transfer Note (for the first time) once the flow coordinator has informed the charge nurse that a GIM bed is free. However, there is often a long delay between when the bed becomes available and when the patient is moved. One ED nurse shadowed explained that in this situation she would update the Transfer Note once every 2 hours, but this practice was not observed with other ED nurses shadowed. During a shadowing session of a GIM nurse, five hours had passed since the ED had called to indicate the patient was being transferred. This means the GIM nurse had printed the Transfer Notes several hours before the patient was to arrive, presumably making the patient information in the note no longer the most recent description of the patient’s condition, and did not reprint an updated version.

Conversely, there are occasions where the Transfer Note is not filled out at all by the ED nurse before the patient is sent to the GIM ward. The ED nurse interviewed explained that this is usually by accident, and that “sometimes we won’t click the ‘accept’ or ‘okay’ button to actually save the transfer report”. If the Transfer Note is not filled, the GIM nurse is unaware that the patient is arriving. As the GIM nurse interviewed described, “you weren’t expecting the patient to be up yet because no one told you... you’re not prepared”.

This results in the GIM needing to call the ED to ask why it was not filled and request a phone transfer, defeating the purpose of the handover system in place.

In addition, there are incidents where important information is not included in the Transfer Note causing issues when the patient arrives in the GIM. The GIM nurse interviewed stressed that special needs information, such as isolation and telemetry, are often excluded. If an isolation requirement is not communicated, the GIM may not have any appropriate rooms free for the patient to be placed in. This often involves moving another patient to a different room, or to another unit, to accommodate the patient who has arrived from the ED. During a shadowing session, a bed allocation switch had to be organized upon patient arrival, as the GIM had not been made aware that the patient would need a semi-private room. In the case of telemetry, the
GIM will often have to send the patient back to the ED as they may not have portable telemetry at the ward. The ED nurse interviewed recommended that as the Transfer Note is in EPR, some sections of the report could be automatically filled in from information already stored in EPR. This could reduce missing information, and at least include some information in the event that the ED nurse has not filled in the report before patient transfer.

While the GIM nurse feels the ED nurse leaves out important information, the ED nurse believes the GIM nurse doesn’t fully read the Transfer Note. The ED nurse interviewed complained that GIM nurses will call the ED for information that is fully included in the transfer report. It was observed during several sessions that the GIM nurse received minimal time to read the Transfer Note before providing direct patient care, and that often it was the ward clerk who printed the Note for them. As such, in many cases it was observed that the Transfer Note was in fact not read.

F.4.9 ED whiteboard system

DESCRIPTION

The SIMS ED whiteboard provides users with a whiteboard-type view of the current status of all ED patients. This is displayed on two large screens at the front desk of the ED, and on computer terminals throughout the unit. The patient information provided on this electronic whiteboard is kept relatively up-to-date, and includes the patient’s room, CTAS score, COS, patient chart access, complaint, physician, nurse, two consult columns, diet, labs, radiology, medications, CCAC, Careplan (e.g. CT or X-ray scheduled), flags, and a free text box for comments (see Figure 5). This information is expressed mostly in short form text, but icons are occasionally used (e.g. pill underneath MEDS columns means medication orders pending).
Figure 5 – SIMS ED Whiteboard at Nursing Station

The whiteboard can also display additional information from the computer workstation, for example clicking on the pill icon under MEDS will show information for medication to be given. Chart review appears as an icon under the chart column, which on a computer workstation can be opened to view a succinct summary of the patient chart information. Work shadowing revealed that ED nurses often glance at the ED whiteboard system, and the GIM physicians view it to find the patient’s room and the nurse responsible for a patient.

BENEFITS

Feedback for the ED whiteboard was very positive. Four out of the five ED nurses shadowed commented that they liked the whiteboard, and several mentioned they preferred to use it over EPR for certain tasks. The nurses shadowed and interviewed explained they prefer the whiteboard as it does not have the same “strange” categorization as EPR for showing results, there is no need to log in, and the whiteboard highlights abnormal results in red.
The main benefit of the ED whiteboard system is that it is connected to EPR. This means that it automatically updates information, and that it provides a quick summary view of patient information from EPR. The comment column is the only area for manual entry, and not automatically updated. The comments area provides a wide range of information, and was observed to often be in use by the ED nurse and ward clerk. The ED ward clerk uses the free text box to notify nurses when a bed is available in the GIM, and the ED nurse uses it to inform the ward clerk that the Transfer Note is completed.

Another benefit of the whiteboard is that it displays two consultation columns, where the type of consultation and whether it has been completed or not is displayed. If completed, the consult appears in a noticeable blue. The only drawback of this feature is that, for example, one of the GIM physicians shadowed never checked off in the whiteboard that he completed the “med” consult. Physicians commented that they rarely used the ED whiteboard, except for tasks such as checking for a patient’s room number at a glance.

DRAWBACKS

It was observed in several shadowing sessions that clinicians are still not aware of patient status and location via the ED whiteboard. During a shadowing session, a patient left for a CT-scan earlier than the scheduled time posted in the whiteboard’s comments section. During this time, the nurse was not sure where the patient had gone, and was eventually called and asked to arrange a porter to return the patient to the ED. This suggests that patient information in the whiteboard is not salient enough to draw clinician’s attention, and can also lag in being updated.

Nurses also commented that the pill icon for medications does not communicate the urgency or importance of the medication pending. As discussed previously, EPR does not have a sufficient system for notifying nurses of stat orders, and nurses cannot check the nursing inbox and orders as often as needed. The pill icon is an attempt to resolve this issue. However, as the pill can represent less immediately needed orders, or medications they have already given but forgotten to sign off on, it is often overlooked. The ED nurse interviewed commented that he rarely looks at this feature.
Another issue, which applies to whiteboard systems in general, is that the users within the ED are more familiar with the whiteboard than users like the GIM physicians. Due to this, the use of flags and symbols in the whiteboard was seen to take on different meanings for different users. During one shadowing session, a nurse complained that a physician had flagged a patient room in the system to convey urgency, which wasn’t the meaning of that flag. There are users from outside the ED using the system who cannot intuitively understand the intended meaning of the system’s symbols, and thus use their own interpretation. In addition to this, the junior resident interviewed admitted that he didn’t know the meaning of most of the content presented in the whiteboard. As an example, he believed that information such as a patient going for a CT-scan was not expressed in the whiteboard (which it is, under Careplan). The ED nurse interviewed even commented that the physicians use the system inefficiently, saying that physicians will go through EPR instead of using the patient chart access in whiteboard. In conclusion, the GIM physicians are untrained in the use of the ED whiteboard, and either do not use the information displayed to their advantage, or use the system to their own interpretation.

F.4.10 GIM whiteboard system

The SIMS whiteboard system in the GIM is a more recent version of the ED whiteboard, and was designed to be customizable for each department. As a result, the whiteboard has various tab views based on the information most relevant to each hospital department (see Figure 6).
Similar to the ED whiteboard, the GIM whiteboard is displayed on a large screen behind both of the GIM ward nursing stations, and can also be accessed from the computer terminals. Information is both manually entered into the whiteboard and automatically updated from EPR. Patient information such as team name, flags, and diet can be manually entered, while new medication orders (e.g., pill symbol under medications column) will be automatically updated based on EPR.

The main difference between the two department electronic whiteboards is that there are more columns in the GIM than in the ED whiteboard, as there is more long term patient care information to be expressed in the GIM. This makes the GIM board more visually congested than the ED board, and harder to scan quickly. The nurse manager briefly interviewed commented that certain types of information aren’t expressed well when condensed into the small space allowed on the whiteboard. For example, she felt that the diet column was inappropriate on the whiteboard, as it requires too much explanation to be expressed within a small box.
In addition, as opposed to the two non-specific consultation columns in the ED (CONS1, CONS2), there are six green coloured columns with specific consultation type defined (PT, OT, SW, SLP, RD, SC).

The GIM nurses use the whiteboard as a quick view of the patient care plan, to check if any Allied Health groups are following the patient, if there are any pending tests, and where the patient may be going.

One of the GIM nurse managers explained that there is a lag in updating, as more information must be manually entered than the ED whiteboard.

Similarly to the ED whiteboard, physicians rarely used the GIM whiteboard beyond checking the nurse assigned to a patient.

F.4.11 Paper patient chart

Despite the implementation of EPR, the paper patient chart is still used extensively at TGH, particularly in the ED. The paper chart consists of various forms filled in by clinicians by hand, and can usually be found at the nursing station nearest to the patient’s room. Refer to section 3.4.11 for further details on paper charting.

A major use of the paper chart at TGH is as an asynchronous communication tool between Allied Health and direct patient care staff. It is primarily used in the ED prior to patient admission to the GIM, however paper charting continues to be used after admission in the ED and also in the GIM.

There are various dangers associated with recording patient information on paper. Clinicians are unable to access patient information simultaneously which leads to ‘chart chasing’, and the individual papers can be misplaced or removed from the bin (see Figure 7). Placing orders on paper is particularly risk, as it is difficult to notice whether a new order has been placed, and whether the physician has made a change to the order. Additionally, if paper orders are lost or missed, patients can fail to receive necessary medications. The telemetry request form is only available on paper, which was observed to be a particular issue. Once telemetry is requested, the form is taped to the ED nursing station bin, and the GIM physician has to return to the ED to
complete the form. As the GIM physicians are mobile, they may not even be aware the form needs to be filled. An ED nurse shadowed explained that this often led to nurses having to find and interrupt the GIM physician to complete the telemetry form.

Another disadvantage of paper charting is that there is minimal structure for the information being logged, unlike in an electronic record. This is particularly an issue for paper order entry, as physicians can easily choose to not specify information required on the free text order sheet. During a shadowing session, a GIM physician didn’t indicate the amount of blood platelets on a paper order. This caused a serious delay in patient care. The blood was ready to be transfused, but the GIM nurse could not legally give the blood without the physician specifying the exact amount, and signing off on it again. The GIM physician was paged and called by the nurse to come to the GIM ward to sign off on an order that had been written in the ED. This situation was not resolved by the end of the shadowing session. Electronic order entry could easily solve this issue, as it has the ability to force clinicians to include all necessary information for an order.

F.4.12 Sign-out tool (printed summary)

The corporate intranet includes an online patient sign-out tool, which contains a brief summary of the diagnosis and care plan of all admitted GIM patients. This is updated once or twice daily by the GIM physicians. GIM physicians carry print-outs of the sign-out tool in their pockets.
They use them often as a “to do” list, and as a communication aid during handover or review within the GIM medical team. GIM nurses also read the online patient sign-out tool, though the GIM nurse interviewed explained that this information can all be found in EPR or the patient chart.

The main advantage of the patient sign-out tool is that it provides GIM medical staff access to summarized medical information while they are in transit (if printed). At TGH, the print out was used mainly to write updated information on top of patient sections. The back of the paper was also used to write quick notes about patients to be admitted. The main disadvantage of using the print out is the risk of breach of patient confidentiality, if the paper is lost.

F.4.13 Mix of paper charting and EPR

The presence of both paper and electronic patient charting created confusion at TGH, and often complicated clinician communication. It was observed that physicians often continued to communicate information via paper charting while also using EPR in the ED. In addition, Allied Health services communicate with the nurses and physicians entirely through paper charting, even though EPR is the primary tool used in the GIM. This causes redundancy and confusion, as it is unclear where to find orders and patient information. Nurses commented that there are sometimes duplications of orders, or orders on paper and in EPR. In these situations, the nurse must get clarification from the physician as occasionally an order in EPR may mean to ignore the order on paper. This is especially the case during the transitional period where the patient is being seen by the GIM while still in the ED.

This can also lead to orders being missed, especially in the ED where nurses are more in the habit of using paper. As the ED nurse interviewed explained:

*I’m looking more at the paper than checking EPR... In the [ED] we have our paper, we have [ED] patients, and we also have admitted patients so... sometimes some things get left behind for the admitted patients.*

During a shadowing session, a medical student had to wait for the ED ward clerk to return from break so that the clerk could transcribe the paper GIM Admission Orders into EPR. Before this
step is completed, the patient is not officially entered as the GIM team’s responsibility, and the admitting physician cannot enter orders for the patient in EPR. It was observed that the transcribing process of the paper order into EPR by the ward clerk caused delays, and also may force the physician to continue to write orders on paper. Similarly, if referral orders are written in the paper chart, the GIM physician needs to cosign and also enter the orders into EPR. The mix of paper and electronic charting in this circumstance causes a lag in information delivery and unnecessary extra clinician workload.

In addition, at TGH some orders must be written on paper instead of in EPR. It was observed that the GIM physicians are often not aware of which orders can only be entered on paper, and which orders can be entered in EPR. This is proliferated by the fact that non-formulary order searches are difficult in EPR. If the physician cannot find the order they are searching for, they will assume it must be written on paper. The GIM junior resident interviewed described a circumstance where he wrote an order on paper that was meant to be ordered in EPR, and this resulted in the pharmacist having to enter the order for the physician. The GIM physician interviewed also commented “it would be nice if it was all on EPR”.

F.4.14 Summary

The benefits and drawbacks of each of the communication tools and communication aids described above were summarized in Table 5.
### Table 5 – Advantages and disadvantages of communication tools used at TGH in ED-GIM patient transfer

<table>
<thead>
<tr>
<th>Tool</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face, verbal communication</td>
<td>- story, context</td>
<td>- interruptive</td>
<td>- preferred means of communication for most clinicians</td>
</tr>
<tr>
<td></td>
<td>- chance to ask questions</td>
<td>- searching for a clinician is time consuming</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- immediate feedback</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- helps build trust &amp; teamwork</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stationary phone (common lines at nursing stations)</td>
<td>- story, context</td>
<td>- very interruptive (GIM units)</td>
<td>- used often for paging and waiting for call-backs</td>
</tr>
<tr>
<td></td>
<td>- chance to ask questions</td>
<td>- noise of overhead announcements (ED)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- immediate feedback</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team BlackBerry</td>
<td>- receive emails and patient information in text, instead of numeric call back extension</td>
<td>- interruptive to user</td>
<td>- functions as a basic alphanumeric pager, still requires call backs</td>
</tr>
<tr>
<td></td>
<td>- easier for GIM nurses to contact GIM physician</td>
<td>- one main BlackBerry receives all information that must be forwarded to Junior Blackberries</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- GIM physician can evaluate response type and urgency</td>
<td>- only used by GIM nurses (ED nurses rare)</td>
<td></td>
</tr>
<tr>
<td>IP tool, smart web paging</td>
<td>- communicate information without waiting for call back</td>
<td>- physicians still must call back if they wish to respond</td>
<td>- tool deployed within the GIM only</td>
</tr>
<tr>
<td></td>
<td>- less incoming non-urgent interruptions for physicians</td>
<td>- nurses must still wait for call back</td>
<td>- numeric paging via call locating is still used for urgent tasks</td>
</tr>
<tr>
<td>Numeric pager</td>
<td>- direct extension to reach one clinician</td>
<td>- delayed, unanswered pages</td>
<td>- user feedback is very poor</td>
</tr>
<tr>
<td></td>
<td>- call locating, faster contact than smart web paging</td>
<td>- caller needs to wait near a phone for page return</td>
<td>- contact information can be difficult to find</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- page user needs to find a phone to respond</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- unknown urgency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- interruptive to user</td>
<td></td>
</tr>
<tr>
<td>Text messaging on personal phones</td>
<td>- convenient workflow for users, easy to respond</td>
<td>- privacy concerns</td>
<td>- users are comfortable with this communication system</td>
</tr>
<tr>
<td></td>
<td>- answer to non-urgent messages can be postponed</td>
<td>- lack of story, context</td>
<td></td>
</tr>
<tr>
<td>EPR</td>
<td>- centralized, accessible database of patient information</td>
<td>- critical results can be easily missed</td>
<td>- used partially in the ED and almost exclusively in GIM</td>
</tr>
<tr>
<td></td>
<td>- no issues with handwriting legibility</td>
<td>- not enough notification for stat orders</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- special orders can’t be entered in EPR, must use or refer to paper orders</td>
<td></td>
</tr>
<tr>
<td>Nursing Transfer Note (in EPR)</td>
<td>- overview of patient</td>
<td>- may be completed long before patient transfer, leading to 'stale' information or missing details</td>
<td>- GIM nurses and ED nurses felt positively about it</td>
</tr>
<tr>
<td></td>
<td>- context provided by not being overly structured</td>
<td>- may not be completed at all before patient transfer</td>
<td>- phone handover is still necessary in certain patient cases</td>
</tr>
<tr>
<td></td>
<td>- can be updated if patient is not transferred</td>
<td>- may be missing crucial information</td>
<td></td>
</tr>
<tr>
<td>ED whiteboard system</td>
<td>- up-to-date</td>
<td>- missing details regarding patient information and order status</td>
<td>- used often by ED staff</td>
</tr>
<tr>
<td></td>
<td>- quick summary view</td>
<td>- GIM physicians use the system to their own interpretation</td>
<td>- preferred over EPR for certain tasks</td>
</tr>
<tr>
<td>GIM whiteboard system</td>
<td>- quick summary view</td>
<td>- not always up-to-date</td>
<td>- more information is displayed than in the ED board</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- missing details regarding patient information if GIM nurse lags in entering data</td>
<td></td>
</tr>
<tr>
<td>Paper patient chart</td>
<td>- portable</td>
<td>- accessible by only one clinician at a time</td>
<td>- used to communicate with Allied Health</td>
</tr>
<tr>
<td></td>
<td>- centralized database of patient information</td>
<td>- delays &amp; interruptions associated with searching for it</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- handwriting legibility issues</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- parts can be lost / incomplete - can lead to omission of tasks if paper continues to be used once online charting begins</td>
<td></td>
</tr>
<tr>
<td>Sign-out tool (printed summary)</td>
<td>- portable</td>
<td>- risk of losing print-out (breach of patient confidentiality)</td>
<td>- used extensively by all GIM physicians</td>
</tr>
</tbody>
</table>
Overall, clinicians seem to prefer synchronous communication over asynchronous communication means, although the web paging system and SMS on mobile phones are also well received. The web paging system seems to have significantly reduced numeric pager use and unnecessary interruption of physicians. Numeric pagers stand out as the least used and least preferred communication tool available at TGH.

EPR has several drawbacks, though it does have important benefits over the traditional paper chart. The paper chart being used as the main communication tool between the GIM medical staff and Allied Health seemed to create redundancies in physician workload. The Transfer Note completed in EPR during nursing handover seems to succinctly communicate patient information between departments, and rarely requires synchronous communication. However, the patient’s physical arrival time to the GIM is not adequately communicated to the GIM nursing staff. The whiteboards throughout the hospital are useful for staff, especially those in the department. However, due to a lack of mutual understanding and awareness of the system’s features, patient status information isn’t communicated as effectively as possible. Having a quick patient summary for all GIM patients available (like the print-out of the Sign-out tool) greatly facilitates communication and acts as a “to do” list for GIM physicians.

Finally, the use of both EPR and paper charting causes confusion and creates the opportunity for orders to be missed.

Descriptions of each communication tool or aid, as well as the observed usage and the main benefits and drawbacks of each, are provided in separate subsections below.
Appendix 1 - Workflow for ED-GIM patient transfer at TGH (UML Diagrams)

Physician handover – part 1
(workflow for ED-GIM patient transfer at Toronto General Hospital, page 1 of 6)

ALTERNATE WORKFLOW:
Occasionally, the junior resident will have questions regarding the patient and receive the call from the ED.

ALTERNATE WORKFLOW:
If the GIM doctor misses the phone call, the ED physician will page either the junior resident or GIM medical student on personal phone to set up review.

ALTERNATE WORKFLOW:
The GIM senior resident may write initial orders and request lab work right away before seeing the patient and before admitting them to the GIM.

RARE OCCURRENCE:
If GIM physicians have questions regarding the patient after the report, they:
- consult patient ED chart (paper)
- find ED physician, ask question face-to-face

ALTERNA TE WORKFLOW:
Occasionally this review is postponed until later in the process (after the admission order and order sets are in EPR), if the senior is too busy, and the admission is certain.

FACE-TO-FACE gameplay:
- Patient information summary, including:
  - Direct consultation notes (diagnosis, HPI, overall patient status, etc)
  - Relevant orders
  - Relevant test results
  - Medications
  - What was done in the ED with props:
    - Patient ED chart (paper) – paper orders
    - EPR – previous admissions, results
    - Web – medical references

ALTERNATE WORKFLOW:
If the GIM doctor misses the phone call, the ED physician will page either normally or via the Smart Web Paging system and the GIM doctor will call them back on a nearby phone.

Unstructured communication:
If GIM physicians are busy and/or physically in the ED, ED nurse implies regarding admission status.

Face-to-face
- Patient information summary
- Course of action with props:
  - EPR
  - EMR, relevant orders (up to date)
  - Radiology images in action
  - Patient ED chart
  - paper ECG

Appendix 1 - Workflow for ED-GIM patient transfer at TGH (UML Diagrams)
**Physician handover – part 2**
(workflow for ED-GIM patient transfer at Toronto General Hospital, page 2 of 6)

---

<table>
<thead>
<tr>
<th>ED Ward Clerk</th>
<th>GIM fellow/ senior resident*</th>
<th>GIM medical student*</th>
<th>GIM junior resident*</th>
<th>Other consulting physician(s)</th>
<th>ED nurse*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Face-to-face</strong></td>
<td><strong>Patient is admitted</strong></td>
<td><strong>Admit Patient</strong></td>
<td><strong>Admit to GIM</strong></td>
<td><strong>Face-to-face</strong></td>
<td><strong>Consult done?</strong></td>
</tr>
<tr>
<td><strong>EPR</strong></td>
<td><strong>Transcribe Admission Orders into EPR</strong></td>
<td><strong>GIM junior resident</strong></td>
<td><strong>Writer</strong></td>
<td><strong>GIM medical student</strong></td>
<td><strong>Admit to GIM</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Write “Admit to GIM” order</strong></td>
<td><strong>GIM medical student</strong></td>
<td><strong>EPR</strong></td>
<td><strong>Write “Admission set”</strong></td>
<td><strong>Admit to GIM</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>GIM junior resident</strong></td>
<td></td>
<td></td>
<td><strong>EPR</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>GIM medical student</strong></td>
<td></td>
<td></td>
<td><strong>Check of consult “med” in Whiteboard</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>EPR</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Write Suggested orders</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>New/modified orders</strong></td>
</tr>
</tbody>
</table>
| | | | | | **ALTERNATE WORKFLOW:**
| | | | | | 1) If personal mobile phones or Junior Blackberry not available, GIM junior resident or medical students may also send a numeric page or web page to the GIM senior resident’s Team Blackberry. GIM junior resident waits for callback near nursing station phone.
| | | | | | GIM senior resident calls extension from nearby phone.
| | | | | | Direct phone conversation to request cosignature.
| | | | | | Unstructured communication. If GIM admitting physician is physically in the ED, they keep ED nurse informed regarding admission status.
| | | | | | **ALTERNATE WORKFLOW:**
| | | | | | Unstructured communication. If GIM admitting physician is physically in the ED, they keep ED nurse informed regarding admission status.
| | | | | | **ALTERNATE WORKFLOW:**
| | | | | | Once patient is admitted, all orders should be submitted by EPR. However, if doctors are in the ED, they may write orders on the paper order sheet instead.

---

*Main caretakers for the patient in this workflow segment*
Regular patient care (transfer patient in ED)
(workflow for ED-GIM patient transfer at Toronto General Hospital, page 3 of 6)

ED nurse*

<table>
<thead>
<tr>
<th>In ED?</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for ED nurse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient status changes/New orders needed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>YES</td>
<td>Follow-up (Face-to-face, or urgent order)</td>
<td></td>
</tr>
<tr>
<td>NO</td>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>

GIM admitting physician*

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face</td>
<td>NO</td>
</tr>
<tr>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Telephone</td>
<td>YES</td>
</tr>
<tr>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

Patient status changes/Concerns/New orders needed?

Yes: Face-to-face communication is likely.

No: Substitute other methods of communication.

ED nurse may also need to contact other medical specialties.

Allied Health, Testing/Imaging and other Medical Specialties (Consultations)

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

Notes:
- Any of the parties may engage in face-to-face communication if they happen to be in the same location (e.g., in the ED).
- Any party may follow-up with any other party at any point in time for various reasons (this is not illustrated here for simplicity).
- Various other calls for order clarification, updates, etc., occur in this workflow segment.
- Pharmacy and social workers will call the Team Blackberry if they need to discuss anything with the physician.
- GIM coordination will ensure that updates are communicated.
- Majority of communication is done through paper charting.

*main caretakers for the patient in this workflow segment
Nursing handover
(workflow for ED-GIM patient transfer at Toronto General Hospital, page 4 of 6)

**ED nurse**<sup>2</sup> **ED ward clerk**

**GIM nurse**

**GIM ward clerk**

**Flow Coordinator**

**ALTERNATE WORKFLOW:**
The ward clerk will choose to communicate this information if the ED nurse is nearby. Otherwise, the ED nurse checks the Whiteboard for bed availability.

**Phone**

- Call ED, ask question on the phone

**GIM phone**

- Note: The Flow Coordinator will also email the GIM Team BlackBerry to inform the GIM physician about bed availability.

**ALTERNATE WORKFLOW:**
The Flow Coordinator leaves at 4 PM, if patients are being transferred later than this, the GIM nurse manager calls the ED.

**Phone**

- Note: Transfers Notes are often partially filled before patient transfer.

**EPR ED Nursing Transfer Note**

- All patient information summarized
- Initial GIM admission orders
- Note: Sometimes ward patients to check for the Transfer Note. Often the GIM ward clerk will check and print it for them.

**Initiate ED -> GIM Transfer**

- Arrange ED Porter to take patient to GIM (face to face or overhead announcement)

**Room ready and clean?**

- **NO**
  - Wait for next available bed
  - **ED Whiteboard**
    - Write GIM Bed Available in comment column. GIM room # & GIM unit ext.
  - **Check/Wait for Transfer Notes**
  - **Note:** The Flow Coordinator will also email the GIM Team BlackBerry to inform the GIM physician about bed availability.
  - **ALTERNATE WORKFLOW:**
The Flow Coordinator leaves at 4 PM, if patients are being transferred later than this, the GIM nurse manager calls the ED.

- **YES**
  - Wait for next available bed

**ED phone**

- Patient special needs
- Time of transfer

**GIM phone**

- Patient name

**EPR Nursing Transfer Note Read and Print**

**EPR MAR**

- Read MAR as a to-do list, since patient is in GIM

**ED phone**

- Patient special needs (if any)
- Time of transfer

**Paper Charting**

- Arrange Chart into binder

**Direct care:**

- Initial assessment

**ED phone**

- Room status inquiry

**Wait for cleaning**

**EPR**

- Patient location in GIM
- GIM Whiteboard automatically updates

**EPR**

- Patient location in GIM
  - GIM Whiteboard automatically updates

**Flow Coordinator**

* main caretakers for the patient in this workflow segment
Regular patient care (transfer patient in GIM) – part 1
(workflow for ED-GIM patient transfer at Toronto General Hospital, page 5 of 6)

**GIM nurse**

**GIM admitting physician**

**Allied Health, Testing/Imaging and other Medical Specialties (Consultations)**

Notes:
- Any of the parties will engage in face-to-face communication if they happen to be in the same location (e.g. in the GIM).
- To reach a GIM nurse:
  - Parties who are in the GIM unit will ask around for the nurse, or have an overhead announcement for them.
  - Parties who are not in the GIM unit will ask around for the nurse, or have an overhead announcement for them.

- To follow-up with any other party at any point in time, for various reasons (not illustrated here for simplicity):
  - GIM admitting physician is contacted often for updates and clarification.

- If nurse is unknown or not nearby, ward clerk will give an overhead announcement, or page the nurse.
- If phone # available?
  - GIM nurse
  - GIM admitting physician
  - (if GIM medical student is admitting, they need cosignature from senior on all orders – omitted here for simplicity)

**ALTERNATE WORKFLOW:**

GIM Phone

Nearby Phone

GIM Phone

NOTICE: The GIM nurse will occasionally contact pharmacy by paging in place of the GIM physician.

- To find the GIM nurse:
  - EPR or Doctor’s Orders Sheet
  - Read Orders
  - Direct patient care
  - Charing (misc.)

- End of shift?
  - Yes
  - No

- End of shift?
  - Yes
  - No

- Paper Charting
  - Read Orders
  - Other relevant patient information

- Direct patient care / consultation / testing
  - (i.e. carry out orders)

- Paper Charting
  - Mark orders as done
  - Charing (misc.)

**Direct patient care**

ALTERNATE WORKFLOW:
The GIM nurse will occasionally contact pharmacy by paging in place of the GIM physician.

- To find the GIM nurse:
  - EPR or Doctor’s Orders Sheet
  - Read Orders
  - Direct patient care
  - Charing (misc.)

- End of shift?
  - Yes
  - No

- End of shift?
  - Yes
  - No

- Paper Charting
  - Read Orders
  - Other relevant patient information

- Direct patient care / consultation / testing
  - (i.e. carry out orders)

- Paper Charting
  - Mark orders as done
  - Charing (misc.)

* main caretakers for the patient in this workflow segment
Regular patient care (transfer patient in GIM) – part 2
(workflow for ED-GIM patient transfer at Toronto General Hospital, page 6 of 6)

**GIM nurse**

- Patient status changes/Concerns/New orders needed?
  - NO
  - YES
    - Urgent?
      - NO
      - YES
        - Call Locating
        - Web paging
        - Periodically check EPR
        - Call back to station?
          - NO
          - YES
            - FOR unanswered urgent: web pages, nurses page or call the Team Blackberry directly

- EPR
  - Summarized patient status changes/Concerns, or new orders needed
  - YES
  - NO
    - Find computer terminal to log into EPR
    - Sign-Out Tool
    - Write Updated info based on EPR

- Overhead announcement, asking around (common phone)
- Direct patient consultation

**GIM admitting physician**

- Team Blackberry
  - Non-urgent text message
  - Find TEAM Blackberry email message
  - Find phone to call back

- ED Overhead announcement (please phone line transfer, asking around common phone)

**Allied Health, Testing/Imaging and other Medical Specialties (Consultations)**

- Email
  - Updates/Concerns/New orders needed?
  - NO
  - YES
    - Nearby Phone
    - Phone
      - Discuss any Updates/Concerns/New orders needed

Note: For unanswered urgent: web pages, nurses page or call the Team Blackberry directly

**ALTERNATE WORKFLOW**

- Pharmacy and social workers will call the Team Blackberry if they need to discuss anything.

* main caretakers for the patient in this workflow segment